

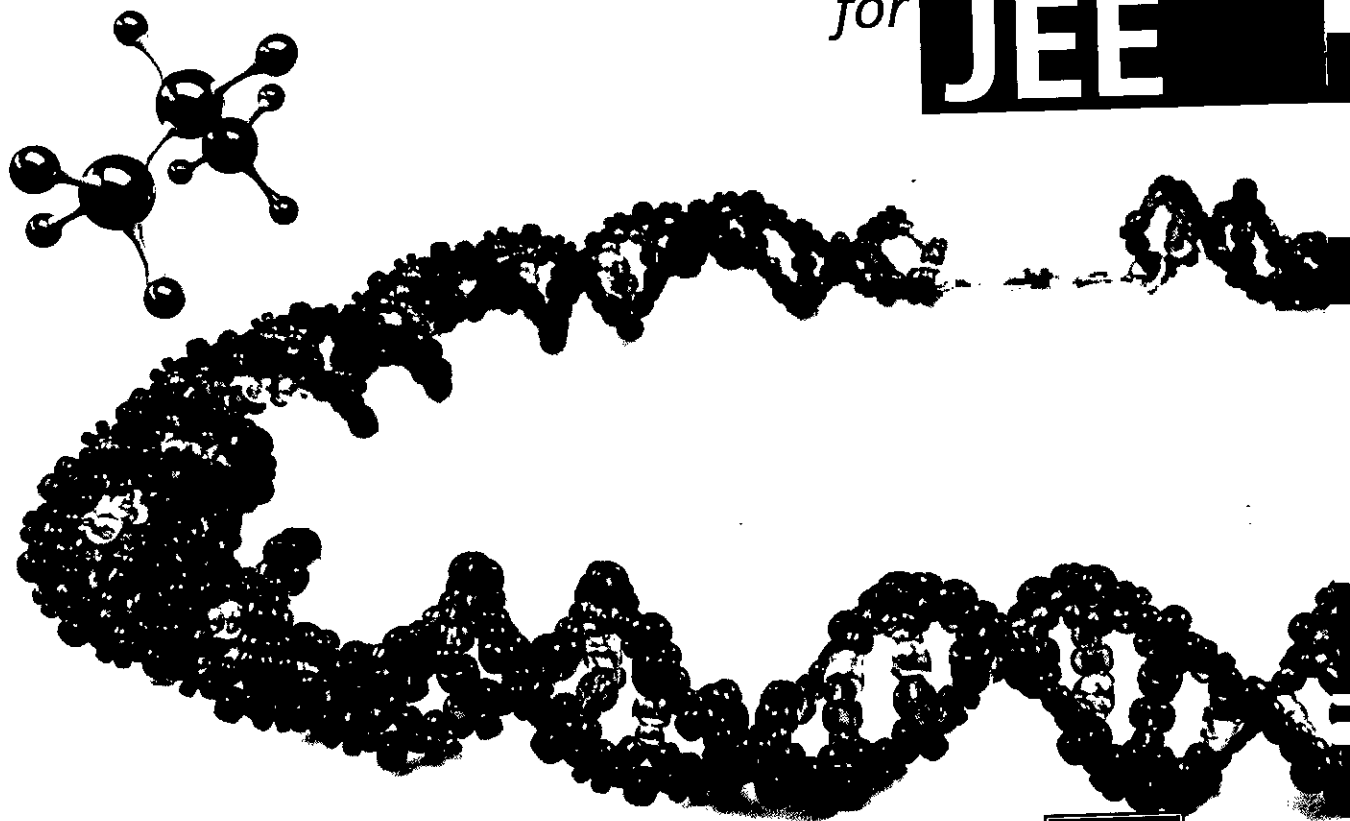
श्री  
**Balaji**

**M.S. Chouhan**

*Advanced Problems in*

# ORGANIC CHEMISTRY

for **JEE**



**8<sup>th</sup>**  
edition

Published by:

**SHRI BALAJI PUBLICATIONS**  
(EDUCATIONAL PUBLISHERS & DISTRIBUTORS)

6, Gulshan Vihar,  
Opp. Mahalaxmi Enclave,  
Jansath Road, Muzaffarnagar (U.P.)  
Phone : 0131-2660440 (O), 2600503 (R)  
website : [www.shribalajibooks.com](http://www.shribalajibooks.com)  
email : [sbjpub@gmail.com](mailto:sbjpub@gmail.com)

- First edition : 2008
- Second edition : April 2008
- Third edition : April 2009
- Seventh edition: April 2013
- Eighth edition : April 2014

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Price : ₹ 480.00

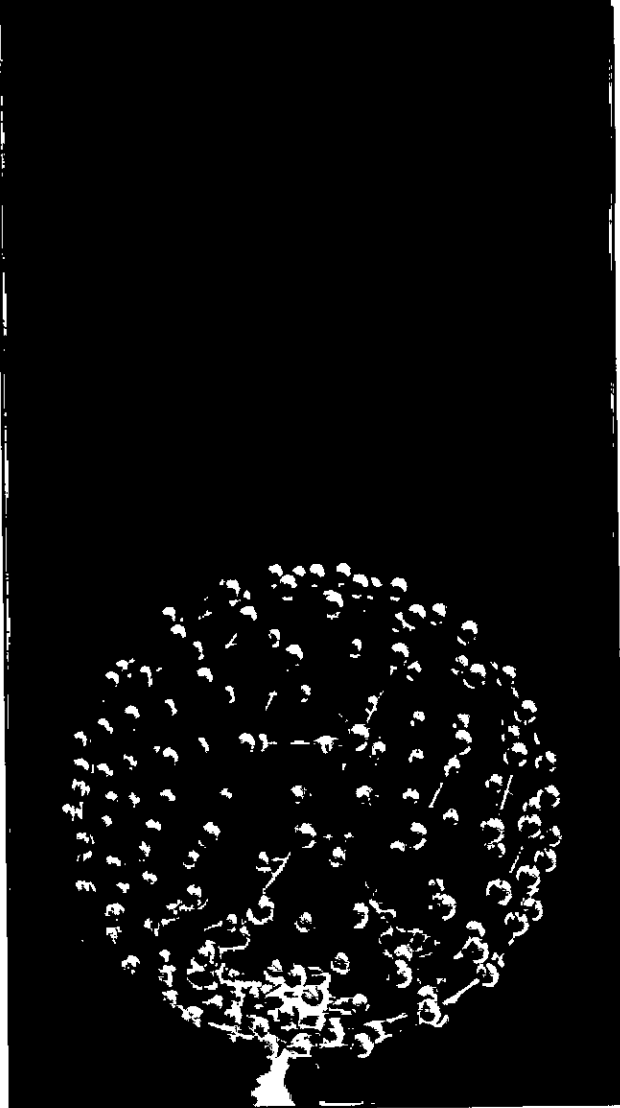
Typeset by :  
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*Dedicated to the  
Lotus feet of  
Revered Guruji*

**SHRI KESARAM JI MAHARAJ**





Advanced Problems in  
**ORGANIC  
CHEMISTRY**

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# Preface

It is a matter of great pleasure for me to present the eighth edition of "Advanced Problems in Organic Chemistry for JEE" before JEE aspirants. During my teaching experience, I felt that the facts may be made more and more clear to the students through problematic approach. Although an ocean of material in Organic Chemistry is available with the students, yet the approach to design the problems has been changed in recent years and if one tries to swim in this ocean, it will be a very difficult task. To make the students more familiar with trends and tricks how to solve problems, the present problem book has been presented. In the current scenario of stiff competition especially for JEE, one must be clear that almost all the sincere applicants are well equipped with the facts of subject, yet the winner is one who knows how to use these equipments with accuracy and efficiency. As an experienced teacher, I would like to suggest students three golden rules to score high in Organic Chemistry:

1. Don't get behind
2. Work out a number of problems of different types
3. Revise through short notes / learning chart.

I hope that the present book will cater to the needs of JEE aspirants & as a matter of fact, they will enjoy the present venture and I would feel rewarded if this book is found helpful to the students and teachers in real terms. All attempts have been made to make the book error free however a few misprints may inadvertently creep.

I acknowledge the blessing and support of my mother Smt. Raj Kanwar, father Shri B.S. Chouhan, brother Dr. V.S. Chouhan, my wife and daughter. They inspired me all the time during the preparation of this book.

The support and valuable suggestions from my colleagues especially Mr. N. Avasthi, Mr. V.K. Jaiswal, Mr. Nitin Jain, Mr. N.K. Sethia, Mr. Vikash Gupta, Mr. Pankaj Joshi, Dr. S. Kothari, Mr. Vineet Khatri, Mr. Ashish Mishra, Mr. Manish Arora, Mr. Govind Khandelwal, Mr. Rahul Pareek, Mr. Rahul Malav, Mr. Akshay Choudhary, Mr. Hanuman Sahay, Mrs. Neha Joshi, Mrs. Neetu Jha, Mr. Kamlesh Gupta, Mr. Kumud Ranjan and Mr. K.D. Tiwari are highly acknowledged. I also pay my sincere thanks to all the esteemed members of **M/s Shri Balaji Publications** in bringing out this book in such a nice form.

In the last, constructive criticism and valuable suggestions from the readers are most welcome to make the book more useful.

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# A few words to the JEE Aspirants

Dear JEE aspirants,

I hope that this collection of problems will surely help you during your preparation for JEE. In this book, each chapter consists of two levels :

**Level 1** - includes the problems having only one option correct. These problems are based on different facts and their twists.

**Level 2** - includes unique approach which may be used to solve the problems altogether different from the prevailing trend followed by JEE. These approaches will undoubtedly help you in the quick revision of the key facts and their applications.

I wish all of you a grand success in the ensuing Joint Entrance Examination. Your valuable suggestions and constructive criticism for the betterment of the book are welcome.

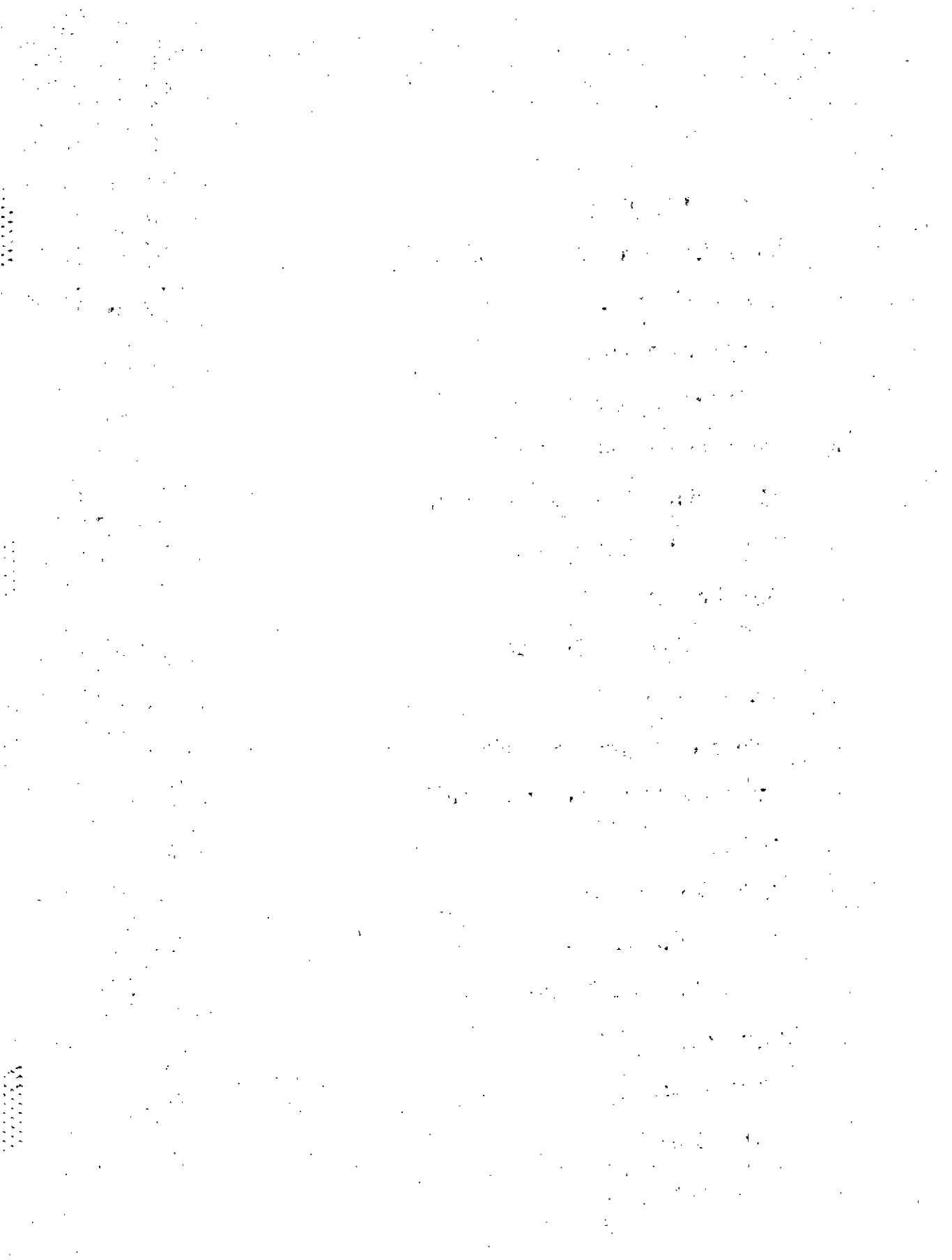
**M.S. Chouhan**

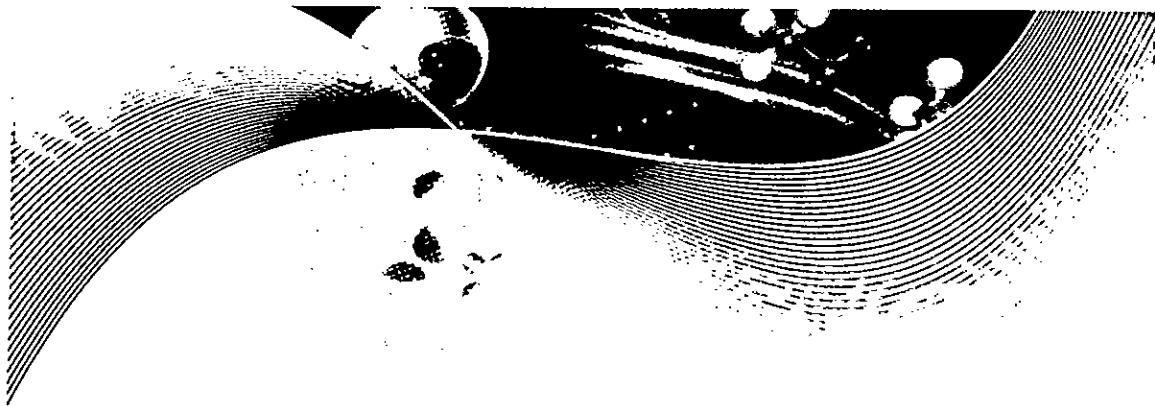
e-mail : mahen\_chouhan@yahoo.com



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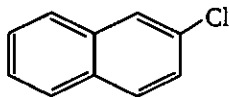
# 1

# GENERAL ORGANIC CHEMISTRY

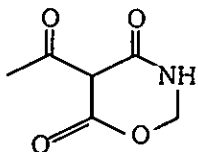


# LEVEL - 1

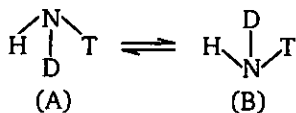
1. How many 2° Hydrogen atoms are present in the given following compound ?

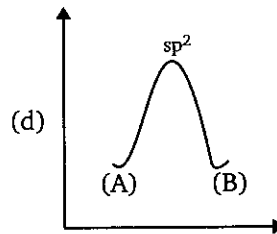
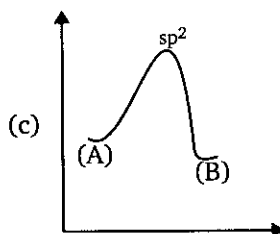
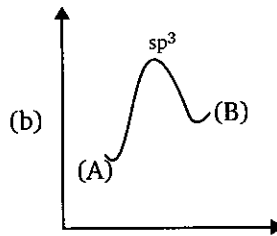
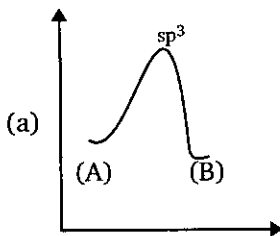


- (a) 2                      (b) 5                      (c) 7                      (d) 8
2. Identify which functional group are **Not** present in the given following compound ?

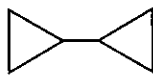


- (a) Ketone                      (b) Ester                      (c) Amide                      (d) Ether
3. Correct energy profile for amine inversion and hybridization of nitrogen in transition state is:





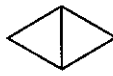
4.



(i)



(ii)

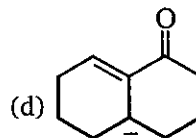
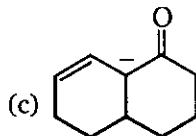
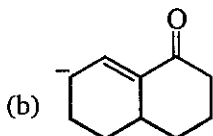
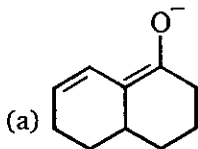


(iii)

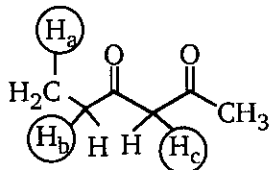
Compare the heats of combustion of above compounds:

(a) (i) > (ii) > (iii) (b) (i) > (iii) > (ii) (c) (ii) > (i) > (iii) (d) (ii) > (iii) > (i)

5. Which of the following is not a resonance structure of the others ?



6. Rank the hydrogen atoms ( $H_a$ ,  $H_b$ ,  $H_c$ ) in the following molecule according to their acidic strength.

(a)  $a > b > c$ (b)  $b > a > c$ (c)  $b > c > a$ (d)  $c > b > a$ 

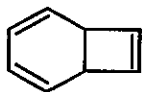
7.  $\text{CH}_3 - \overset{\text{O}}{\parallel}{\text{C}} - \underset{a}{\text{O}} - \underset{b}{\text{O}} - \text{CH}_3$ ;

Compare the bond lengths  $a$  and  $b$ .

(a)  $a = b$ (b)  $b > a$ (c)  $b < a$ 

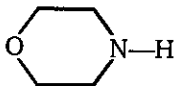
(d) Impossible to predict

8. The number of  $sp^2 - sp^2$  sigma bonds in the compound given below is :



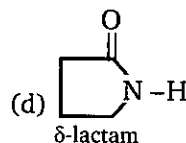
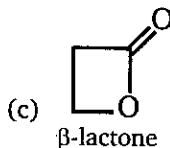
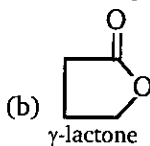
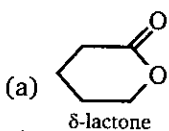
- (a) 1                      (b) 3                      (c) 4                      (d) 5

9. The total number of lone pair of electrons in the given molecule is :

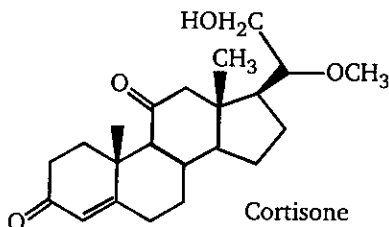


- (a) 2                      (b) 3                      (c) 4                      (d) 5

10. Which of the following rings is highly strained ?

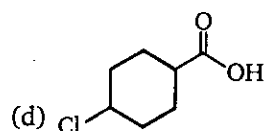
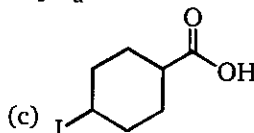
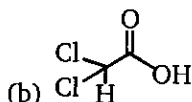
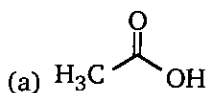


11. The functional groups present in Cortisone are :

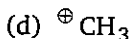
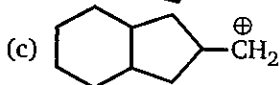
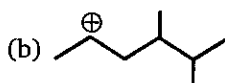


- (a) Ether, alkene, alcohol                      (b) Alcohol, ketone, alkene, ether  
 (c) Alcohol, ketone, amine                      (d) Ether, amine, ketone

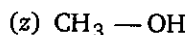
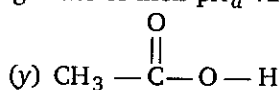
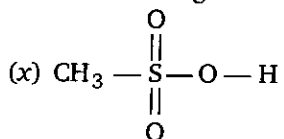
12. Select the acid with the highest  $K_a$  (i. e., lowest  $pK_a$ ).



13. Most stable carbocation among the given example is :



14. Set the following in increasing order of their  $pK_a$  values.



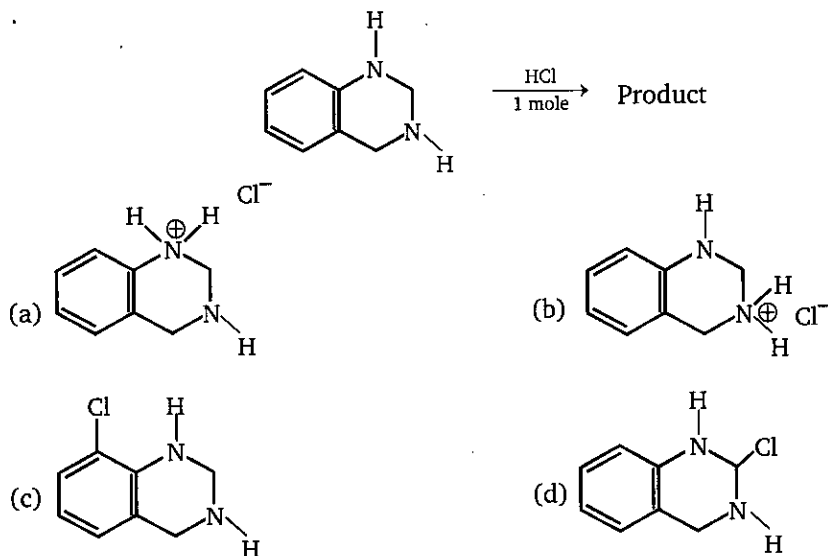
(a)  $y < x < z$

(b)  $x < y < z$

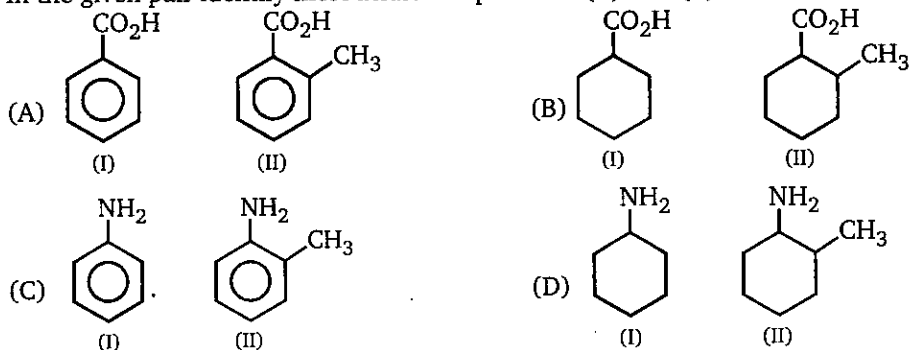
(c)  $y < z < x$

(d)  $x < z < y$

15. Which is the major product of the following reaction ?



16. In the given pair identify most acidic compound in (A) and (B). Most basic in (C) and (D).



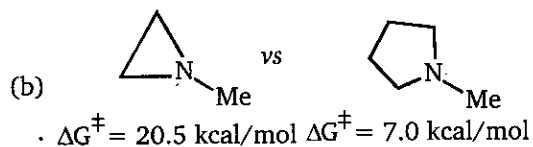
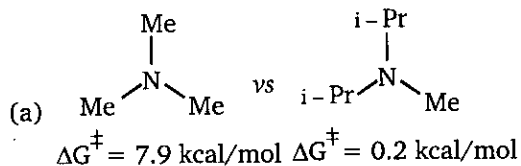
(a) A - I, B - II, C - I, D - II

(c) A - II, B - II, C - II, D - II

(b) A - II, B - I, C - I, D - II

(d) A - I, B - II, C - I, D - I

17. Several factors (steric, electronic, orbital interactions etc.) can affect the inversion barrier of an amine. In the given pair which data is correctly placed ?





26. Rank the following in decreasing order of the acidic strengths. (a) Cc1c(C)nc(C)c1 vs (b) Cc1c(Cl)nc(C)c1 vs (c) Cc1c(Cl)nc(Cl)c1 vs (d) Cc1c(Cl)nc(Cl)c1Cl
27. Which of the following compound is most stable?  $\Delta G^\ddagger = 7.9 \text{ kcal/mol}$  vs  $\Delta G^\ddagger = 22.9 \text{ kcal/mol}$
28. Select the response that correctly identifies the number of carbon atoms of each type of hybridization in the compound given below.
29. Circle represents most basic atoms in these molecule. Which of the following is correct representation?
30. Circle represent most acidic hydrogens in these molecules. Which of the following is correct representation?
31. Which of the following acids would have a STRONGER CONJUGATE BASE?
32. Which OH item about the following equilibrium.
33. Rank the following reaction involving two acids shown below.
34. Rank the following in decreasing order of the acidic strengths.
35. Rank the following in decreasing order of the acidic strengths.
36. Rank the following in decreasing order of the acidic strengths.
37. Rank the following in decreasing order of the acidic strengths.
38. Rank the following in decreasing order of the acidic strengths.
39. Rank the following in decreasing order of the acidic strengths.
40. Rank the following in decreasing order of the acidic strengths.
41. Rank the following in decreasing order of the acidic strengths.
42. Rank the following in decreasing order of the acidic strengths.
43. Rank the following in decreasing order of the acidic strengths.
44. Rank the following in decreasing order of the acidic strengths.
45. Rank the following in decreasing order of the acidic strengths.
46. Rank the following in decreasing order of the acidic strengths.
47. Rank the following in decreasing order of the acidic strengths.
48. Rank the following in decreasing order of the acidic strengths.
49. Rank the following in decreasing order of the acidic strengths.
50. Rank the following in decreasing order of the acidic strengths.

Which of the following statements about this reaction are true ?

- (A) Formic acid is the strongest Bronsted acid in the reaction  
 (B) HF is the strongest Bronsted acid in the reaction  
 (C) KF is the strongest Bronsted base in the reaction  
 (D)  $\text{KO}_2\text{CH}$  is the strongest Bronsted base in the reaction  
 (E) The equilibrium favours the reactants  
 (F) The equilibrium favours the products  
 (G) Formic acid has a weaker conjugate base  
 (H) HF has a weaker conjugate base

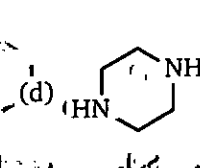
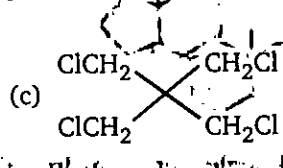
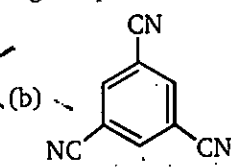
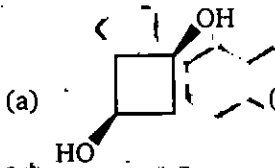
(a) A, D and F

(b) B, D, and H

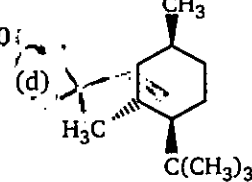
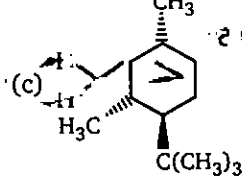
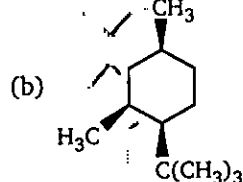
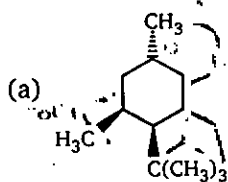
(c) A, C, and H

(d) B, D, E and H

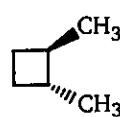
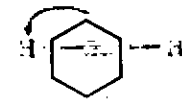
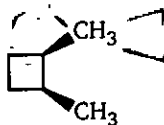
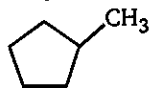
30. Which one of the following compounds has a dipole moment significantly different from zero?



31. Which one of the following has the smallest heat of combustion?



32. Rank the following substances in order of decreasing heat of combustion (maximum  $\rightarrow$  minimum).



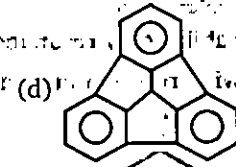
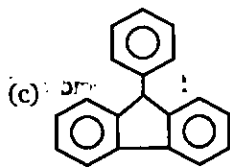
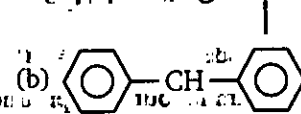
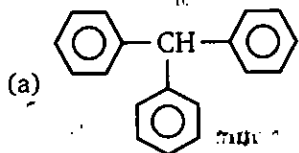
(a) 1 > 2 > 4 > 3

(b) 3 > 4 > 2 > 1

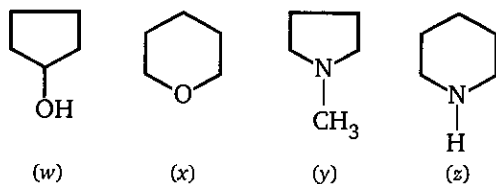
(c) 2 > 4 > 1 > 3

(d) 1 > 3 > 2 > 4

33. Which of the following has lowest  $\text{pK}_a$  value?



34. Arrange the following (w, x, y, z) in decreasing order of their boiling points:



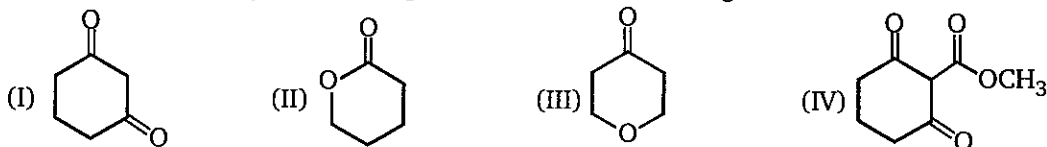
(a)  $w > x > z > y$

(b)  $w > x > y > z$

(c)  $w > z > y > x$

(d)  $w > z > x > y$

35. Arrange the following in increasing order of their acidic strength.



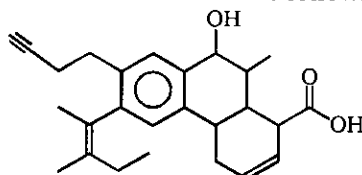
(a)  $\text{III} < \text{I} < \text{IV} < \text{II}$

(b)  $\text{II} < \text{I} < \text{IV} < \text{III}$

(c)  $\text{I} < \text{III} < \text{IV} < \text{II}$

(d)  $\text{II} < \text{III} < \text{I} < \text{IV}$

36. How many degrees of unsaturation are there the following compound ?



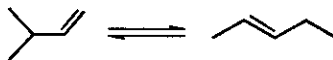
(a) 6

(b) 7

(c) 10

(d) 11

37. The heat of hydrogenation for 3-methylbutene and 2-pentene are  $-30$  kcal/mol and  $-28$  kcal/mol respectively. The heats of combustion of 2-methylbutane and pentane are  $-784$  kcal/mol and  $-782$  kcal/mol respectively. All the values are given under standard conditions. Taking into account that combustion of both alkanes give the same products, what is  $\Delta H$  (in kcal/mol) for the following reaction under same conditions ?



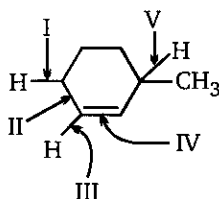
(a) 0

(b)  $-4$

(c)  $-2$

(d) 2

38. Which of the following  $\sigma$ -bonds participate in hyperconjugation ?

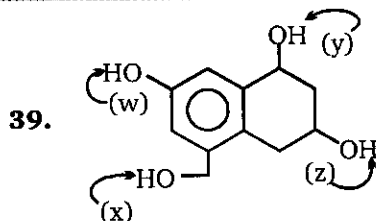


(a) I and II

(b) I and V

(c) II and V

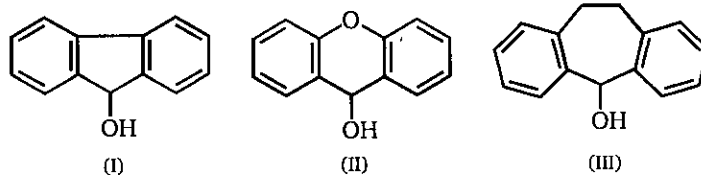
(d) III and IV



Decreasing order of acidic strength of different (-OH) groups is :

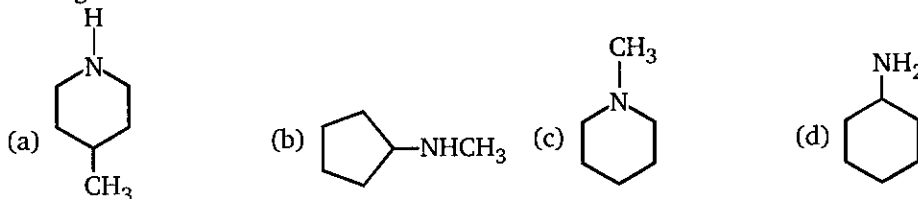
- (a)  $w > x > y > z$  (b)  $w > z > x > y$  (c)  $z > w > x > y$  (d)  $z > x > w > y$

40. Arrange the following alcohols in decreasing order of the ease of ionization under acidic conditions.

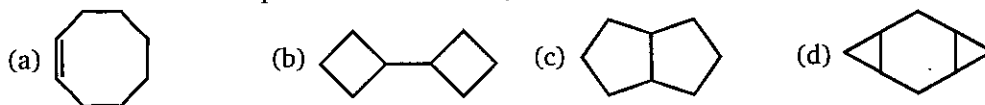


- (a) I > III > II (b) I > II > III (c) II > III > I (d) II > I > III

41. Among the isomeric amines select the one with the lowest boiling point.



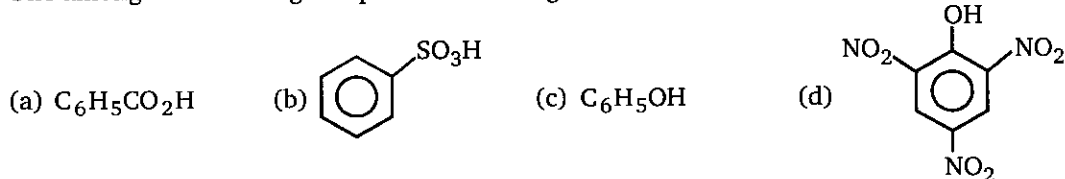
42. Which one of the compounds shown below, is not an isomer of the others ?



43. Arrange the anions (p)  $\text{CH}_3^-$ , (q)  $\text{NH}_2^-$ , (r)  $\text{OH}^-$ , (s)  $\text{F}^-$ , in decreasing order of their basic strength.

- (a)  $p > q > r > s$  (b)  $q > p > r > s$  (c)  $r > q > p > s$  (d)  $r > p > q > s$

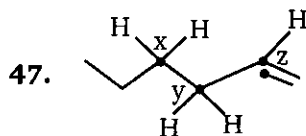
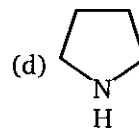
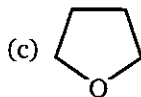
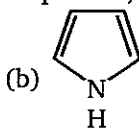
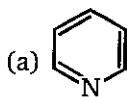
44. One among the following compounds will not give effervescence with sodium carbonate:



45. The carboxylic acid which has maximum solubility in water is:

- (a) phthalic acid (b) succinic acid  
(c) malonic acid (d) salicylic acid

46. Among the following compounds, the most basic compound is :



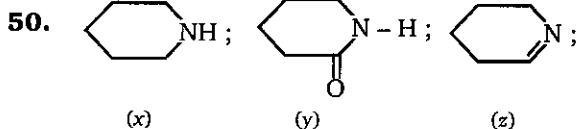
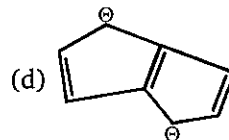
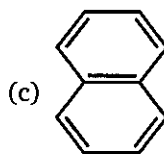
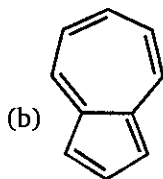
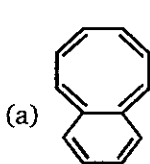
Arrange the (C - H) bonds x, y and z in decreasing order of their bond dissociation energies in homolysis.

- (a)  $y > x > z$       (b)  $z > x > y$       (c)  $z > y > x$       (d)  $y > z > x$

48. 23 g of sodium will react with methyl alcohol to give :

- (a) one mole of oxygen      (b)  $22.4 \text{ dm}^3$  of hydrogen gas at NTP  
 (c) 1 mole of  $\text{H}_2$       (d) 11.2 L of hydrogen gas at NTP

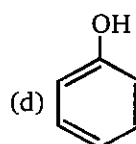
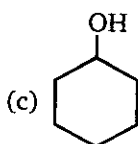
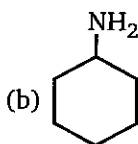
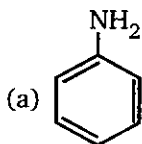
49. Which of the following is most polar?



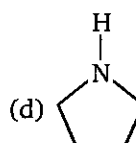
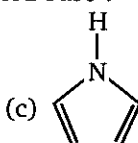
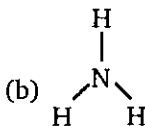
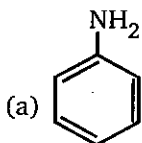
The correct order of decreasing basic strengths of x, y and z is :

- (a)  $x > y > z$       (b)  $x > z > y$       (c)  $y > x > z$       (d)  $y > z > x$

51. Which of the following is the strongest Bronsted acid ?



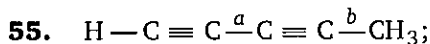
52. Which of the following is the strongest Bronsted base ?



53. Which of the following is polar aprotic solvent ?

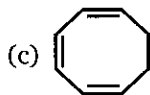
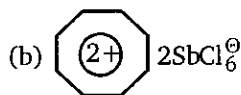
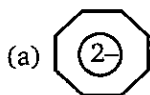
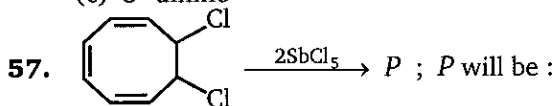
- (a) DMSO      (b) Crown ether      (c) DMG      (d) All of these

54. Some pairs of acids are given below. Select the pair in which second acid is stronger than first
- (a)  $\text{CH}_3\text{CO}_2\text{H}$  and  $\text{CH}_2\text{FCO}_2\text{H}$   
 (b)  $\text{CH}_2\text{FCO}_2\text{H}$  and  $\text{CH}_2\text{ClCO}_2\text{H}$   
 (c)  $\text{CH}_2\text{ClCO}_2\text{H}$  and  $\text{CH}_2\text{BrCO}_2\text{H}$   
 (d)  $\text{CH}_3\text{CH}_2\text{CHFCH}_2\text{CO}_2\text{H}$  and  $\text{CH}_3\text{CHFCH}_2\text{CO}_2\text{H}$



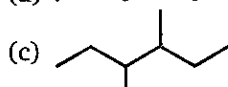
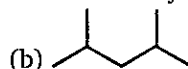
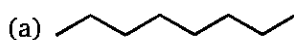
Compare the bond lengths  $a$  and  $b$ :

- (a)  $a = b$                       (b)  $a > b$                       (c)  $b > a$                       (d)  $a \gg \gg b$
56. Which (isomeric) amine has lowest boiling point ?
- (a)  $1^\circ$  amine                      (b)  $2^\circ$  amine  
 (c)  $3^\circ$  amine                      (d) cannot predict



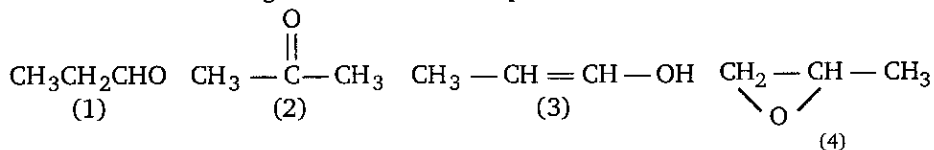
(d) mixture of (a) and (b)

58. Which of the following substances is not an isomer of 3-ethyl 2-methyl pentane ?

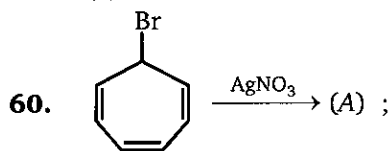


(d) All are isomers

59. Which of the following is an isomer of compound 1 ?



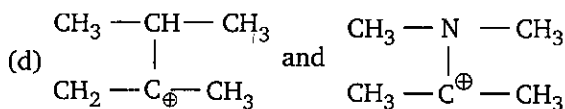
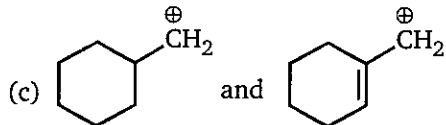
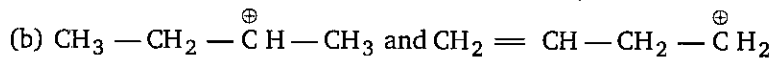
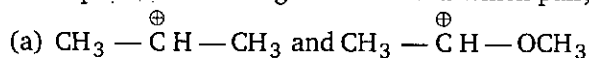
- (a) 2                      (b) 4                      (c) 2 and 3                      (d) all are isomers



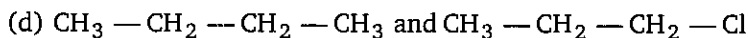
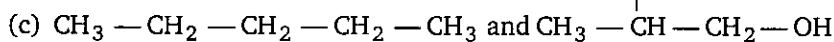
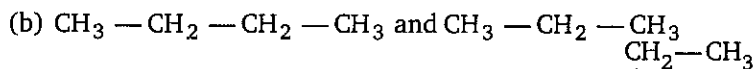
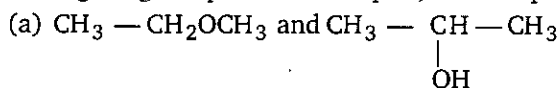
Which statement is incorrect in respect of the above reaction ?

- (a) Product is aromatic                      (b) Product has high dipole moment  
 (c) Product has less resonance energy                      (d) Product is soluble in polar solvent

61. Some pairs of ions are given below. In which pair, first ion is more stable than second?



62. Among the given pairs in which pair, first compound has higher boiling point than second?



63. Which of the following alcohols is the least soluble in water?

(a) Ethanol

(b) 1-Propanol

(c) 1-Butanol

(d) 1-Pentanol

64. Which of the following alcohols is expected to have a lowest  $\text{pK}_a$  value?

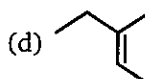
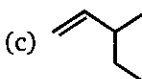
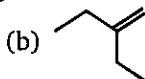
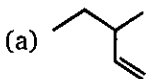
(a) Ethanol

(b) 1-propanol

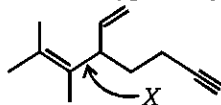
(c) 2, 2, 2-trifluoroethanol

(d) 2-chloroethanol

65. Which of the following alkenes is the most stable?



66. Bond X is made by the overlap of which type of hybridized orbitals?



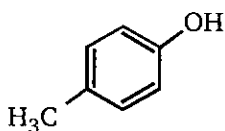
(a)  $sp$  and  $sp^3$

(b)  $sp$  and  $sp^2$

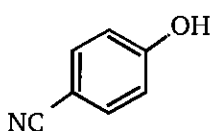
(c)  $sp^2$  and  $sp^3$

(d) none of these

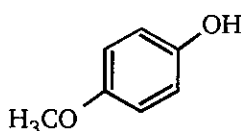
67. Increasing order of acidic strength of given compounds is :



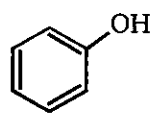
(I)



(II)



(III)



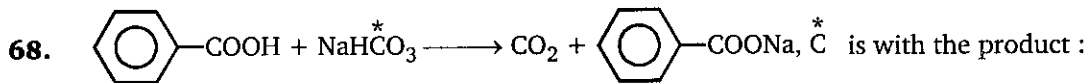
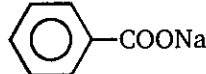
(IV)

(a) III &lt; I &lt; IV &lt; II

(b) II &lt; I &lt; IV &lt; III

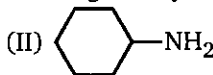
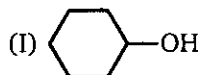
(c) I &lt; III &lt; IV &lt; II

(d) I &lt; III &lt; II &lt; IV

(a) CO<sub>2</sub>(b)  (c) both

(d) none of these

69. Rank in the order of increasing acidity.

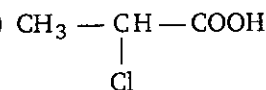
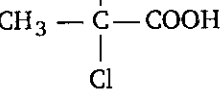


(a) III &lt; I &lt; II

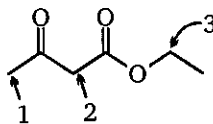
(b) I &lt; III &lt; II

(c) III &lt; II &lt; I

(d) II &lt; I &lt; III

70. Which compound has the highest value of pK<sub>a</sub>?(a) Cl—CH<sub>2</sub>—CH<sub>2</sub>—COOH(b) CH<sub>3</sub>—CH<sub>2</sub>—COOH(c) (d) 

71. Consider the hydrogen atoms attached to three different carbon atoms (labeled 1, 2 &amp; 3). Rank the attached hydrogen atoms in order from most acidic to least acidic.



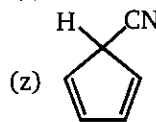
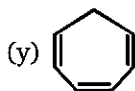
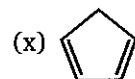
(a) 2 &gt; 1 &gt; 3

(b) 1 &gt; 2 &gt; 3

(c) 2 &gt; 3 &gt; 1

(d) 3 &gt; 2 &gt; 1

72. Decreasing order of acidic strengths of following compounds is :



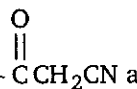
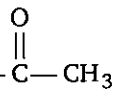
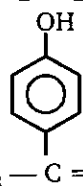

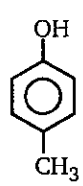
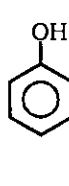
(a) x &gt; y &gt; z

(b) y &gt; x &gt; z

(c) z &gt; y &gt; x

(d) z &gt; x &gt; y

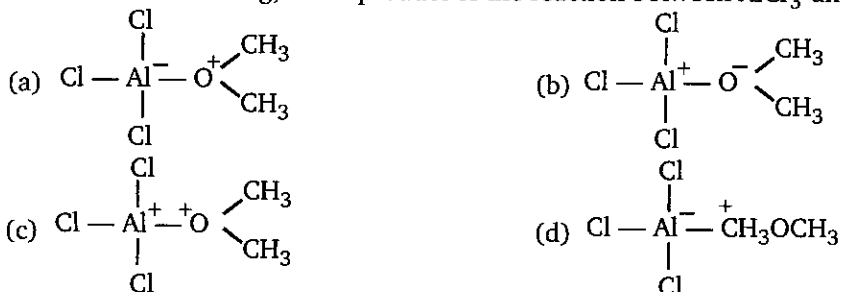
73. Among the given pairs, in which pair second compound is more acidic than first?

(a) BrCH<sub>2</sub>NO<sub>2</sub> and CH<sub>3</sub>CH<sub>3</sub>(b)  and (c)  & (d)  & 

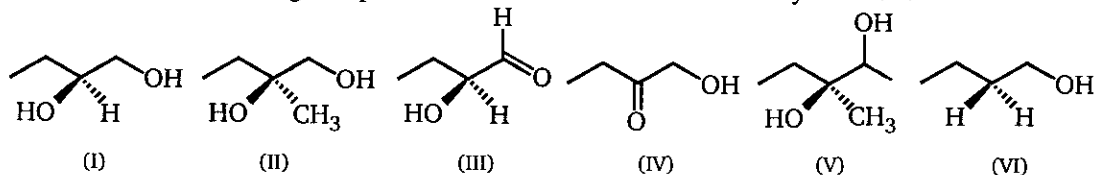


74. Which of the underlined atoms in the molecules shown below have  $sp$ -hybridization ?  
 (u)  $\underline{\text{C}}\text{H}_2\text{CHCH}_3$       (v)  $\text{CH}_2\underline{\text{C}}\text{CHCl}$       (w)  $\text{CH}_3\underline{\text{C}}\text{H}_2^+$       (x)  $\text{H}-\text{C}\equiv\text{C}-\text{H}$   
 (y)  $\text{CH}_3\underline{\text{C}}\text{N}$       (z)  $(\text{CH}_3)_2\underline{\text{C}}\text{N}\text{NH}_2$   
 (a) x and z      (b) x, y, and z      (c) u, w and x      (d) v, x and y

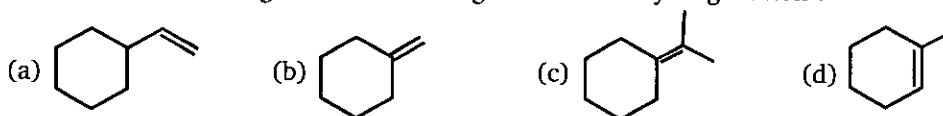
75. Which of the following, is the product of the reaction between  $\text{AlCl}_3$  and  $\text{CH}_3\text{OCH}_3$  ?



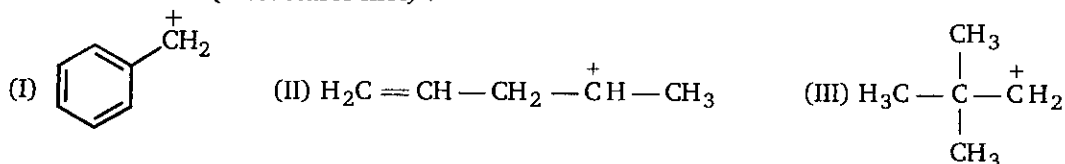
76. Which of the following compounds contain at least one secondary alcohol ?



- (a) I, II, IV, VI      (b) I, III      (c) I, II, III, V      (d) I, III, V
77. Which of the following has the most negative heat of hydrogenation ?

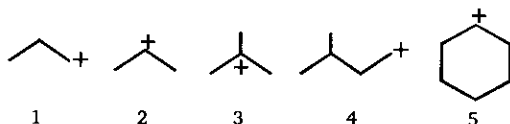


78. Which of the following options is the correct order of relative stabilities of cations I, II and III as written below (most stable first) ?



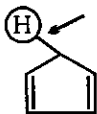
- (a) I > II > III      (b) II > III > I      (c) III > I > II      (d) I > III > II

79. What is the decreasing order of stability (most stable  $\rightarrow$  least stable) of the following carbocations ?



- (a) 3 > 2 > 1 > 4 > 5      (b) 3 > 2 > 5 > 4 > 1  
 (c) 1  $\approx$  4 > 2  $\approx$  5 > 3      (d) 3 > 1  $\approx$  4 > 2  $\approx$  5

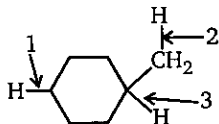
80.



the hydrogen indicated by arrow will be easily removed as :

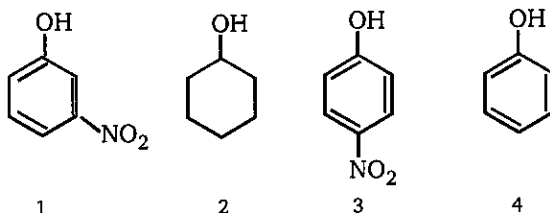
- (a)  $H^+$                       (b)  $H^\ominus$                       (c)  $H^\bullet$                       (d)  $H^{-2}$

81. Rank the bond dissociation energies of the bonds indicated with the arrows. (from smallest to largest).



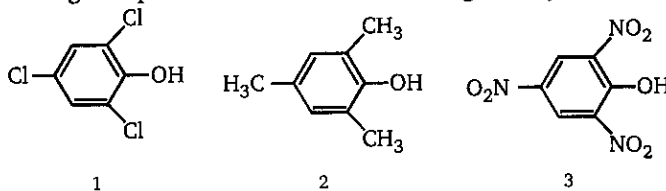
- (a)  $1 < 2 < 3$                       (b)  $3 < 2 < 1$                       (c)  $2 < 3 < 1$                       (d)  $3 < 1 < 2$

82. Rank the following compounds in order of decreasing acid strength (most acidic  $\rightarrow$  least acidic) .



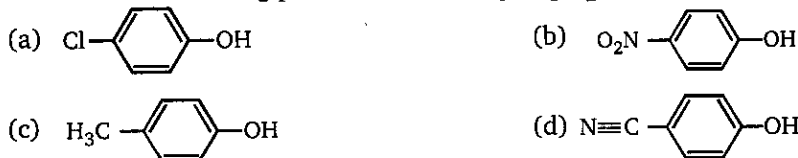
- (a)  $2 > 4 > 1 > 3$                       (b)  $1 > 3 > 4 > 2$                       (c)  $3 > 1 > 2 > 4$                       (d)  $3 > 1 > 4 > 2$

83. Rank the following compounds in order of increasing acidity (weakest acid first).

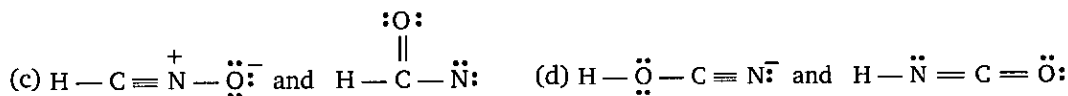
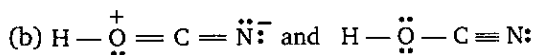
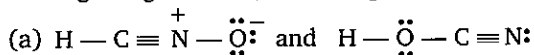


- (a)  $2 < 3 < 1$                       (b)  $3 < 1 < 2$                       (c)  $1 < 2 < 3$                       (d)  $2 < 1 < 3$

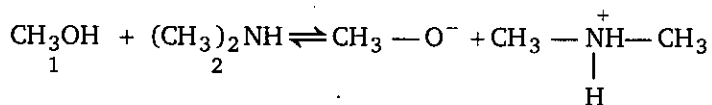
84. Which of the following phenols has the largest  $pK_a$  value (i. e., is least acidic) ?



85. Among the given sets, which represents the resonating structures ?

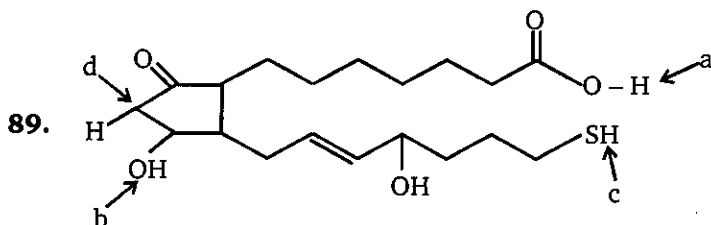


86. Identify each species in the following equilibrium according to the code :  
 SA = stronger acid ; SB = stronger base ; WA = weaker acid ; WB = weaker base.  
 The  $pK_a$  of  $(CH_3)_2NH$  is 36 ; the  $pK_a$  of  $CH_3OH$  is 15.2.



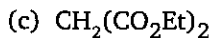
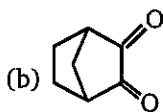
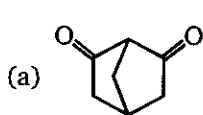
- (a) 1 WA 2 WB                      (b) 1 WB 2 WA                      (c) 1 SA 2 SB                      (d) 1 SB 2 SA  
 (e) WA WA

87. The hydrogen bonding is strongest in which one of the following set ?  
 (a)  $F - H \cdots F$                       (b)  $O - H \cdots S$                       (c)  $S - H \cdots F$                       (d)  $F - H \cdots O$
88. Intermolecular hydrogen bonding is strongest in :  
 (a) methylamine                      (b) phenol                      (c) formaldehyde                      (d) methanol

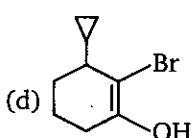
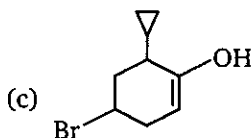
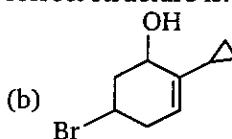
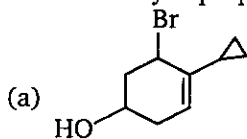


Identify most acidic hydrogen in given compound.

- (a) a                      (b) b                      (c) c                      (d) d
90. Which of the following compounds would you expect to be strongest carbon acid ?

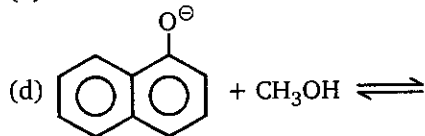
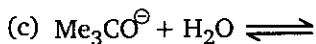


91. 5-Bromo-2-cyclopropyl cyclohex-2-enol have correct structure is:



92. Rearrange the following in the increasing order of acidic strength:
- (i) benzoic acid      (ii) *p*-methoxybenzoic acid      (iii) *o*-methoxybenzoic acid
- (a) i < ii < iii      (b) iii < i < ii      (c) ii < i < iii      (d) iii < ii < i

93. In the following acid-base reaction, in which can backward reaction be favoured?



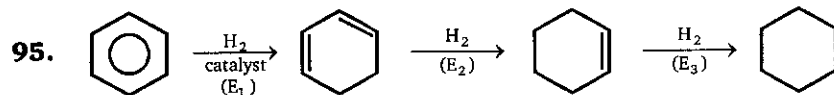
94. Which compound possesses highest dipole moment?

(a) naphthalene

(b) phenanthrene

(c) anthracene

(d) azulene

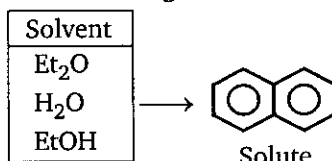


(E = activation energy)

Relation between activation energies of above reactions is :

- (a)  $E_2 > E_1 > E_3$       (b)  $E_3 > E_1 > E_2$       (c)  $E_3 > E_2 > E_1$       (d)  $E_1 > E_2 > E_3$

96. Rank the following solvents in decreasing order of ability to dissolve given compound.



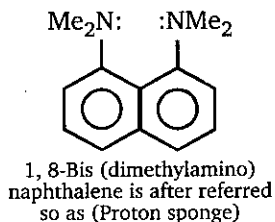
(a) Et<sub>2</sub>O > H<sub>2</sub>O > EtOH

(b) H<sub>2</sub>O > EtOH > Et<sub>2</sub>O

(c) H<sub>2</sub>O > Et<sub>2</sub>O > EtOH

(d) Et<sub>2</sub>O > EtOH > H<sub>2</sub>O

- 97.



Its basic strength is  $10^{10}$  more than 1-dimethyl amino naphthalene.

Reason for high basic strength is :

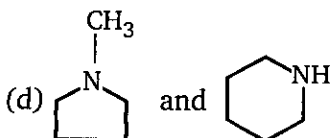
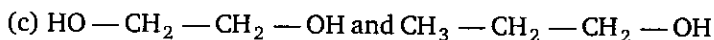
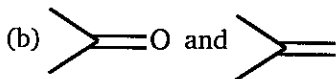
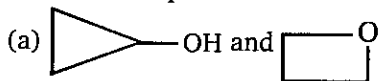
(a) resonance

(b) steric inhibition of resonance

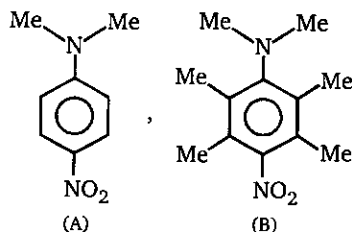
(c) ortho effect

(d) hyperconjugation

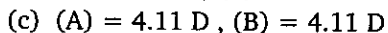
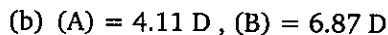
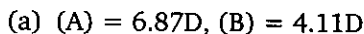
98. In the given pair of compounds, in which pair second compound has higher boiling point than first compound ?



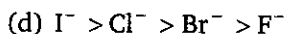
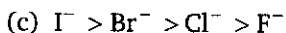
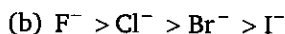
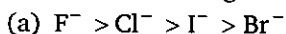
99.



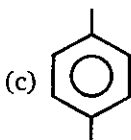
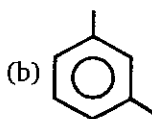
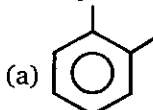
Dipole moments of given compound will be :



100. Order of decreasing basic strengths of halides is :

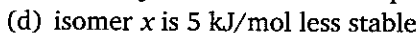
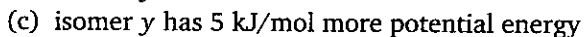
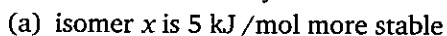


101. Among the xylenes, which is thermodynamically most stable ?

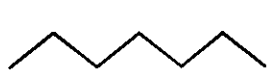


(d) All are equally stable

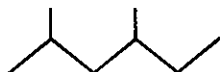
102. Heat of combustion of two isomer x and y are 17 kJ/mol and 12 kJ/mol respectively. From this information it may be concluded that :



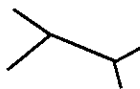
103. Rank the following substances in decreasing order of heat of combustion (most exothermic  $\rightarrow$  least exothermic)



(A)



(B)



(C)

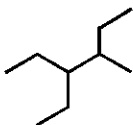
(a)  $B > A > C$

(b)  $A > B > C$

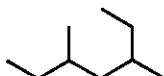
(c)  $C > A > B$

(d)  $C > B > A$

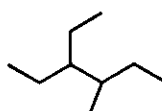
104.



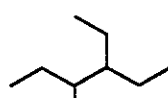
(1)



(2)



(3)



(4)

Choose the statement that best describes given compounds.

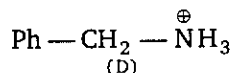
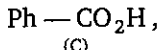
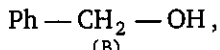
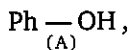
(a) 1, 3, 4 represent same compound

(b) 1 and 3 are isomer of 2 and 4

(c) 1, 4 are isomer of 2 and 3

(d) All the structure represent the same compound

105. Decreasing order of acid strengths is :



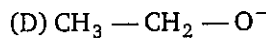
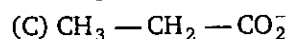
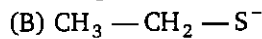
(a)  $B > A > C > D$

(b)  $C > A > B > D$

(c)  $C > A > D > B$

(d)  $C > B > A > D$

106. Rank the following in decreasing order of basic strength is :



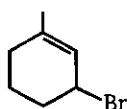
(a)  $B > A > D > C$

(b)  $D > A > B > C$

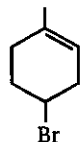
(c)  $A > D > B > C$

(d)  $A > D > C > B$

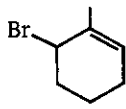
107. Among the given compound choose the two that yield same carbocation on ionization.



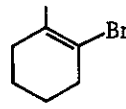
(A)



(B)



(C)



(D)

(a) A, C

(b) B, D

(c) A, B

(d) B, C

108. Oxalic acid  $pK_1$   
 Malonic acid  $pK_2$   
 Heptanedioic acid  $pK_3$

where  $pK_1, pK_2, pK_3$  are first ionization constants. Incorrect order is :

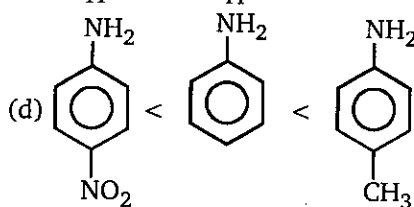
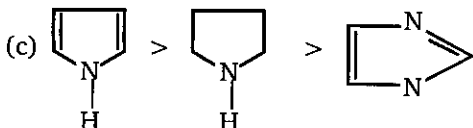
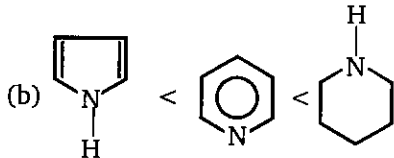
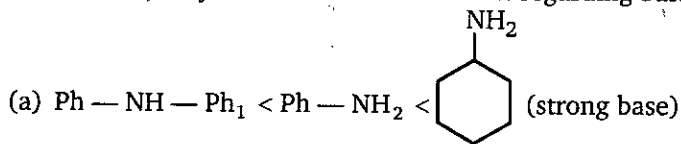
(a)  $pK_1 > pK_2 > pK_3$

(b)  $pK_1 < pK_2 < pK_3$

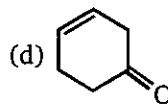
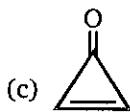
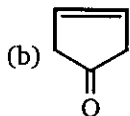
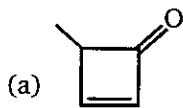
(c)  $pK_3 > pK_2 > pK_1$

(d)  $pK_3 > pK_1 > pK_2$

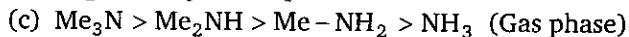
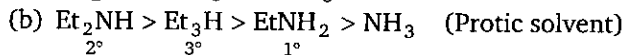
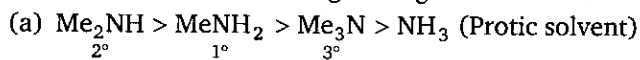
109. In sets a – d, only one of the set is incorrect regarding basic strength. Select it :



110. Dipole moment of which ketone is maximum ?

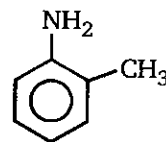


111. Correct order of basic strengths of given amines is :



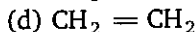
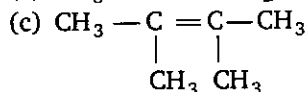
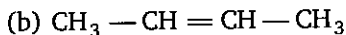
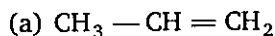
(d) All are correct

112. Order of basic strength  $\text{Ph} - \text{NH}_2$ ,  $\text{Ph} - \text{NH} - \text{Me}$ ,  $\text{Ph} - \text{N}(\text{Me})_2$ ,

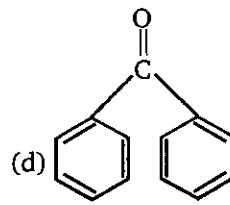
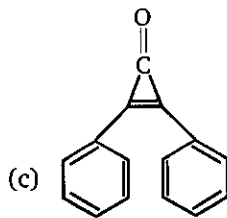
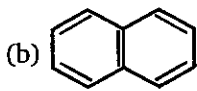
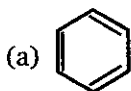


- (A) (B) (C) (D)
- (a)  $A > B > C > D$  (b)  $B > A > C > D$  (c)  $C > B > A > D$  (d)  $C > B > D > A$

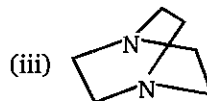
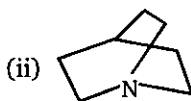
113. Carbon-carbon double bond length will be maximum in which of the following compounds ?



114. Which has maximum dipole moment ?



115. (i)  $\text{Et}_3\text{N}$



Compare the basic strengths of compounds given:

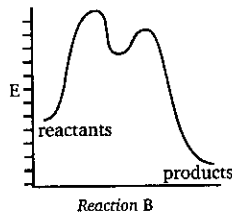
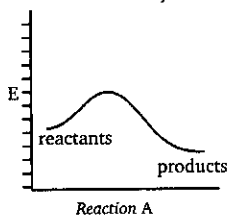
(a) (i) > (ii) > (iii)

(b) (ii) > (i) > (iii)

(c) (ii) > (iii) > (i)

(d) (iii) > (ii) > (i)

116. For the following two reactions, which statement is true ?

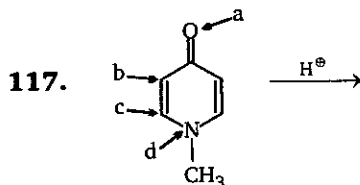


(a) Reaction A is faster and less exergonic than B

(b) Reaction B is faster and more exergonic than A

(c) Reaction A is faster and less endergonic than B

(d) Reaction B is faster and more endergonic than A



Identify the site, where attack of  $\text{H}^+$  is most favourable.

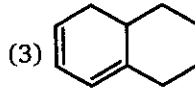
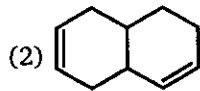
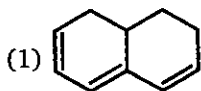
(a) a

(b) b

(c) c

(d) d

118. Rank the following alkenes on order of increasing  $\lambda_{\text{max}}$ .



(a)  $1 < 2 < 3$

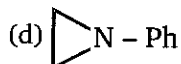
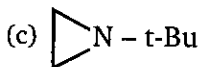
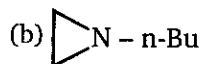
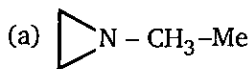
(b)  $1 < 3 < 2$

(c)  $2 < 1 < 3$

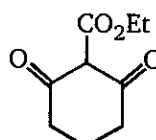
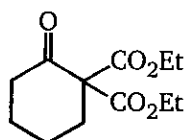
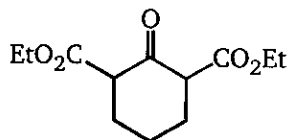
(d)  $2 < 3 < 1$



119. Which of the following cyclic amine has lowest  $\Delta G^\ddagger$  for inversion ?



120. Rank in the order of increasing acidic strength:



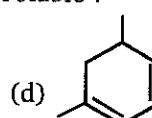
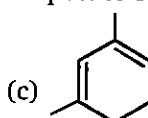
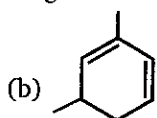
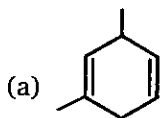
(a) A < B < C

(b) A < C < B

(c) B < A < C

(d) B < C < A

121. Which one of the following dienes would you expect to be the most stable ?



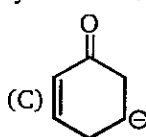
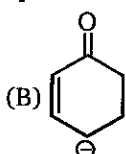
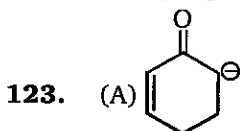
122. Which metal catalyzed reaction would release the maximum amount of heat per CH<sub>2</sub> unit ?

(a) cyclopropane + H<sub>2</sub> → propane

(b) cyclobutane + H<sub>2</sub> → butane

(c) cyclopentane + H<sub>2</sub> → pentane

(d) cyclohexane + H<sub>2</sub> → hexane



Compare basic strengths of the above compounds:

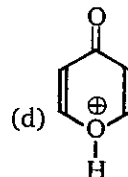
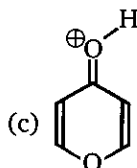
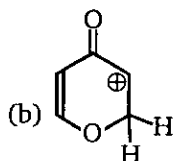
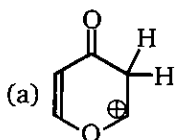
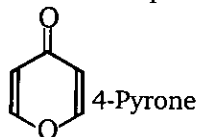
(a) A > B > C

(b) B > A > C

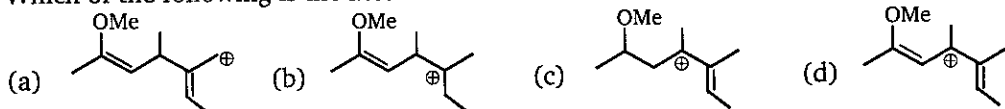
(c) C > A > B

(d) C > B > A

124. On reaction with acid, 4-pyrone gives a very stable cationic product. Which of the following structures shows the protonation site in that product ?



125. Which of the following is the most stabilized carbocation ?



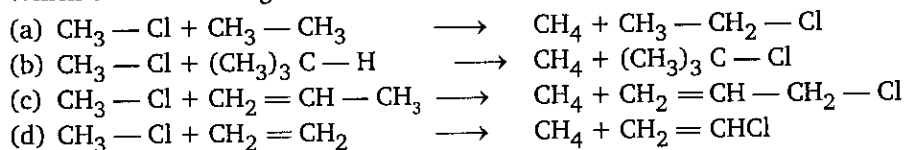
126. Which carbocation is the most stable ?



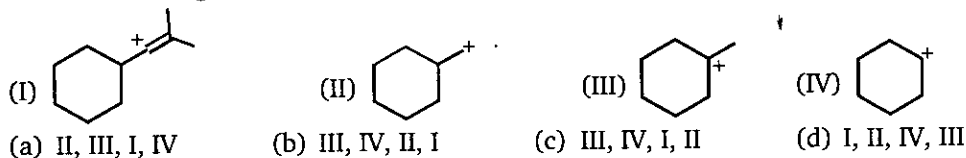
127. Consider a positively charged  $C_2H_3$  species in which the positively charged carbon is  $sp$ -hybridized, the uncharged carbon is  $sp^2$ -hybridized and an empty  $p$ -orbital is perpendicular to the  $\pi$  system. What is the best description of this cation ?

- (a) vinyl (b) allenyl (c) alkyl (d) allyl

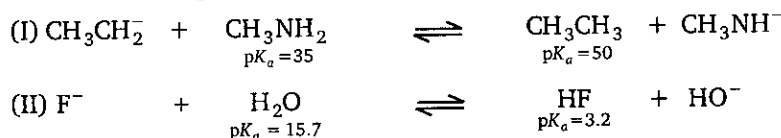
128. Which of the following reactions is not exothermic ?



129. List the following carbocations in order of decreasing stabilization energies.

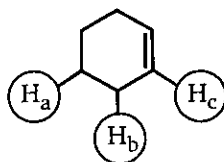


130. For the following two acid-base reactions, which statement is true ?



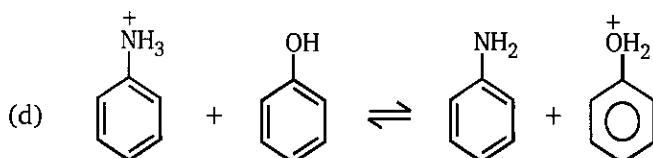
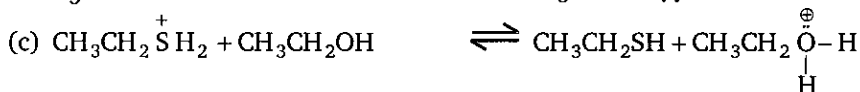
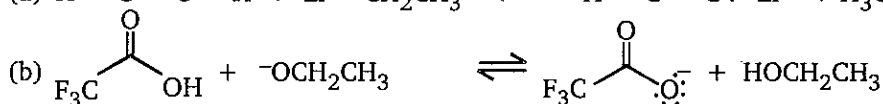
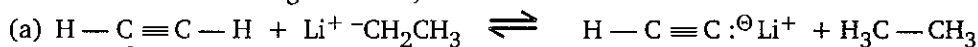
- (a) I is favoured to the right, II is favoured to the left  
 (b) I is favoured to the left, II is favoured to the right  
 (c) I is favoured to the right, II is favoured to the right  
 (d) I is favoured to the left, II is favoured to the left

131. Rank the hydrogen atoms ( $H_a$ ,  $H_b$ ,  $H_c$ ) in the following molecules according to their acidic strengths:

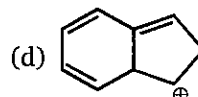
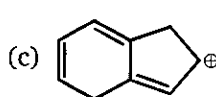
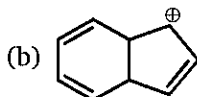
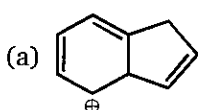


- (a)  $a > b > c$  (b)  $b > a > c$  (c)  $b > c > a$  (d)  $a > c > b$

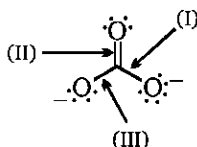
132. In which of the following reactions, backward reaction is favoured ?



133. Which carbocation is the most stabilized ?

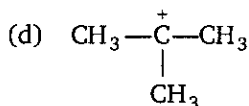
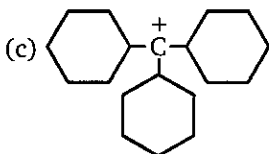
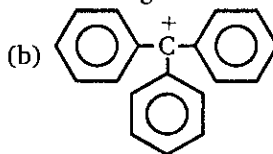
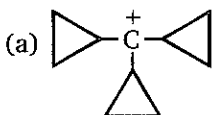


134. Taking into account of hybridization and resonance effects, rank the following bonds in order of decreasing bond length.

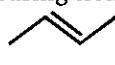
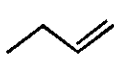


- (a) I > II = III      (b) II > III > I      (c) I > III > II      (d) II = III = I

135. Which one among the following carbocations has the longest half-life ?



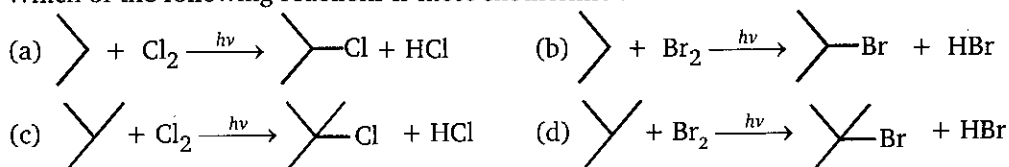
136. Rank the following alkenes in order of decreasing heats of hydrogenation (largest first)



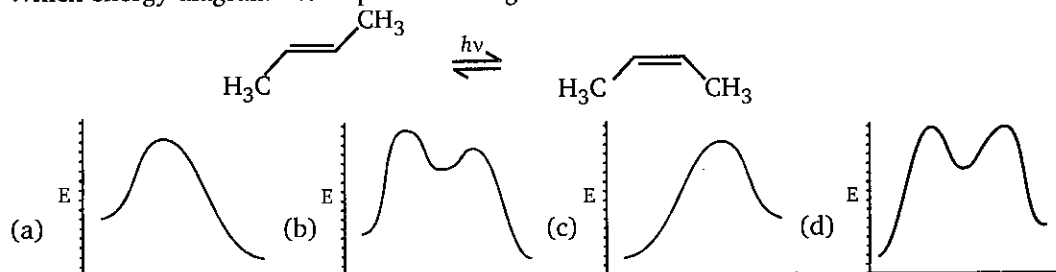
- (a) 2 > 3 > 4 > 1  
(c) 1 > 3 > 4 > 2

- (b) 2 > 4 > 3 > 1  
(d) 1 > 4 > 3 > 2

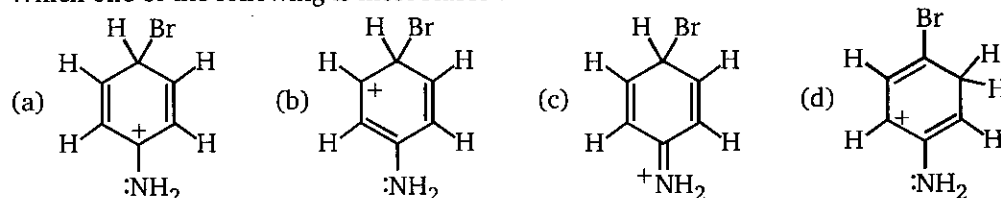
137. Which of the following reactions is most exothermic ?



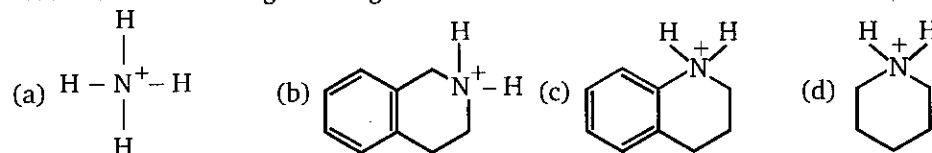
138. Which energy diagram best represents the given reaction ?



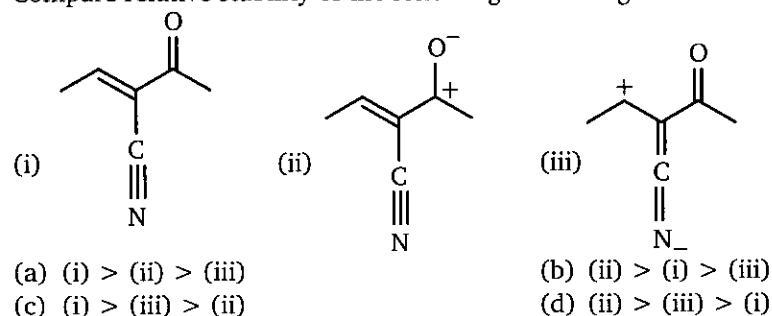
139. Which one of the following is most stable ?



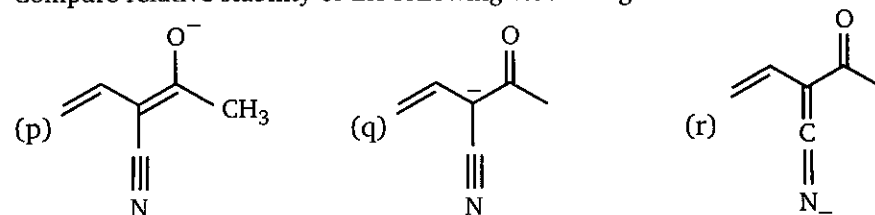
140. Which of the following is strongest acid ?



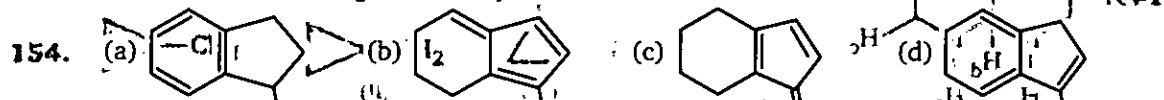
141. Compare relative stability of the following resonating structure.



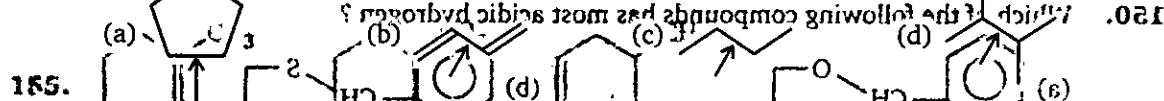
142. Compare relative stability of the following resonating structure.



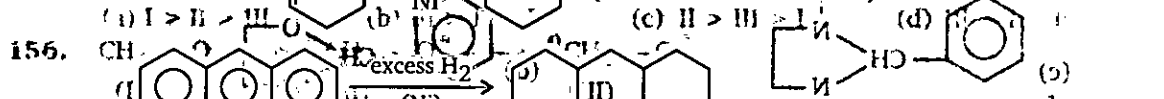
143. Which of the following isomeric hydrocarbons is most acidic?  
 (a)  $p > q > r$  (b)  $q > p > r$   
 (c)  $q > r > p$  (d)  $p > r > q$



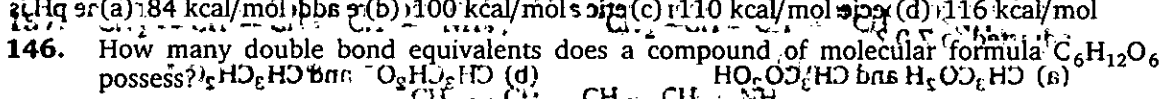
145. Use the following data to answer the question below.  
 (a)  $I > II > III$  (b)  $II > I > III$   
 (c)  $III > I > II$  (d)  $I > III > II$



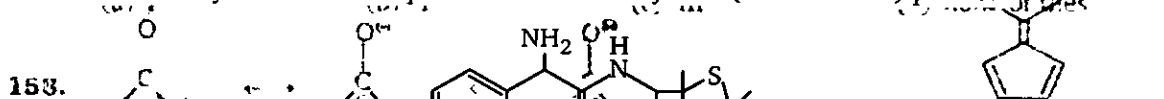
147. How many double bond equivalents does amoxicillin (shown below) possess?  
 (a) 5 (b) 6 (c) 7 (d) 9



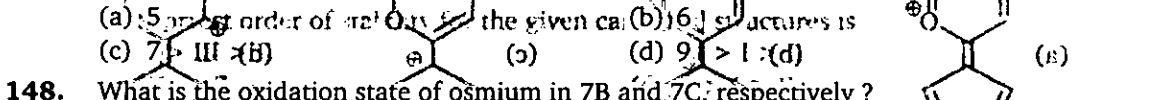
149. Which of the following structures is not a valid canonical structure?  
 (a) I (b) II (c) III (d) all are equally stable



151. Calculate the resonance energy of anthracene.  
 (a) 84 kcal/mol (b) 100 kcal/mol (c) 110 kcal/mol (d) 116 kcal/mol



153. In the following reaction, the order of reactivity is  
 (a)  $I > II > III$  (b)  $II > I > III$   
 (c)  $III > I > II$  (d)  $I > III > II$

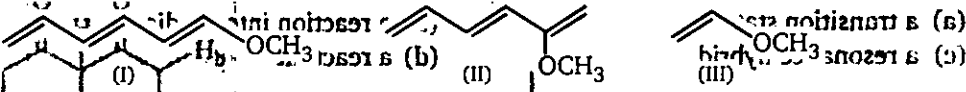
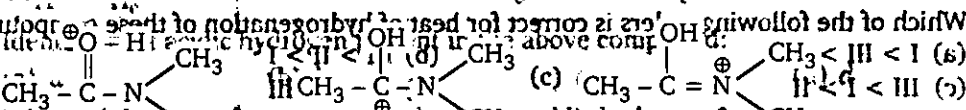
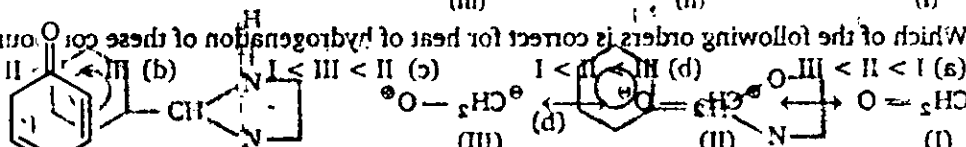
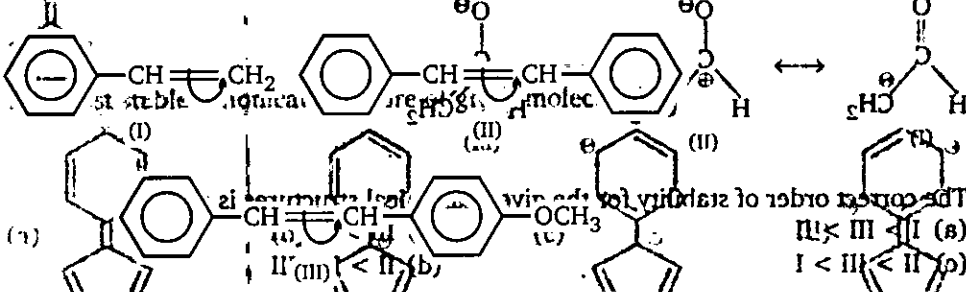
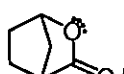
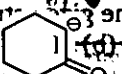
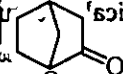
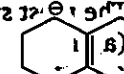


155. Which of the following structures is practically not a canonical structure?  
 (a) I (b) II (c) III (d) IV



157. Which of the following structures is practically not a canonical structure?  
 (a) I (b) II (c) III (d) IV

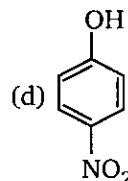
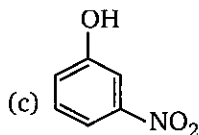
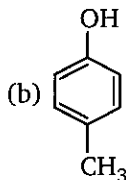
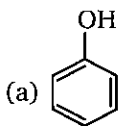


160. 
149. For the given compounds the correct order of resonance energy is :  
 (a) III > I > II (b) II > I > III  
 (c) I > II > III (d) III > II > I
161. 
150. Which of the following is correct for heat of hydrogenation of these compounds?  
 (a) I > II > III (b) III > I > II  
 (c) I > III > II (d) II > III > I
162. 
151. In the above compound, how many sites are available for the attack of  $\text{CH}_3\text{O}^-$ ?  
 (a) 1 (b) 2 (c) 3 (d) 4
163.  $\text{CH}_2=\text{CH}_2$  and  $\text{CH}_3\text{O}-\text{CH}=\text{CH}_2$  are adjusted to 7.0 pH. What is the pH of the solution?  
 (a) 1 (b) 2 (c) 3 (d) 4
152. Which of the following orders of rotation barrier about the  $\text{C}=\text{C}$  bond, as indicated, is correct?  
 (a) I > II > III (b) III > II > I  
 (c) III > I > II (d) II > I > III
164. 
153. Which of the following orders of rotation barrier about the  $\text{C}=\text{C}$  bond, as indicated, is correct?  
 (a) I > II > III (b) III > II > I  
 (c) III > I > II (d) II > I > III
165. Which of the following compound is not resonance stabilized?  
 (a)  (b)  (c)  (d) 

166. Homologous compound have same:

- (a) General formula (b) Empirical formula  
(c) Structural formula (d) Molecular formula

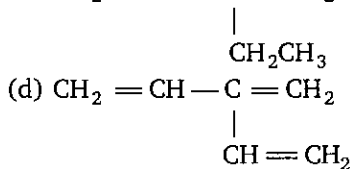
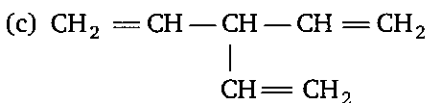
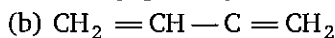
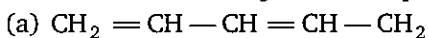
167. Most acidic is:



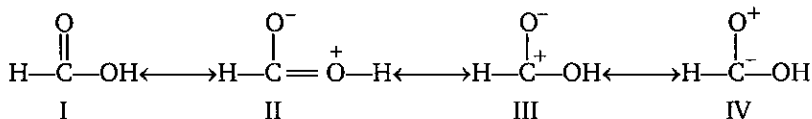
168. Which of the following substituents will decrease the acidic strength of phenol?

- (a)  $-\text{NO}_2$  (b)  $-\text{CN}$   
(c)  $-\text{CH}_3$  (d)  $-\text{CHO}$

169. Which of the following structures possesses a cross-conjugated system?



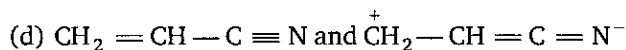
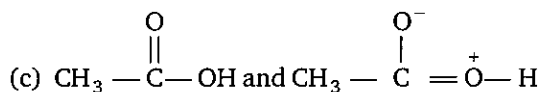
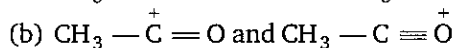
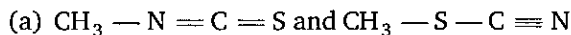
170. Examine the following resonating structures of formic acid for their individual stability and then answer the question given below.



Which of the following arrangements gives the correct order of decreasing stability of the above-mentioned resonance contributors?

- (a)  $\text{II} > \text{I} > \text{III} > \text{IV}$  (b)  $\text{I} > \text{II} > \text{III} > \text{IV}$   
(c)  $\text{IV} > \text{III} > \text{I} > \text{II}$  (d)  $\text{IV} > \text{III} > \text{I} > \text{II}$

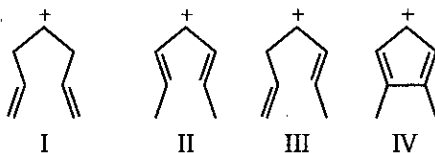
171. Which of the following is not resonating structure of each other?



172. In the molecule  $\text{CH}_3\text{C} \equiv \text{CCH} = \text{CH}_2$ , the maximum number of carbon atoms arranged linearly is:

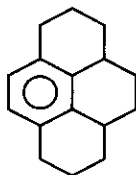
- (a) 2 (b) 3  
(c) 4 (d) 5

173. The stability order of the following carbocations is:



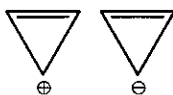
- (a) II > IV > III > I                                  (b) IV > II > III > I  
 (c) II > III > I > IV                                  (d) I > III > II > IV

174. Total number of  $\alpha$ -hydrogen in given compound is:

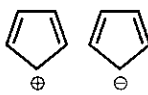


- (a) 4                                  (b) 5                                  (c) 6                                  (d) 7

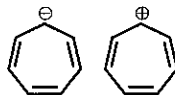
175. In which pair second ion is more stable than first?



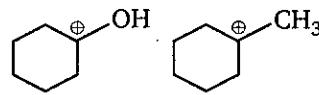
(i)



(ii)



(iii)



(iv)

- (a) (i) and (ii)                                  (b) (ii) and (iii)  
 (c) (ii) and (iv)                                  (d) (iii) and (iv)

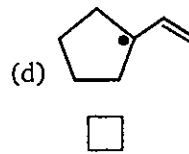
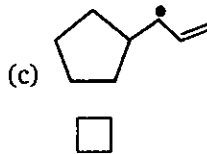
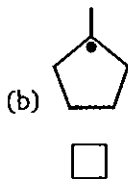
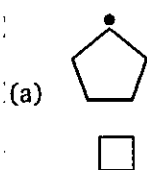


## ANSWERS — LEVEL 1

1.	(c)	2.	(d)	3.	(d)	4.	(a)	5.	(d)	6.	(d)	7.	(b)	8.	(c)
9.	(b)	10.	(c)	11.	(b)	12.	(b)	13.	(a)	14.	(b)	15.	(b)	16.	(b)
17.	(d)	18.	(c)	19.	(d)	20.	(d)	21.	(c)	22.	(c)	23.	(c)	24.	(a)
25.	(d)	26.	(d)	27.	(d)	28.	(a)	29.	(d)	30.	(a)	31.	(c)	32.	(c)
33.	(d)	34.	(d)	35.	(d)	36.	(d)	37.	(b)	38.	(b)	39.	(a)	40.	(c)
41.	(c)	42.	(d)	43.	(a)	44.	(c)	45.	(c)	46.	(d)	47.	(b)	48.	(d)
49.	(b)	50.	(b)	51.	(d)	52.	(d)	53.	(d)	54.	(a)	55.	(c)	56.	(c)
57.	(b)	58.	(b)	59.	(d)	60.	(c)	61.	(b)	62.	(b)	63.	(d)	64.	(c)
65.	(d)	66.	(c)	67.	(a)	68.	(a)	69.	(d)	70.	(b)	71.	(a)	72.	(d)
73.	(d)	74.	(d)	75.	(a)	76.	(d)	77.	(a)	78.	(a)	79.	(b)	80.	(a)
81.	(d)	82.	(d)	83.	(d)	84.	(c)	85.	(b)	86.	(a)	87.	(a)	88.	(b)
89.	(a)	90.	(d)	91.	(b)	92.	(c)	93.	(d)	94.	(d)	95.	(d)	96.	(d)
97.	(b)	98.	(d)	99.	(a)	100.	(b)	101.	(b)	102.	(d)	103.	(a)	104.	(a)
105.	(c)	106.	(c)	107.	(c)	108.	(b)	109.	(c)	110.	(c)	111.	(d)	112.	(c)
113.	(c)	114.	(c)	115.	(c)	116.	(a)	117.	(a)	118.	(d)	119.	(c)	120.	(c)
121.	(c)	122.	(a)	123.	(c)	124.	(c)	125.	(d)	126.	(b)	127.	(a)	128.	(d)
129.	(b)	130.	(a)	131.	(c)	132.	(d)	133.	(c)	134.	(d)	135.	(a)	136.	(d)
137.	(c)	138.	(d)	139.	(c)	140.	(c)	141.	(a)	142.	(d)	143.	(b)	144.	(c)
145.	(a)	146.	(b)	147.	(d)	148.	(b)	149.	(a)	150.	(b)	151.	(d)	152.	(b)
153.	(a)	154.	(a)	155.	(c)	156.	(c)	157.	(c)	158.	(b)	159.	(c)	160.	(c)
161.	(b)	162.	(c)	163.	(a)	164.	(a)	165.	(c)	166.	(a)	167.	(d)	168.	(c)
169.	(d)	170.	(b)	171.	(a)	172.	(d)	173.	(c)	174.	(c)	175.	(b)		

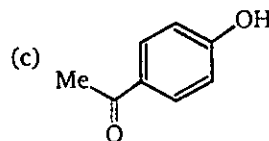
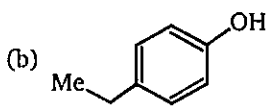
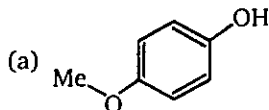
# LEVEL-2

1. Rank in order of radical stability (1 = most stable).



2. Predict the acidity order for the three phenols shown below :

Acidity order : 1 (most) to 3 (least)

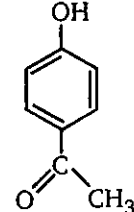
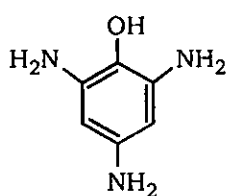
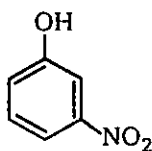
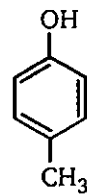
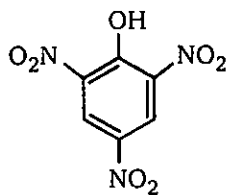
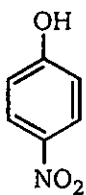


Acidity order : .....

.....

.....

### 3. Comprehension



A. Which of the phenol derivatives above is the strongest acid ?

- Compound A       Compound B       Compound C  
 Compound D       Compound E       Compound F

B. Which of the phenol derivatives above is the weakest acid ?

- Compound A       Compound B       Compound C  
 Compound D       Compound E       Compound F

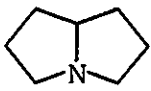
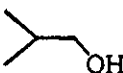
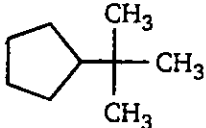

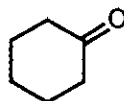
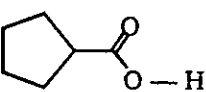
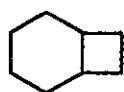
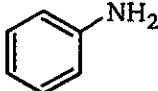
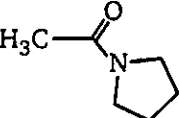
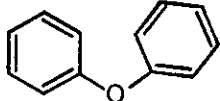
C. Which of the mono-nitrophenol derivatives above is the strongest acid ?

- Compound A       Compound D

D. Which of the carbon-substituted phenol derivatives above is the strongest acid ?

- Compound C       Compound F

4. The following questions refer to the twelve compounds given below. You may enter as many as six choices in each answer box.

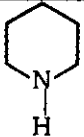
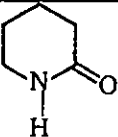
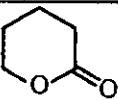
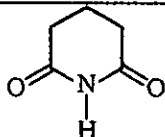
(a)		(b)		(c)	$\text{H}_3\text{C}-\text{C}(=\text{O})-\text{O}-\text{C}_2\text{H}_5$
(d)	H—F	(e)		(f)	
(g)		(h)		(i)	
(j)		(k)		(l)	

A. Which compound may serve only as H-bond acceptors ?

B. Which may serve both as H-bond donors and acceptors?

C. Which compounds will not participate in H-bonding ?

5. Consider the following compounds and answer A and B.

(I) 	(II) 	(III) 	(IV) 
---	--	---	--

A. Which of the compounds is the strongest Bronsted acid ?

(a) I

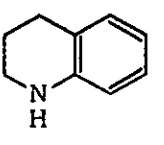
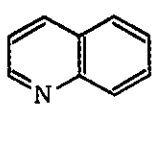
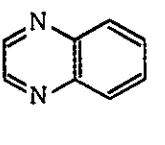
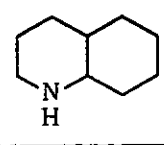
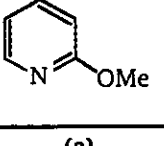
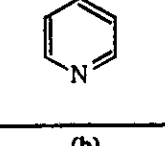
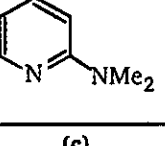
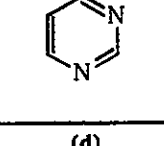
(b) II

(c) III

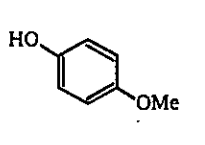
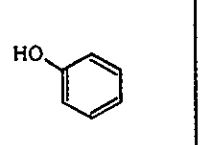
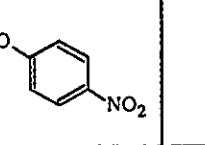
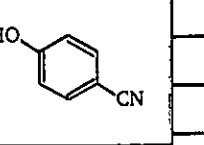
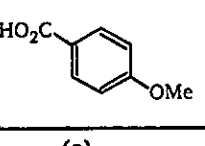
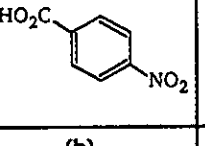
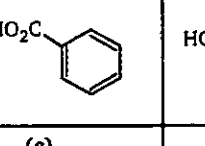
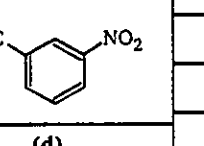
(d) IV

10. In the two questions below, you are asked to rank the relative strengths of illustrated acids and bases. Use your knowledge of resonance and inductive to answer this.

A. For the series of bases shown below, rank the set from strongest to weakest.

(i)						Strongest
	(a)	(b)	(c)	(d)		
(ii)						Strongest
	(a)	(b)	(c)	(d)		

B. For the series of acids shown below, rank the set from strongest to weakest.

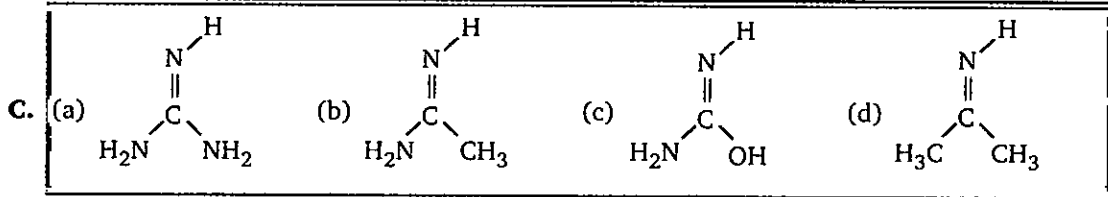
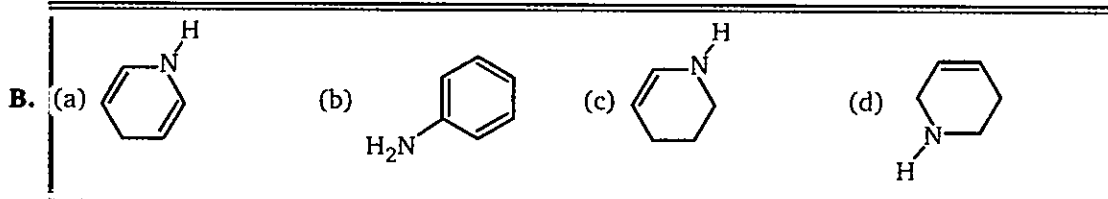
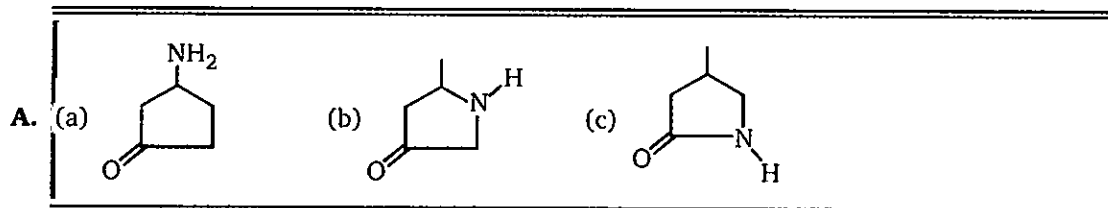
(i)						Strongest
	(a)	(b)	(c)	(d)		
(ii)						Strongest
	(a)	(b)	(c)	(d)		

11. In each of the following sections four compounds are listed. (Decreasing order of acidic strength, 1 is strongest & 4 is weakest).

(a)	$\text{CH}_2(\text{CO}_2\text{C}_2\text{H}_5)_2$	$\text{CH}_3\text{COCH}_2\text{CO}_2\text{C}_2\text{H}_5$	$(\text{CH}_3\text{CO})_2\text{CH}_2$	$\text{RC}\equiv\text{CH}$
(b)	$\text{RCH}_2\text{NO}_2$	$\text{RSO}_2\text{CH}_3$	$(\text{C}_6\text{H}_5)_3\text{CH}$	$\text{RCOCH}_3$
(c)	$\text{CH}_2(\text{C}\equiv\text{N})_2$	$\text{CH}_2(\text{NO}_2)_2$	$\text{HC}\equiv\text{N}$	$\text{RCH}_2\text{CO}_2\text{C}_2\text{H}_5$

(d)				

12. Rank in the order of increasing basic strength.

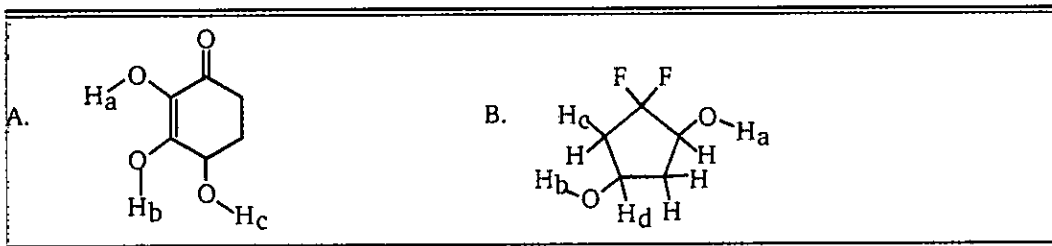


13. Compare acidic strength of the following (Write your answer in box).

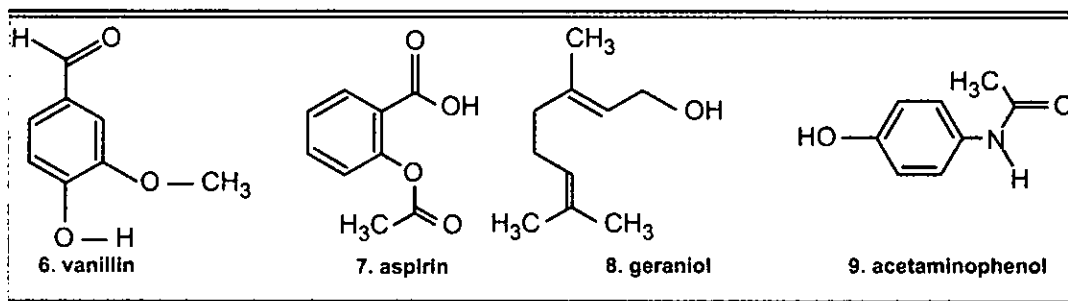
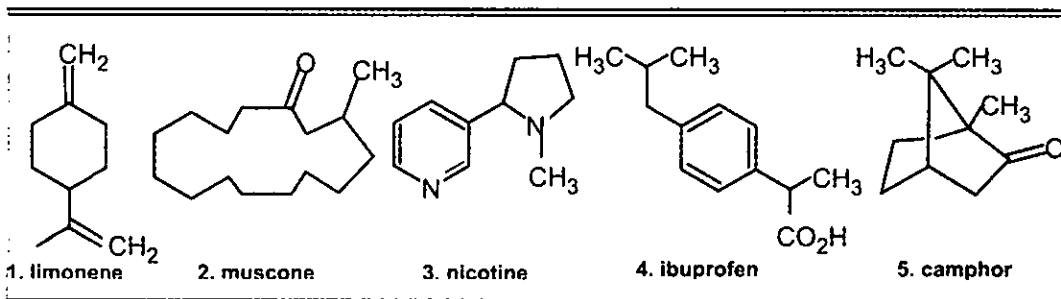
A.					
	(a)	(b)	(c)		
B.					
	(a)	(b)	(c)		

C.						
	(a)	(b)	(c)			
D.						
	(a)	(b)	(c)	(d)		
E.						
	(a)	(b)	(c)			
F.						
	(a)	(b)	(c)			

14. Arrange the hydrogens in increasing order of their acidic strengths.


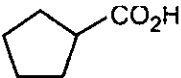
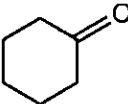
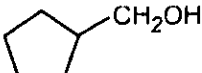
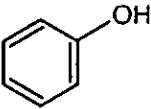
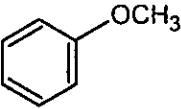
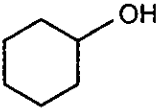
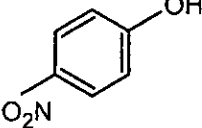
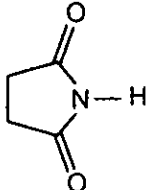
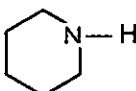
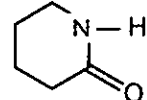
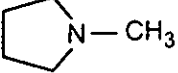
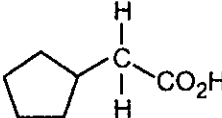
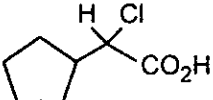
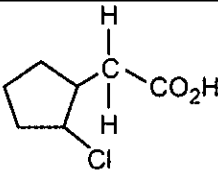
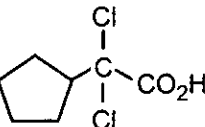


15. The compounds whose structures are shown below, incorporate a variety of functional groups. The question on the right ask you to identify which compounds have a specific functional group. For each compound that has the designed group, enter the appropriate number. The aromatic rings should not be counted as double bonds.



<b>A.</b>	Which have carbon-carbon double bonds ?	
<b>B.</b>	Which have a ketone carbonyl group ?	
<b>C.</b>	Which have an aldehyde carbonyl group ?	
<b>D.</b>	Which have aromatic rings ?	
<b>E.</b>	Which have a hydroxy group ?	
<b>F.</b>	Which have ether groups ?	
<b>G.</b>	Which have an ester group ?	
<b>H.</b>	Which have an amide group ?	
<b>I.</b>	Which have a carboxylic acid group ?	

16.

Problem	A	B	C	D
1				
2				
3				
4				

A. Which is the strongest acid in 1?

- (a) A (b) B (c) C (d) D

B. Which is weakest acid in 1?

- (a) A (b) B (c) C (d) D

C. Which is the strongest acid in 2?

- (a) A (b) B (c) C (d) D

D. Which is weakest acid in 2?

- (a) A (b) B (c) C (d) D

E. Which is the strongest acid in 3?

- (a) A (b) B (c) C (d) D

F. Which is weakest acid in 3?

- (a) A (b) B (c) C (d) D

G. Which is the strongest acid in 4?

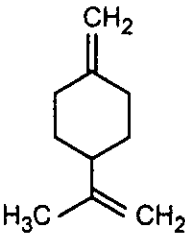
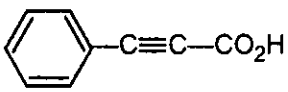
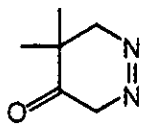
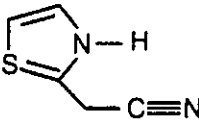
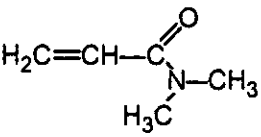
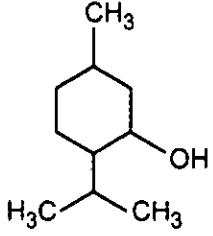
- (a) A (b) B (c) C (d) D

H. Which is weakest acid in 4?

- (a) A (b) B (c) C (d) D



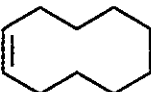
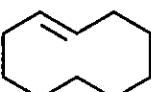


17. For each of the six structural formulae (A through F), shown below, five questions are posed. The answer to each is a number that should be entered in the appropriate answer box.

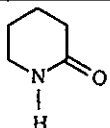
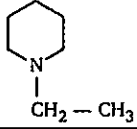
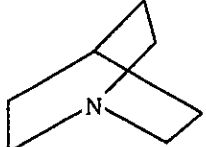
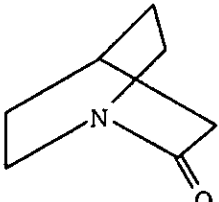
 <p style="text-align: center;"><b>A</b></p>	 <p style="text-align: center;"><b>B</b></p>	 <p style="text-align: center;"><b>C</b></p>
 <p style="text-align: center;"><b>D</b></p>	 <p style="text-align: center;"><b>E</b></p>	 <p style="text-align: center;"><b>F</b></p>

- |   |   |   |
|---|---|---|
| <p><b>A.</b> (i) Number of <math>sp^3</math> carbons : .....</p> <p>(ii) Number of <math>sp^2</math> carbons : .....</p> <p>(iii) Number of <math>sp</math> carbons : .....</p> <p>(iv) Number of carbon-carbon <math>\sigma</math>-bonds : .....</p> <p>(v) Number of <math>\pi</math>-bonds to carbon : .....</p> | <p><b>B.</b> Number of <math>sp^3</math> carbons : .....</p> <p>Number of <math>sp^2</math> carbons : .....</p> <p>Number of <math>sp</math> carbons : .....</p> <p>Number of carbon-carbon <math>\sigma</math>-bonds : .....</p> <p>Number of <math>\pi</math>-bonds to carbon : .....</p> | <p><b>C.</b> Number of <math>sp^3</math> carbons : .....</p> <p>Number of <math>sp^2</math> carbons : .....</p> <p>Number of <math>sp</math> carbons : .....</p> <p>Number of carbon-carbon <math>\sigma</math>-bonds : .....</p> <p>Number of <math>\pi</math>-bonds to carbon : .....</p> |
| <p><b>D.</b> (i) Number of <math>sp^3</math> carbons : .....</p> <p>(ii) Number of <math>sp^2</math> carbons : .....</p> <p>(iii) Number of <math>sp</math> carbons : .....</p> <p>(iv) Number of carbon-carbon <math>\sigma</math>-bonds : .....</p> <p>(v) Number of <math>\pi</math>-bonds to carbon : .....</p> | <p><b>E.</b> Number of <math>sp^3</math> carbons : .....</p> <p>Number of <math>sp^2</math> carbons : .....</p> <p>Number of <math>sp</math> carbons : .....</p> <p>Number of carbon-carbon <math>\sigma</math>-bonds : .....</p> <p>Number of <math>\pi</math>-bonds to carbon : .....</p> | <p><b>F.</b> Number of <math>sp^3</math> carbons : .....</p> <p>Number of <math>sp^2</math> carbons : .....</p> <p>Number of <math>sp</math> carbons : .....</p> <p>Number of carbon-carbon <math>\sigma</math>-bonds : .....</p> <p>Number of <math>\pi</math>-bonds to carbon : .....</p> |

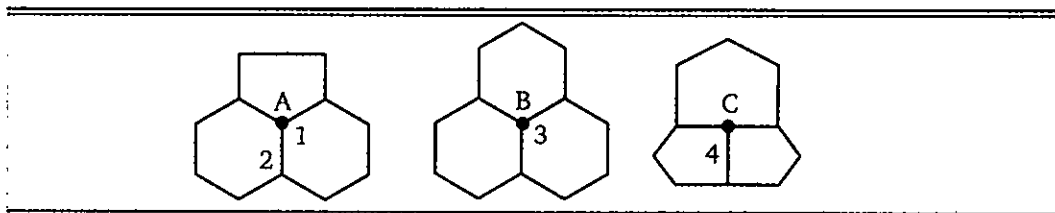
## 18. Match the column (I) and (II). (Matrix)

Column (I)		Column (II)	
	Molecule		Property
(a)		(p)	cis-compound
(b)		(q)	trans-compound
(c)		(r)	Highest heat of combustion
(d)		(s)	lowest heat of combustion

## 19. Match the column (I) and (II).

Column (I)		Column (II)	
	Molecule		$pK_a$ of Conjugate acid
(a)		(p)	0.8
(b)		(q)	5.33
(c)		(r)	10.65
(d)		(s)	10.95

20. The junctures centred on atoms A, B and C on the given structure.



- A. Which juncture has the greatest deviation from planarity ?  
 (a) A (b) B (c) C (d) Cannot be predicted
- B. Of the carbon-carbon bonds, (shown above) numbered from 1 to 4, which represent the most favourable site for  $H_2$  addition ?  
 (a) 1 (b) 2 (c) 3 (d) 4
21. Select the most stable structure in each of the following

Part (A)			
(a)	(b)	(c)	(d)
Part (B)			
(a)	(b)	(c)	(d)
Part (C)			
(a) $H_2C = CH - CH = CH - CH_3$	(b) $H_2C = C = CH - CH_2 - CH_3$		
(c) $H_3C - CH = C = CH - CH_3$	(d) $H_2C = CH - CH_2 - CH = CH_2$		

22. Match the column I and II. (Matrix)

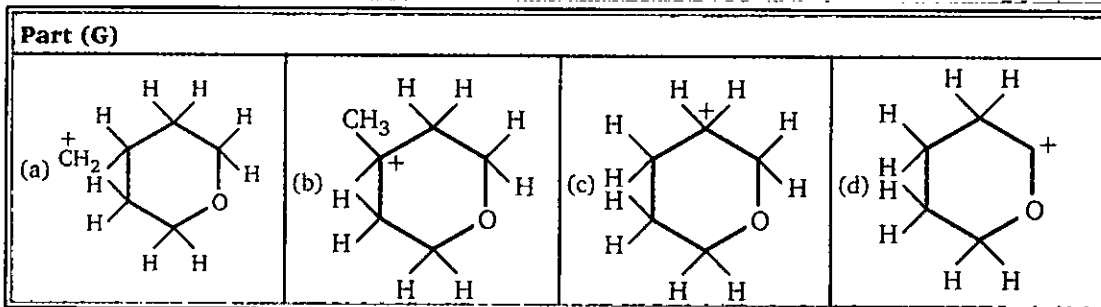
Column (I)		Column (II)	
(a) $-NO_2$	(p) $-m$ effect	(q) $+m$ effect	
(b) $-O^-$	(r) $+I$ effect	(s) $-I$ effect	
(c) $-O - CH_3$			
(d) $-C \equiv N$			

23. Match the column I and II. (Matrix)

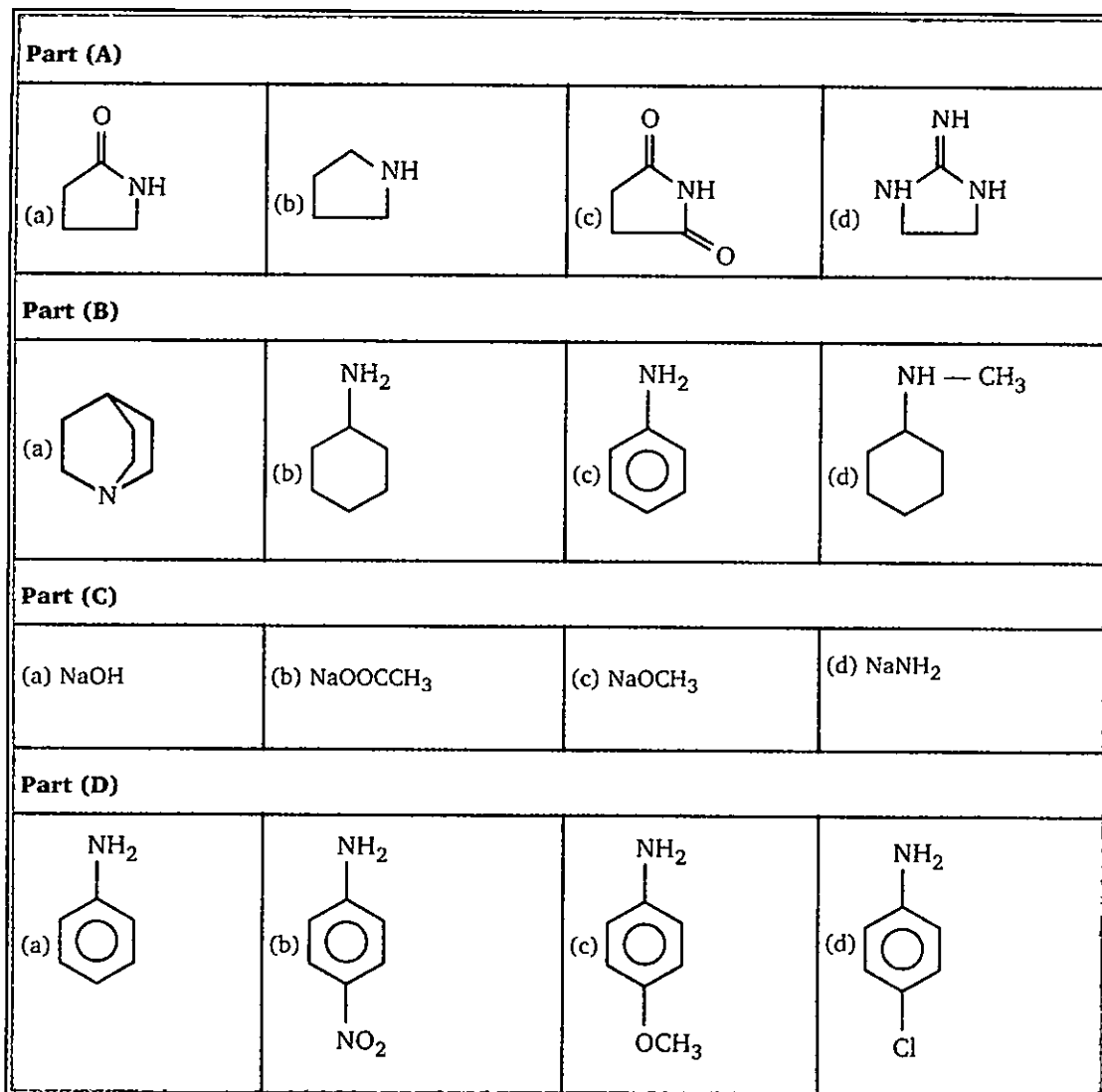
Column (I)		Column (II)	
(a) $H_3C - CH = CH - CH_3$	(p) Dipole ( <i>cis</i> > <i>trans</i> )	(q) Dipole ( <i>trans</i> > <i>cis</i> )	
(b) $H_3C - CH = CH - CN$	(r) Melting point ( <i>trans</i> > <i>cis</i> )	(s) Boiling point ( <i>cis</i> > <i>trans</i> )	
(c) $H_3C - CH = CH - Cl$			
(d) $Cl - CH = CH - Cl$			

24. Identify the most stable structure in each of the following :

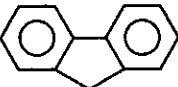
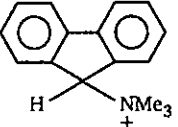
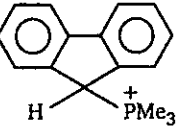
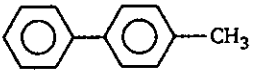
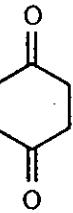
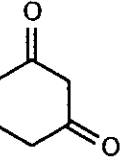
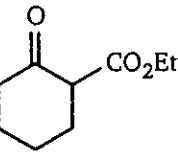
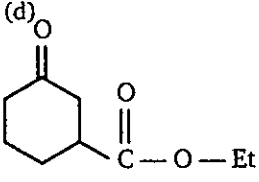
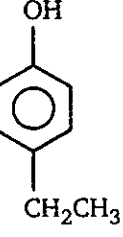

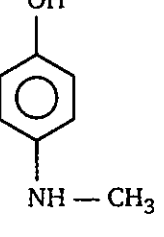
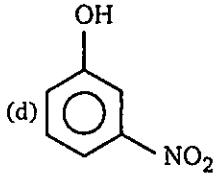
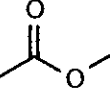
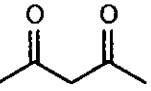

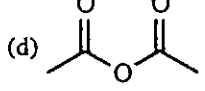
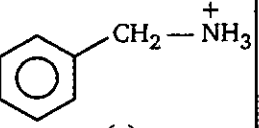
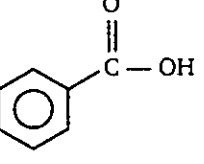
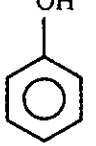
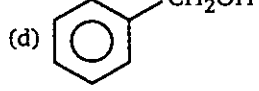
Part (A)			
(a)	(b)	(c)	(d)
Part (B)			
(a)	(b)	(c)	(d)
Part (C)			
(a)	(b)	(c)	(d)
Part (D)			
(a)	(b)	(c)	(d)
Part (E)			
(a)	(b)	(c)	(d)
Part (F)			
(a)	(b)	(c)	(d)

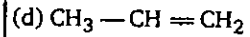
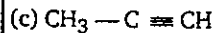
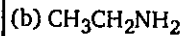
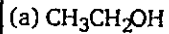
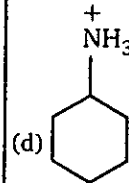
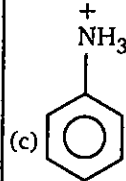
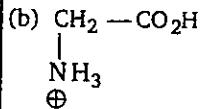
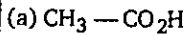
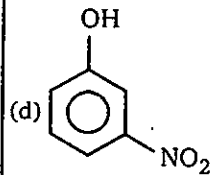
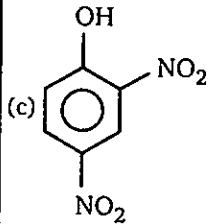
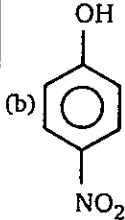
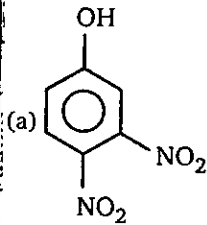
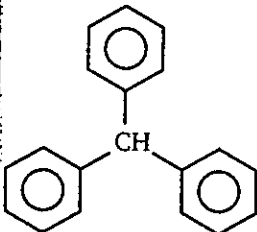


25. Identify the most basic compound in the following.

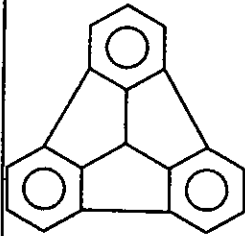


26. Identify the most acidic hydrogen containing compound from the following.

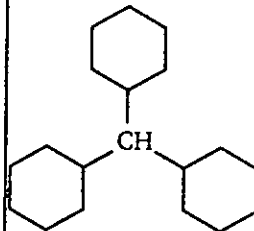
<b>Part (A)</b>			
(a) 	(b) 	(c) 	(d) 
<b>Part (B)</b>			
(a) 	(b) 	(c) 	(d) 
<b>Part (C)</b>			
(a) 	(b) 	(c) 	(d) 
<b>Part (D)</b>			
(a) 	(b) 	(c) 	(d) 
<b>Part (E)</b>			
(a) 	(b) 	(c) 	(d) 

**Part (F)****Part (G)****Part (H)****Part (I)**

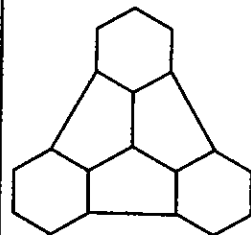
(a)



(b)

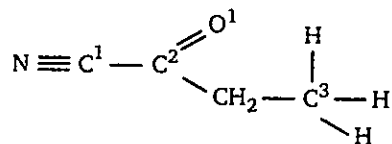


(c)



(d)

27.

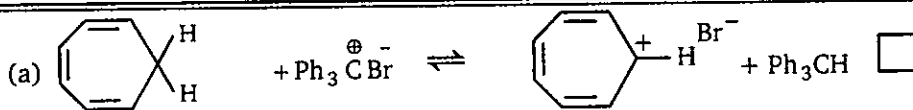


Give the type of hybridization present at each atom.

(i) N —.....

(ii) C<sub>1</sub> —.....(iii) C<sub>2</sub> —.....(iv) O<sub>1</sub> —.....(v) CH<sub>2</sub> —.....(vi) C<sub>3</sub> —.....

28. Predict the direction of the following equilibrium. Write your answer in the box given below.



(A)

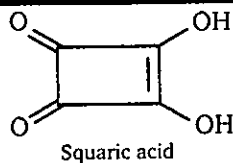
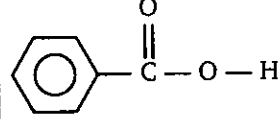
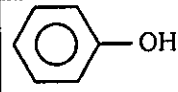
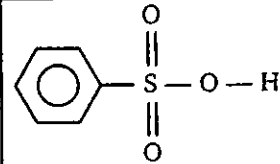
(B)

(C)

(D)



29. Match the column I and II. (Matrix)

Column (I)		Column (II)	
(a)	$\text{NaHCO}_3$ will react with	(p)	 Squaric acid
(b)	Na will react with	(q)	
(c)	NaOH will react with	(r)	
(d)	$\text{NaNH}_2$ will react with	(s)	

30. Match the column I and II.

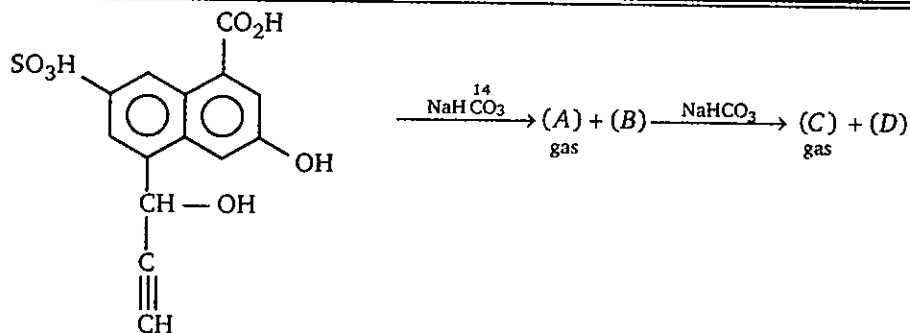
Column (I)		Column (II)	
Acid		$\text{pK}_a$	
(a)	$\text{CH}_3 - \text{CO}_2\text{H}$	(p)	5.69
(b)	$(\text{CH}_3)_3\text{N}^{\oplus}\text{CH}_2\text{CO}_2\text{H}$	(q)	4.27
(c)	$(\text{CH}_3)_3\text{N}^{\oplus}(\text{CH}_2)_4\text{CO}_2\text{H}$	(r)	1.83
(d)	$\text{O}_2\text{C} - \text{CH}_2 - \text{CO}_2\text{H}$	(s)	4.80



## 31. Match the column I and II.

Column (I)		Column (II)	
(a)	$\text{C}_6\text{H}_5\text{C}(=\text{O})\text{OH} + \text{NaHCO}_3 \rightarrow$	(p)	$\text{NH}_3$
(b)	$\text{C}_6\text{H}_5\text{C}(=\text{O})\text{OH} + \text{NaHCO}_3^{14} \rightarrow$	(q)	$^{14}\text{CO}_2$
(c)	$\text{C}_6\text{H}_5\text{C}(=\text{O})\text{OH} + \text{Na} \rightarrow$	(r)	$\text{CO}_2$
(d)	$\text{C}_6\text{H}_5\text{SO}_3\text{H} + \text{NaNH}_2 \rightarrow$	(s)	$\text{H}_2$

32.



Sum of molecular mass of gas (A + C) is :

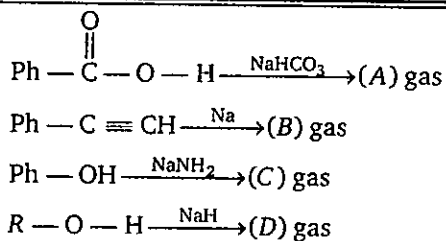
(a) 88

(b) 90

(c) 92

(d) 40

33.

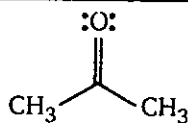


Sum of molecular mass of gas A + B + C + D is :

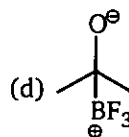
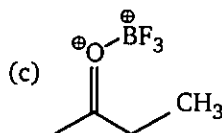
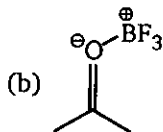
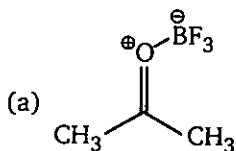
## 34. Match the column I and II.

Column (I)		Column (II)	
	Molecule		Rotational free energy barrier
(a)		(p)	180 kJ/mol
(b)		(q)	88.3 kJ/mol
(c)		(r)	21 kJ/mol
(d)		(s)	Negative barrier

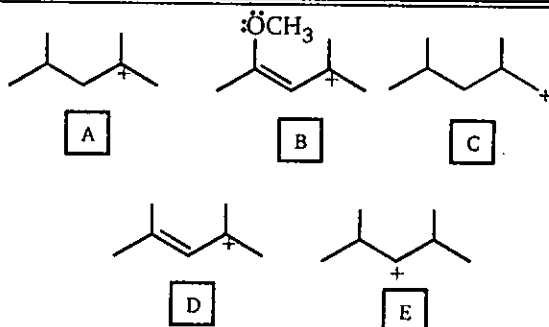
35. Consider the following reaction of boron trifluoride ( $\text{BF}_3$ ) and acetone :



- A. What is the critical HOMO (nucleophile) of this reaction ?
- (a) non-bonding orbital on boron                      (b)  $\sigma$ -orbital of acetone  
 (c)  $\pi$ -orbital of acetone                              (d) non-bonding electron pair orbital on oxygen
- B. What is the critical LUMO (electrophile) of the reaction ?
- (a)  $p$ -orbital of  $\text{BF}_3$                                 (b)  $\sigma$ -orbital of  $\text{BF}_3$   
 (c)  $\pi^*$  orbital of acetone                            (d) non-bonding electron pair orbital on oxygen
- C. Which of the following is the correct product of this reaction ?  
 (Lone electron pairs are not shown explicitly).

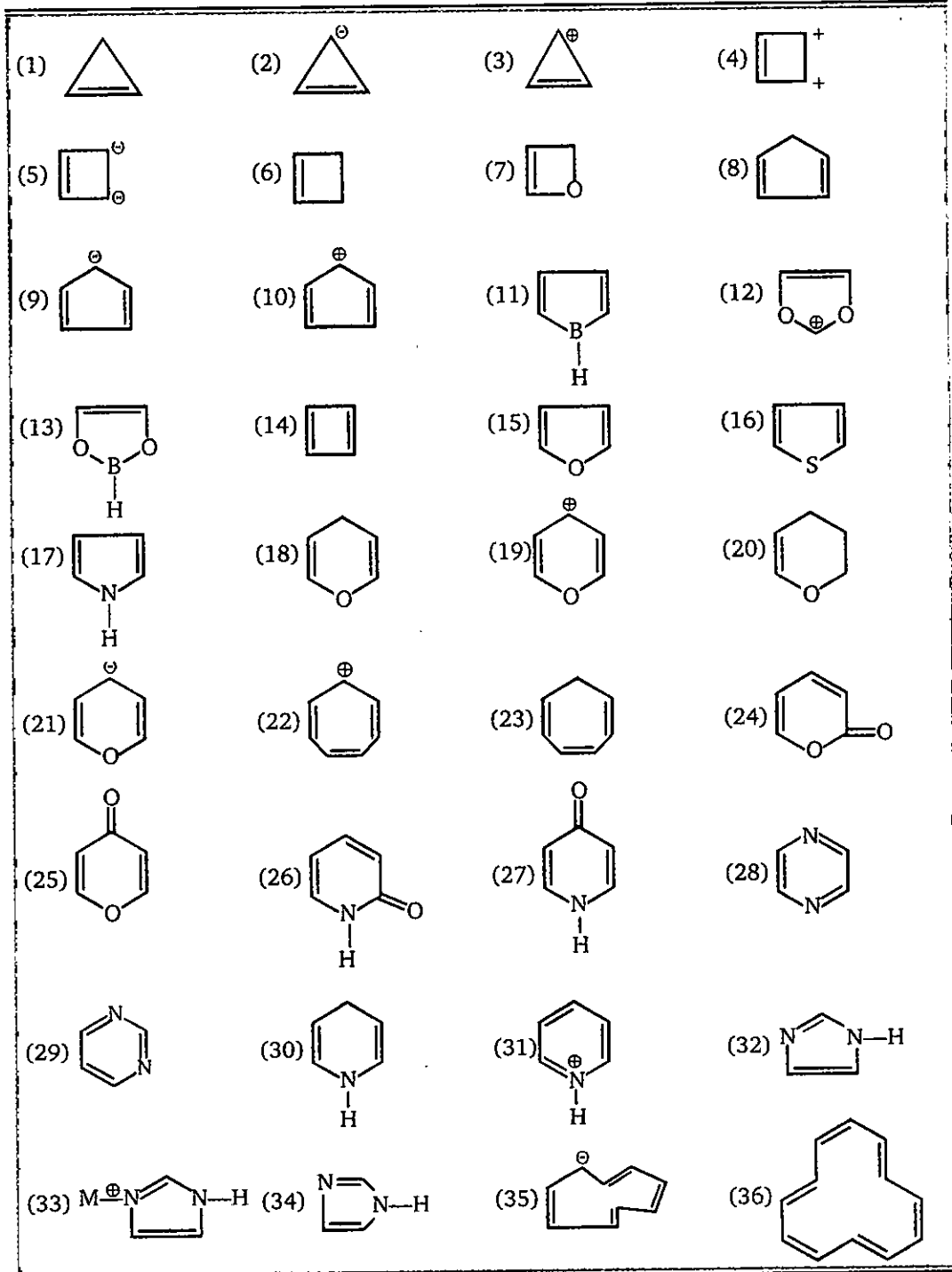


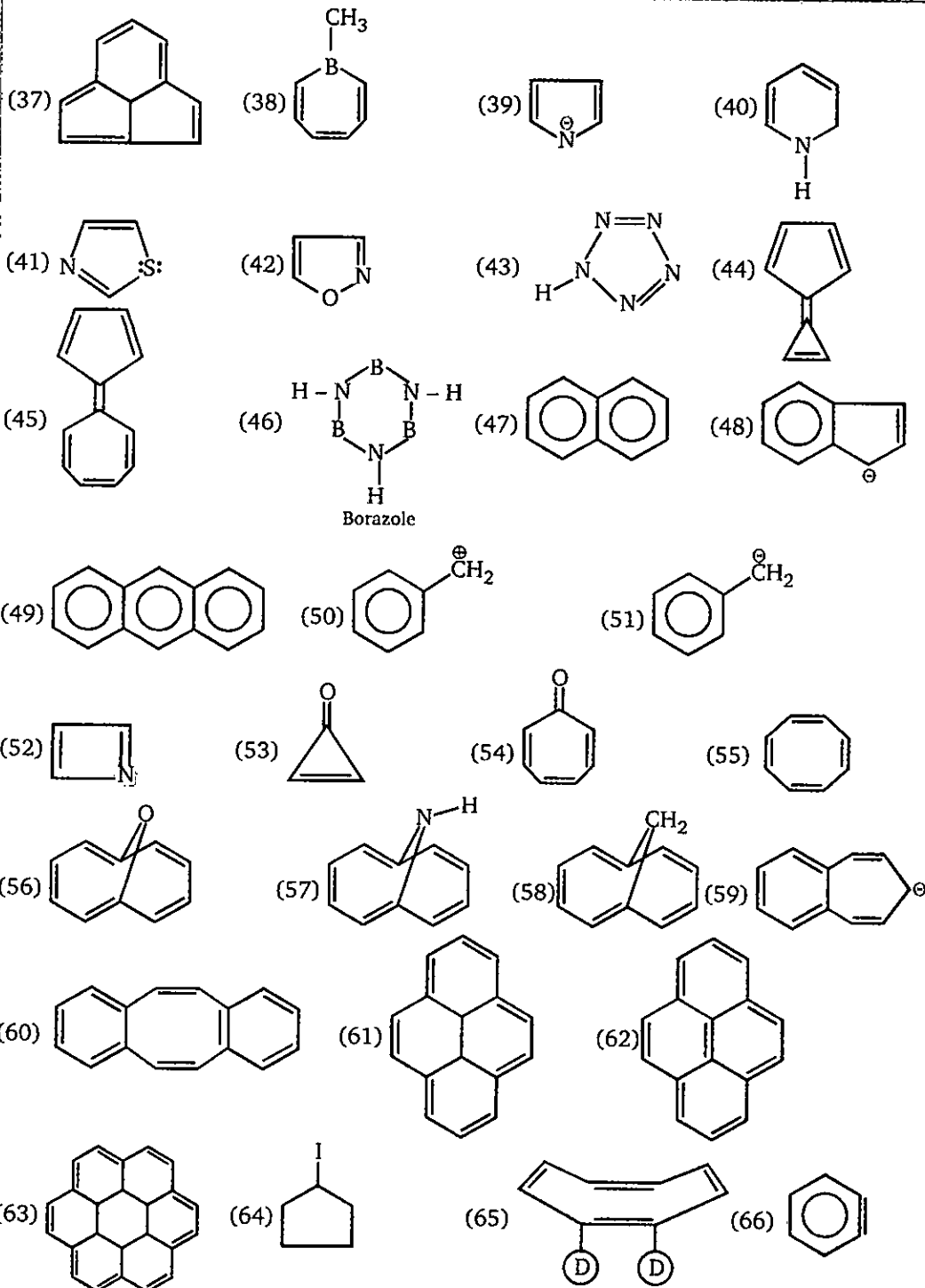
36. Rank the following carbocations according to stability (1 = most stable, 5 = least stable).



Put the answer in the boxes.

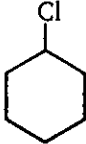
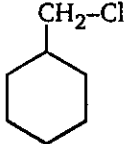
37. Among the given molecules, identify aromatic, anti-aromatic and non-aromatic molecules.




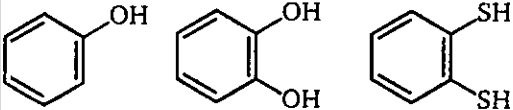



38. Among the given pairs, which is more reactive towards  $\text{AgNO}_3$  (or) toward hydrolysis.

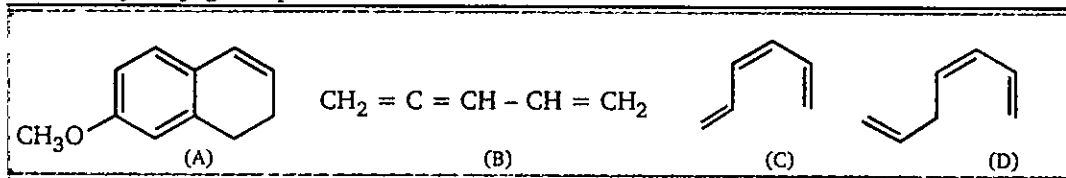
	Compound (A)	Compound (B)	Put the Answer here
1.			
2.			
3.			
4.			
5.			
6.	$\text{CH}_3 - \text{O} - \text{CH}_2 - \text{Cl}$	$\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{Cl}$	
7.			
8.			
9.			

10.			
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39. Put the answer in boxes given as directed.

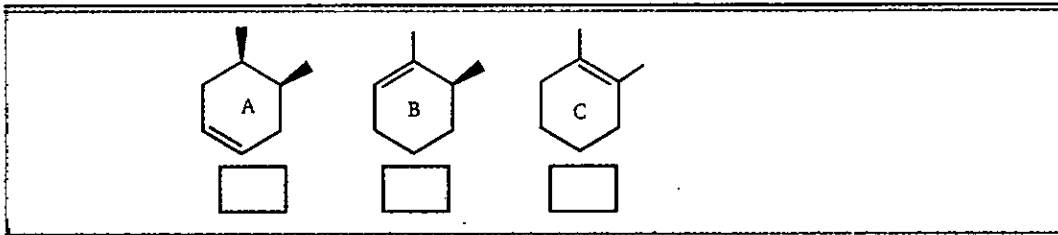
S.No.	Property	Molecules	Correct Answer	Name of force responsible for the property
A.	highest boiling point	$\text{NCl}_3$ $\text{ClNH}_2$ $\text{NH}_4\text{Cl}$ $\text{NH}_3$		
B.	highest boiling point			
C.	most soluble in water			
D.	highest solubility in benzene			

40. Circle any conjugated portions of these molecules.

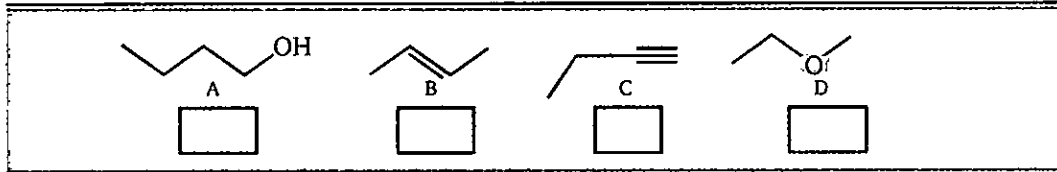


41. Arrange in the order as directed -

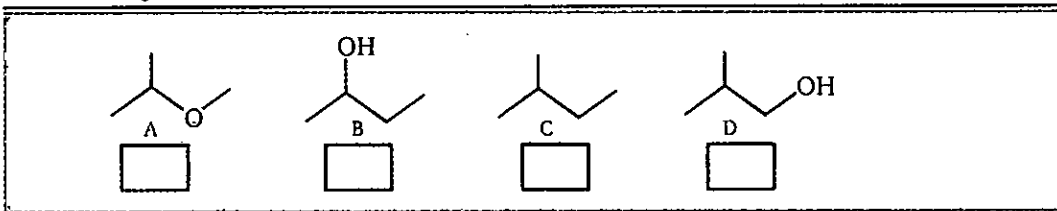
A. The given alkenes in the order of their stability (1- most stable, 3-least stable).



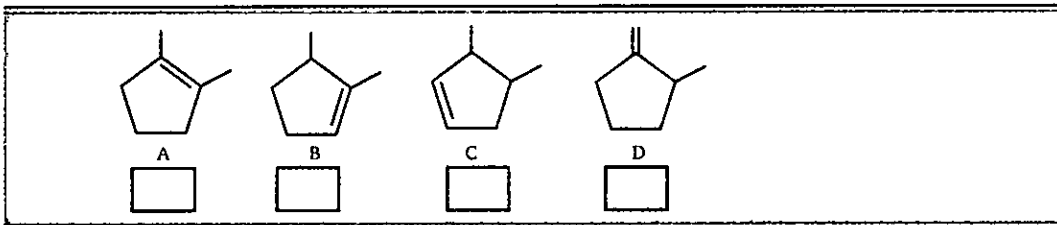
B. Arrange the following in the order of their acidic strength (1-most acidic, 4-least acidic)



C. Arrange the following molecules in order of expected boiling point. (1=highest bpt ; 4=lowest bpt.)

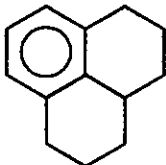
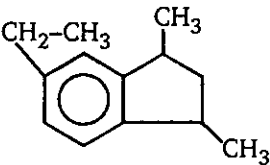
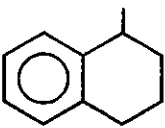
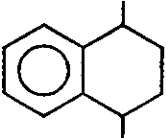


D. Arrange the following alkenes in order of their stability. (1 = most stable ; 5 = least stable).

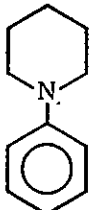
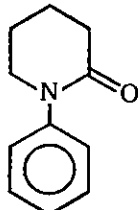




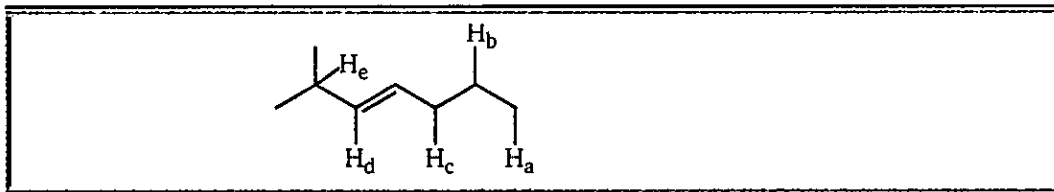
42. Match the column. (Matrix)

Column (I)		Column (II)	
Compounds		Number of Benzylic hydrogen	
(a)		(p)	2
(b)		(q)	3
(c)		(r)	4
(d)		(s)	5

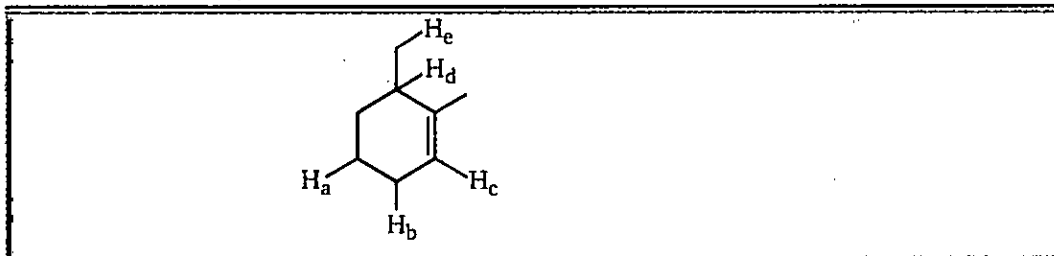
43. Identify (+M) mesomeric & (-M) group of following.

	+M	-M	-I	+I
				
				

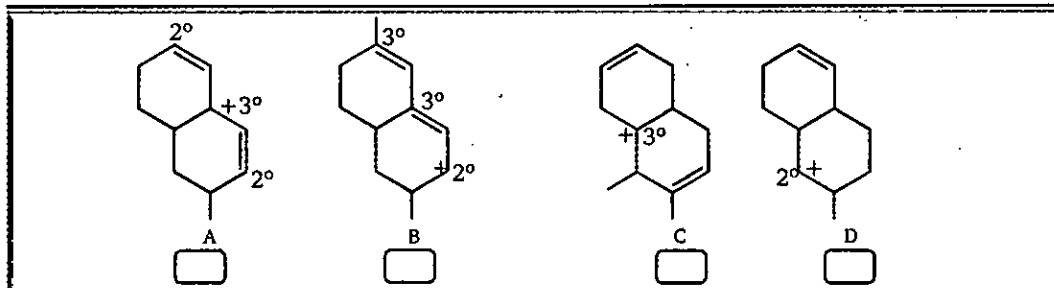
50. Consider the H-atoms in the molecule given below and answer the following.



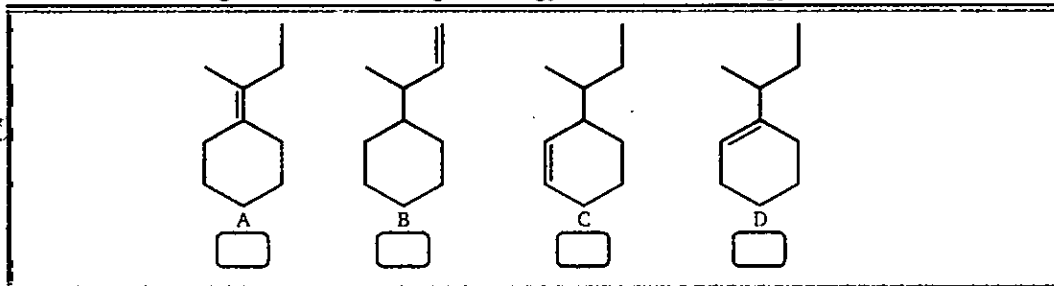
- (A) Identify the type ( $1^\circ$ ,  $2^\circ$  or  $3^\circ$  alkyl, vinyl, allyl etc.) of these H-atoms.  
 (B) Arrange them in the decreasing order of their ease of abstraction (easiest first).
51. Consider the molecule shown below and answer with respect to  $H_a \rightarrow H_e$ .



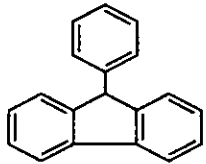
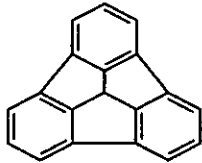
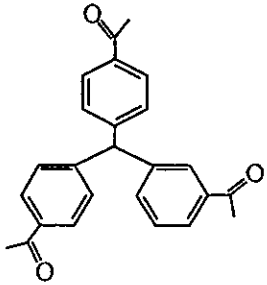
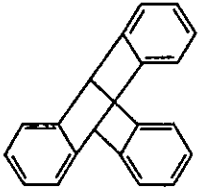
- (A) Identify the type of H-atom ( $1^\circ$ ,  $2^\circ$ ,  $3^\circ$  alkyl, vinyl or allyl).  
 (B) Arrange them in decreasing order of their bond energy.
52. Rank the following carbocations in order of stability (1 = most stable).



53. Rank the following alkenes according to energy (1 = lowest energy).

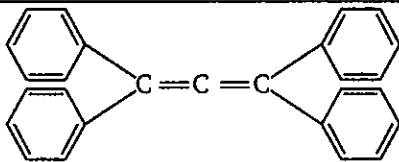


54. Match the column:

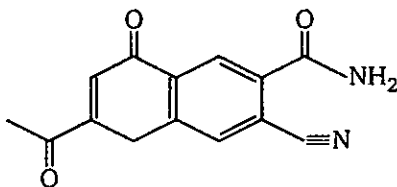
Column (I)		Column (II)	
(Compounds)		(Double bond equivalent value)	
(a)		(p)	11
(b)		(q)	12
(c)		(r)	13
(d)		(s)	14
		(t)	15

## SUBJECTIVE PROBLEMS

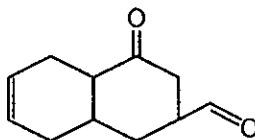
1. How many  $2^\circ$  carbon in the following ?



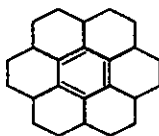
2. Find out the double bond equivalent (DBE) value of the given following compound:



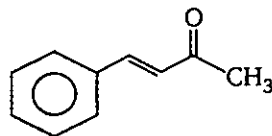
3. Total number of functional groups present in the given following compound :



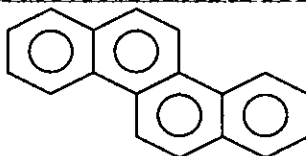
4. Total number of  $\alpha$ -hydrogen in the given following compound is:



5. How many carbon atom present in the parent chain in the given following compound?

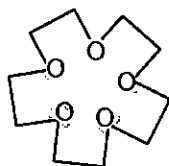


6. Total number of DBE value in :



7. How many isomers of  $C_4H_{10}O$  reacts with Na metal to evolve  $H_2$  gas ? (excluding stereoisomer)

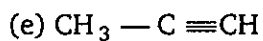
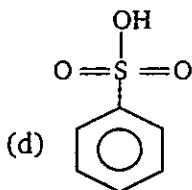
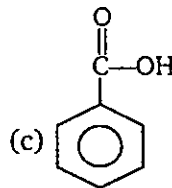
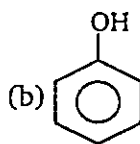
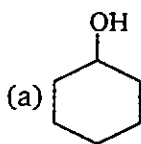
8.



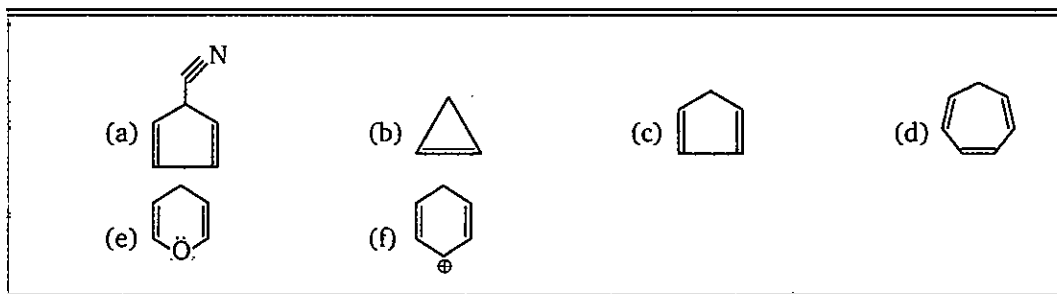
[x]-crown-[y]-ether.

$$\text{value of } \frac{x+y}{3} = ?$$

9. Which of the given following compound will react with  $NaHCO_3$  or soluble in  $NaHCO_3$  ?



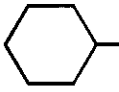
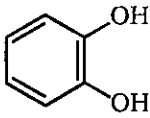

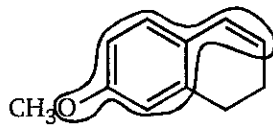


10. How many compound are stable after deprotonation ?



## ANSWERS — LEVEL 2

1. a - 4; b - 3; c - 2; d - 1
2. a - 3; b - 2; c - 1
3. A - b; B - e; C - a; D - b
4. A - a, c, f, g, k, l; B - b, d, h, j; C - e, i
5. A - d; B - a
6.  $C < B < A$
7. a - 2, 1, 4, 3; b - 1, 2, 3, 4; c - 3, 4, 1, 2; d - 3, 2, 4, 1
8. a - iv > ii > i > iii; b - iii > iv > i > ii
9. a - 4, 2, 3, 1; b - 3, 1, 4, 2; c - 2, 1, 3, 4; d - 2, 3, 4, 1
10. A (i) - d > b > c > a; (ii) - c > a > b > d  
B (i) - c > d > b > a; (ii) - b > d > c > a
11. (a) 3 2 1 4; (b) 2 1 4 3; (c) 3 1 2 4; (d) 3 4 1 2
12. A - c < a < b; B - b < a < c < d; C - d < b < c < a
13. A - c < a < b; B - a < b < c; C - c < b < a; D - d < c < a < b; E - c < a < b; F - c < a < b
14. A - H<sub>c</sub> < H<sub>a</sub> < H<sub>b</sub>; B - H<sub>d</sub> < H<sub>c</sub> < H<sub>b</sub> < H<sub>a</sub>
15. A - 1, 3, 4, 6, 7, 8, 9; B - 2, 5; C - 6; D - 3, 4, 6, 7, 9; E - 6, 8, 9; F - 6; G - 7; H - 9; I - 4, 7
16. A - b; B - a; C - d; D - b; E - a; F - d; G - d; H - a
17.

	(i)	(ii)	(iii)	(iv)	(v)
A	6	4	0	10	2
B	0	7	2	9	6
C	5	1	0	5	1
D	1	3	1	3	4
E	2	3	0	2	2
F	10	0	0	10	0
18. a - q; b - p, r; c - p, s; d - q
19. a - p; b - r; c - s; d - q
20. A - c; B - d
21. A - b; B - b; C - a
22. a - p, s; b - q, r; c - q, s; d - p, s
23. a - p, r, s; b - q, r; c - q, r; d - p, r, s

24. A - b; B - c; C - a; D - c; E - a; F - b; G - d
25. A - d; B - a; C - d; D - c
26. A - c; B - b; C - b; D - b; E - b; F - a; G - b; H - c; I - b
27. i -  $sp$ ; ii -  $sp$ ; iii -  $sp^2$ ; iv -  $sp^2$ ; v -  $sp^3$ ; vi -  $sp^3$
28. a - forward      b - backward
29. a - p, q, s; b - p, q, r, s; c - p, q, r, s; d - p, q, r, s
30. a - s; b - r; c - q; d - p
31. a - r; b - q; c - s; d - p
32. b
33. 65
34. a - q; b - r; c - s; d - p
35. A - d; B - a; C - a
36. A - 3; B - 1; C - 5; D - 2; E - 4
37. Aromatic— 3, 4, 5, 9, 12, 13, 15, 16, 17, 19, 22, 24, 25, 26, 27, 28, 29, 31, 32, 33, 34, 35, 37, 38, 39, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 53, 54, 56, 57, 58, 61, 62, 63, 66  
 Non-aromatic— 1, 6, 7, 8, 18, 20, 23, 30, 40, 55, 64, 65  
 Anti-aromatic— 2, 10, 11, 14, 21, 36, 52, 59, 60
38. 1 - B; 2 - A; 3 - B; 4 - A; 5 - A; 6 - A; 7 - B; 8 - B; 9 - A; 10 - A
39. A.  $\text{NH}_4\text{Cl}$ , cation-anion interaction
- B. - $\text{CH}_3$ , van der Waals' forces
- C. , H-bonding (Also dipole-dipole)
- D. -NH, Aromatic stacking
40.   $\text{CH}_2 = \text{C} = \text{CH} - \text{CH} = \text{CH}_2$   
41. A. A - 3, B - 2, C - 1,      B. A - 1, B - 3, C - 2, D - 4  
 C. A - 3, B - 1, C - 4, D - 2      D. A - 1, B - 2, C - 3, D - 4
42. a - s; b - r; c - q; d - p



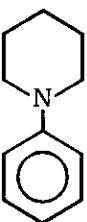
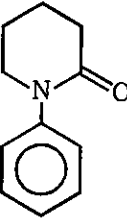
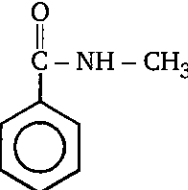
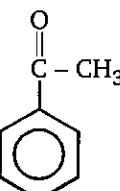
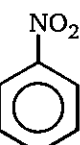
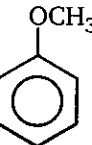
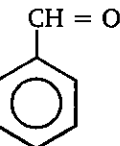
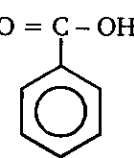
43.

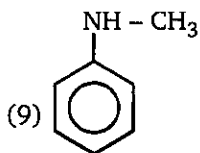
+M

-M

-I

+I

(1)		✓	×	✓	×
(2)		✓	×	✓	×
(3)		×	✓	✓	×
(4)		×	✓	✓	×
(5)		×	✓	✓	×
(6)		✓	×	✓	×
(7)		×	✓	✓	×
(8)		×	✓	✓	×



✓

×

✓

×

44. A - PA; B - PP; C - NPA; D - PA

45. (i) B, (ii) B, (iii) B, (iv) A

46. (a)  $\text{HCl}$ ; (b)  $\text{CH}_3 - \text{CH}_2 - \text{OH}$ ; (c)  $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{CH}_2 - \text{CH}_3$ ;(d)  $\text{CH}_3 - \text{CH}_2 - \text{CH}_3$ ; (e)  $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{CH}_2 - \text{CH}_3$ 47. (a)  $\text{BF}_3$ ; (b)  $\text{HO}^-$ ; (c)  $\text{HO}^-$ ; (d)  $\text{HI}$ ; (e)  $\text{HOCl}$ 

48. In A, highly electronegative F-atoms are present at the periphery. In liquid term these F-atoms will repel each other due to partial negative charge and thus A will have lower b.pt.

49.  $H_d > H_a > H_b > H_c$ 50. A-  $H_a = 1^\circ$  alkyl;  $H_b = 2^\circ$  alkyl;  $H_c = 2^\circ$  allyl;  $H_d = \text{vinyl}$ ;  $H_e = 3^\circ$  allylB- Easiest to abstract:  $H_e > H_c > H_b > H_a > H_d$  Hardest to abstract51. A-  $H_a = 2^\circ$  alkyl;  $H_b = 2^\circ$  allyl;  $H_c = \text{vinyl}$ ;  $H_d = 3^\circ$  allyl;  $H_e = 1^\circ$  alkylB-  $H_c > H_e > H_a > H_b > H_d$ 

52. A-2; B-1; C-3; D-4

53. A-1; B-4; C-3; D-2

54. a-r; b-t; c-t; d-s

**Subjective Solutions:**

1. 21

2. 11

3. 3

4. 6

5. 4

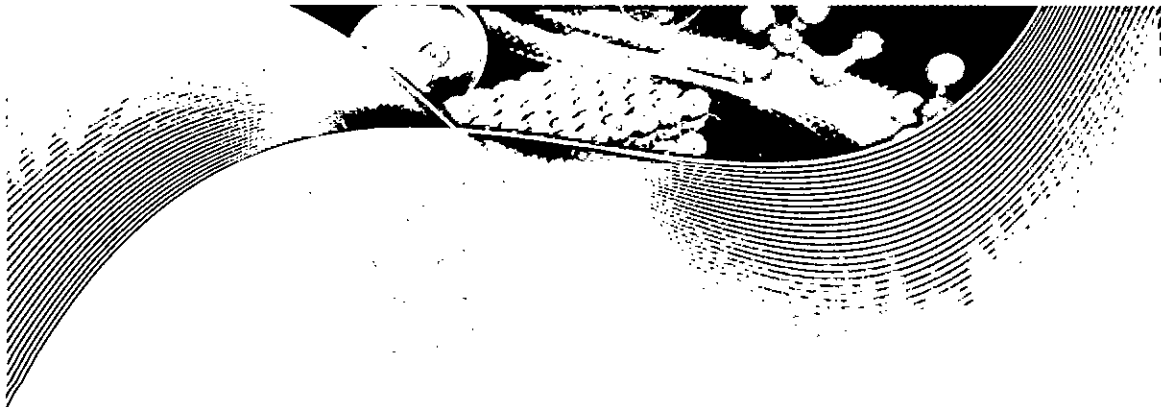
6. 13

7. 4

8. 7

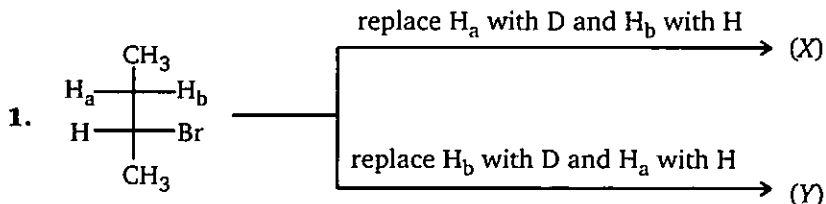
9. 2 (c, d)

10. 3 (a, c, f)



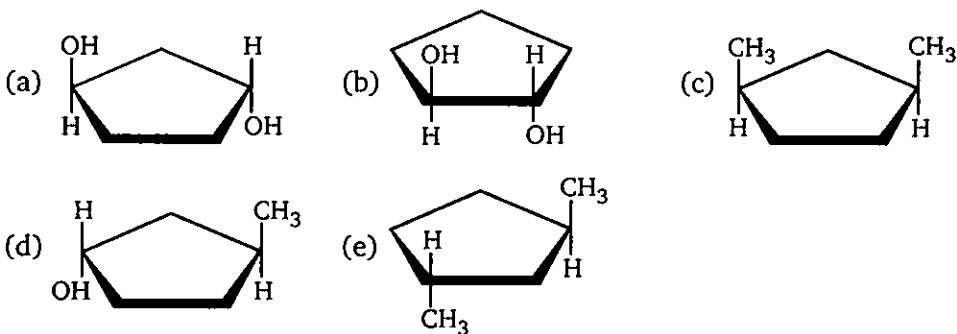
# 2 ISOMERISM (Structural & Stereoisomerism)

## LEVEL - 1

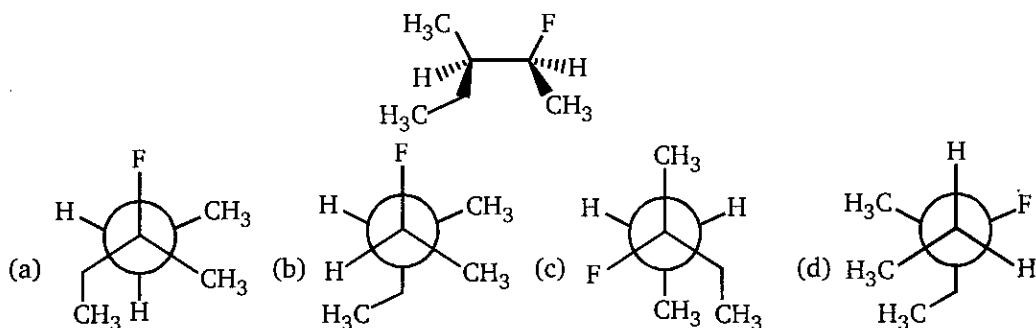


Relation between (X) and (Y) is :

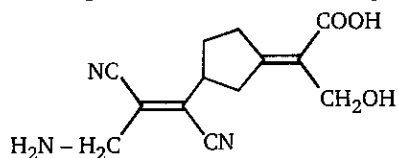
- (a) enantiomers (b) diastereomers  
 (c) *E* and *Z* isomer (d) constitutional isomer
2. Which of the following cyclopentane derivative is optically **inactive** ?



3. Which is the most stable conformer along the 2, 3 C – C bond axis of the compound ?

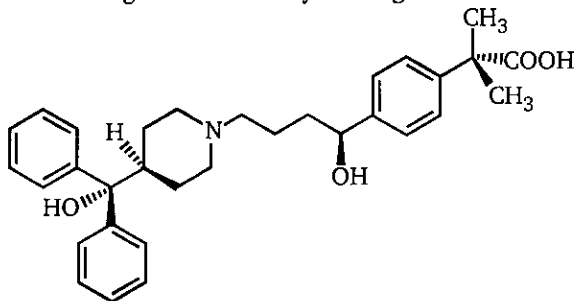


4. Assign double bond configurations to the following :



(a) E (b) Z (c) E, E (d) Z, Z

5. Allegra, a common prescription drug with the structure shown below, is given for the treatment of seasonal allergies. How many stereogenic carbon does Allegra possess ?

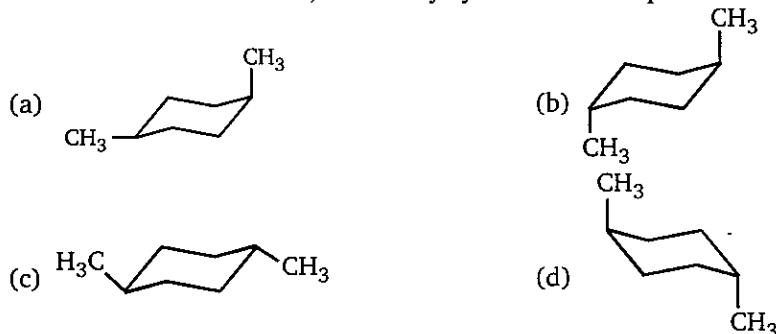


(a) 1 (b) 2 (c) 3 (d) 4

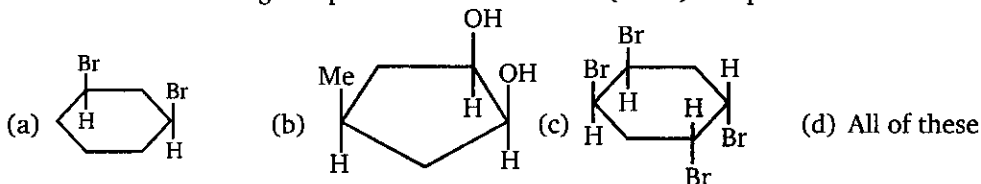
6. How many meso isomers of  $C_4H_8Cl_2$  will be ?

(a) 0 (b) 1 (c) 2 (d) 3

7. The stable form of *trans*-1, 4-dimethylcyclohexane is represented as:



8. Which of the following compound is non-resolvable (meso) compounds ?

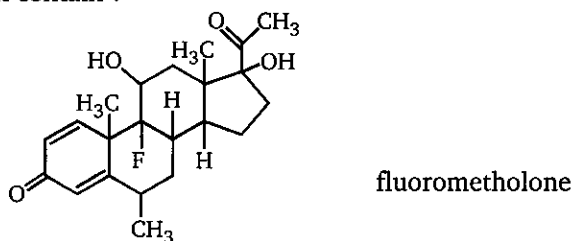


9.  $\text{HO}-\underset{(2)}{\text{CH}_2}-\underset{(3)}{\text{CH}_2}-\text{F}$

Which conformer of above compound is most stable across  $\text{C}_2-\text{C}_3$ ?

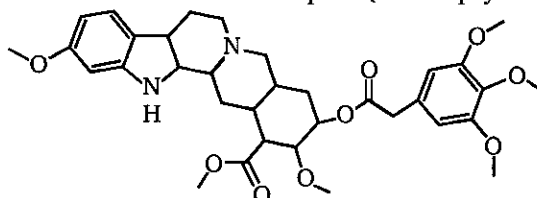
- (a) staggered (b) eclipsed (partially)  
(c) gauche (d) fully eclipsed

10. The following molecule is fluorometholone, a steroidal anti-inflammatory agent. How many stereogenic centers does it contain ?



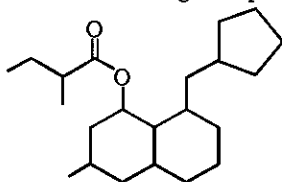
- (a) 5 (b) 6 (c) 7 (d) 8

11. How many chiral carbons are there in Reserpine (an antipsychotic drug) ?



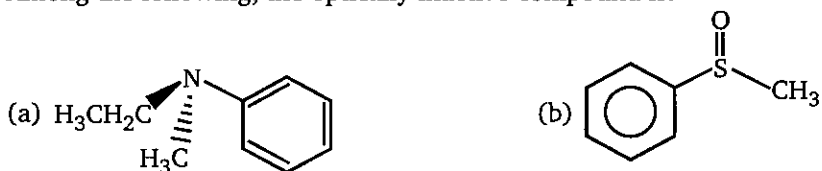
- (a) 9 (b) 8 (c) 7 (d) 6

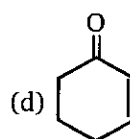
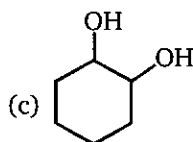
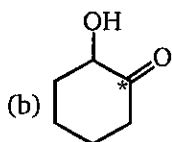
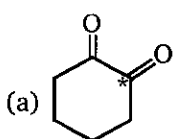
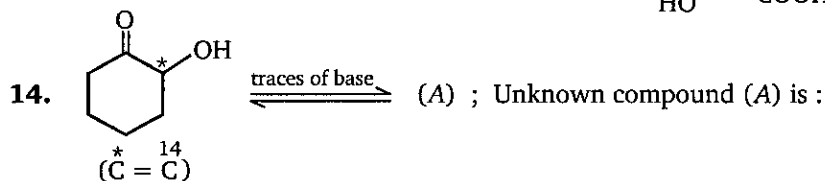
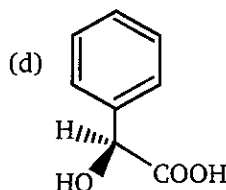
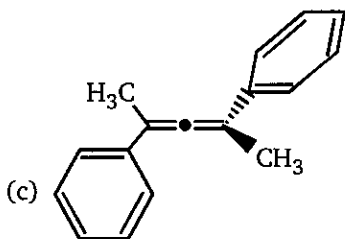
12. How many chiral centers are in the following compound ?



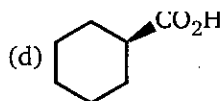
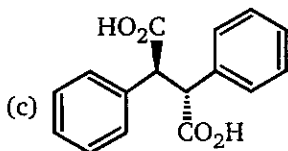
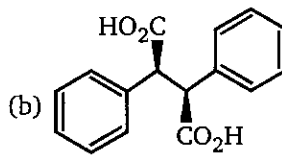
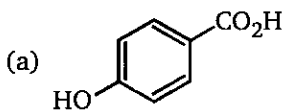
- (a) 4 (b) 5 (c) 6 (d) 7

13. Among the following, the optically inactive compound is:

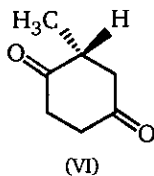
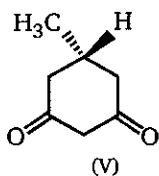
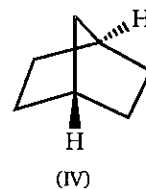
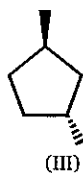
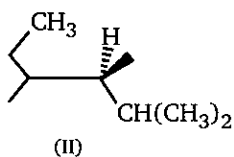
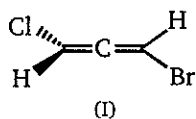




15. Which of the following compounds might be useful to the chemist trying to increase the optical purity of the (d) sample ?



16. Which of the following molecules is (are) chiral ?



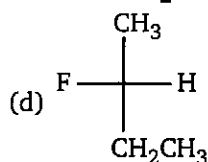
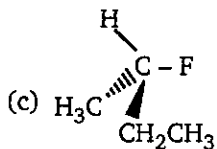
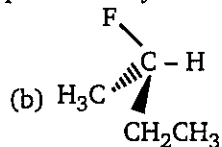
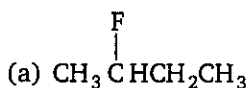
(a) I and II

(b) III and IV

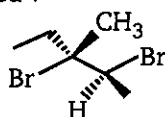
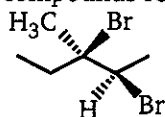
(c) II, IV and VI

(d) I, II, III and VI

17. The structure of (S)-2-fluorobutane is best represented by :



18. How are the following compounds related ?



(a) Diastereomers

(b) Enantiomers

(c) Meso compounds

(d) Identical

19. Which one of the following is chiral ?

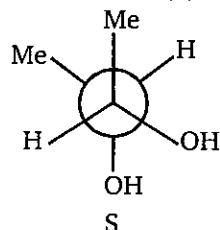
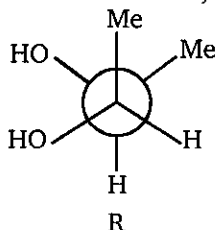
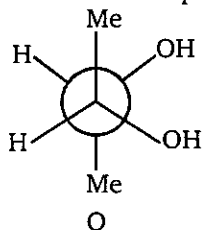
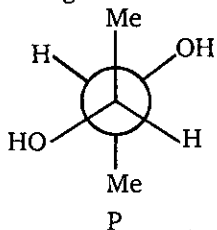
(a) 1, 1-Dibromo-1-chloropropane

(b) 1, 3-Dibromo-1-chloropropane

(c) 1, 1-Dibromo-3-chloropropane

(d) 1, 3-Dibromo-2-chloropropane

20. Among the following, the Newmann projections of meso-2, 3-butanediol are :



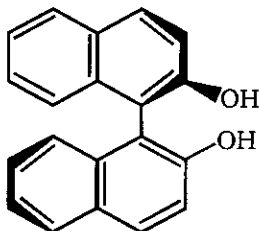
(a) P, Q

(b) P, R

(c) R, S

(d) Q, S

21. The binaphthol (**Bnp**) is:



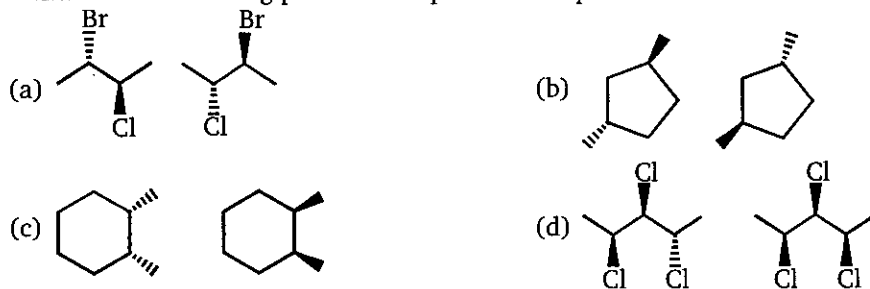
(a) an optically active compound having chiral centre

(b) an optically inactive compound

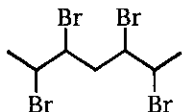
(c) a meso compound

(d) an optically active compound without having chiral centre

22. Which of the following pairs of compounds is a pair of enantiomers ?

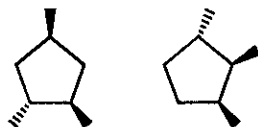


23. The maximum number of stereoisomers that could exist for the compound below ?



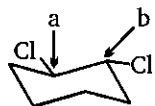
- (a) 6                      (b) 8                      (c) 10                      (d) 16

24. The following pair of compounds is best described as :



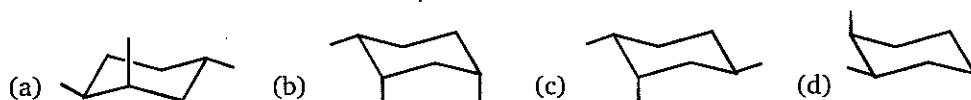
- (a) identical                      (b) diastereomers  
(c) enantiomers                      (d) none of the above

25. Determine the absolute configurations of the labeled carbons (a and b):

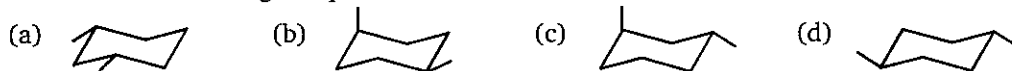


- (a)  $a = R$  ;  $b = R$                       (b)  $a = R$  ;  $b = S$   
(c)  $a = S$  ;  $b = R$                       (d)  $a = S$  ;  $b = S$

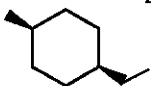
26. Which of the structures (a - d) will be produced if a "ring flip" occurs in the following compound in chair form ?



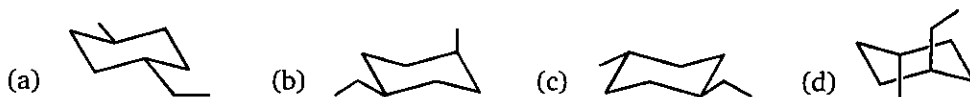
27. Which of the following compounds is most stable ?



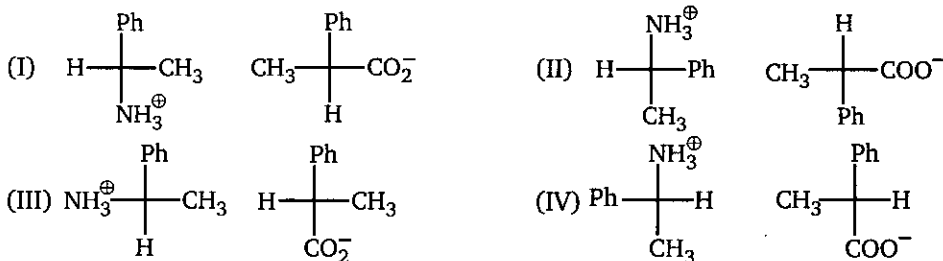
28. Which is the most stable chair form of this compound ?





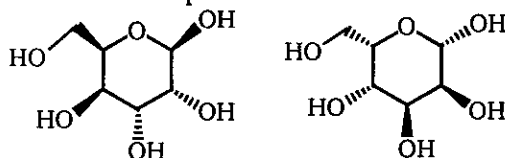


29. Which pairs of the salts would have identical solubilities in methanol ?



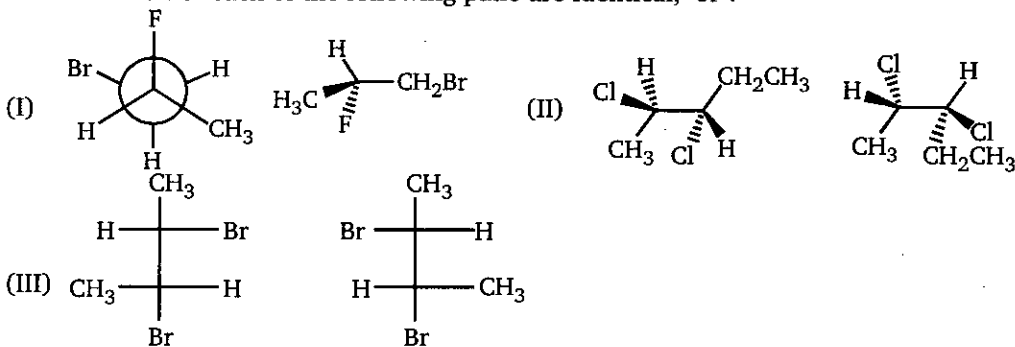
(a) I & IV (b) I & III (c) I & II (d) II & IV

30. The following compounds differ in respect of :



(a) their chemical and physical properties  
 (b) nothing  
 (c) the direction in which they rotate plane of polarized light  
 (d) their interactions with molecules

31. Indicate whether each of the following pairs are identical, or ?

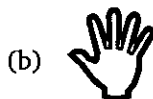


I (a) enantiomers (b) identical (c) enantiomers (d) enantiomers

II (a) diastereomers (b) enantiomers (c) diastereomers (d) identical

III (a) enantiomers (b) enantiomers (c) identical (d) identical

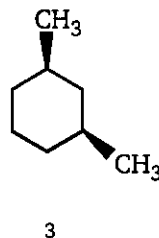
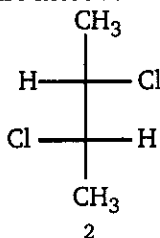
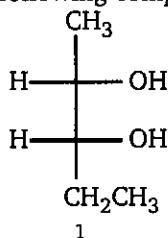
32. Which of the following is achiral ?





(d) a molecule of 3-methylheptane

33. Which of the following compounds are meso forms ?



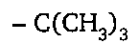
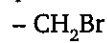
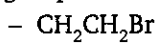
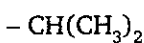
- (a) 1 only  
(c) 1 and 2

- (b) 3 only  
(d) 2 and 3

34. The separation of a racemic mixture into pure enantiomers is termed as :

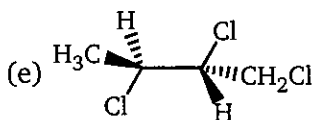
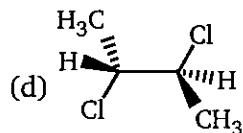
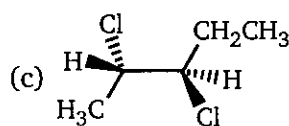
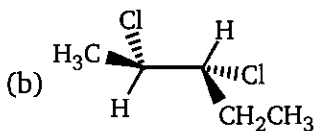
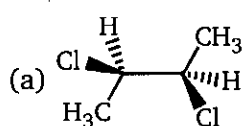
- (a) Racemization (b) Isomerization (c) Resolution (d) Equilibration

35. Rank of the following groups in order of R, S precedence (IV is highest) :

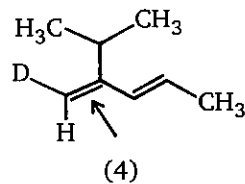
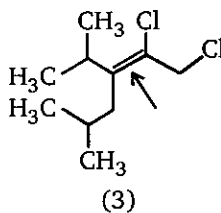
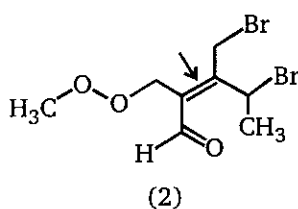
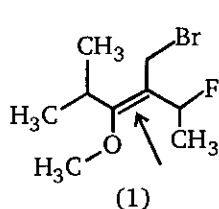


- |       |    |   |     |       |   |    |     |    |
|-------|----|---|-----|-------|---|----|-----|----|
| 1     | II | 2 | III | IV    | I | II | III | IV |
| (a) 3 | 2  | 4 | 1   | (b) 1 | 4 | 2  | 3   |    |
| (c) 3 | 4  | 1 | 2   | (d) 3 | 4 | 2  | 1   |    |

36. Which of the following is a meso compound ?



37. Among the following structures, select E isomers (arrows indicate the bonds to be considered) ?



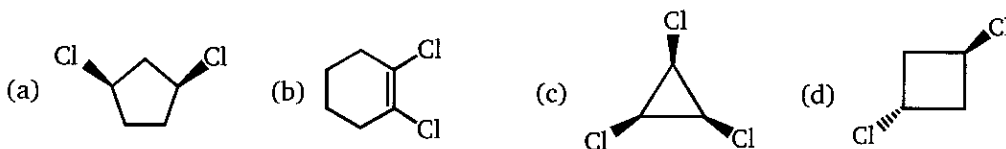
- (a) 1 and 2

- (b) 1 and 3

- (c) 1 and 4

- (d) 2 and 3

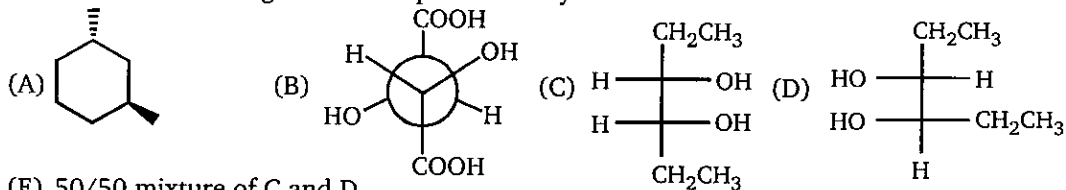
38. Which of the following compounds has a zero dipole moment ?



39. On Pluto, where everything is frozen, astronauts discovered two forms of butane gauche and anti. Assuming that there are no rotations around single bonds, which statement about the two forms is correct ?

- (a) They are enantiomers  
 (b) They are diastereoisomers  
 (c) They are meso compounds  
 (d) The gauche form has two stereogenic centers, and the anti has only one

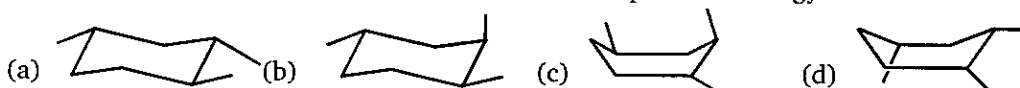
40. Which of the following will show optical activity ?



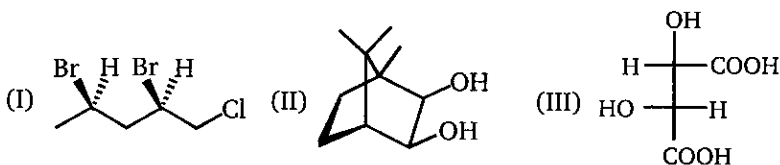
(E) 50/50 mixture of C and D

- (a) A, D and E (b) A and E only (c) B, C and D (d) All except C

41. Among the structure shown below, which has lowest potential energy ?

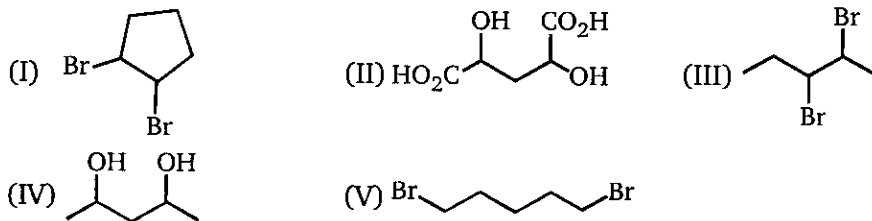


42. Which of the following molecules is/are chiral ?



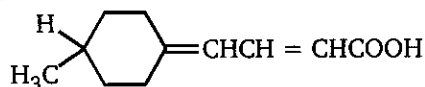
- (a) I (b) II (c) III (d) I, II

43. A compound was synthesized by a student, but its structure was not identified. However, his wonderfully helpful instructor told him that it was a meso compound with 5 carbons and 2 stereogenic centers. Which of the following structures should the student consider as possibilities for his compound ?



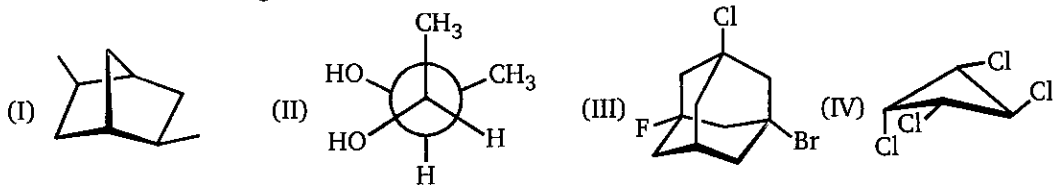
- (a) I, II, IV (b) II, IV (c) I, III, V (d) II, IV, V

44. How many isomers are possible for the following molecule ?



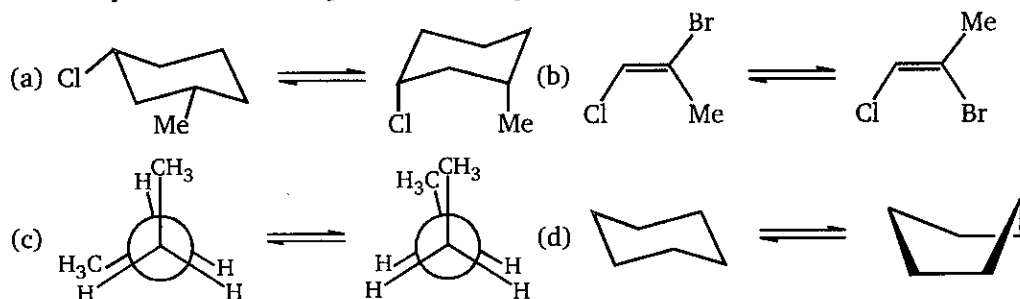
- (a) 1 (b) 2 (c) 3 (d) 4

45. Which of the following molecules are chiral ?

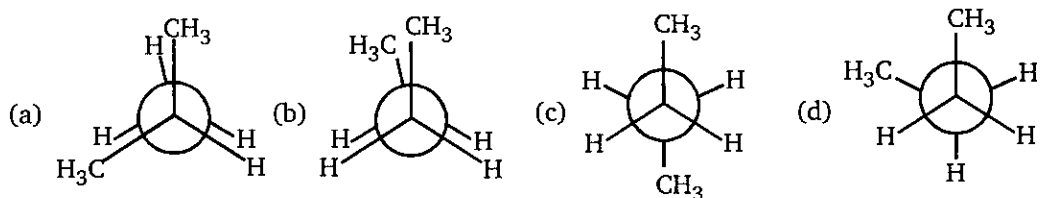


- (a) I, II, III and IV (b) II, III and IV (c) II and IV (d) I and II

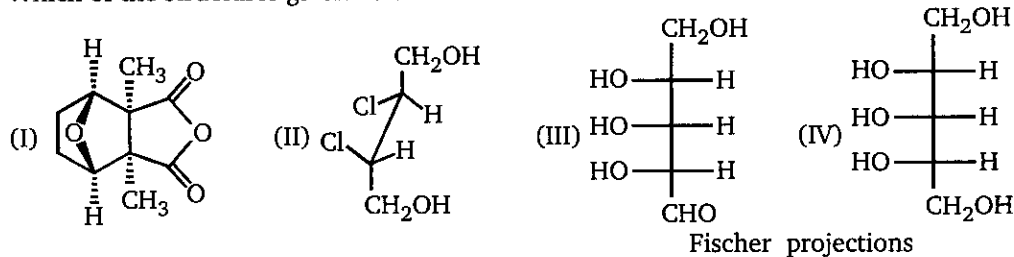
46. Which equilibrium is not rapid at room temperature ?



47. Which is the lowest energy conformation of butane ?

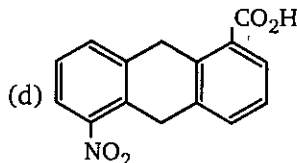
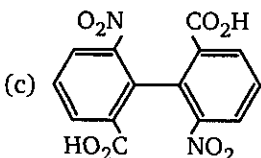
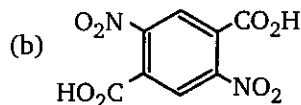
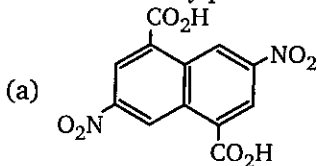


48. Which of the structures given below are chiral ?

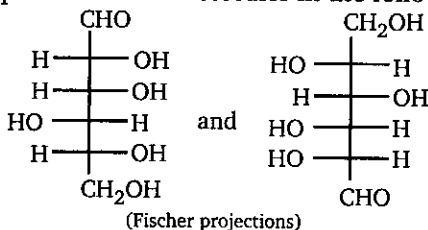


- (a) I, II, III (b) II, III, V (c) II, III (d) I, II

49. Which of the following carboxylic acids could be resolved by reaction with an enantiomerically pure chiral amine ?

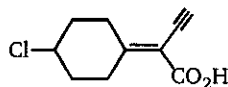


50. What is the relationship between the molecules in the following pairs ?



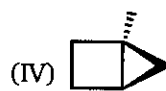
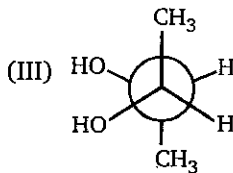
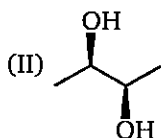
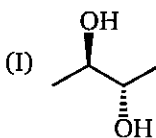
- (a) enantiomers      (b) diastereomers      (c) identical      (d) structural isomers

51. What are the correct designations for the structure below ?



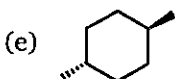
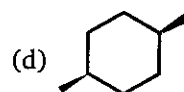
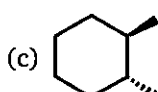
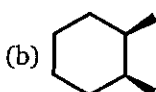
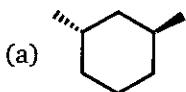
- (a) E, E      (b) Z, E  
 (c) E, Z      (d) No geometrical isomers are possible

52. Which of the following molecules are chiral ?

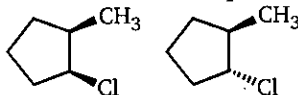


- (a) I and III      (b) I and V      (c) II and III      (d) II, III, IV

53. Which one of the following isomeric structures has the lowest energy ?

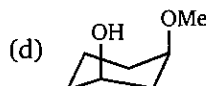
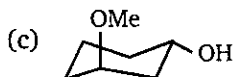
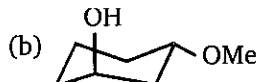
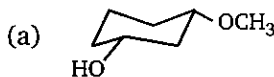


54. The following compounds are identical with respect to :

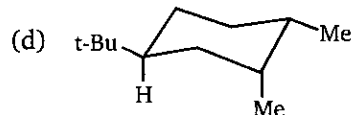
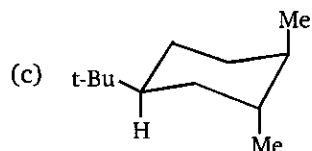
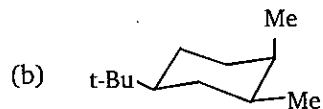
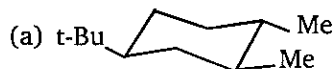
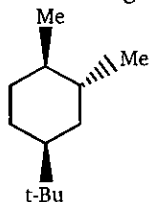


- (a) molecular composition (b) boiling point  
(c) melting point (d) IUPAC name

55. Among the following, the most stable isomer is :



56. The most stable conformation of the following compound is :

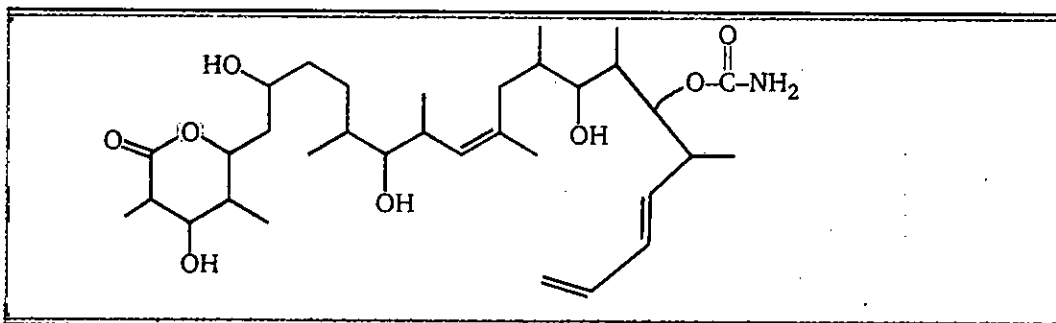


57. Which of the following molecules have non-zero dipole moments ?

- (I) gauche conformation of 1, 2-dibromoethane  
(II) anti conformation of 1, 2-dibromoethane  
(III) *trans*-1, 4-dibromocyclohexane  
(IV) *cis*-1, 4-dibromocyclohexane  
(V) tetrabromomethane  
(VI) 1, 1-dibromocyclohexane

- (a) I and II (b) I and IV  
(c) II and V (d) I, IV and VI

58. What is the maximum number of stereoisomers possible for discodermolide ?

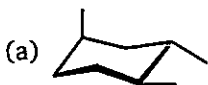


- (a)  $2^{14}$                       (b)  $2^{15}$                       (c)  $2^{16}$                       (d)  $2^{17}$

59. An aqueous solution containing compounds *A* and *B* shows optical activity. *A* and *B* are stereoisomers. Which of the following possibilities cannot be correct ?

- (a) *A* has two chiral centers, but *B* does not have any because it has a symmetry plane  
 (b) *A* and *B* are enantiomers  
 (c) *A* and *B* are diastereomers  
 (d) *A* and *B* are not present in equal amounts

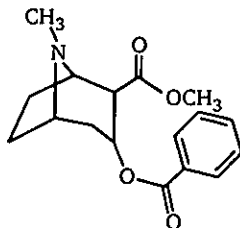
60. Which of the following structures represents the lowest-energy form of (1*S*, 2*S*, 4*R*)-trimethyl-cyclohexane ?



61. Which one of the following is a diastereomer of (*R*)-4-bromo-*cis*-2-hexene ?

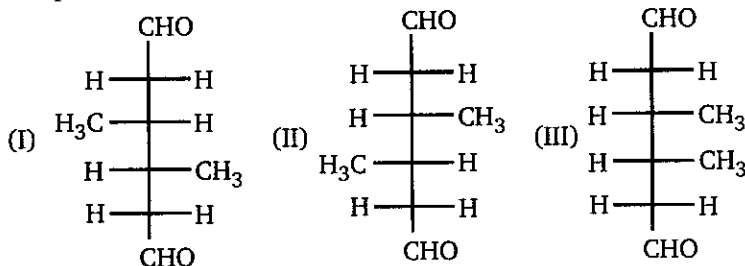
- (a) (*S*)-4-bromo-*cis*-2-hexene  
 (b) (*S*)-5-bromo-*trans*-2-hexene  
 (c) (*R*)-4-bromo-*trans*-2-hexene  
 (d) (*R*)-5-bromo-*trans*-2-hexene

62. The structural formula of cocaine is shown below. How many stereogenic carbon atoms are there in this molecule ?

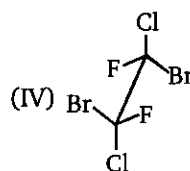
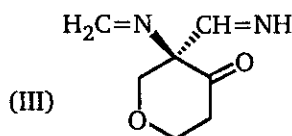
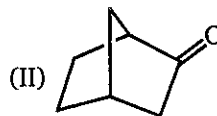
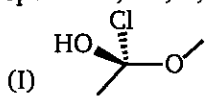


- (a) 1                      (b) 2                      (c) 3                      (d) 4

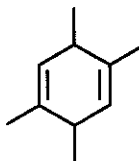
63. Which of the following statements best describes the stereochemical relationships of compound I, II and III shown below ?



- (a) All compounds are chiral  
 (b) None of the compounds is chiral  
 (c) I and II are meso compounds  
 (d) I and II are diastereomers, and III is a meso compound  
 (e) I and II are chiral
64. What is the absolute configuration of the following molecules ? (NS = the molecule has no center) Note : For the purpose of this question only, the order of stereocenters is not specified ; i.e., R, S = S, R.



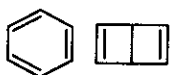
- |     | I | II   | III | IV |     | I | II   | III | IV   |
|-----|---|------|-----|----|-----|---|------|-----|------|
| (a) | R | R, S | R   | NS | (b) | R | R, R | S   | R, R |
| (c) | R | R, S | NS  | NS | (d) | R | R, S | R   | R, S |
65. The number of all the possible stereoisomers formed by the given compound is :



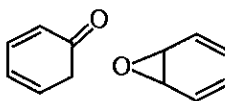
- (a) 2  
 (b) 3  
 (c) 32  
 (d) 64



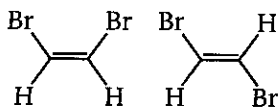
66. The relationship among the following pairs of isomers is:



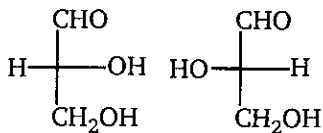
(I)



(II)



(III)



(IV)

<b>I</b>	A: Constitutional
<b>II</b>	B: Configurational
<b>III</b>	C: Conformational
<b>IV</b>	D: Optical

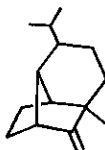
(a) I - A, II - B, III - B, IV - D

(b) I - A, II - A, III - B, IV - D

(c) I - B, II - A, III - B, IV - D

(d) I - B, II - B, III - A, IV - B

67. The structural formula of sativene is shown below. How many stereogenic centers are there in this molecule?



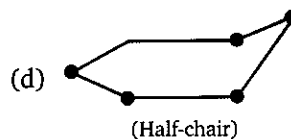
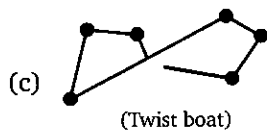
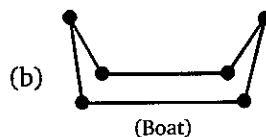
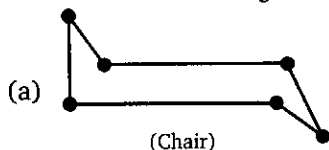
(a) 2

(b) 3

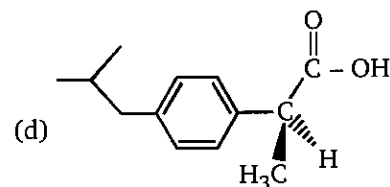
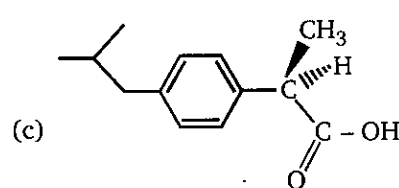
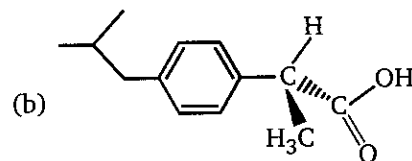
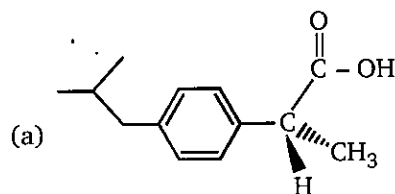
(c) 4

(d) 5

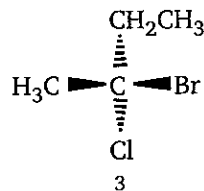
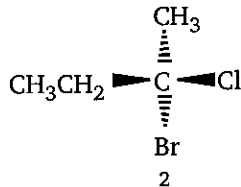
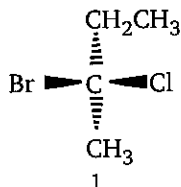
68. Which of the following is the least stable conformer of cyclohexane ?



69. The S- enantiomer of ibuprofen is responsible for its pain-relieving properties. Which one of the following structures shown below is (S)-ibuprofen ?



70. Which of the following depict the same ?



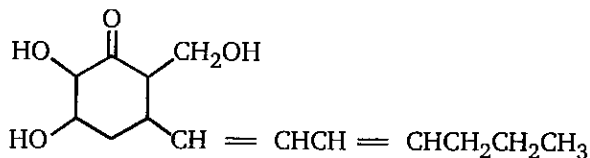
(a) 1 and 2

(c) 2 and 3

(b) 1 and 3

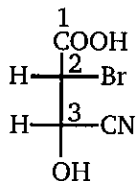
(d) 1, 2, and 3

71. A naturally occurring substance has the constitution shown below. How many may have this constitution ?



- (a) 2                                      (b) 8                                      (c) 16                                      (d) 64

72. The absolute configurations of the two centers in the following molecule are :

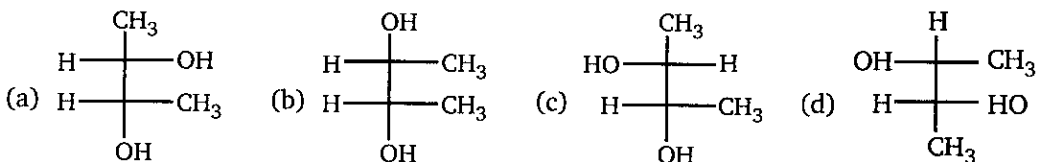


- (a) 2(R), 3(S)                      (b) 2(R), 3(R)                      (c) 2(S), 3(S)                      (d) 2(S), 3(R)

73. The total number of stereoisomer possible for 2, 3-dichloro butane :

- (a) 2                                      (b) 3  
(c) 4                                      (d) 5

74. Which of the following structure is not meso-2,3-butanediol ?

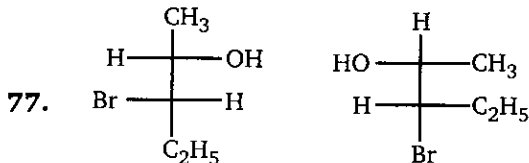


75. A solution of optically active 1-phenylethanol racemizes in acidified aqueous medium. It is due to :

- (a) enolization                                      (b) carbonium ion formation  
(c) carbanion formation                                      (d) reversible oxidation-reduction

76. The most stable conformation of ethylene glycol is :

- (a) Anti                                      (b) Gauche                                      (c) Partially eclipsed                                      (d) Fully eclipsed



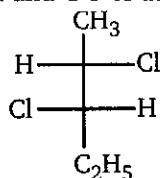
The molecules represented by the above two structures are :

- (a) identical                                      (b) enantiomers  
(c) diastereomers                                      (d) epimers

78. The correct order of priority of groups  $-\text{SCH}_3$  (I),  $-\text{NO}_2$  (II),  $-\text{C}\equiv\text{CH}$  (III) and  $-\text{CH}_2\text{C}_6\text{H}_5$  (IV), on the basis of CIP classification, is (increasing order) :

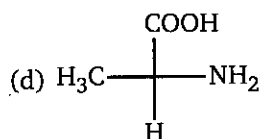
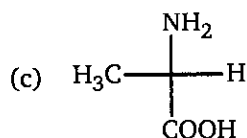
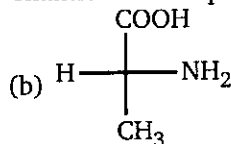
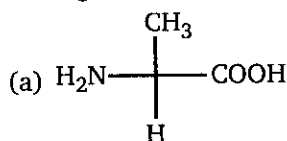
- (a) I, III, II, IV                                      (b) IV, III, II, I  
(c) II, IV, I, III                                      (d) III, IV, II, I

79. The configuration at C-2 and C-3 of the compound given :

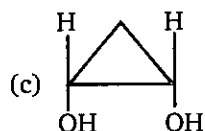
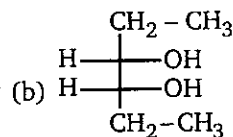
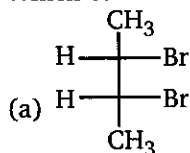


- (a) 2R, 3S                      (b) 2S, 3R                      (c) 2S, 3S                      (d) 2R, 3R

80. Amongst the following amino acids, the (R) - enantiomer is represented by :



81. Which of the following is a meso compound ?

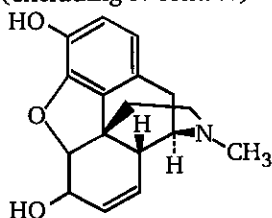


(d) All of these

82. Predict stereochemistry of product when *d* and *l*-amine reacts with *l*-acid:

- (a) Diastereomers                      (b) Meso  
(c) Racemic                              (d) Pure Enantiomer

83. How many chiral center (excluding N centres) are there in morphine?

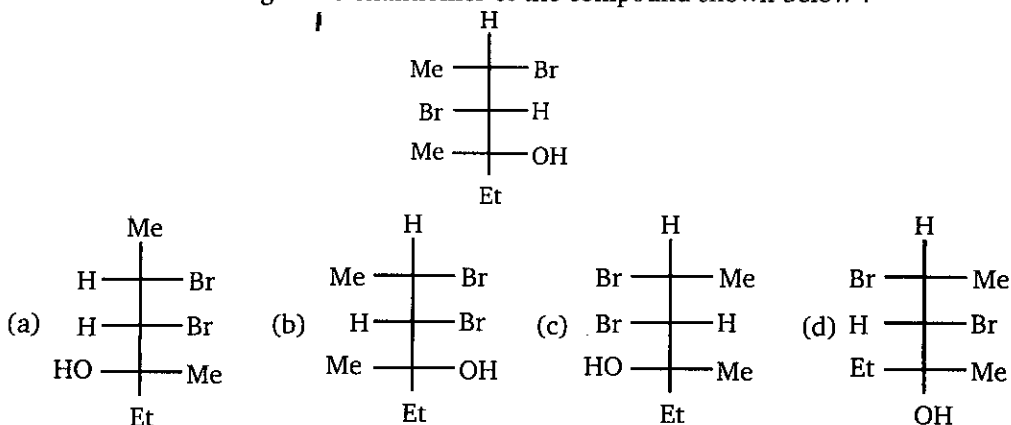


- (a) 4                                      (b) 5  
(c) 6                                      (d) More than 6

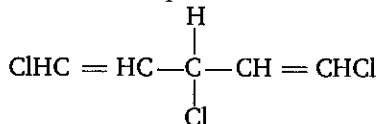
84. Which dimethylcyclobutane is optically active ?

- (a) *trans*-1, 2                      (b) *cis*-1, 2  
(c) *trans*-1, 3                      (d) *cis*-1, 3

85. Which of the following is the enantiomer of the compound shown below ?

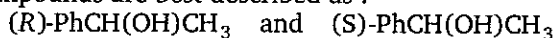


86. How many different stereoisomers are possible for the following compound ?



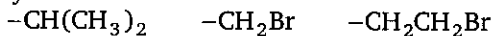
- (a) 1                      (b) 2                      (c) 3                      (d) 4

87. The following compounds are best described as :



- (a) enantiomers  
 (b) diastereomers  
 (c) not stereoisomers  
 (d) conformational isomers (differing by single bond rotation)

88. Rank the following substituent groups in order of decreasing priority according to the Cahn-Ingold-Prelog system :



- (a) 2 > 3 > 1      (b) <sup>1</sup>1 > 3 > 2      (c) 3 > 1<sup>3</sup> > 2      (d) 2 > 1 > 3

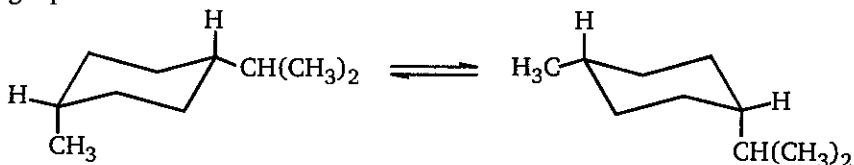
89. Compare the stabilities of the following two compounds :

A : *cis*-1-Ethyl-3-methylcyclohexane

B : *trans*-1-Ethyl-3-methylcyclohexane

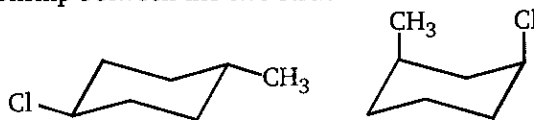
- (a) A is more stable                      (b) A and B are of equal stability  
 (c) B is more stable                      (d) No comparison can be made

90. What, if anything, can be said about the magnitude of the equilibrium constant *K* for the following equilibrium ?



- (a) *K* = 1                      (b) *K* < 1  
 (c) *K* > 1                      (d) No estimate of *K* can be made

91. What is the relationship between the two structures shown ?



- (a) Constitutional isomers  
 (b) Stereoisomers  
 (c) Different drawing of the same conformation of the same compound  
 (d) Different conformation of the same compound

92. Which of the following statements is true ?

- (a) van der Waals' strain in *cis*-1, 2-dimethylcyclopropane is the principal reason for its decreased stability relative to the *trans* isomer  
 (b) Cyclohexane gives off more heat per  $\text{CH}_2$  group on being burned in air than any other cycloalkane  
 (c) The principal source of strain in the boat conformation of cyclohexane is angle strain  
 (d) The principal source of strain in the *gauche* conformation of butane is torsional strain

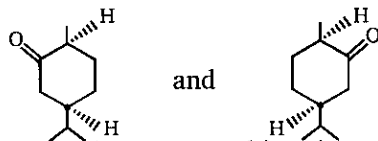
93.  $\text{Ph}-\text{CH}=\text{NO}_2\text{H} \xrightarrow[3 \text{ days}]{\text{isomerises}} (\text{x})$ , Isomer (x) is :  
 (50-50%)

- (a)  $\text{Ph}-\text{NO}-\text{CH}_2\text{OH}$  (b)  $\text{Ph}-\text{CH}_2-\text{NO}_2$   
 (c)  $\text{Ph}-\text{NH}-\text{CO}_2\text{H}$  (d) None

94. Which of the following will not show geometrical isomerism ?

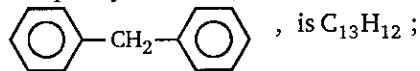
- (a)  $\text{CH}_3-\underset{\text{CH}_3}{\text{C}}=\text{CH}-\text{CH}_2-\text{CH}_3$  (b)  $\text{CH}_3-\underset{\text{CH}_3}{\text{CH}}-\text{CH}=\text{CH}-\text{CH}_2-\text{CH}_3$   
 (c)  $\text{CH}_3-\text{CH}=\text{CH}-\text{CH}_3$  (d)  $\text{CH}_3-\text{CH}_2-\text{CH}=\text{CH}-\text{CH}_2-\text{CH}_3$

95. The two compounds shown below are :



- (a) diastereomers (b) enantiomers (c) epimers (d) regiomers

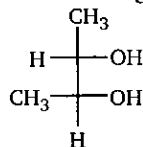
96. The molecular formula of diphenylmethane,



How many structural isomers are possible when one of the hydrogen is replaced by a chlorine atom ?

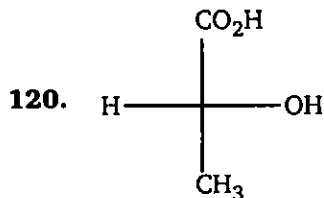
- (a) 6 (b) 4 (c) 8 (d) 7

97. Correct configuration of the following molecule is :



- (a) 2S, 3S (b) 2S, 3R (c) 2R, 3S (d) 2R, 3R

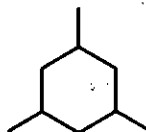
98. Maximum enol content is in : (a) CH3CHO (b) CH3C(=O)CH2CH3 (c) CH3C(=O)CH=CH2 (d) CH3C(=O)C(=O)CH3
99. Which of the following will have one of the stereoisomer meso ? (a) 2-chlorobutane (b) 2,3-dichlorobutane (c) 2,3-dichloropentane (d) 2-hydroxypropanoic acid
100. The correct decreasing order in the enol content of following molecules is : (a) CH3CHO (b) CH3C(=O)CH2CH3 (c) CH3C(=O)CH=CH2 (d) CH3C(=O)C(=O)CH3
101. Total number of stereoisomers of the compound 1-bromo-3-chlorocyclobutane is : (a) 0 (b) 1 (c) 2 (d) 3
102. Total number of stereoisomers of the 1,3-dichlorocyclohexane is : (a) 0 (b) 1 (c) 3 (d) 4
103. Total number of stereoisomers of the compound 1,4-dichlorocyclohexane is : (a) 0 (b) 1 (c) 2 (d) 4
104. Total number of stereoisomers of the compound 2,4-dichloroheptane is : (a) 0 (b) 2 (c) 3 (d) 4
105. In which of the following keto form is more dominating than enol form : (a) CH3C(=O)CH2CH3 (b) CH3C(=O)CH=CH2 (c) CH3C(=O)C(=O)CH3 (d) CH3C(=O)CH2CH2OH
106. Among the following compounds, which will give maximum enol content in solution : (a) CH3C(=O)CH2CH3 (b) CH3C(=O)CH=CH2 (c) CH3C(=O)C(=O)CH3 (d) CH3C(=O)CH2CH2OH
107. Which of the following has unstable enol form ? (a) CH3C(=O)CH2CH3 (b) CH3C(=O)CH=CH2 (c) CH3C(=O)C(=O)CH3 (d) CH3C(=O)CH2CH2OH
108. Calculate enantiomeric excess of mixture containing 6g of (+) 2-butanol and 4g of (-) 2-butanol.



How many representations of lactic acid are possible in Fischer projection (*d* & *l*) ?

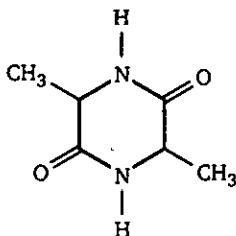
- (a) 8 (b) 12  
(c) 24 (d) 36

121. Total number of stereoisomer formed by the given compound is :



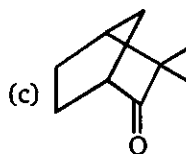
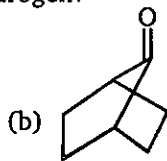
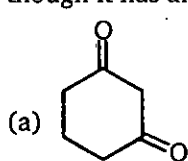
- (a) 2 (b) 3  
(c) 4 (d) 8

122. The number of stereoisomers formed by the given compound is :

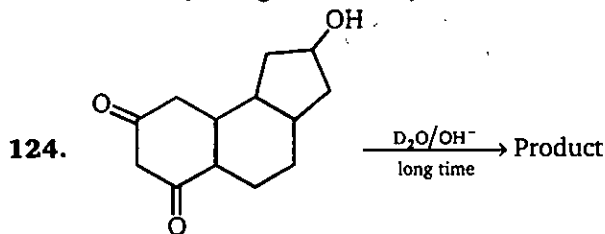


- (a) 2 (b) 3  
(c) 4 (d) 5

123. Which of the following compound does not undergo base-catalyzed exchange in  $D_2O$  even though it has an  $\alpha$ -hydrogen?

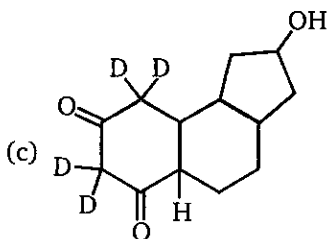
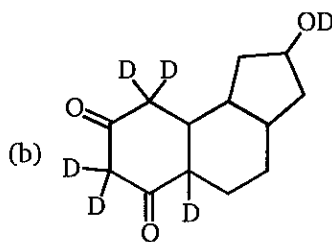
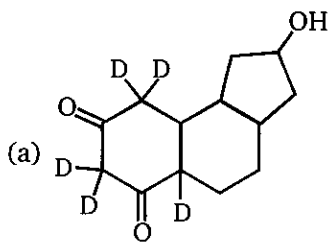


(d) both (b) & (c)



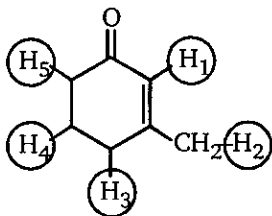
Identify the product formed in the above reaction:





(d) None of these

125. In 3-methyl-2-cyclohexenone which hydrogen cannot undergo deuterium exchange when it reacts with  $\text{CH}_3\text{O}^\ominus/\text{CH}_3\text{OD}$ ?



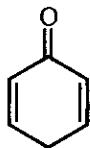
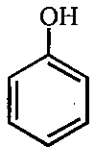
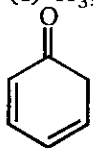
(a)  $\text{H}_1, \text{H}_4$

(c)  $\text{H}_3, \text{H}_2$

(b)  $\text{H}_4$

(d)  $\text{H}_5, \text{H}_3$

126.



The tautomer of II is :

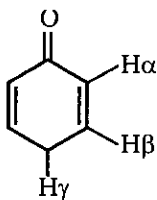
(a) I

(c) both I and III

(b) III

(d) none of these

127.



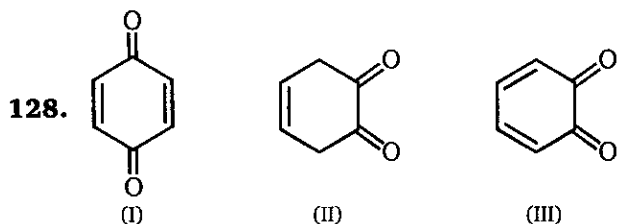
In the enolization of the given molecule, the H-atom involved is :

(a)  $\alpha\text{-H}$

(c)  $\gamma\text{-H}$

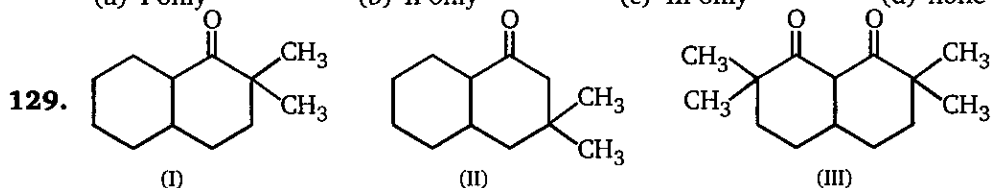
(b)  $\beta\text{-H}$

(d) cannot be enolized



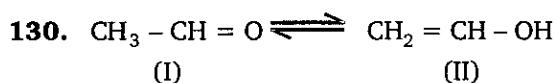
Among the given structure which can exhibit tautomerism ?

- (a) I only (b) II only (c) III only (d) none of these



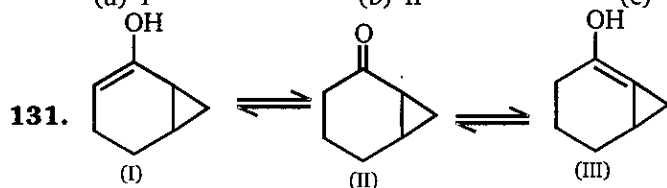
Identify the which can exhibit tautomerism ?

- (a) I only (b) II only (c) III only (d) all of these



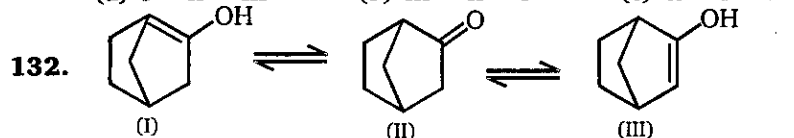
Between the two tautomers which is more stable ?

- (a) I (b) II (c) I = II (d) none of these



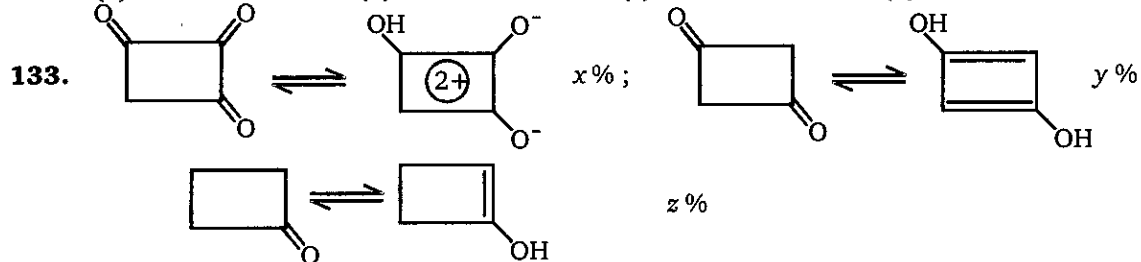
Correct stability order of the given tautomers is :

- (a) I > II > III (b) III > II > I (c) II > I > III (d) II > III > I

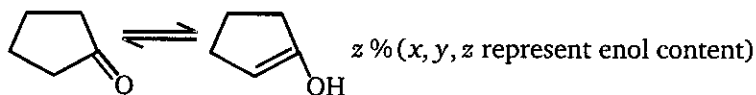
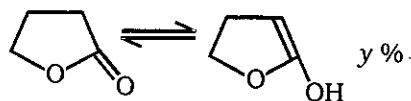
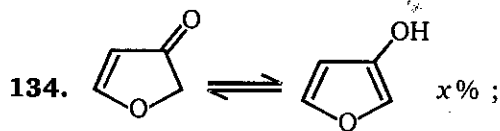
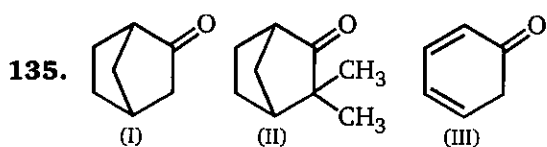


Correct stability order of the given tautomers is :

- (a) I > II > III (b) III > II > I (c) II > I > III (d) II > III > I



The correct order of enol contents x, y, z is :

(a)  $x > y > z$ (b)  $z > y > x$ (c)  $y > x > z$ (d)  $x > z > y$ The correct order of  $x, y, z$  is :(a)  $x > y > z$ (b)  $z > y > x$ (c)  $y > x > z$ (d)  $x > z > y$ 

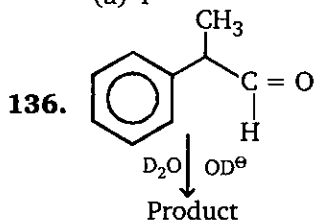
Among the given ketones, the one which does not enolize is :

(a) I

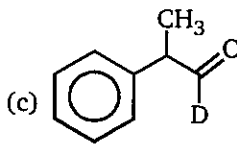
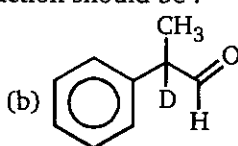
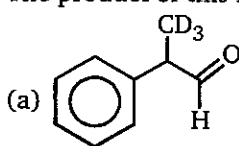
(b) II

(c) III

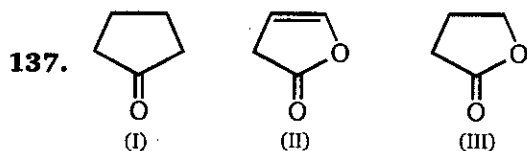
(d) none of these



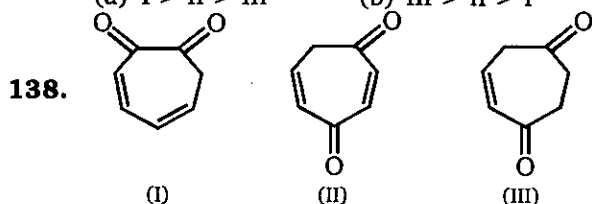
The product of this reaction should be :



(d) All of these

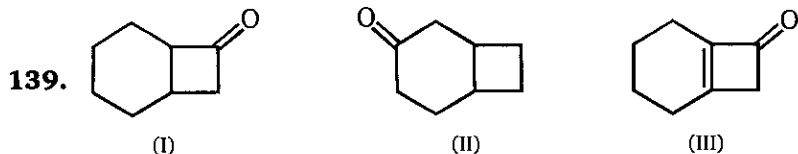


Among the given compounds, the correct order of enol content is :

(a)  $I > II > III$ (b)  $III > II > I$ (c)  $II > I > III$ (d)  $II > III > I$ 

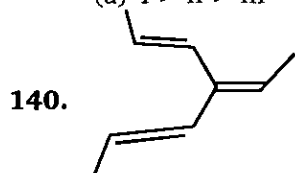
Among the given compounds, the correct order of enol content is :

(a)  $I > II > III$ (b)  $III > II > I$ (c)  $II > I > III$ (d)  $II > III > I$



Among the given compounds, the correct order of enol content is :

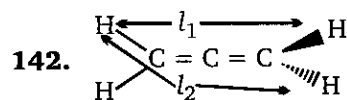
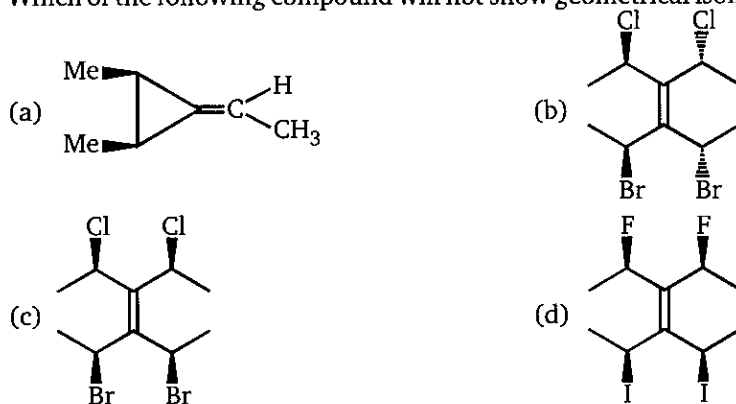
- (a) I > II > III (b) III > II > I (c) III > I > II (d) II > I > III



How many geometrical isomers are possible for the above compound ?

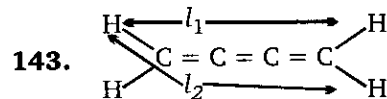
- (a) 3 (b) 4 (c) 6 (d) 8

141. Which of the following compound will not show geometrical isomerism across the  $\pi$ -bond ?



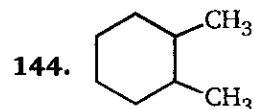
Choose the correct relation between  $l_1$  and  $l_2$  ?

- (a)  $l_1 = l_2$  (b)  $l_1 > l_2$  (c)  $l_1 < l_2$  (d)  $l_2 = 2l_1$



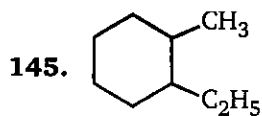
Choose the correct relation between  $l_1$  and  $l_2$  ?

- (a)  $l_1 = l_2$  (b)  $l_1 > l_2$  (c)  $l_1 < l_2$  (d)  $l_2 = 2l_1$



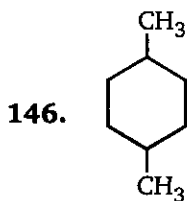
How many geometrical isomers are possible for the above compound ?

- (a) 0 (b) 2 (c) 3 (d) 4



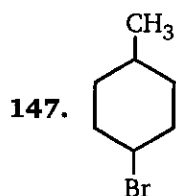
How many geometrical isomers are possible for the above compound ?

- (a) 0 (b) 2 (c) 3 (d) 4



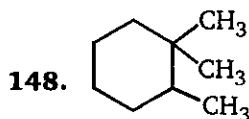
How many geometrical isomers are possible for the above compound ?

- (a) 0 (b) 2 (c) 3 (d) 4



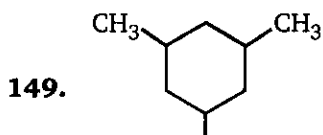
How many geometrical isomers are possible for the above compound ?

- (a) 0 (b) 2 (c) 3 (d) 4



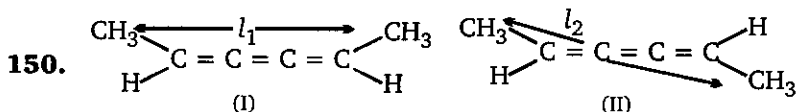
How many geometrical isomers are possible for the above compound ?

- (a) 0 (b) 2 (c) 3 (d) 4



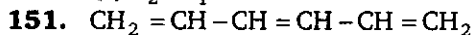
How many geometrical isomers are possible for the above compound ?

- (a) 0 (b) 2 (c) 3 (d) 4



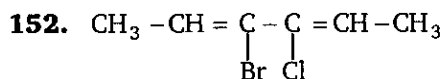
I and II are geometrical isomers of each other because

- (a)  $l_1 = l_2$  (b)  $l_1 > l_2$   
 (c)  $l_2 > l_1$  (d)  $l_1$  and  $l_2$  cannot be compared.



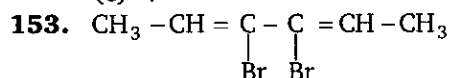
How many geometrical isomers are possible for this compound ?

- (a) 2 (b) 3 (c) 4 (d) 8



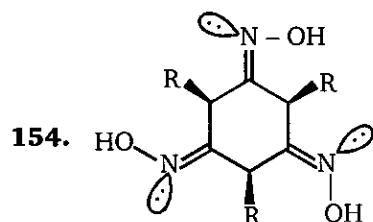
How many geometrical isomers are possible for this compound?

- (a) 2 (b) 3  
(c) 4 (d) 6

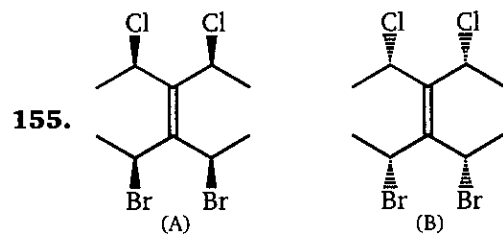


How many geometrical isomers of this compound are possible ?

- (a) 2 (b) 3  
(c) 4 (d) 6

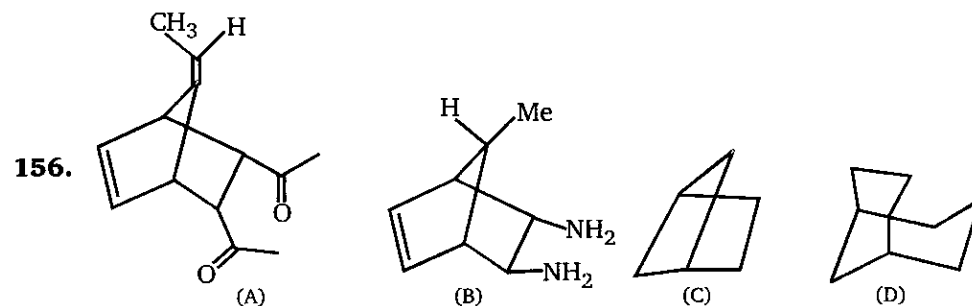


- (a) chiral (b)  $C_3$  axis of symmetry  
(c) Optically active (d) All of these



Relationship between above pair (A) & (B) is :

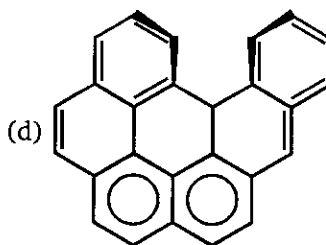
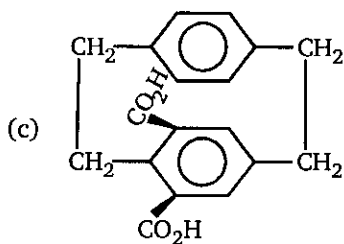
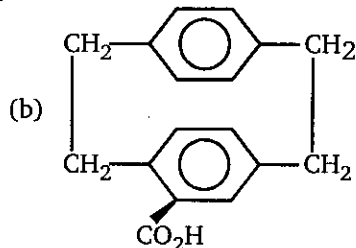
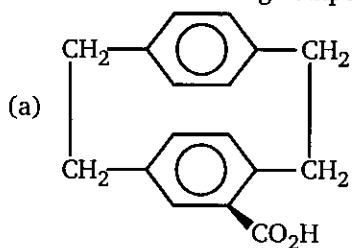
- (a) Enantiomer (b) Diastereomers (c) Identical (d) Structural isomer



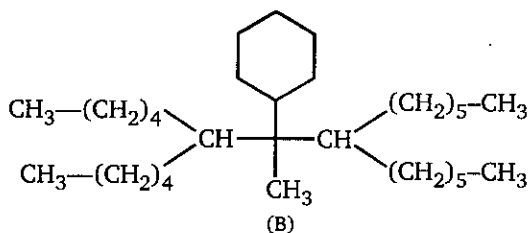
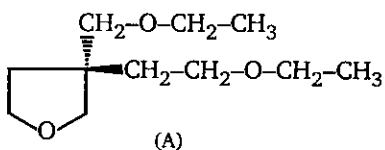
From the above compound (A), (B), (C) & (D) chiral compound is :

- (a) A (b) B (c) C (d) D

157. Which of the following compound is achiral ?



158.



R and S configuration of compound (A) & (B) will be :

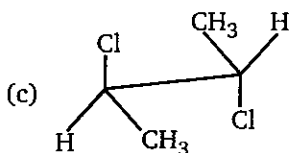
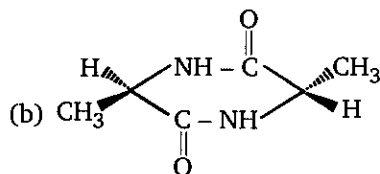
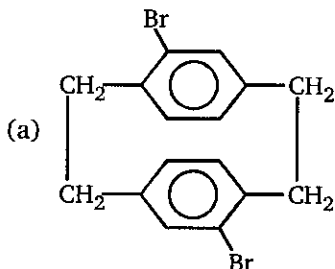
(a) R, R

(b) R, S

(c) S, R

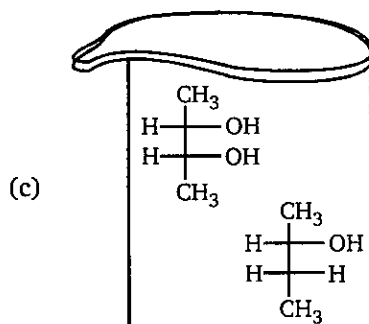
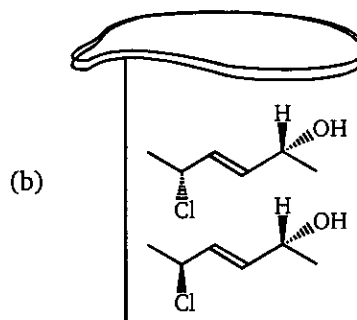
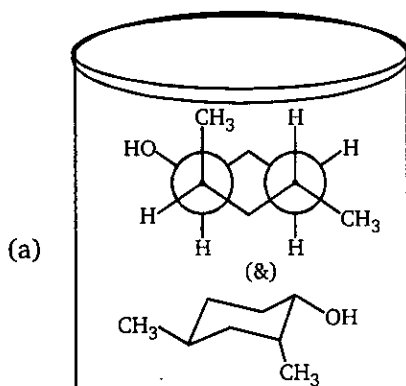
(d) S, S

159. Which of following compound has center of symmetry?



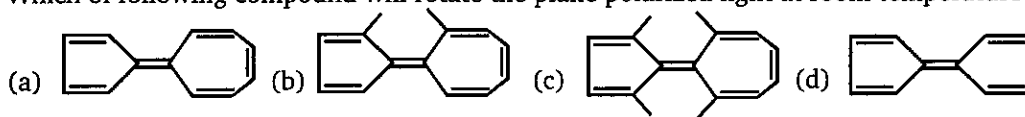
(d) All of these

160. Which mixture of structure in each beaker would rotate plane polarized light ?

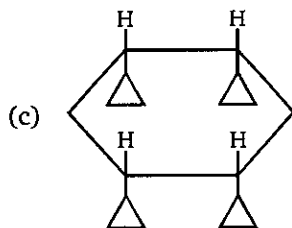
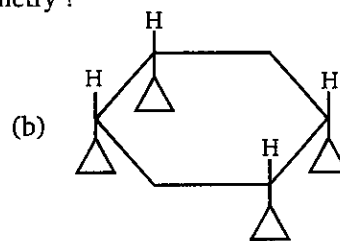
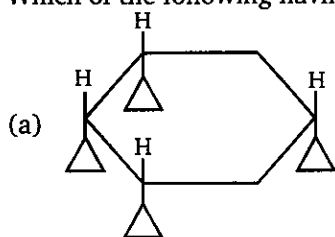


(d) All of these

161. Which of following compound will rotate the plane polarized light at room temperature?



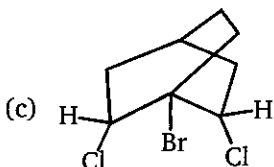
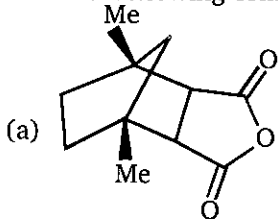
162. Which of the following having plane of symmetry ?



(d) All of these

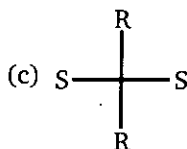
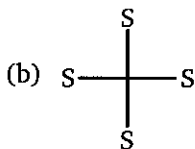
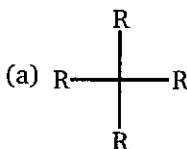
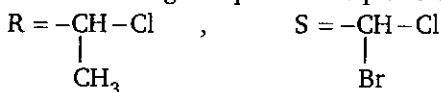


163. Which of following compound is achiral ?



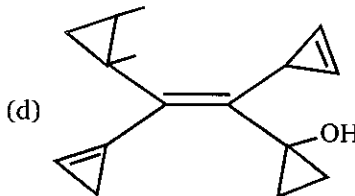
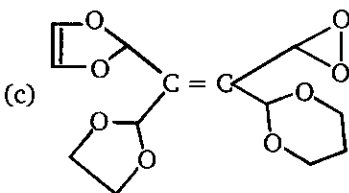
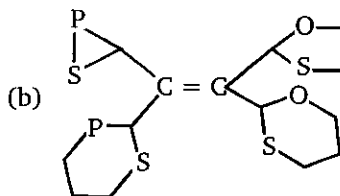
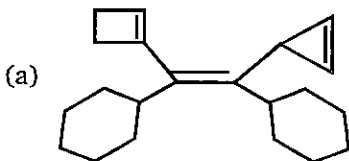
(d) All of these

164. Which of the following compound has plane of symmetry ?

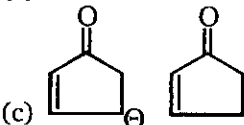
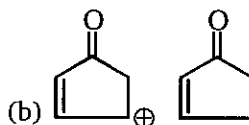
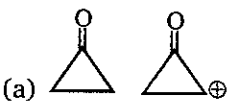


(d) None of these

165. Which of following is E isomer ?

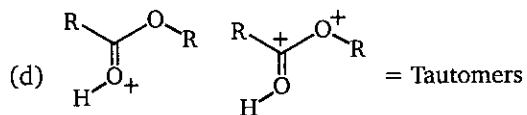
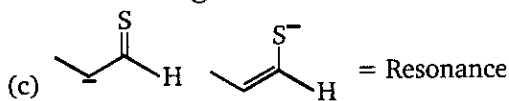
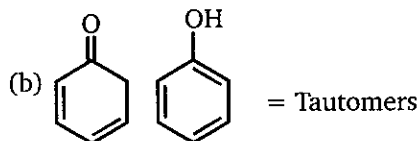
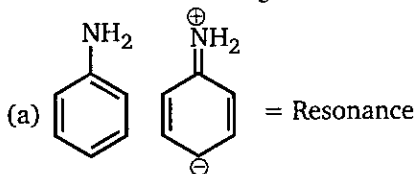


166. Among the given pairs, in which pair second compound has less enol content than first compound?

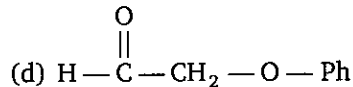
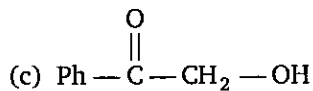
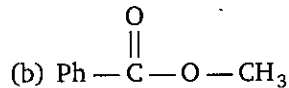
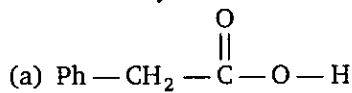


(d) none of these

167. Which of the following is incorrect relation between given pairs ?



168.  $\text{Ph}-\underset{\text{OH}}{\underset{\text{(A)}}{\text{CH}}}-\overset{\text{O}}{\parallel}{\text{C}}-\text{H} \xrightarrow[\text{H}_2\text{O}]{\text{HO}^\ominus} (\text{B})$ ; (A) and (B) are isomer and isomerization effectively carried out by trace of base (B). Identify (B).



169.  $\text{CH}_3-\text{CH}=\text{CH}-\text{CH}=\text{CH}-\text{CH}_3$ ; total number of geometrical isomer is :

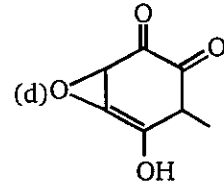
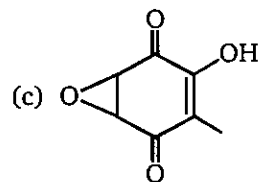
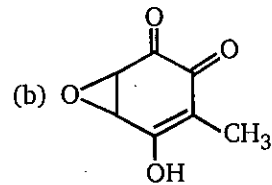
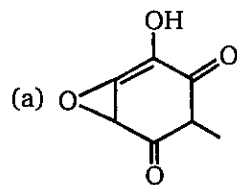
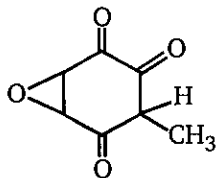
(a) 2

(b) 3

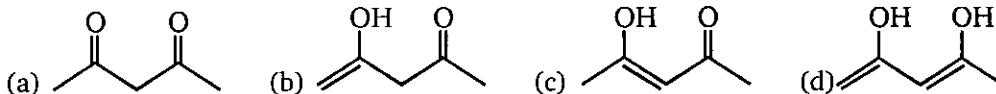
(c) 4

(d) 6

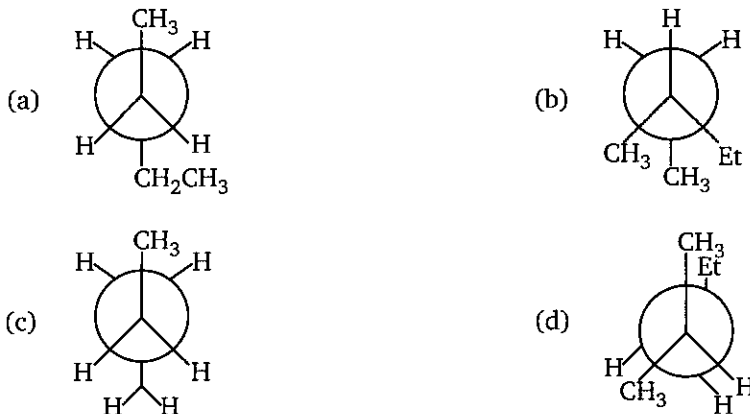
170. Identify most stable enol form of teric acid:



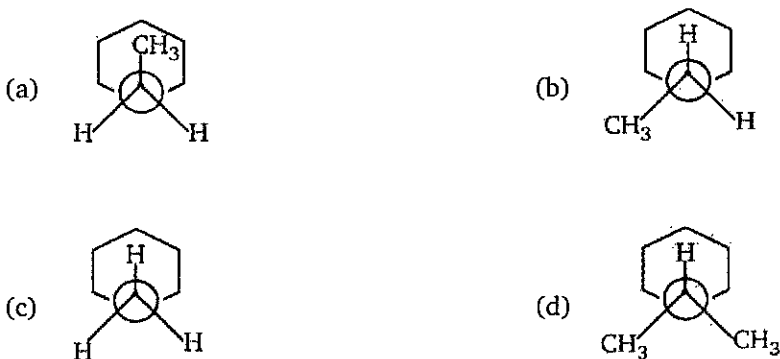
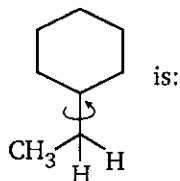
171. Which structure is most stable ?



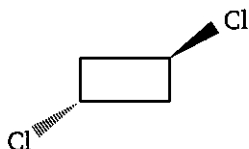
172. Identify conformer of 2-methyl pentane :



173. The lowest energy conformer of



174.



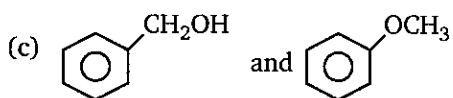
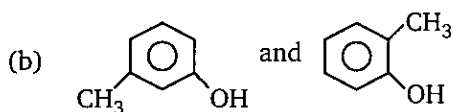
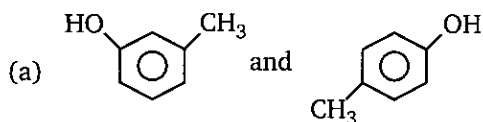
How many atoms will be bisect during plane of symmetry ?

- (a) 2 (b) 4  
 (c) 6 (d) 8

175. The number of all types of isomers of chlorobutane is :

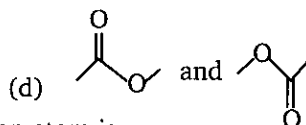
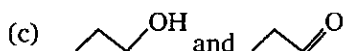
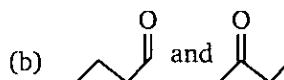
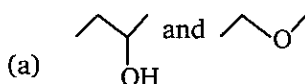
- (a) 2 (b) 4  
(c) 6 (d) 5

176. Which of the following pairs of compounds are not positional isomers ?



(d) All of these

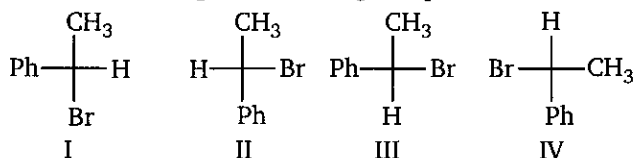
177. Which of the following pairs of compounds are functional isomers ?



178. The isomeric alcohol which has a chiral carbon atom is:

- (a) *n*-butyl alcohol (b) *iso*-butyl alcohol (c) *sec*-butyl alcohol (d) *tert*-butyl alcohol

179. The pair of enantiomers among the following compound is:

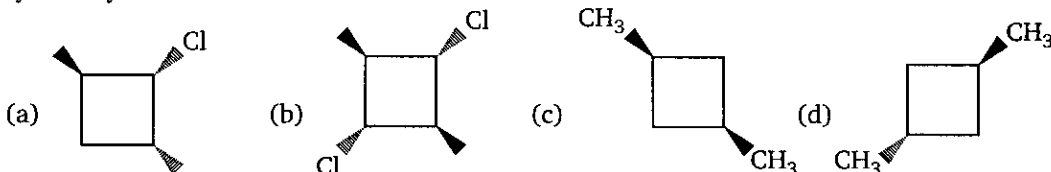


- (a) I and IV (b) II and IV (c) II and III (d) I and II

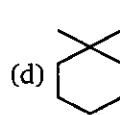
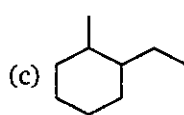
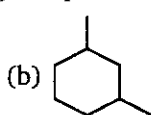
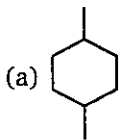
180. Which of the following is chiral?

- (a) Cell phone (b) Spiral staircase (c) Scissor (d) All of these

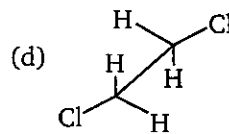
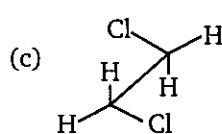
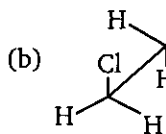
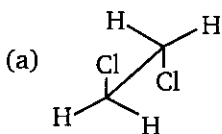
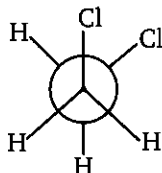
181. In which of the following compound, possess plane of symmetry as well as centre of symmetry?



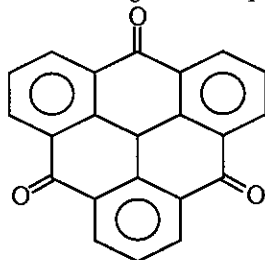
182. Which of the following compound has one of the stereoisomers as a meso compound?



183. For the following Newman projection

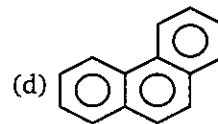
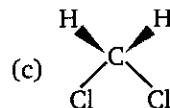
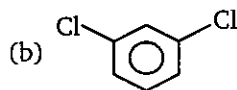
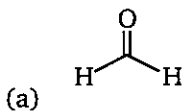


184. Which of the following is correct for the given compound?



- (a) It possess centre of symmetry
- (b) It possess  $C_4$  axis of symmetry
- (c) It possess plane of symmetry
- (d) Compound is chiral

185. Which of the following molecules has axis of symmetry and a coaxial plane of symmetry?

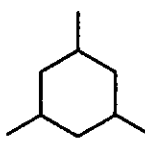


- (e) All of these

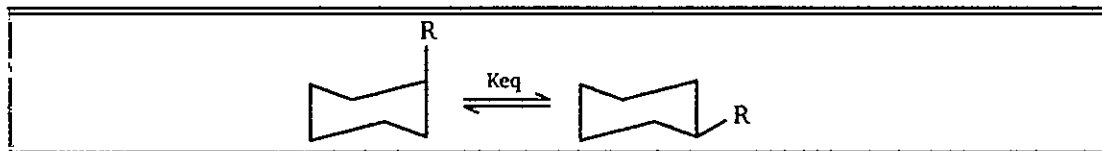




## 1. Match the Column (I) and (II).

Column (I)		Column (II)	
Reaction		Stereoisomers	
(a)	$\text{CH}_3 - \text{CH} = \text{CH} - \text{CH} = \text{N} - \text{OH}$	(p)	2
(b)		(q)	4
(c)	$\text{CH}_3 - \text{CH} = \text{CH} - \text{CH} = \text{CH} - \text{CH} = \text{CH} - \text{CH}_3$	(r)	6
(d)	$\text{CH}_3 - \text{CH} = \text{CH} - \text{CH} = \text{CH} - \text{CH} = \text{CH} - \text{Ph}$	(s)	8

## 2. Match the Column (I) and (II).



Column (I)		Column (II)	
Group		Equilibrium Constant	
(a)	$\text{R} = -\text{H}$	(p)	38
(b)	$\text{R} = -\text{CH}_3$	(q)	23
(c)	$\text{R} = -\text{Et}$	(r)	18
(d)	$\text{R} = -\begin{array}{l} \text{CH}-\text{CH}_3 \\   \\ \text{CH}_3 \end{array}$	(s)	1

## 3. Match the Column (I) and (II). (Matrix)

Column (I)		Column (II)	
Molecule		Nature	
(a)		(p)	Chiral
(b)		(q)	Achiral
(c)		(r)	Meso
(d)		(s)	Compound containing even number of chiral centers



## 4. Match the Column (I) and (II). (Matrix)

Column (I)		Column (II)	
Compound		Isomerism	
(a)		(p)	Geometrical isomerism
(b)		(q)	Optical isomerism
(c)		(r)	Compound containing plane of symmetry
(d)		(s)	Compound containing center of symmetry

## 5. Match the Column (I) and (II).

Column (I)		Column (II)	
Molecules		Relationship	
(a)		(p)	Identical
(b)		(q)	Enantiomer
(c)		(r)	Diastereomer
(d)		(s)	Structural Isomerism

## 6. Match the Column (I) and (II). (Matrix)

Column (I)		Column (II)	
Compound		Nature	
(a)		(p)	cis-compound
(b)		(q)	trans-compound
(c)		(r)	Optically active
(d)		(s)	Optically inactive

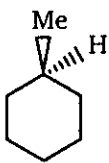
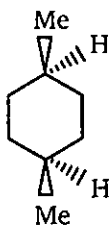
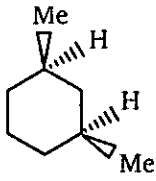
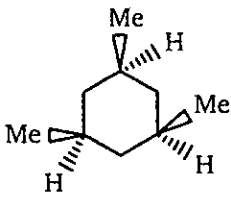
## 7. Match the Column (I) and (II). (Matrix)

Column (I)		Column (II)	
Molecule		Property	
(a)		(p)	Chiral centers containing compound
(b)		(q)	Presence of stereocenter
(c)		(r)	Optically active compound
(d)		(s)	Compound containing plane of symmetry

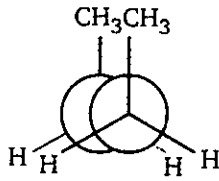
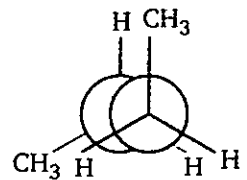
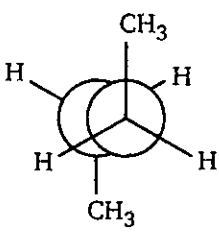
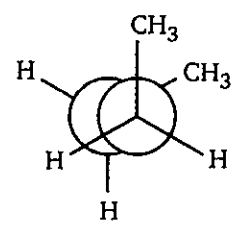
## 8. Match the Column (I) and (II). (Matrix)

Column (I)		Column (II)	
Molecule		Property	
(a)		(p)	Polar molecule
(b)		(q)	Optically active
(c)		(r)	Optically inactive
(d)		(s)	Plane of symmetry

## 9. Match the Column (I) and (II). (Matrix)

Column (I)		Column (II)	
	Molecule		Property
(a)		(p)	Meso compound
(b)		(q)	Achiral
(c)		(r)	Chiral compound
(d)		(s)	Compound will show geometrical isomerism

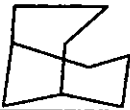
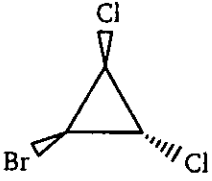
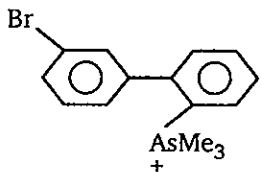
## 10. Match the Column (I) and (II).

Column (I)		Column (II)	
Modified Newmann Projection		Conformers	
(a)		(p)	Fully eclipsed
(b)		(q)	Partially eclipsed
(c)		(r)	Gauche
(d)		(s)	Staggered

## 11. Match the Column (I) and (II).

Column (I)		Column (II)	
	Newmann Projection		Name of the Compound
(a)		(p)	3-methyl pentane
(b)		(q)	n-butane
(c)		(r)	Methyl-cyclopentane
(d)		(s)	1,2,4-trimethyl cyclohexane

## 12. Match the Column (I) and (II). (Matrix)

Column (I)		Column (II)	
Molecule		Property	
(a)		(p)	Rotates plane polarized light
(b)		(q)	Cannot rotate plane polarized light
(c)		(r)	Plane of symmetry
(d)	$\begin{array}{c} \text{CH}_3 \\ \diagdown \\ \text{C} = \text{C} = \text{C} \\ \diagup \\ \text{CH}_3 \end{array} \begin{array}{c} \text{I} \\ \text{---} \\ \text{Cl} \end{array}$	(s)	Centre of symmetry

## 13. Match the Column (I) and (II).

Column (I)		Column (II)	
Molecule		Stereocenters	
(a)	$\text{CH}_3 - \text{CH} = \text{CH} - \underset{\text{Br}}{\text{CH}} - \text{CH}_3$	(p)	1
(b)	$\text{H} - \text{C} \equiv \text{C} - \text{CH} = \text{CH} - \underset{\text{Br}}{\text{CH}} - \underset{\text{Br}}{\text{CH}} - \text{CH}_3$	(q)	2
(c)	$\text{Ph} - \overset{\text{O}}{\parallel}{\text{S}} - \text{CH} = \text{CH} - \underset{\text{CH}_3}{\text{CH}} - \text{CH}_3$	(r)	3
(d)	$\text{Ph} - \underset{\text{Cl}}{\text{CH}} - \text{Et}$	(s)	4

## 14. Match the Column (I) and (II).

Column (I)		Column (II)	
	Molecule		Stereoisomers
(a)		(p)	2
(b)		(q)	0
(c)		(r)	4
(d)		(s)	8



## 15. Match the Column (I) and (II). (Matrix)

Column (I)		Column (II)	
	Molecule		Property
(a)		(p)	Meso Compound
(b)		(q)	Compound having even no. of chiral centres
(c)		(r)	Optically active compound
(d)		(s)	Compound having odd no. of chiral centres.

## 16. Match the Column (I), (II) and (III). (Matrix)

Column (I)		Column (II)		Column (III)	
Property		Molecule		No. of Chiral Center	
(a)		(p)	Optically active	(w)	0
(b)		(q)	Optically inactive	(x)	1
(c)		(r)	Plane of symmetry	(y)	2
(d)		(s)	Centre of symmetry	(z)	3

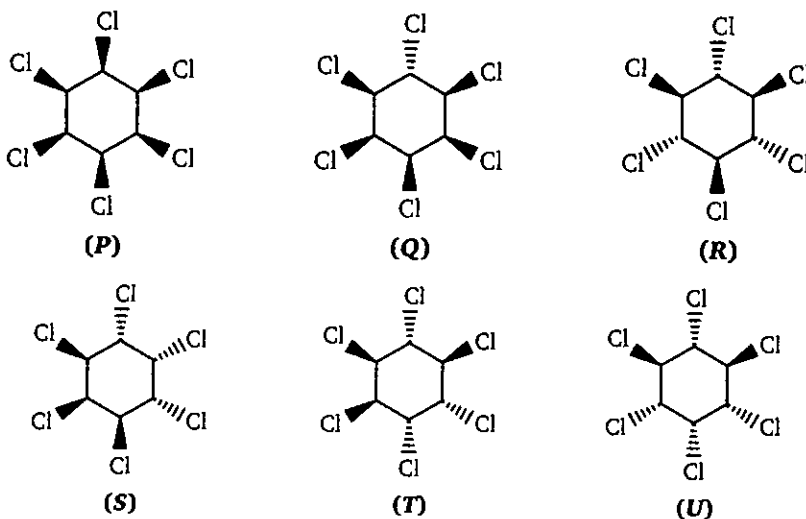
## 17.

(a)		(b)		(c)	
(d)		(e)		(f)	
(g)		(h)			

From the above compounds select :

(A)	two of which are chiral and contain chiral centre :	
(B)	two of which are achiral and contains chiral centre :	
(C)	two of which are chiral and does not contain chiral centre :	
(D)	two of which are achiral and does not contain chiral centre :	

## 18. Comprehension



Consider the given structures and answer A, B & C.

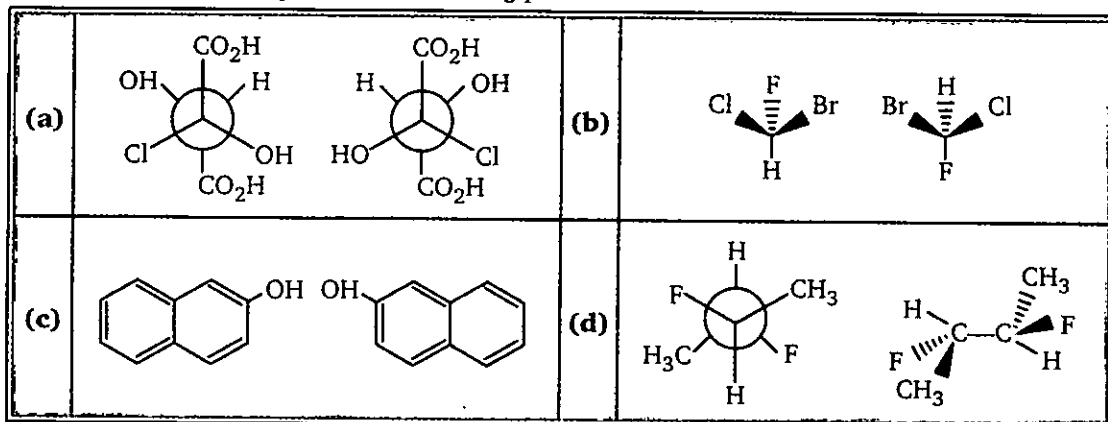
A. Which of the compound is optically active ?

- (a) P                      (b) R                      (c) S                      (d) T

B. Which of the isomer is most stable ?

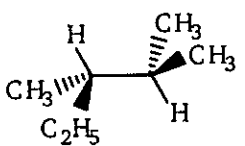
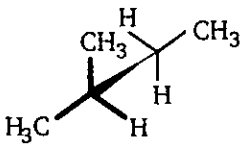
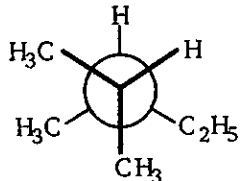
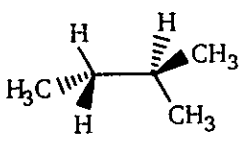
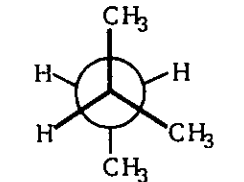
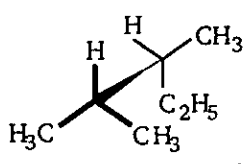
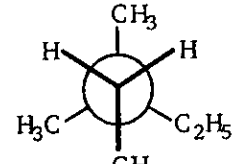
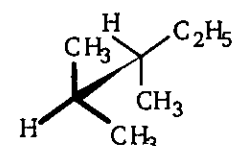
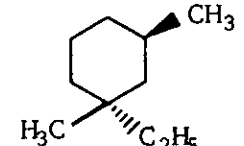
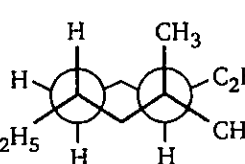
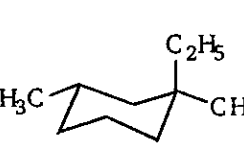
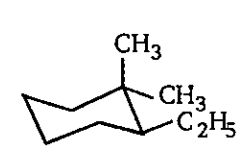
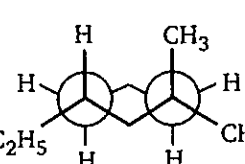
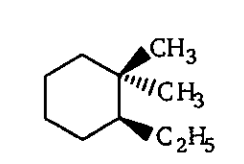
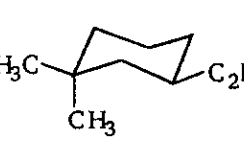
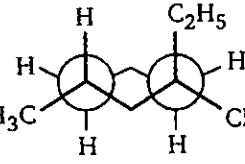
- (a) R                      (b) S                      (c) T                      (d) U

19. Identify relationship between following pairs :

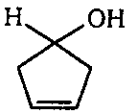

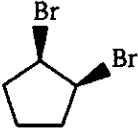
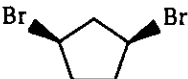
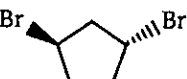
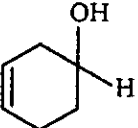
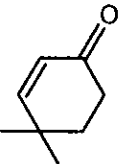


If they are enantiomer answer will be 1, if they are diastereomers answer will be 2, if they are constitutional isomers answer will be 3 and if they are identical present 4 as the answer. Sum of answer of each part  $a + b + c + d$  is : .....

20. In each of the following three questions a hydrocarbon is named. For each select from among the sixteen conformational structures (a through p) all structures that represent possible conformers of that compound. Write letters (a through p), corresponding to your selections, in each answer box.

A.	2-methylbutane		
B.	2,3-dimethylpentane		
C.	1-ethyl-1, 3-dimethyl cyclohexane		
(a)		(b) 	(c) 
(d)		(e) 	(f) 
(g)		(h) 	(i) 
(j)		(k) 	(l) 
(m)		(n) 	(o) 
(p)			

21. Examine structures a through j, shown below, with respect to their symmetry or lack of it. Assume that the five-membered rings and the ring in compound g are planar. The wedge-hatched bonds in b, c, d & e designate specific configurations. Also, for the acyclic compounds assume stable anti conformations. Answer each of the following questions by writing letters (a through j), corresponding to your selections, in each answer box. If there is no structure that fits the description enter an x in the answer box.

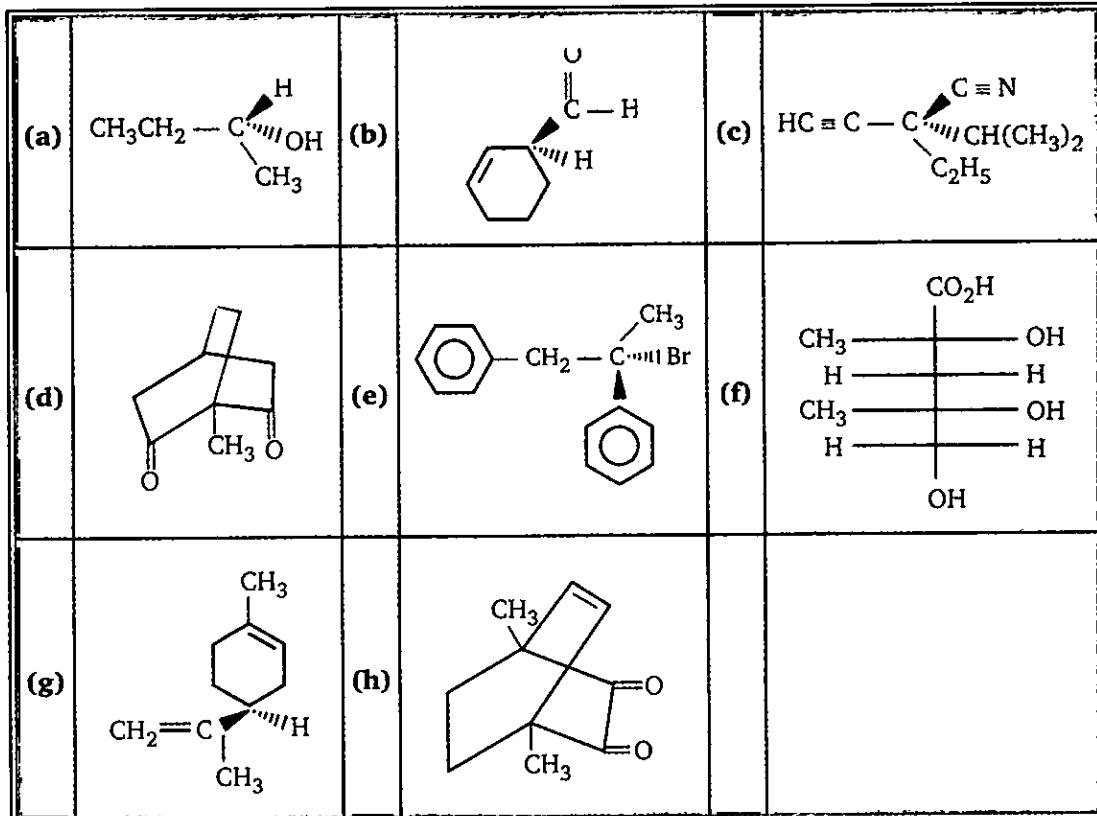
A.	Which structures are chiral ?				
B.	Which structures have a plane of symmetry ?				
C.	Which structures have a center of symmetry ?				
(a)		(b)		(c)	
(d)		(e)		(f)	
(g)		(h)	$C_2H_5CHCl_2$	(i)	$C_2H_5CHClC_2H_5$
(j)	$C_2H_5CHClCH_3$				

22. (i) 1,2-dichlorocyclopropane = w  
 (ii) 1,3-dimethyl-cyclobutane = x  
 (iii) 2-bromo-3-chlorobutane = y  
 (iv) 1,3-dimethyl cyclohexane = z

Calculate total number of stereoisomer of the above compounds.

Sum of  $w + x + y + z = \dots$

27. The configuration of eight compounds, a through h are shown below, using various kind of stereo representations. To answer the question given below, write (a through h) indicating your choice.



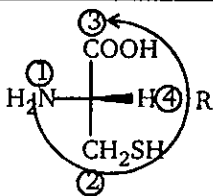
A.	Which of these configuration are achiral?	
B.	Which configuration has no stereogenic center?	
C.	Which configuration has more than one stereogenic center?	
D.	Which of these configuration are meso compound?	

28. The structural formula of ten compounds, (I) through (X) are drawn below, you may select any one of these structure.

Answer the following question about that compound.

I		II		III	
IV		V		VI	
VII		VIII		IX	
X					

- A. How many chiral centre are present in this compound ?  
 (a) 0 (b) 1 (c) 2 (d) 3  
 (e) 4 (f) 5
- B. Is this compound chiral or achiral ?  
 (a) Chiral (b) Achiral
- C. What symmetry element are present in this compound ?  
 (a) None (b) Plane of symmetry (c) Center of symmetry
29. The structure of one of the enantiomers of the amino acid cysteine is shown below.



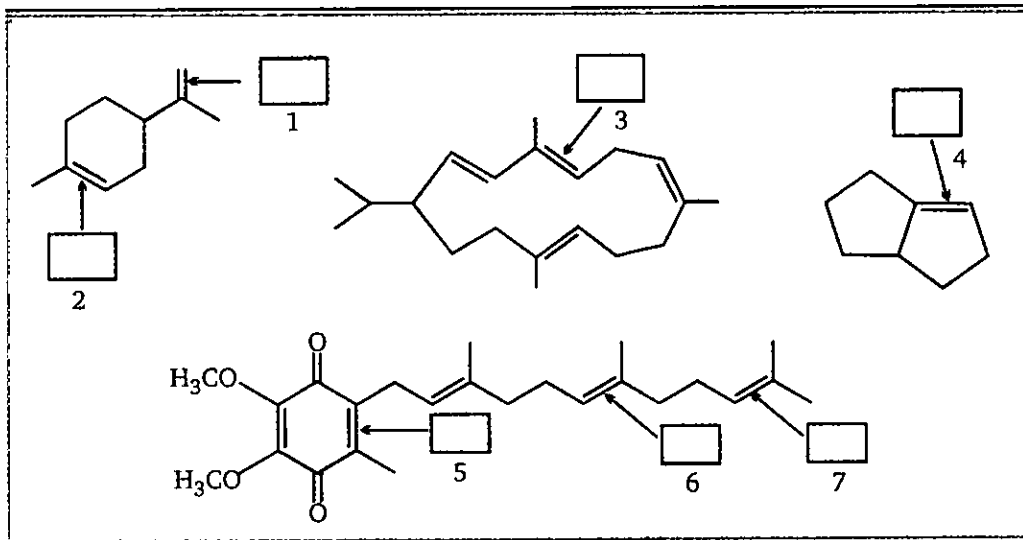
Classify this structure as :

(a) R or S

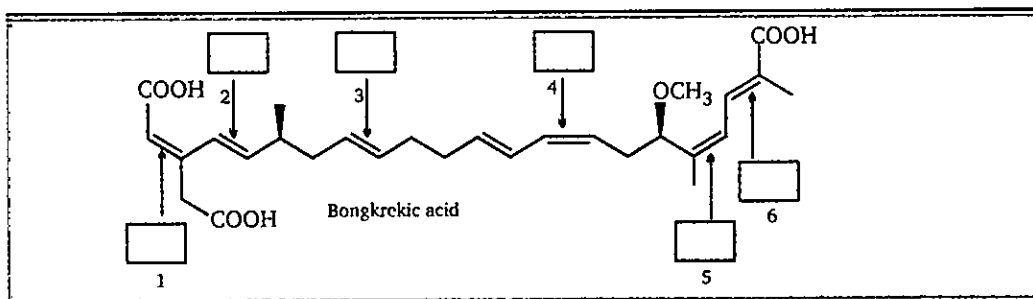
(b) D or L

30. Identify the following double bonds either E, Z or None (N) in the compounds given below either.

A.



- B. (a) Bongkreik acid is a toxic compound produced by *Pseudomonas cocovenenans*, and isolated from a mold that grows on bongkreik, a fermented Indonesian coconut dish. (a) Label each double bond as E, Z or neither (N).



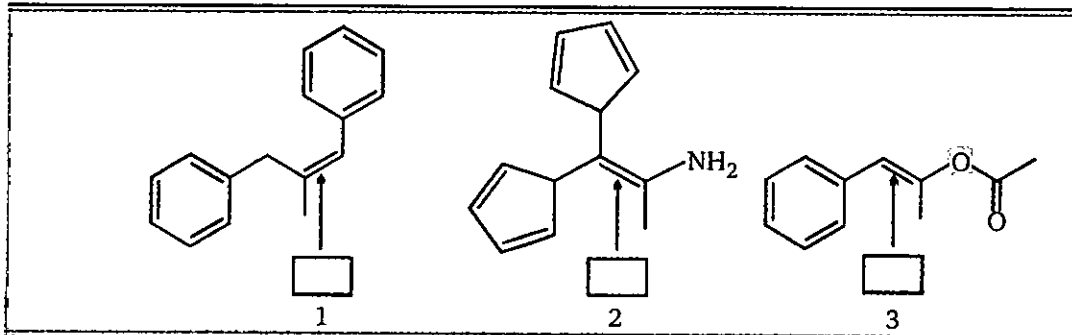
- (b) How many total stereoisomers (including all types) are possible for bongkreik acid ?

.....

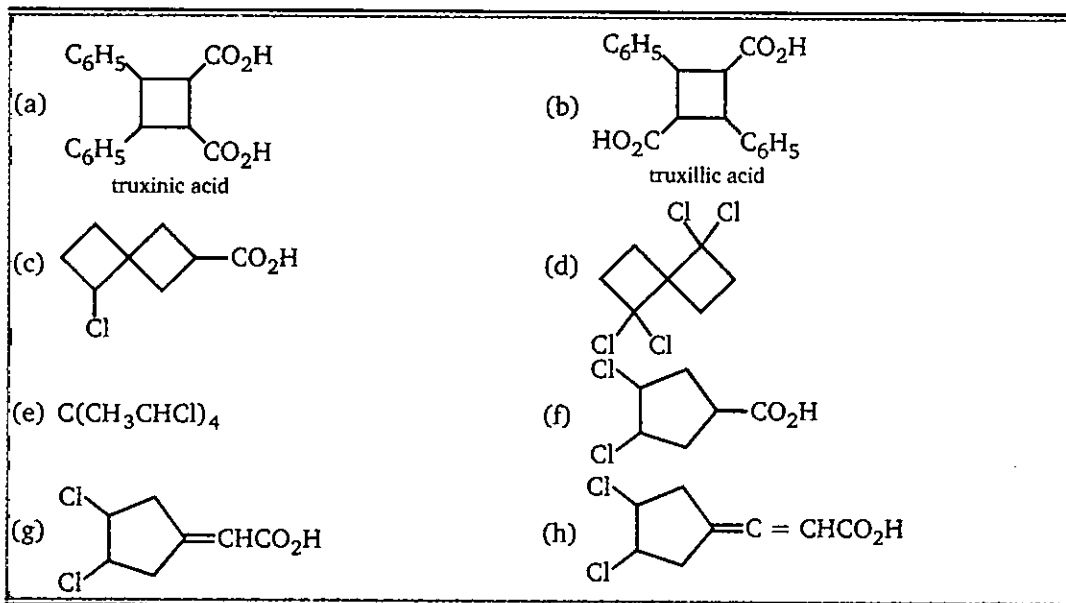
- (c) How many sites of unsaturation are present in bongkreik acid ? .....



31. Designate the following double bonds as E, Z or none (N) configuration in the boxes provided below.



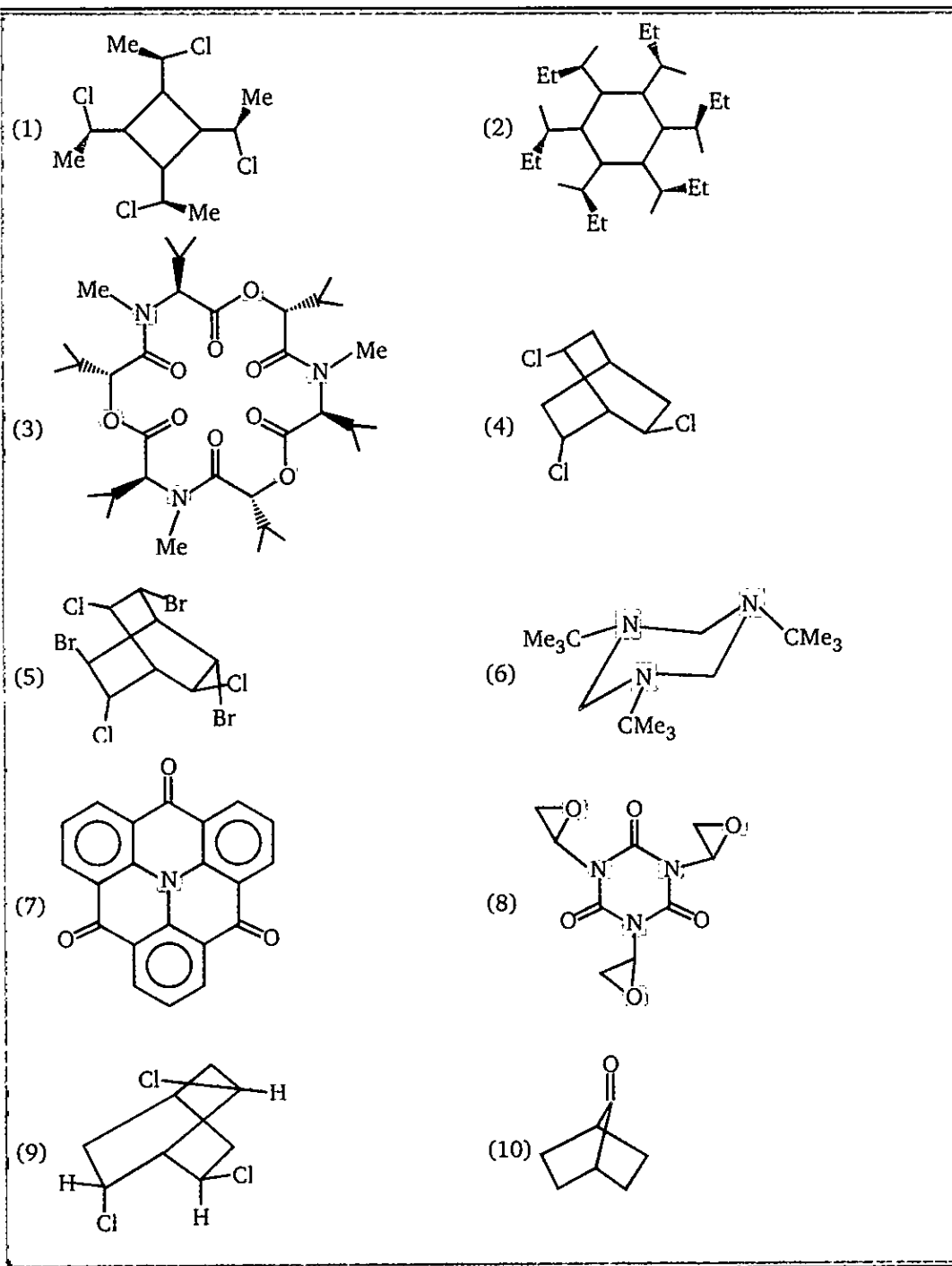
32. The following compounds may exist as two or more stereoisomers. These may be classified as enantiomer pairs or meso compounds.

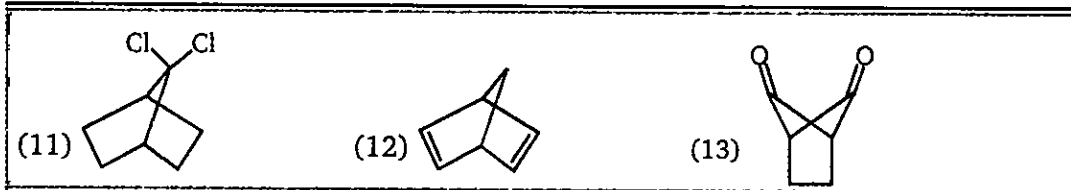


Answer the following question about the above structure.

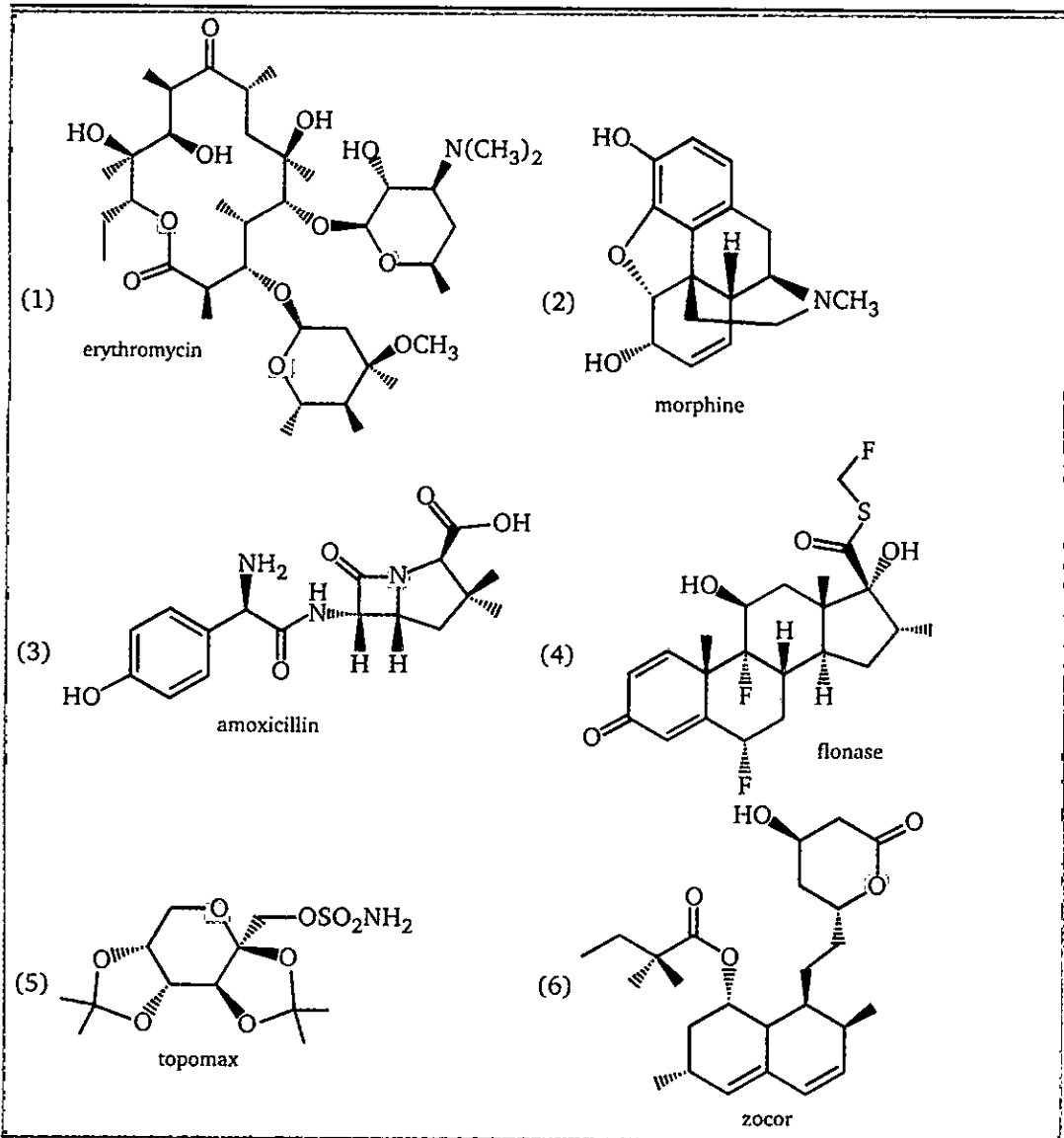
- (A) Total number of stereoisomers :  
 (B) Number of enantiomeric pairs :  
 (C) Number of meso compounds :

33. Identify axis of symmetry in the given compound.

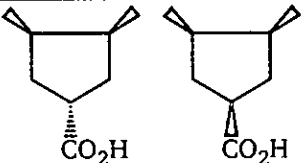
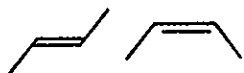
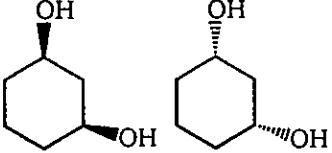
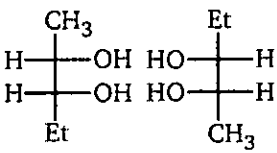
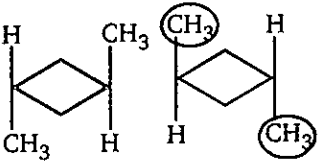
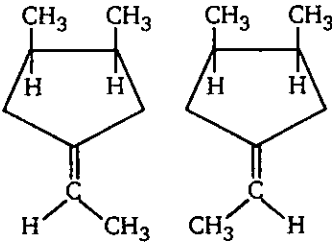
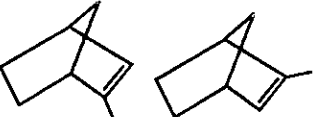




34. For each of the following pharmaceutical compounds, identify all stereogenic (i.e., all asymmetric carbon atoms) and label the configuration of each as being either (R) or (S).



35. Find relationship between given pair :

		Identical	Enantiomer	Diastereomer	Constitutional Isomer
1.					
2.					
3.					
4.					
5.					
6.					
7.					

8.					
9.					
10.					

**36. Comprehension**

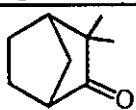
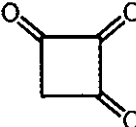
Structural formula of compound (A) is following:



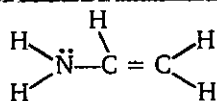
- A.** The correct statement(s) about the compound (A) is/are:
- The total number of stereoisomers possible for (A) is 3
  - The total number of mesoisomer possible for (A) is 1
  - The total number of pair of enantiomer possible for (A) is 1
  - All of these
- B.** Number of plane of symmetry in *cis*-form of compound (A) is:
- 0
  - 1
  - 2
  - 3
- 37.** Match the column. **(Matrix)**

Column (I)		Column (II)	
	No. of Carbon		No. of structural isomer
(a)	$C_4H_{10}$	(p)	2
(b)	$C_5H_{12}$	(q)	3
(c)	$C_6H_{14}$	(r)	5
(d)	$C_7H_{16}$	(s)	9

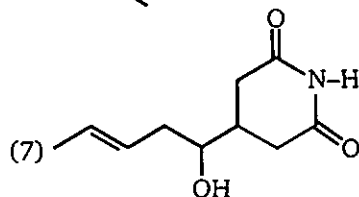
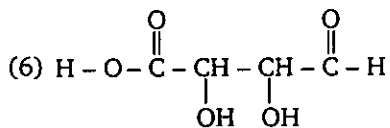
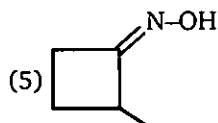
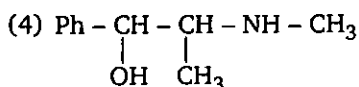
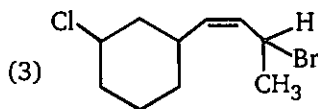
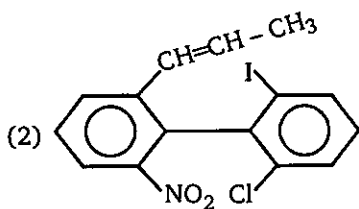
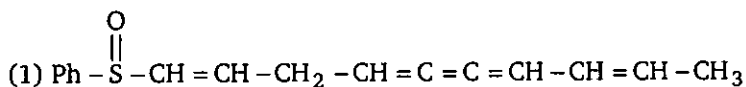
38. Match the column. (Matrix)

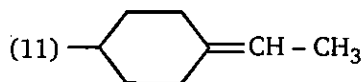
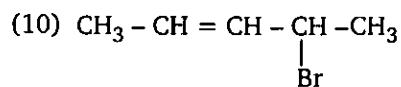
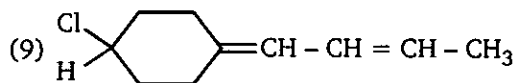
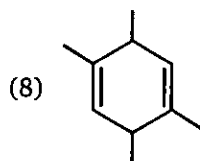
Column (I)		Column (II)	
Compound		% of enol content	
(a)		(p)	100 %
(b)		(q)	76 %
(c)	$\text{CH}_3 - \overset{\text{O}}{\parallel}{\text{C}} - \text{CH}_2 - \overset{\text{O}}{\parallel}{\text{C}} - \text{CH}_3$	(r)	8%
(d)	$\text{CH}_3 - \overset{\text{O}}{\parallel}{\text{C}} - \text{CH}_2 - \overset{\text{O}}{\parallel}{\text{C}} - \text{O} - \text{Et}$	(s)	Keto-Enol is not possible

39. Draw a most stable conformation (N - C) bond in the following compound.

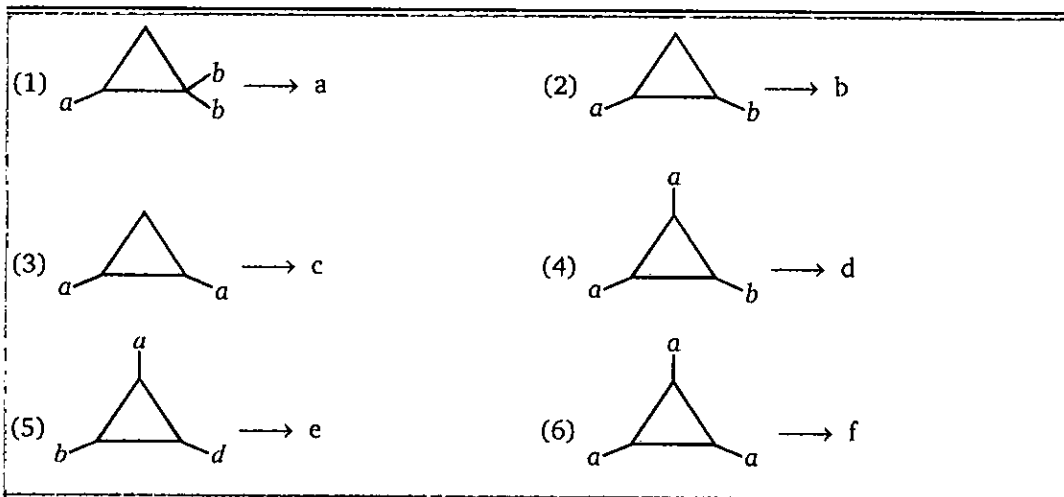


40. Find total number of stereoisomers for each compound given below :

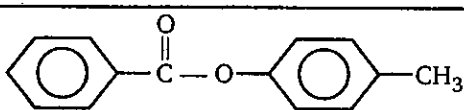
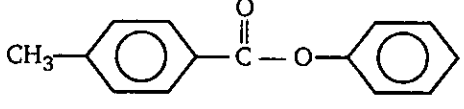


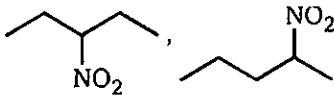
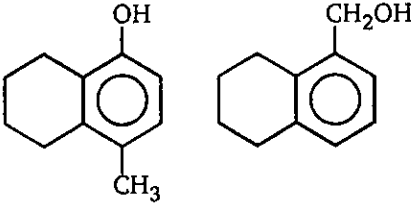


41. Find the total number of stereoisomer for each compound :

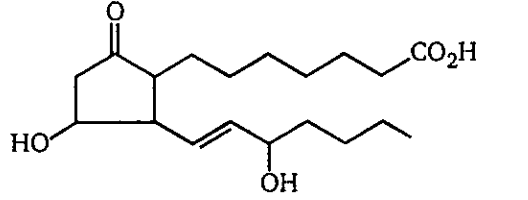
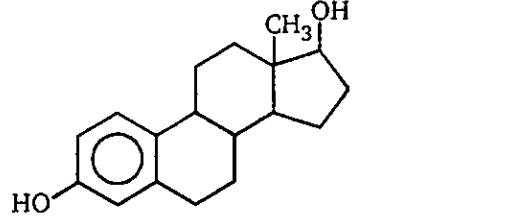
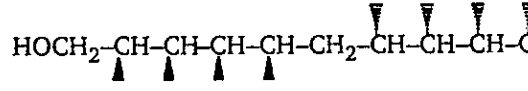
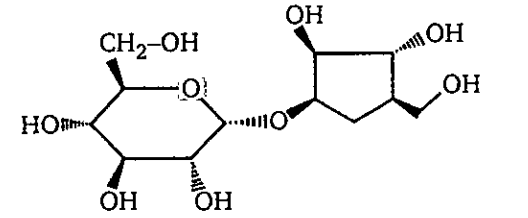


42. Match the column :

Column (I)		Column (II)	
Pair		Isomeric Relationship	
(a)	 	(p)	Chain
(b)	$\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \overset{\text{O}}{\parallel} \text{C} - \text{OH}$ , $\text{CH}_3 - \underset{\text{CO}_2\text{H}}{\text{CH}} - \text{CH}_3$	(q)	Positional

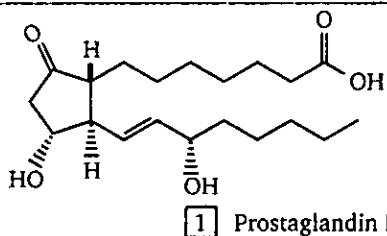
(c)		(r)	Functional
(d)		(s)	Metamers

43. Find sum of stereoisomer of following compound.

		Number of stereoisomers
(a)		→ (a)
(b)		→ (b)
(c)		→ (c)
(d)		→ (d)



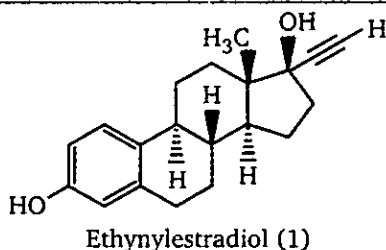
44.



Prostaglandin E<sub>1</sub> 1 is a compound produced by the body to regulate a variety of processes including blood clotting, fever, pain and inflammation.

- A. Which of the following functional groups is not contained in 1 ?  
 (a) A ketone                    (b) An alcohol                    (c) A carboxylic acid   (d) An alkene  
 (e) A nitrile
- B. How many asymmetric (stereogenic) centres are present in compound 1 ?  
 (a) 3                                (b) 4                                (c) 5                                (d) 6
- C. How many  $sp^2$  hybridised carbon atoms are present in compound 1 ?  
 (a) 1                                (b) 2                                (c) 3                                (d) 4
- D. What is the geometric configuration about the double bond in compound 1 ?  
 (a) E                                (b) Z

45.

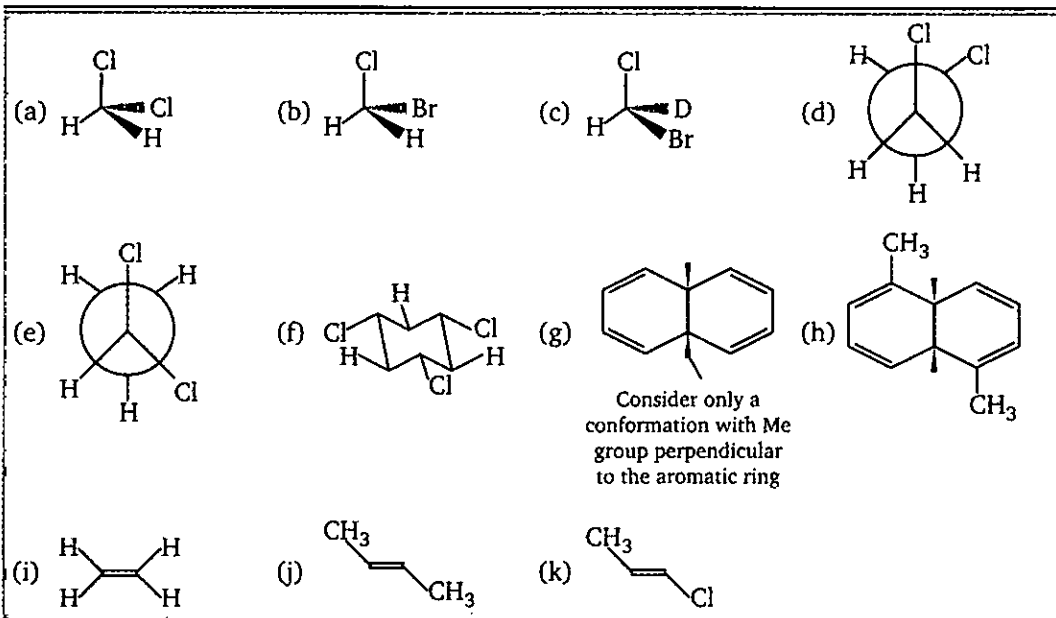


The synthetic steroid ethynylestradiol (1) is a compound used in the birth control pill.

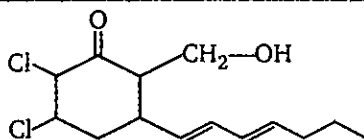
- A. How many  $sp^3$  hybridised carbon atoms are present in compound (1) ?  
 (a) 8                                (b) 9                                (c) 10                                (d) 11   (e) 12
- B. How many  $sp^2$  hybridised carbon atoms are present in compound (1) ?  
 (a) 4                                (b) 5                                (c) 6                                (d) 7   (e) 8
- C. How many  $sp$  hybridised carbon atoms are present in compound (1) ?  
 (a) 2                                (b) 4                                (c) 6                                (d) 8   (e) 10
- D. Which of the following functional group is contained in compound (1) ?  
 (a) A ketone                    (b) An alcohol                    (c) A carboxylic acid   (d) An ester
- E. How many asymmetric (stereogenic) centres are present in compound (1) ?  
 (a) 2                                (b) 3                                (c) 4                                (d) 5

## SUBJECTIVE PROBLEMS

1. Number of chiral isomers are:

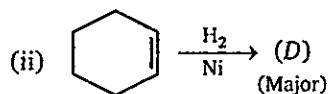
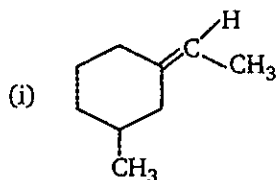


2.



Number of stereoisomer are

3.

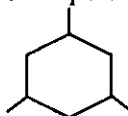


(C)

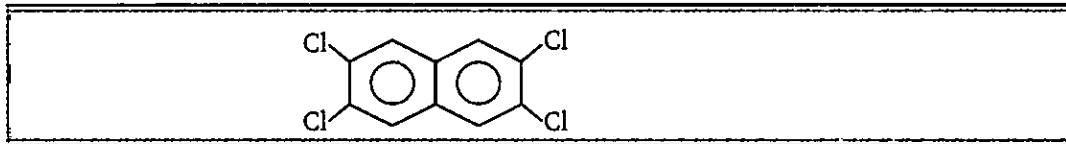
Sum of number of stereoisomer (C) Degree of unsaturations in (D).

4. How many 5 membered parent chain alkane are possible for  $C_7H_{16}$ ?

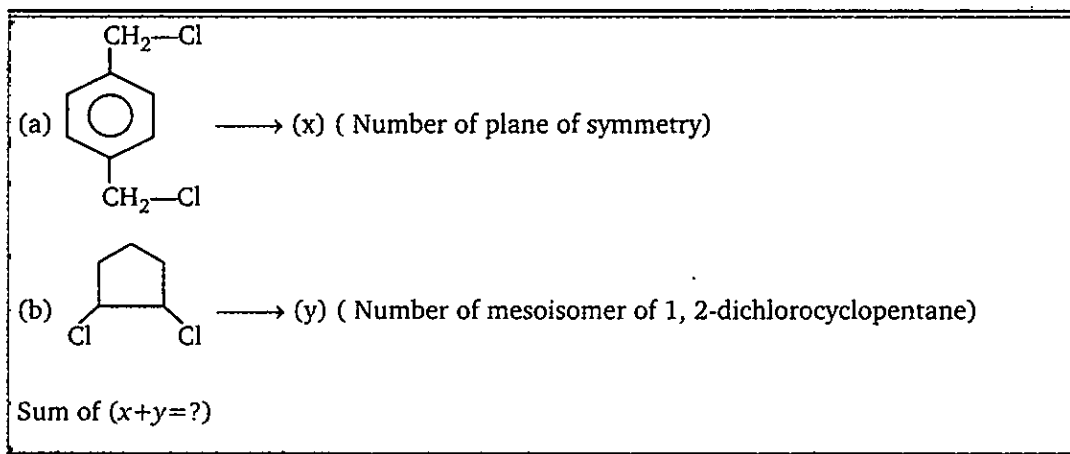
5. Theoretical possible geometrical isomer of



6. Total number of possible structural isomers of  $C_5H_{11}Br$ .  
 7. Total number of plane of symmetry present in given compound is

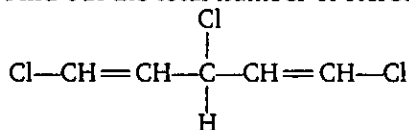


8. Total number of isomers for  $C_4H_6Br_2$  containing cyclobutane ring are ( including stereoisomer) ?  
 9. Total number of structural isomers of  $C_9H_{18}$  containing cyclohexane ring.  
 10. How many structural isomer are possible for  $C_4H_{10}O$  (only alcohol).  
 11. Number of structural isomer of  $C_6H_{14}$  is .



13. Find out the total number of stereocentre in the given compound.  
 $CH_3-CH=CH-\underset{\text{Br}}{\underset{|}{CH}}-\underset{\text{Cl}}{\underset{|}{CH}}-CH_3$

14. Find out the total number of stereoisomers of the given following compound.



15. Find the total number of isomers of  $C_7H_{14}$  (only 5-membered ring).

## ANSWERS — LEVEL 2

1. a - q; b - p; c - r; d - s
2. a - s; b - r; c - q; d - p
3. a - p, s; b - q, r, s; c - q, r, s; d - p, s
4. a - p, q; b - p, q; c - p, q; d - p, r
5. a - r; b - r; c - p; d - s
6. a - p, r; b - q, s; c - q, r; d - p, s
7. a - q, r; b - q, s; c - p, q, r; d - q, s
8. a - r, s; b - p, q; c - r, s; d - p, r, s
9. a - q; b - q, s; c - p, q, s; d - q, s
10. a - p; b - q; c - s; d - r
11. a - p; b - q; c - r; d - s
12. a - q, r; b - p; c - p; d - q, r
13. a - r; b - s; c - r; d - p
14. a - s; b - r; c - q; d - p
15. a - q, r; b - r, s; c - q, r; d - p, q
16. (a - p - x); (b - q, r - y); (c - p - x); (d - q, r - w)
17. A - b, h; B - a, g; C - c, e; D - d, f
18. A - d; B - a
19.  $a + b + c + d = 13$
20. A - b, d, e; B - a, c, f, h; C - i, k, p
21. A - e, f, j; B - a, c, d, g, h, i, b; C - None
22.  $w + x + y + z = 12$
23. A - (c & e), (b & d); B - (a & b) or (a & d); C - (a & c) or (a & e), (b & c), (b & e), (c & d) and (d & e)
24. A - (a & c) (b & f); B - (a & d) or (c & d), (a & e) (c & d); C - (d & e)
25. a - True; b - True; c - True; d - False
26. b, e, f, g, h, i
27. A - d, h; B - d; C - f, h; D - h
28.

Compound	A	B	C
I	c	a	a
II	c	b	b
III	c	a	a
IV	c	b	b
V	c	a	a
VI	c	a	a
VII	c	a	a
VIII	e	b	b
IX	e	a	a
X	e	b	b
29. (a) (R) (b) (L)

30A. 1 - N; 2 - Z; 3 - E; 4 - Z; 5 - Z; 6 - E; 7 - N

B. (a) 1 - Z; 2 - E; 3 - E; 4 - Z; 5 - Z; 6 - E (b)  $2^9$  (c) 10

31. 1 - Z; 2 - N; 3 - E

32. (a) A - 10, B - 4, C - 2

(c) A - 4, B - 2, C - 0

(e) A - 5, B - 2, C - 1

(g) A - 4, B - 2, C - 0

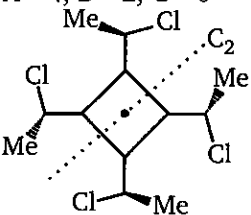
(b) A - 5, B - 0, C - 5

(d) A - 2, B - 1, C - 0

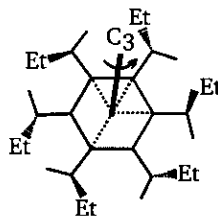
(f) A - 4, B - 1, C - 2

(h) A - 4, B - 1, C - 2

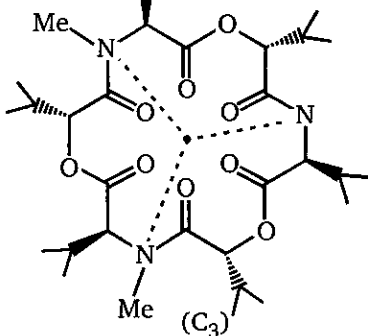
33. (1)



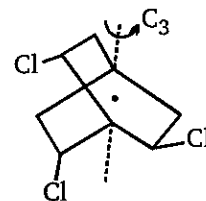
(2)



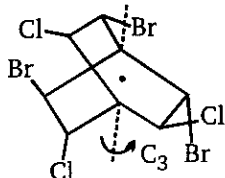
(3)



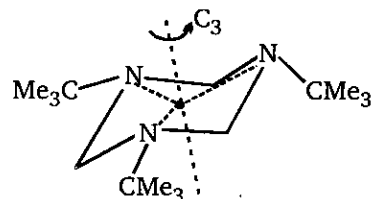
(4)



(5)



(6)

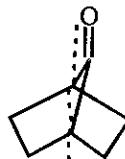


(7)  $C_3$  axis,  $C_2$  axis

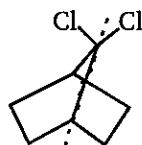
(8)  $C_3$ -axis

(9)  $C_3$  axis

(10)

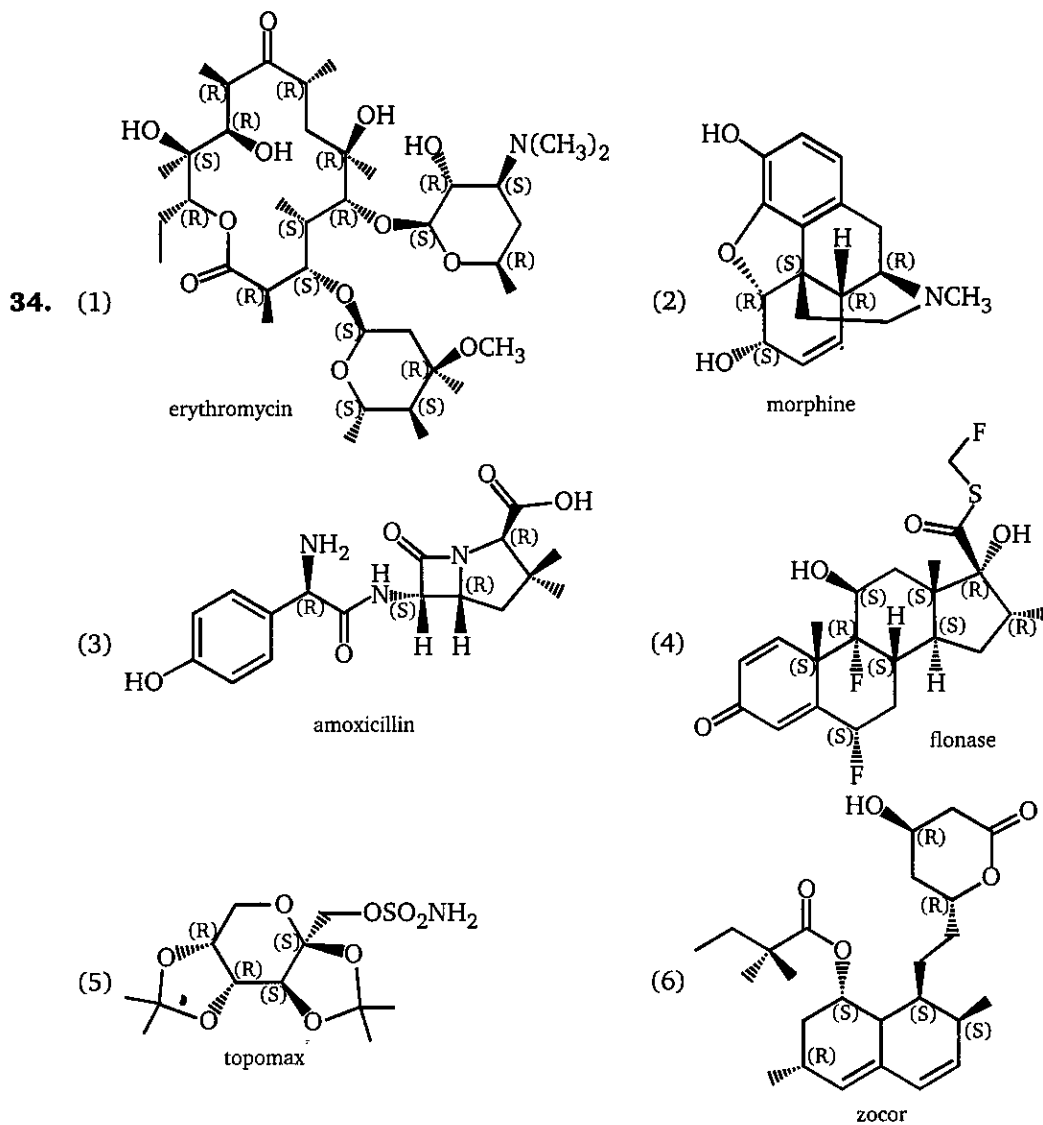


(11)



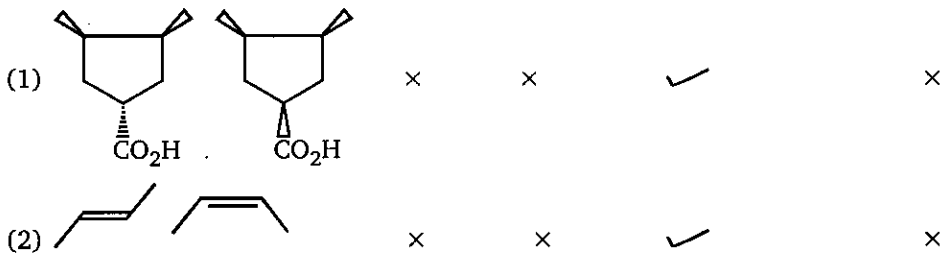
(12)  $C_2$ -axis

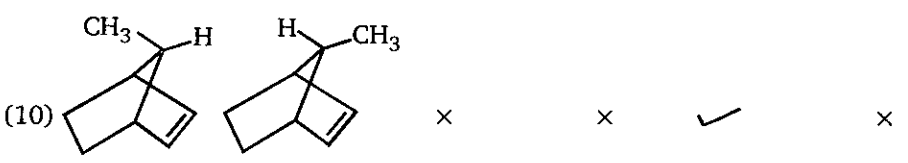
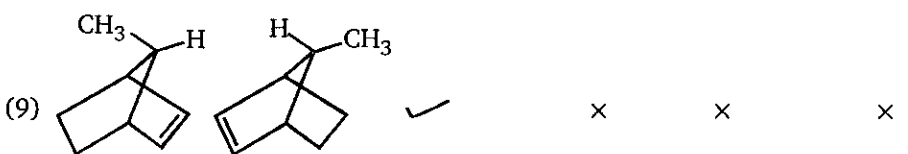
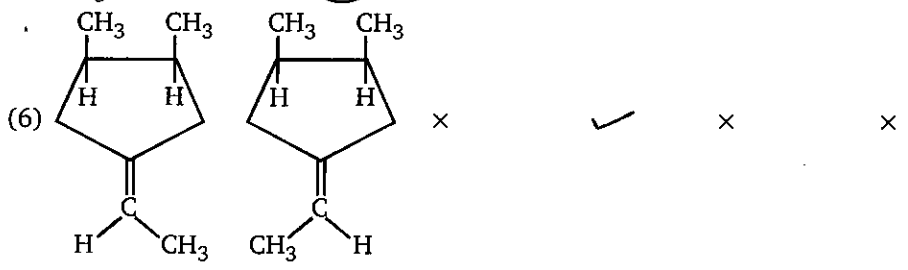
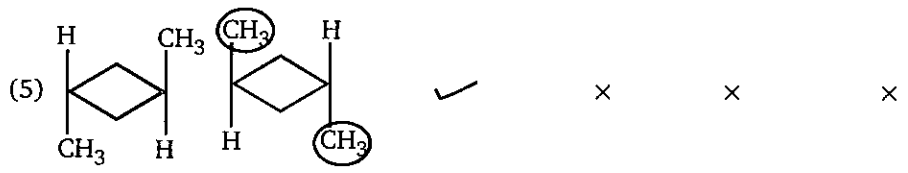
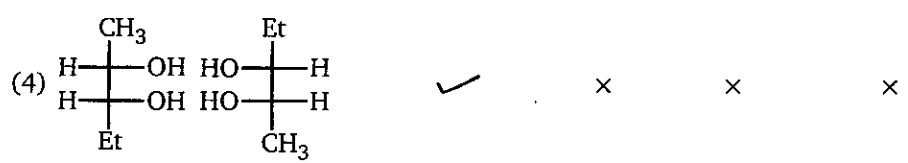
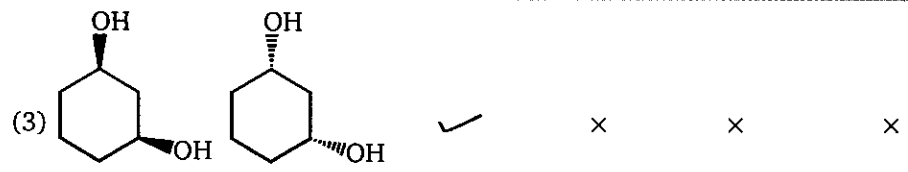
(13)  $C_2$ -axis



35.

Identical Enantiomer Diastereomer Constitutional Isomer

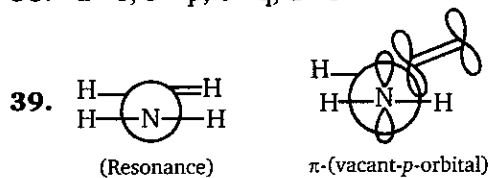




36. (A) - (d) (B) - (b)

37. a - p; b - q; c - r; d - s

38. a - s; b - p; c - q; d - r



40. (1) 16 (2) 4 (3) 16 (4) 4 (5) 4  
(6) 4 (7) 4 (8) 3 (9) 4 (10) 4

(11) 2

41. a - 2, b - 4, c - 3, d - 4, e - 8, f - 2

42. a - s; b - p; c - q; d - r

43. a -  $2^5$ , b -  $2^5$ , c -  $2^7 + 2^3$ , d -  $2^9$

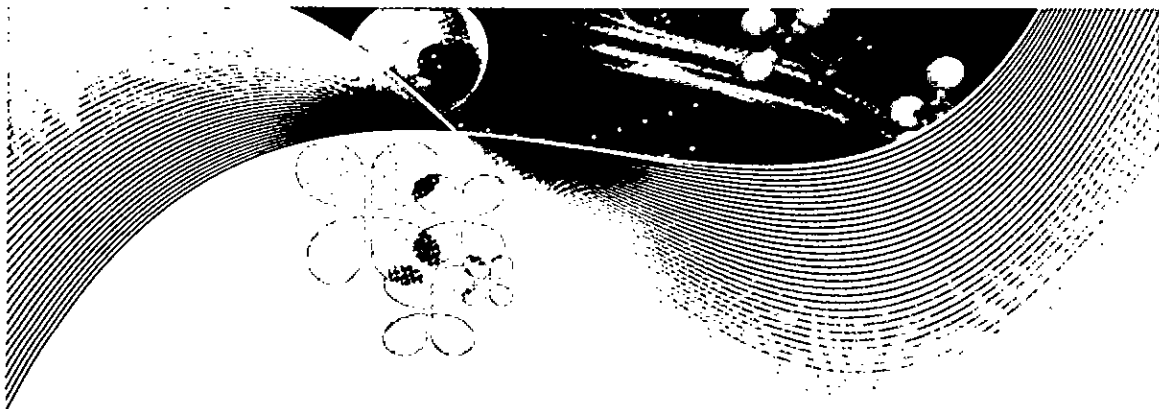
44. A - e; B - b; C - d; D - a

45. A - e; B - c; C - a; D - b; E - d

### Subjective Problems:

1. 3 (c, f, h)      2. 64      3. 5      4. 5      5. 2      6. 8.      7. 3  
8. 6      9. 12      10. 4      11. 5      12. 4      13. 4      14. 4      15. 8





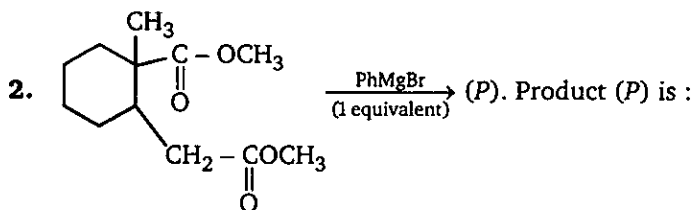
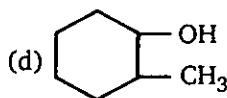
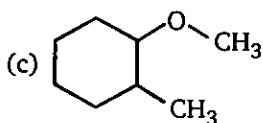
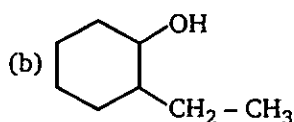
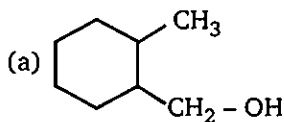
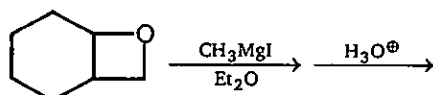
# 3

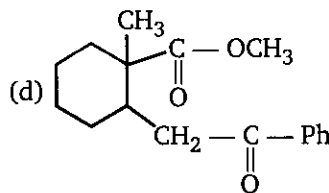
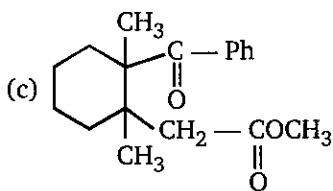
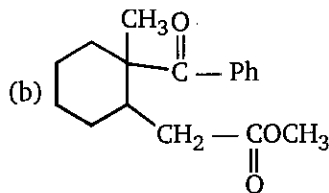
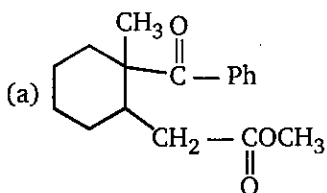
# GRIGNARD REAGENT



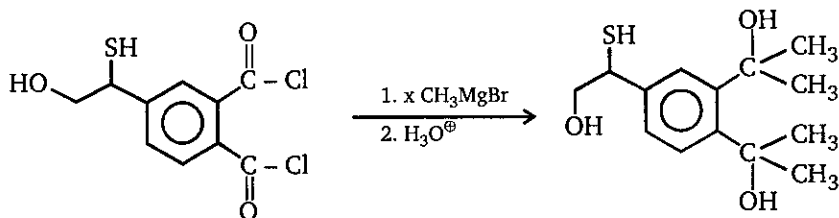
# LEVEL - 1

1. What is the major product of the following reaction ?

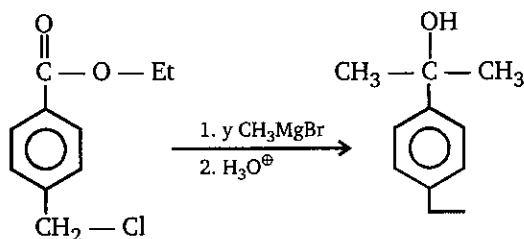




3. Reaction-1 ;



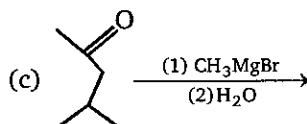
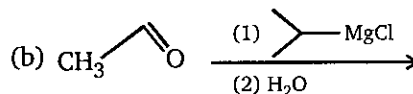
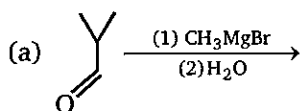
Reaction-2 ;



What is the ratio of (x/y) in above problem ?

- (a) 1.5                      (b) 2                      (c) 2.5                      (d) 3

4. In which of the following reaction 2° alcohol is obtained as a product ?

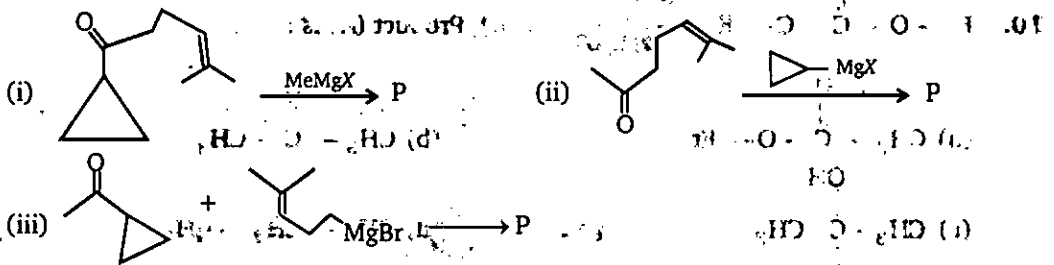


(d) Both (a) and (b)

5. What product would you expect to obtain from Grignard reaction when an excess of phenylmagnesium bromide reacts with dimethyl carbonate  $\text{CH}_3\text{OCOOCH}_3$  ?

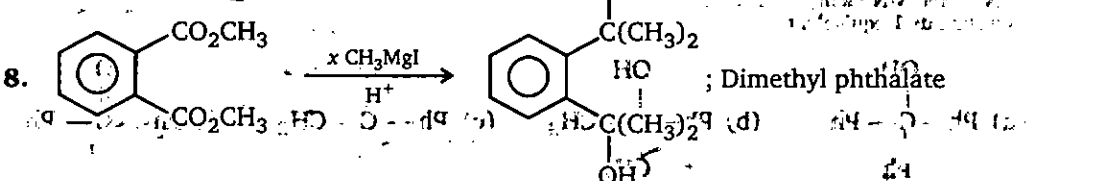
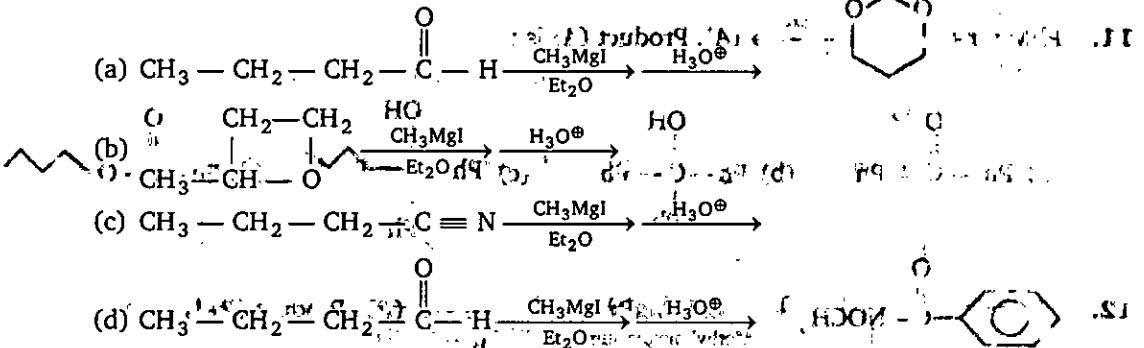
- (a)
- (b)
- (c)
- (d)

6. In which of the following reactions product formed is same ?



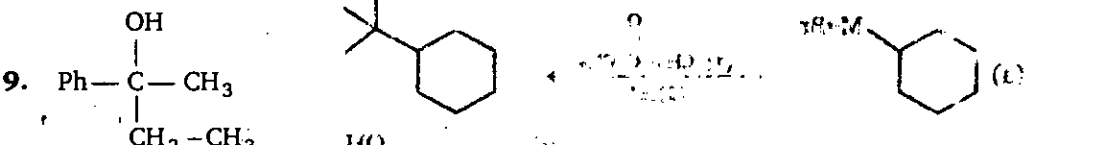
- (a) (i) and (ii)      (b) (ii) and (iii)      (c) (i) and (iii)      (d) (i), (ii) and (iii)

7. Which of the following reaction sequences would be the best for synthesis of 2-pentanone ?

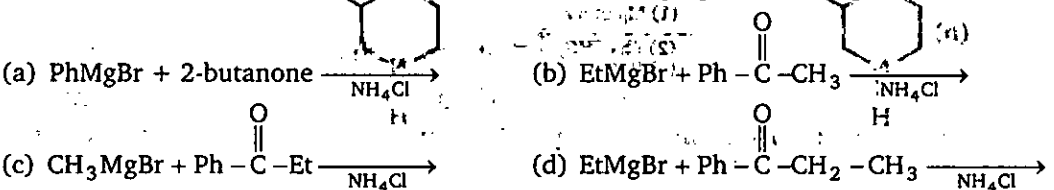


Number of moles (x) of Grignard reagent consumed in the above reaction is :

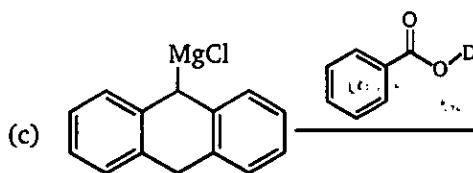
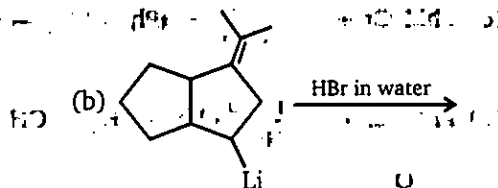
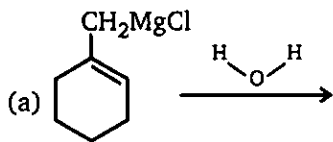
- (a) 2      (b) 3      (c) 4      (d) 5



Which of the following combinations can not be used to prepare alcohol given above ?

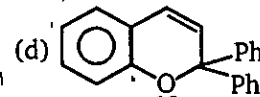
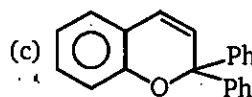
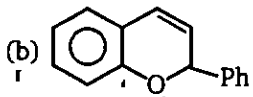
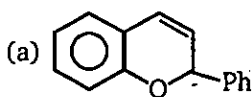


17. In which of the following reaction an acid-base reaction takes place ?

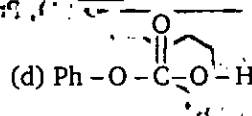
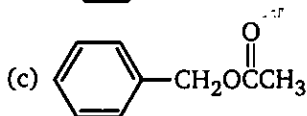
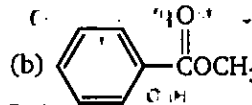
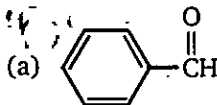


(d) All of these

18. Product (B) in this reaction is :



19. All of the following compounds react with ethylmagnesium bromide. Alcohols are formed from three of the compounds. Which one does not give an alcohol ?



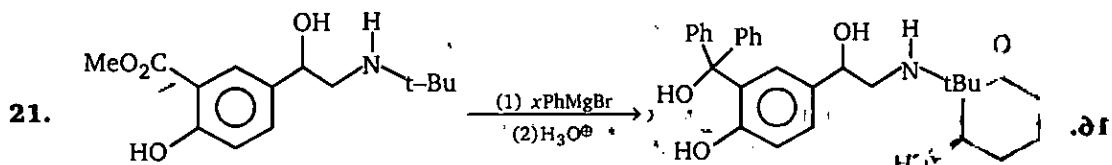
20. A student was carrying out a Grignard reaction between PhMgBr and ethyl benzoate. She ran out of anhydrous ether just after the Grignard reagent was made. Which of the following solvents can still be used to dissolve the ethyl benzoate for its reaction with already formed PhMgBr ?

(a) acetone

(b) ethyl acetate

(c) absolute alcohol

(d) benzene



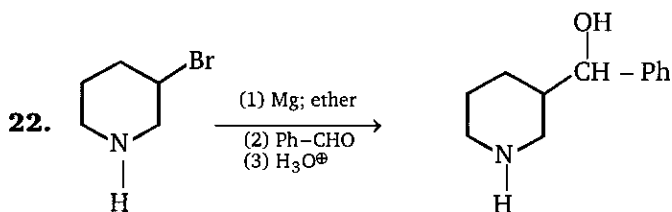
Number of equivalents of Grignard reagent (x) used in reaction (1) is :

(a) 3 equivalent

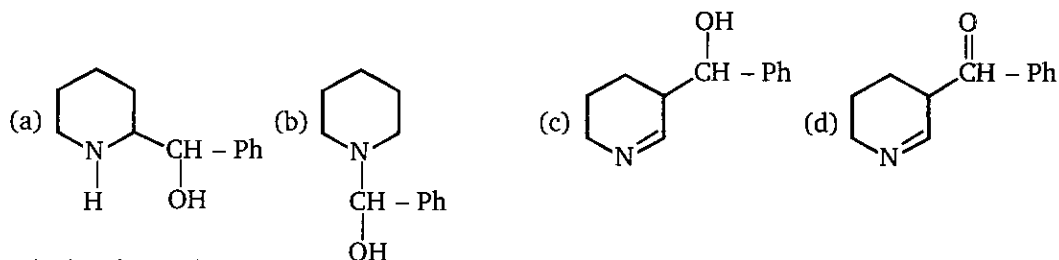
(b) 4 equivalent

(c) 5 equivalent

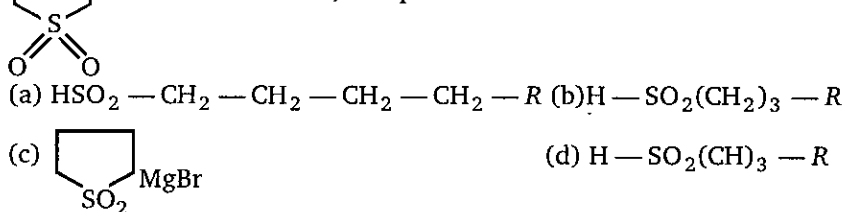
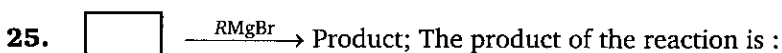
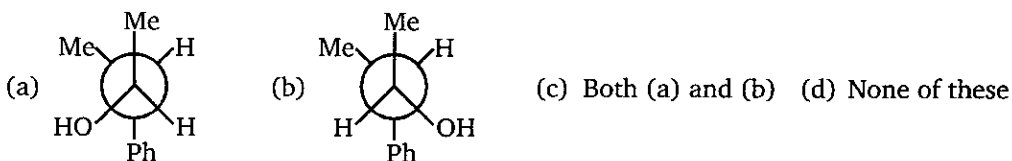
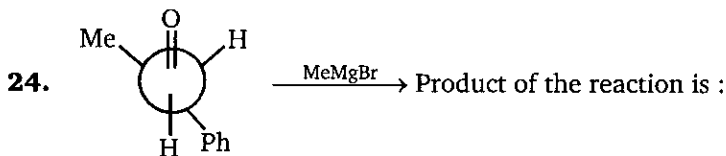
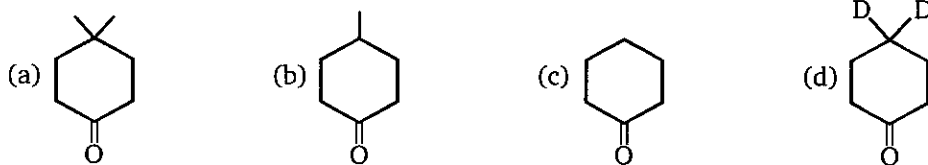
(d) 6 equivalent



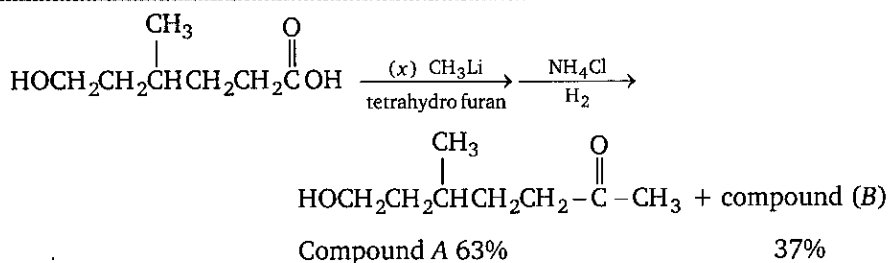
The given product can not be obtained in the above reaction. Identify the correct product obtained.



23. Which of the following gives two isomers of 3° alcohol, when treated with phenyl magnesium bromide ?



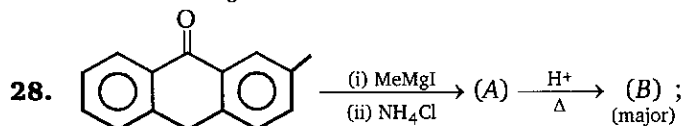
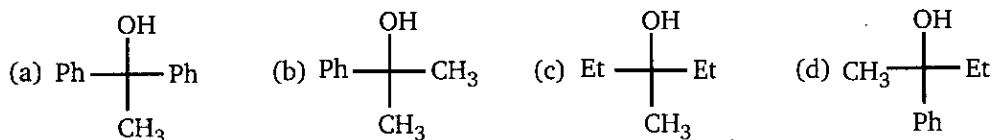
26. When carboxylic acid reacts with organolithium reagents to give ketones, side reaction sometimes occur. For example,



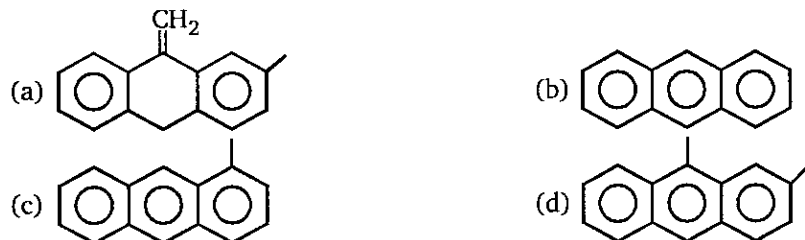
Value of (x) in above reaction is :

- (a) 2 (b) 3 (c) 4 (d) 5

27. Which of the following alcohol can not be prepared by the reaction of acid chloride with excess of Grignard reagent followed by acidification ?

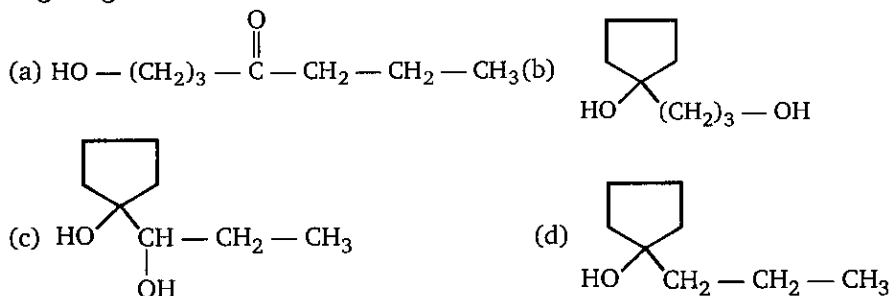
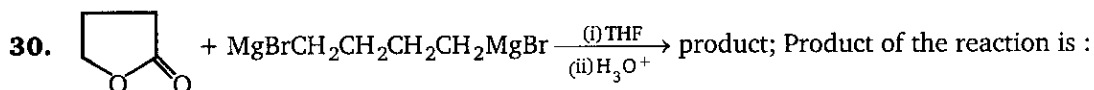


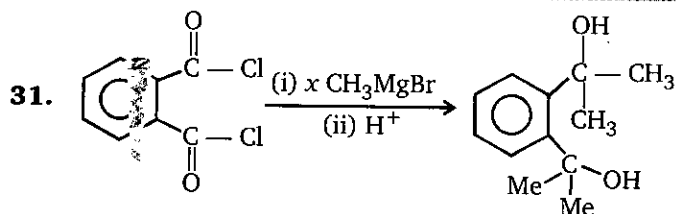
Product (B) of the above reaction is :



29. The reaction of elemental sulphur with Grignard reagent followed by acidification leads to the formation of

- (a) mercaptan (b) sulphoxide (c) thioether (d) sulphonic acid

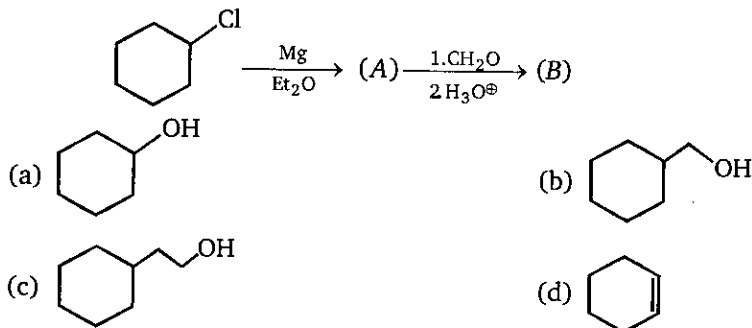




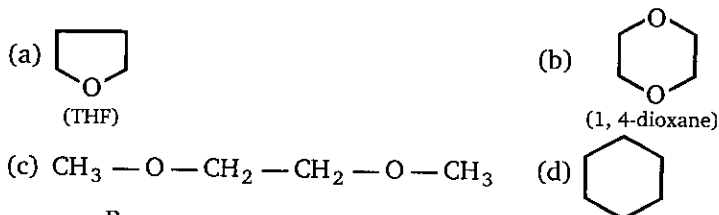
Number of moles of  $\text{CH}_3\text{MgBr}$  consumed in above reaction is :

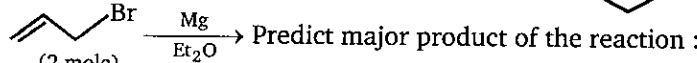
- (a) 2                      (b) 4                      (c) 6                      (d) 8

32. End product of the given reaction is :



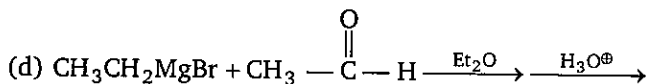
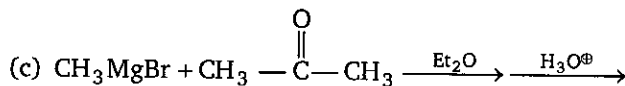
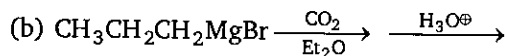
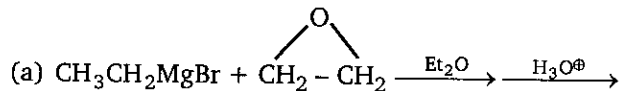
33. Which of the following compound is not a suitable solvent for Grignard reaction ?



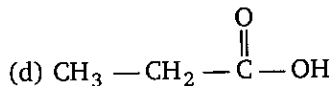
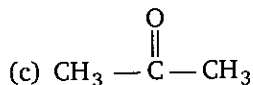
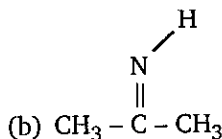
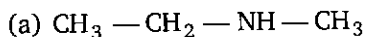
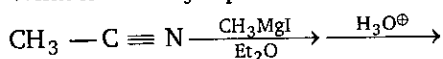
34. 

- (a)                       (b)                       (c)                       (d) 

35. Which of the following reaction sequences would be the best for synthesis of t-butyl alcohol ?



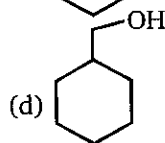
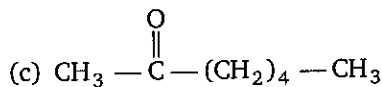
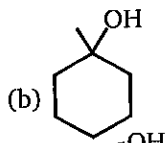
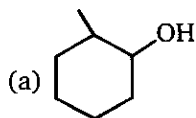
36. What is the major product of the following reaction ?



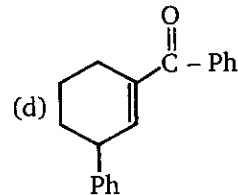
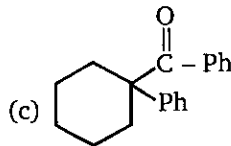
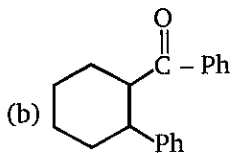
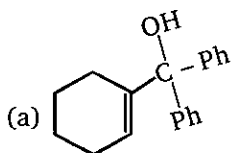
37.  $\text{H} - \overset{\text{O}}{\parallel} \text{C} - \text{CH}_3 \xrightarrow[\text{(2) H}^+]{\text{(1) PhMgBr}}$  Products; Product obtained in this reaction are :

- (a) diastereomers (b) racemic (c) pure enantiomer (d) meso

38.  $\text{CH}_3\text{CO}_2\text{Et} + (\text{CH}_2)_5(\text{MgBr})_2 \xrightarrow[\text{(2) H}^+]{\text{(A)}} \text{C}_7\text{H}_{14}\text{O}$ ; compound (A) will be :

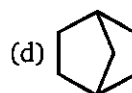
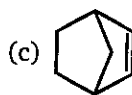
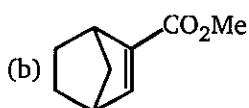
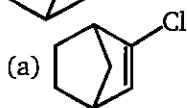
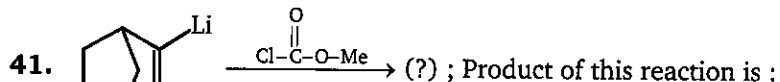
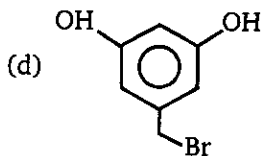
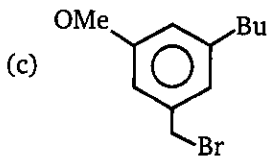
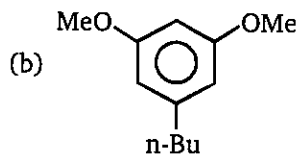
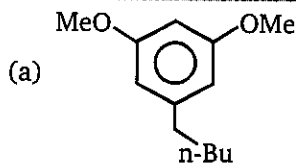


39.  $\xrightarrow[\text{(2) H}^+]{\text{(1) PhMgBr/CuCl}}$  (A) ; A will be :  $\text{C}_{19}\text{H}_{20}\text{O}$

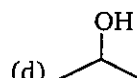
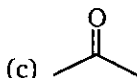
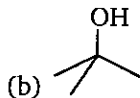
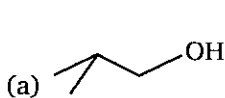
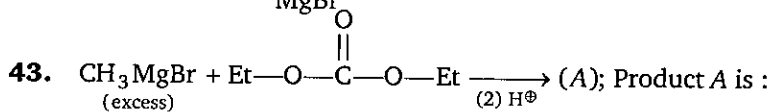
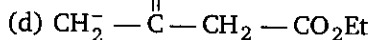
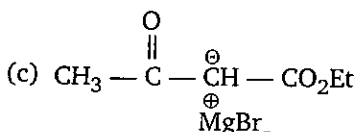
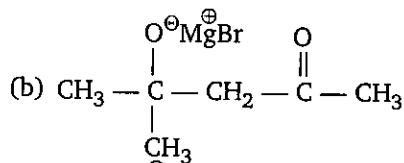
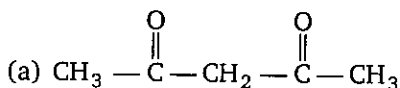


40.  $\xrightarrow[\text{(n-Bu = n-butyl group)}]{\text{n-Bu}_2\text{CuLi}}$  Product of the reaction will be :





42. Ethyl acetoacetate when reacts with one mole methyl magnesium iodide then product of reaction will be :



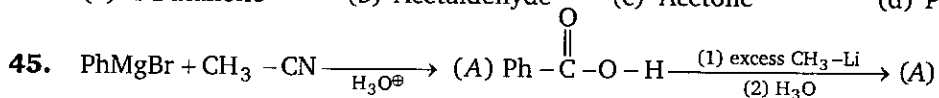
44. For the sequence of reactions,  $A \xrightarrow[\text{ether}]{\text{C}_2\text{H}_5\text{MgI}}$  B  $\xrightarrow{\text{H}_2\text{O}/\text{H}^\oplus}$  tert-Pentyl alcohol. The compound A in the sequence is :

(a) 2-Butanone

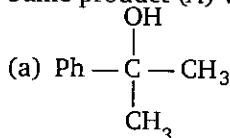
(b) Acetaldehyde

(c) Acetone

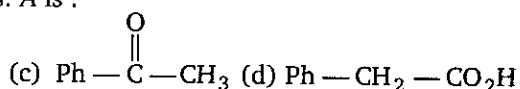
(d) Propanal



Same product (A) will form in both reactions. A is :



(b) Ph - CHO

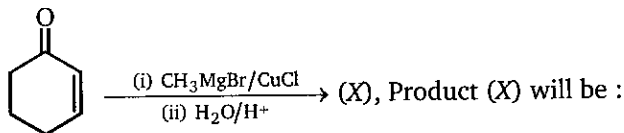


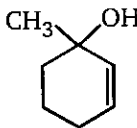
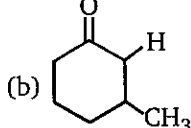
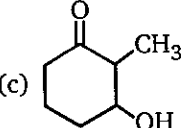
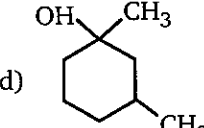
(d) Ph - CH<sub>2</sub> - CO<sub>2</sub>H

46. Which of the following Grignard reagent can be prepared ?

- (a)  $\text{Br} - \text{Mg} - \text{CH}_2 - \text{CH}_2 - \text{CH}_2 - \text{O} - \text{H}$  (b)  $\text{Br} - \text{Mg} - \text{CH}_2 - \text{CH}_2 - \text{SH}$   
 (c)  $\text{BrMg} - \text{CH}_2 - \text{CH}_2 - \text{NH}_2$  (d)  $\text{BrMg} - \text{CH}_2 - \text{CH}_2 - \text{N}(\text{CH}_3)_2$

47. In the reaction sequence :



- (a)  (b)  (c)  (d) 

48.  $(\text{C}_2\text{H}_5\text{O})_2\text{CO} \xrightarrow[\text{H}_3\text{O}^+]{\text{CH}_3\text{MgBr}(\text{excess})} \text{A}$ . A (alcohol) can also be obtained by :

- (a)  $\text{CH}_3\text{CH}_2\text{CHO} \xrightarrow[\text{H}_3\text{O}^+]{\text{CH}_3\text{MgBr}(2\text{mol})}$  (b)  $\text{CH}_3\text{C}(=\text{O})\text{OC}_2\text{H}_5 \xrightarrow[\text{H}_3\text{O}^+]{\text{CH}_3\text{MgBr}(2\text{mol})}$   
 (c)  $\text{CH}_3\text{C}(=\text{O})\text{CH}_3 \xrightarrow[\text{H}_3\text{O}^+]{\text{CH}_3\text{MgBr}(1\text{mol})}$  (d) as in (b) and (c)

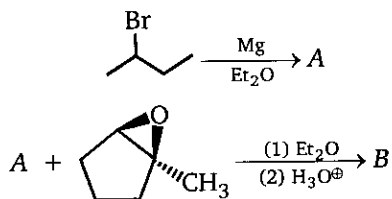
49. The principal product of the reaction between methyl butanoate and 2 moles of  $\text{CH}_3\text{MgBr}$  after hydrolysis is :

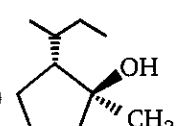
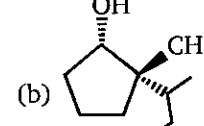
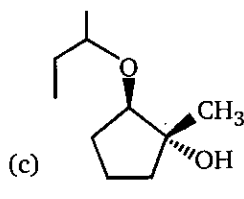
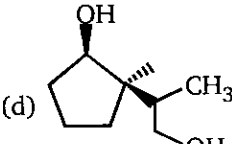
- (a)  $\text{C}_3\text{H}_7\text{COCH}_3$  (b)  $\text{C}_3\text{H}_7\text{C}(\text{OH})(\text{CH}_3)_2$   
 (c)  $\text{C}_3\text{H}_7\text{CHOHCH}_3$  (d)  $\text{C}_3\text{H}_7\text{COCH}(\text{CH}_3)_2$

50. Which of the following compounds will form hydrocarbon on reaction with Grignard reagent ?

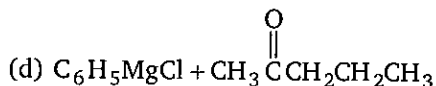
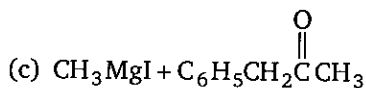
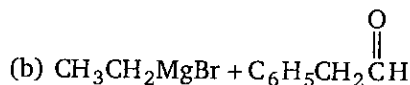
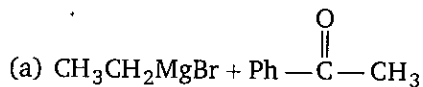
- (a)  $\text{CH}_3\text{CH}_2\text{OH}$  (b)  $\text{CH}_3\text{CHO}$  (c)  $\text{CH}_3\text{COCH}_3$  (d)  $\text{CH}_3\text{CO}_2\text{CH}_3$

51. What is the product (B) of the following reaction sequence ?

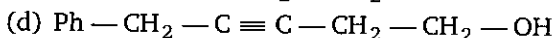
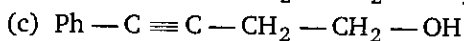
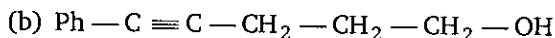
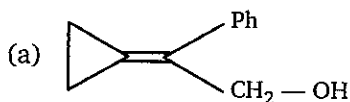
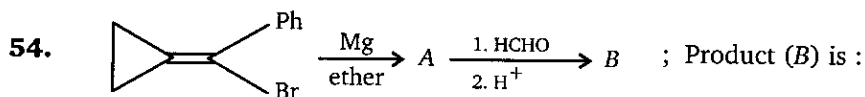
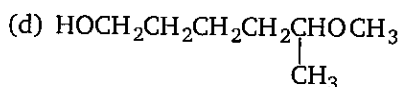
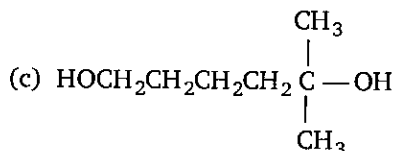
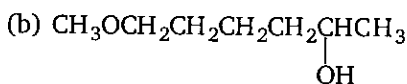
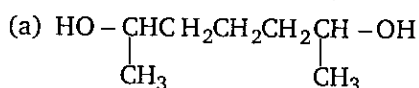
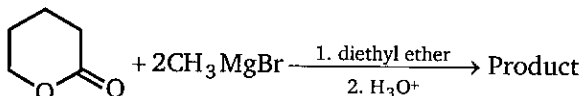


- (a)  (b)  (c)  (d) 

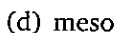
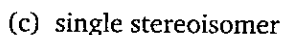
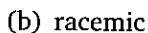
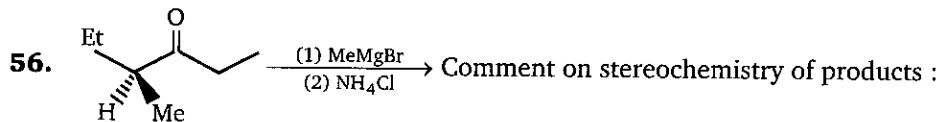
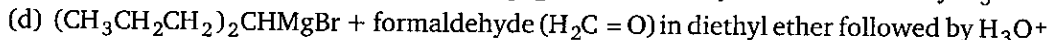
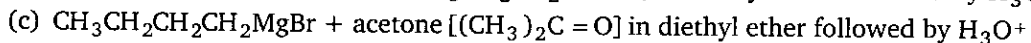
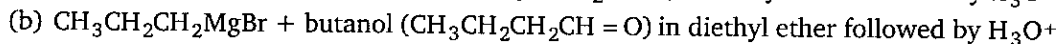
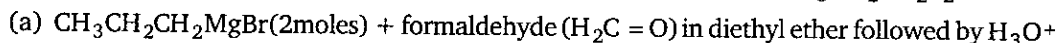
52. Which, if any, of the following pairs of reagents could be used to prepare 2-phenyl-2-butanol?

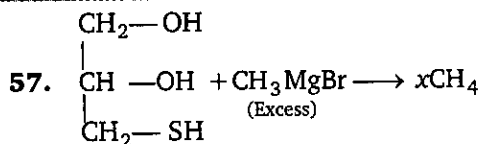


53. What is the product of the following reaction?



55. What sequence of steps represents the best synthesis of 4-heptanol  $(\text{CH}_3\text{CH}_2\text{CH}_2)_2\text{CHOH}$ ?



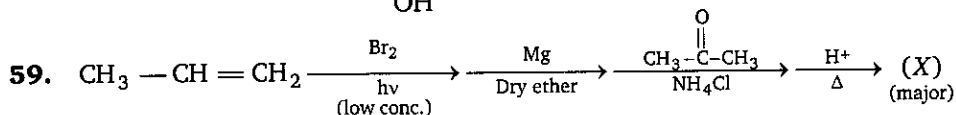


What is the value of  $x$  in the above reaction ?

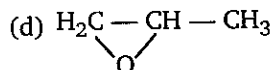
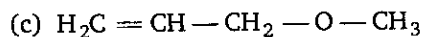
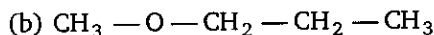
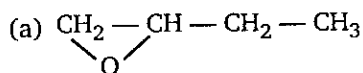
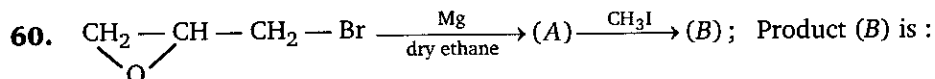
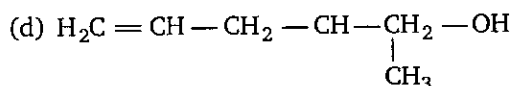
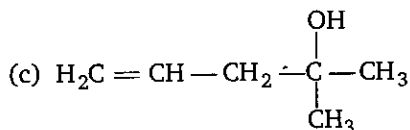
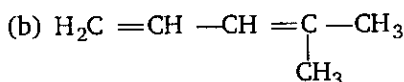
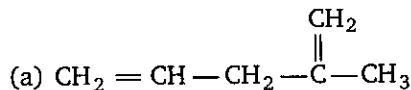
- (a) 1 (b) 2  
(c) 3 (d) 4

58. 0.40 g of an organic compound (A), (M.F.-  $\text{C}_5\text{H}_8\text{O}$ ) reacts with  $x$  mole of  $\text{CH}_3\text{MgBr}$  to liberate 224 mL of a gas at STP. With excess of  $\text{H}_2$ , (A) gives pentan-1-ol. The correct structure of (A) is :

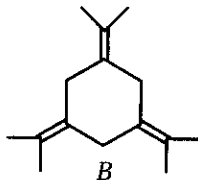
- (a)  $\text{CH}_3\text{—C}\equiv\text{C—CH}_2\text{—CH}_2\text{—OH}$   
(b)  $\text{CH}_3\text{—CH}_2\text{—C}\equiv\text{C—CH}_2\text{—OH}$   
(c)  $\text{H—C}\equiv\text{C—CH}_2\text{—CH}_2\text{—CH}_2\text{—OH}$   
(d)  $\text{H—C}\equiv\text{C—CH}_2\text{—CH—CH}_3$



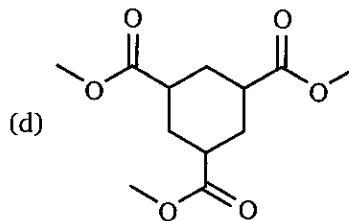
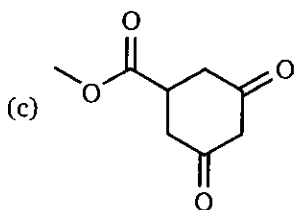
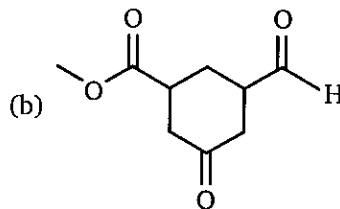
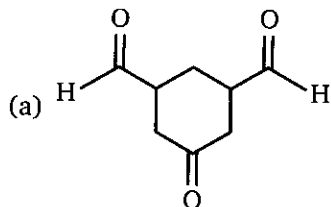
End product (X) of the above reaction is :



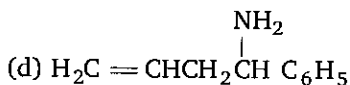
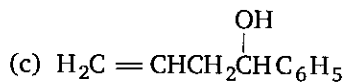
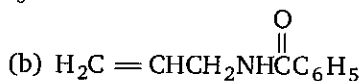
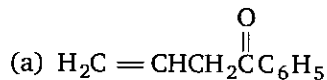
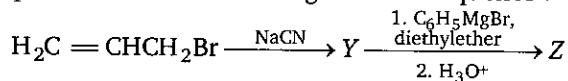
61. Compound A was treated with a large excess of  $\text{CH}_3\text{MgBr}$ . The resulting product was exposed to  $\text{POCl}_3/\text{pyridine}$  to give compound B, as one of many products:



Which of the following compounds can be A ?



62. Identify product Z in the following reaction sequence :



## ANSWERS — LEVEL 1

1.	(b)	2.	(d)	3.	(b)	4.	(d)	5.	(c)	6.	(d)	7.	(c)	8.	(c)
9.	(d)	10.	(c)	11.	(b)	12.	(b)	13.	(b)	14.	(c)	15.	(b)	16.	(b)
17.	(d)	18.	(d)	19.	(d)	20.	(d)	21.	(c)	22.	(b)	23.	(b)	24.	(c)
25.	(c)	26.	(b)	27.	(d)	28.	(d)	29.	(a)	30.	(b)	31.	(b)	32.	(b)
33.	(d)	34.	(b)	35.	(c)	36.	(c)	37.	(b)	38.	(b)	39.	(b)	40.	(a)
41.	(b)	42.	(c)	43.	(b)	44.	(c)	45.	(c)	46.	(d)	47.	(b)	48.	(d)
49.	(b)	50.	(a)	51.	(a)	52.	(a)	53.	(c)	54.	(b)	55.	(b)	56.	(a)
57.	(c)	58.	(c)	59.	(b)	60.	(c)	61.	(d)	62.	(a)				



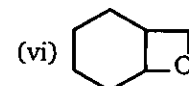
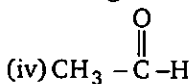
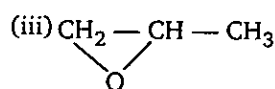
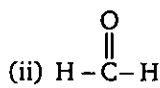
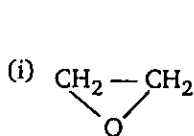
## 1. Comprehension

Grignard reagent is usually prepared by



Grignard reagent acts as a strong base. Grignard reagent carry out nucleophilic attack in absence of acidic hydrogen. Grignard reagent form complex with its ether solvent. Complex formation with molecule of ether is an important factor in the formation and stability of Grignard reagent.

- A.** What is the correct order of reactivity of halides with magnesium ?
- (a)  $R-Cl > R-Br > R-I$  (b)  $R-Br > R-Cl > R-I$   
 (c)  $R-I > R-Br > R-Cl$  (d)  $R-I = R-Br = R-Cl$
- B.** Which of the following will undergo acid-base reaction with Grignard reagent ?
- (a)  $HC \equiv CH$  (b)  $R-OH$   
 (c)  $R-CO_2H$  (d) All of these
- C.** Which of the following reactants give primary alcohol as a major product when reacts with  $RMgX$  followed by acidification ?

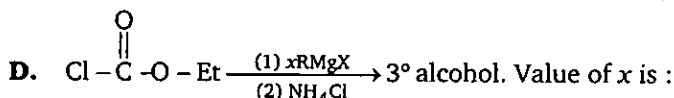


(a) i, ii, v

(b) i, ii, v, vi

(c) ii, iv, vi

(d) v, iv, iii, vi

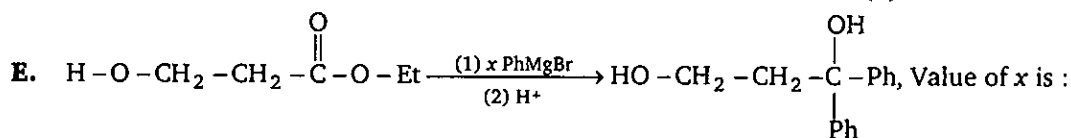


(a) 2

(b) 3

(c) 4

(d) 5



(a) 2

(b) 3

(c) 4

(d) 5

F. Which of the following Grignard reagents is not possible ?

- (a)  $\text{HS}-\text{CH}_2-\text{CH}_2-\text{CH}_2\text{MgBr}$                       (b)  $\text{HO}-\text{CH}_2-\text{CH}_2-\text{CH}_2\text{MgBr}$   
 (c)  $\text{NH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_2\text{MgBr}$                       (d) All of these

G. How many different Grignard reagents when react with EtOH, give *n*-butane as product (excluding stereoisomerism).

- (a) 1                      (b) 2                      (c) 3                      (d) 4

2. Match the column I and II. (Matrix)

Column (I)		Column (II)	
	Reactant		Product
(a)	$\text{PhMgBr} + \text{Cl}-\overset{\text{O}}{\parallel}{\text{C}}-\text{O}-\text{Et} \xrightarrow{\text{H}^\oplus}$ (excess)	(p)	$\text{Ph}-\text{CH}_2-\text{OH}$
(b)	$\text{PhMgBr} + \text{H}-\overset{\text{O}}{\parallel}{\text{C}}-\text{O}-\text{Et} \xrightarrow{\text{H}^\oplus}$ (excess)	(q)	$\begin{array}{c} \text{Ph}-\text{CH}-\text{Ph} \\   \\ \text{OH} \end{array}$
(c)	$\text{PhMgBr} + \text{H}-\overset{\text{O}}{\parallel}{\text{C}}-\text{H} \xrightarrow{\text{H}^\oplus}$ (excess)	(r)	$\begin{array}{c} \text{OH} \\   \\ \text{Ph}-\text{C}-\text{Ph} \\   \\ \text{Ph} \end{array}$
(d)	$\text{PhMgBr} + \text{CH}_3-\overset{\text{O}}{\parallel}{\text{C}}-\text{O}-\text{Et} \xrightarrow{\text{H}^\oplus}$ (excess)	(s)	$\begin{array}{c} \text{OH} \\   \\ \text{Ph}-\text{C}-\text{Ph} \\   \\ \text{CH}_3 \end{array}$

3. Match the column I and II. (Matrix)

Column (I)		Column (II)	
	Reaction		Reactant
(a)	$\text{PhMgBr} + (\text{A}) \xrightarrow{\text{H}^\oplus} 1^\circ\text{alcohol}$	(p)	$\text{CH}_3-\overset{\text{O}}{\parallel}{\text{C}}-\text{CH}_2-\overset{\text{O}}{\parallel}{\text{C}}-\text{CH}_3$
(b)	$\text{PhMgBr} + (\text{B}) \xrightarrow{\text{H}^\oplus} 2^\circ\text{alcohol}$	(q)	$\text{CH}_3-\overset{\text{O}}{\parallel}{\text{C}}-\text{CH}_3$
(c)	$\text{PhMgBr} + (\text{C}) \xrightarrow{\text{H}^\oplus} 3^\circ\text{alcohol}$	(r)	$\text{CH}_3-\overset{\text{O}}{\parallel}{\text{C}}-\text{H}$
(d)	$\text{PhMgBr} + (\text{D}) \xrightarrow{\text{H}^\oplus} \text{C}_6\text{H}_6$	(s)	$\text{H}-\overset{\text{O}}{\parallel}{\text{C}}-\text{H}$

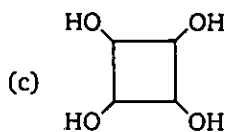
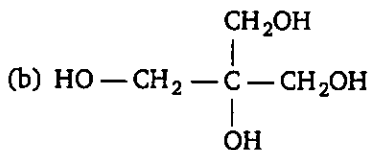
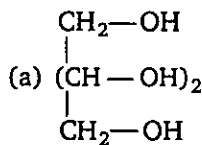
Match the missing reactant A, B, C, D



4. Match the column I and II. (Matrix)

Column (I)		Column (II)	
Reaction		Moles of PhMgBr used	
(a)	$\text{PhMgBr} + \text{Et} - \text{O} - \overset{\text{O}}{\parallel} \text{C} - \text{O} - \text{Et} \xrightarrow{\text{H}^{\oplus}} 3^{\circ}\text{alcohol}$	(p)	1
(b)	$\text{PhMgBr} + \text{HO} - \text{CH}_2 - \overset{\text{O}}{\parallel} \text{C} - \text{CH}_3 \xrightarrow{\text{H}^{\oplus}} 3^{\circ}\text{alcohol}$	(q)	2
(c)	$\text{PhMgBr} + \text{CH}_3 - \overset{\text{O}}{\parallel} \text{C} - \text{CH}_3 \xrightarrow{\text{H}^{\oplus}} 3^{\circ}\text{alcohol}$	(r)	3
(d)	$\text{PhMgBr} + \text{HO} - \text{C}_6\text{H}_3(\text{OH})_2 - \overset{\text{O}}{\parallel} \text{C} - \text{Cl} \xrightarrow{\text{H}^{\oplus}} 3^{\circ}\text{alcohol}$	(s)	4

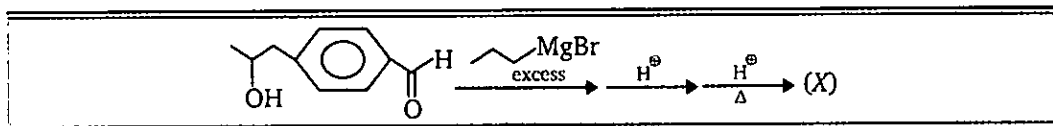
5. When 20 g of a compound (A) (M.F. =  $\text{C}_4\text{H}_{10}\text{O}_4$ ) reacts with excess of  $\text{CH}_3\text{MgBr}$ , 14.6 L of  $\text{CH}_4$  is obtained at STP. What is structural formula of (A) ?



(d) Both (a) & (b)

## SUBJECTIVE PROBLEMS

1.

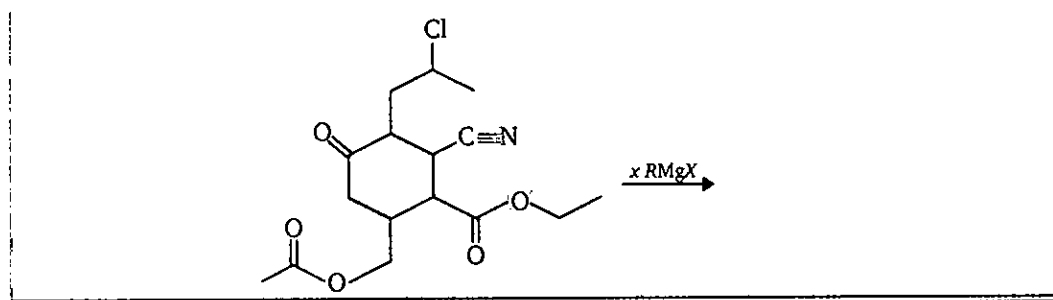


How many geometrical isomer of (X) is possible ?

2. How many isomer of  $C_4H_8O$  when reacts with  $CH_3MgBr$  followed by acidification to give  $2^\circ$  alcohol (only consider carbonyl isomers)?  
(including stereoisomer)

3.

Total number of  $RMgX$  are consumed in the following reaction



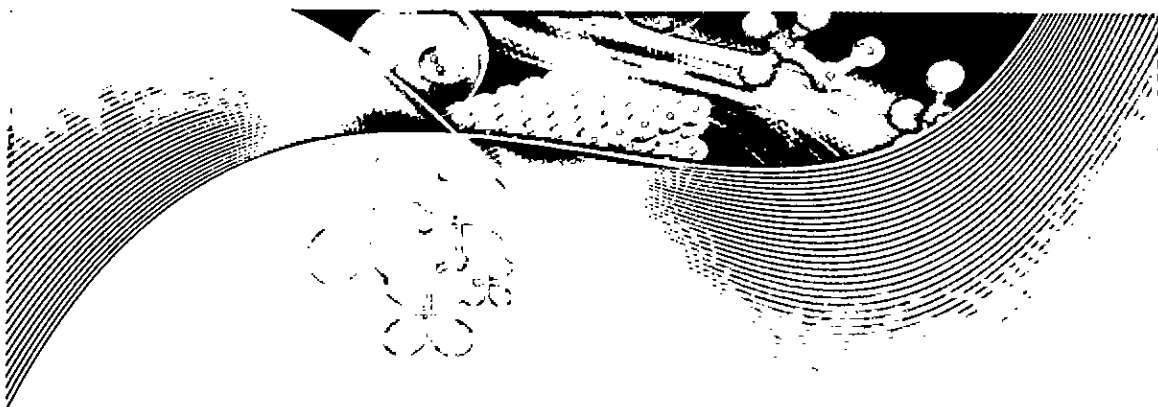
4. How many isomers of  $C_4H_{10}O$  reacts with  $CH_3MgBr$  to evolve  $CH_4$  gas ? ( Excluding stereoisomer)

## ANSWERS — LEVEL 2

1. A - c; B - d; C - a; D - b; E - b; F - d; G - b
2. a - r; b - q; c - p; d - s
3. a - s; b - r; c - q; d - p
4. a - r; b - q; c - p; d - s
5. (d)

## Subjective Problems

1. 4      2. 2      3. 7      4. 4



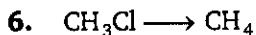
## 4A HYDROCARBONS (ALKANES)



- On halogenation, an alkane gives only one monohalogenated product. The alkane may be :
  - 2-methyl butane
  - 2, 2-dimethyl propane
  - cyclopentane
  - both (b) and (c)
- Which of the following compounds can be best prepared by Wurtz-reaction ?
  - Iso-butane
  - n*-butane
  - n*-pentane
  - Iso-pentane
- A hydrocarbon A (V.D. = 36) forms only one monochloro substitution product. A will be :
  - iso-pentane
  - neo-pentane
  - cyclohexane
  - methyl-cyclohexane
- Ethyl iodide and *n*-propyl iodide are allowed to undergo Wurtz reaction. The alkane which will not be obtained in this reaction is :
  - butane
  - propane
  - pentane
  - hexane
- $$\text{CH}_3 - \underset{\text{CH}_3}{\text{CH}} - \text{CH}_2 - \text{CH}_3 \xrightarrow[\text{h}\nu]{\text{Cl}_2} \rightarrow$$

Number of chiral centers generated during monochlorination in the above reaction :

- 1
- 2
- 3
- 4



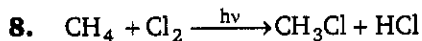
Above conversion can be achieved by :

- (a)  $\text{Zn} / \text{H}^+$  (b)  $\text{LiAlH}_4$   
 (c)  $\text{Mg} / (\text{ether})$  then  $\text{H}_2\text{O}$  (d) all of these



Give the total number of monochloro products(including stereoisomers), which are possible in the above reaction.

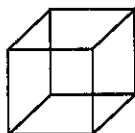
- (a) 2 (b) 3 (c) 4 (d) 5



To obtain high yields of  $\text{CH}_3\text{Cl}$ , the ratio of  $\text{CH}_4$  to  $\text{Cl}_2$  must be :

- (a) high (b) low  
 (c) equal (d) can't be predicted

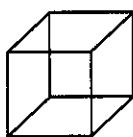
9. Double bond equivalent of cubane is :



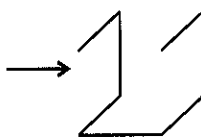
Cubane

- (a) 4 (b) 5 (c) 6 (d) 7

10. How many bond cleavages are required to convert cubane into non-cyclic skeleton ?



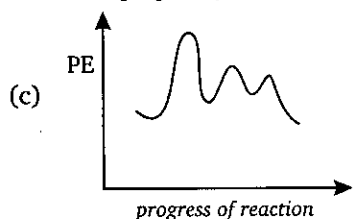
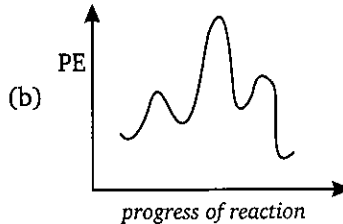
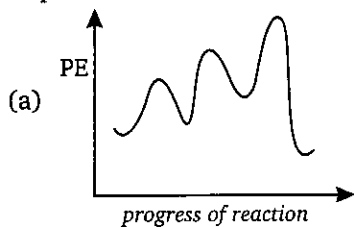
Cubane



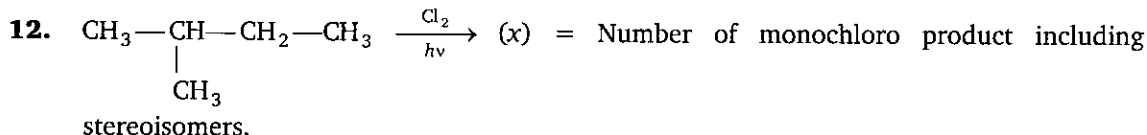
Non-cyclic skeleton

- (a) 2 (b) 3 (c) 4 (d) 5

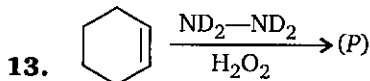
11. Draw an energy profile diagram for a three step reaction in which first step is slowest and last step is fastest. (Assume that reaction is exothermic)



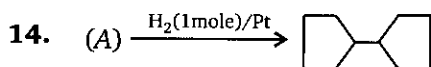
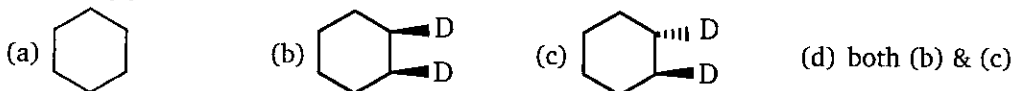
- (d) None of these



- (a) 4                                      (b) 5                                      (c) 6                                      (d) 7



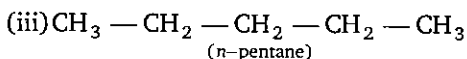
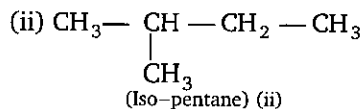
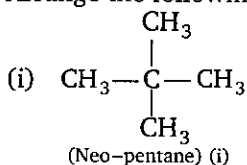
Product (P) is :



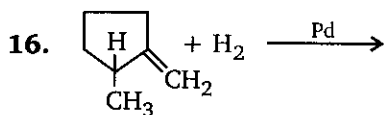
Double bond equivalent (degree of Unsaturation) of (A) is :

- (a) 1                                      (b) 2                                      (c) 3                                      (d) 4

15. Arrange the following alkanes in decreasing order of their heats of combustion.

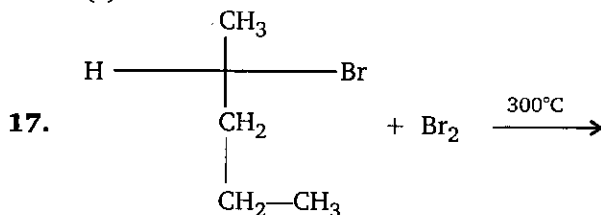


- (a) (i) > (ii) > (iii)                      (b) (iii) > (i) > (ii)  
(c) (iii) > (ii) > (i)                      (d) (i) > (iii) > (ii)

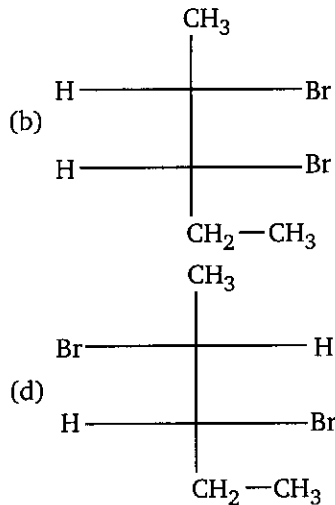
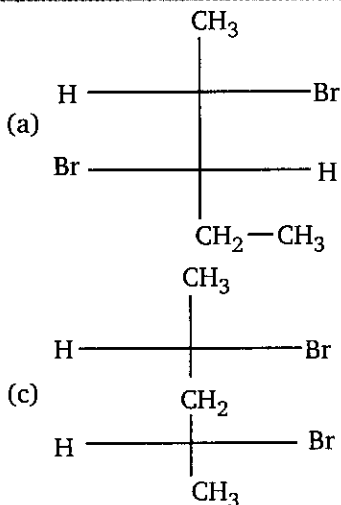


Product of the above reaction will be :

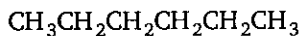
- (a) Racemic mixture                      (b) Diastereomers  
(c) Meso                                      (d) Constitutional isomers



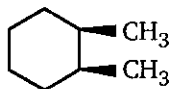
Which of the following compound will not be obtained as a product in the above reaction ?



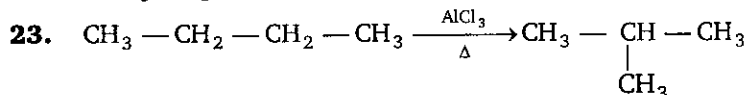
18. Following are the structures of four isomer of hexane. Among the names given below, which correctly identifies the fifth isomer ?



- (a) 2-Methyl pentane  
(b) 2-Ethyl butane  
(c) 2,3-Dimethyl butane  
(d) 3-Methyl pentane
19. Which of the following describes the best relationship between the methyl groups in the chair conformation of the substance shown below ?



- (a) Trans  
(b) Anti  
(c) Gauche  
(d) Eclipsed
20. Compare the stabilities of the following two compounds (A) and (B):  
A : *cis*-1-ethyl-3-methyl cyclohexane  
B : *trans*-1-ethyl-3-methyl cyclohexane
- (a) A is more stable  
(b) B is more stable  
(c) A and B are of equal stability  
(d) No comparison can be made
21. Which conformation of ethane has the lowest potential energy ?  
(a) Eclipsed  
(b) Skew  
(c) Staggered  
(d) All will have equal potential energy
22. Ethane is subjected to combustion process. During the combustion the hybrid state of carbon changes from :  
(a)  $sp^2$  to  $sp^3$   
(b)  $sp^3$  to  $sp$   
(c)  $sp$  to  $sp^3$   
(d)  $sp^2$  to  $sp^2$



Above reaction is an example of :

- (a) isomerization (b) polymerization  
(c) cracking (d) de-hydrogenation

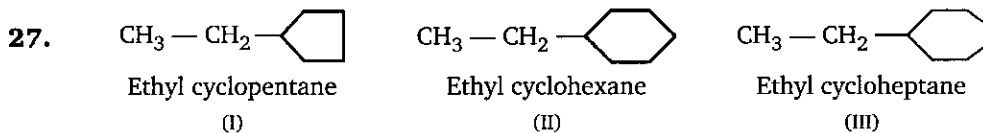
24. Which of the following has highest chlorine content ?  
(a) Pyrene (b) DDT (c) Chloral (d) Gammaxene

25. Pure methane can be prepared by :  
(a) Wurtz reaction (b) Kolbe electrolysis method  
(c) soda-lime de-carboxylation (d) reduction with  $H_2$

26. Calcium carbide + heavy water  $\longrightarrow$  ?

The product of the above reaction is :

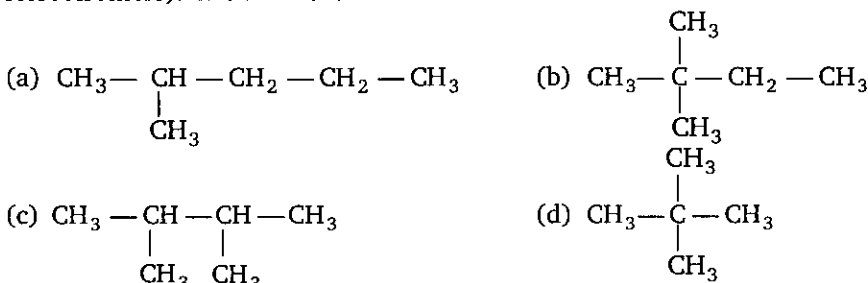
- (a)  $C_2H_2$  (b)  $CaD_2$  (c)  $Ca(OD)_2$  (d)  $CD_4$



Arrange the compounds I, II and III in decreasing order of their heats of combustion:

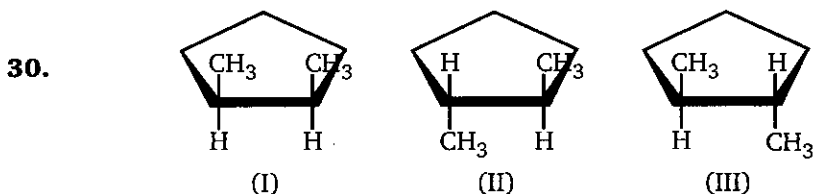
- (a)  $II > I > III$  (b)  $I > II > III$   
(c)  $III > II > I$  (d)  $III > I > II$

28. An alkane (mol. wt. = 86) on bromination gives only two monobromo derivatives (excluding stereoisomers). The alkane is :



29. Order of the bond strength of C — H bonds involving  $sp$ ,  $sp^2$  and  $sp^3$  hybridized carbon atoms is :

- (a)  $sp > sp^2 > sp^3$  (b)  $sp^3 > sp^2 > sp$   
(c)  $sp^2 > sp^3 > sp$  (d)  $sp^2 > sp > sp^3$



Among the structures given, select the enantiomers :

- (a) I and II (b) I and III  
(c) II and III (d) I, II and III

31.



(I)



(II)

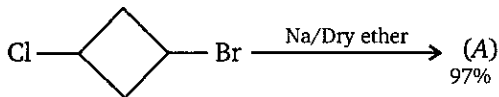


(III)

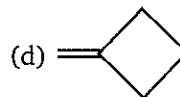
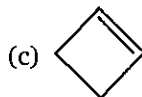
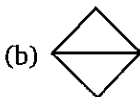
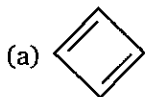
The correct order of reactivity of I, II & III towards addition reactions is :

- (a) I > III > II      (b) I > II > III      (c) III > II > I      (d) III > I > II

32.



Product (A) of above reaction is :



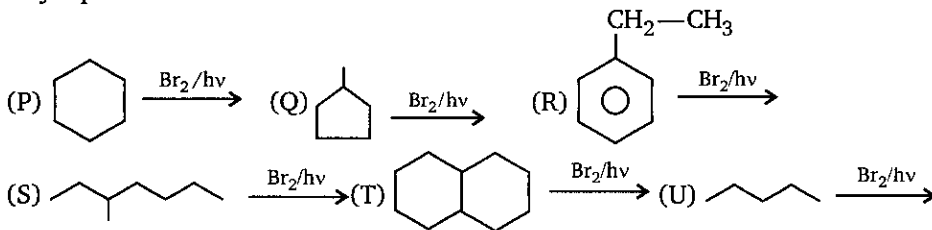
33. Which of the following reactants is suitable for preparation of methane and ethane by using one step only ?

- (a)  $\text{H}_2\text{C} = \text{CH}_2$       (b)  $\text{CH}_3\text{OH}$   
 (c)  $\text{CH}_3 - \text{Br}$       (d)  $\text{CH}_3 - \text{CH}_2 - \text{OH}$

34. How many carbon atoms does an alkane (not a cycloalkane) need before it is capable to exist in enantiomeric form ?

- (a) 4      (b) 5      (c) 6      (d) 7

35. Among the following free radical bromination reactions, select those in which  $2^\circ$  halide is the major product —



- (a) P, Q, R, S      (b) P, R, U      (c) P, R, S, T      (d) P, Q, R, S, T

36. (A) +  $\text{Cl}_2 \xrightarrow{h\nu}$  monochloro product

To maximise the yield of monochloro product in the above reaction ?

- (a)  $\text{Cl}_2$  must be added in excess  
 (b) Reactant (A) must be added in excess  
 (c) Reaction must be carried out in dark  
 (d) Reaction must be carried out with equimolar mixture of  $\text{Cl}_2$  and A

37.  $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{CH}_3 \xrightarrow{\text{Br}_2/h\nu}$

Major product in the above reaction is :

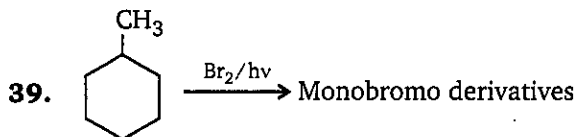
- (a) Racemic mixture      (b) Meso  
 (c) Diastereomers      (d) Constitutional isomers



38. Select the chain propagation steps in the free-radical chlorination of methane.

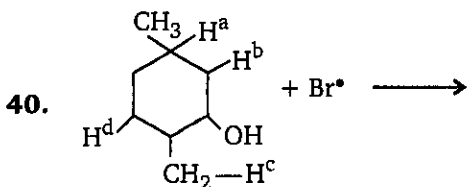
- (1)  $\text{Cl}_2 \longrightarrow 2\text{Cl}^\bullet$  (2)  $\text{Cl}^\bullet + \text{CH}_4 \longrightarrow \text{CH}_3\text{Cl} + \text{H}^\bullet$   
 (3)  $\text{Cl}^\bullet + \text{CH}_4 \longrightarrow \text{CH}_3^\bullet + \text{HCl}$  (4)  $\text{H}^\bullet + \text{Cl}_2 \longrightarrow \text{HCl} + \text{Cl}^\bullet$   
 (5)  $\text{CH}_3^\bullet + \text{Cl}_2 \longrightarrow \text{CH}_3\text{Cl} + \text{Cl}^\bullet$

- (a) 2, 3, 5 (b) 1, 3, 6  
 (c) 3, 5 (d) 2, 3, 4



The number of possible monobromo products is (excluding stereoisomers):

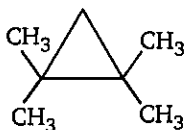
- (a) 4 (b) 5 (c) 8 (d) 10



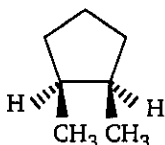
$\text{Br}^\bullet$  will abstract which of the hydrogen most readily?

- (a) a (b) b (c) c (d) d

41. Arrange the following compounds in decreasing order of their heats of combustion :



(i)

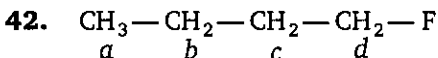


(ii)



(iii)

- (a) (iii) > (ii) > (i) (b) (ii) > (i) > (iii)  
 (c) (iii) > (i) > (ii) (d) (i) > (ii) > (iii)



Arrange the hydrogens a, b, c, d, in decreasing order of their reactivities towards chlorination:

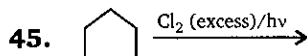
- (a)  $a > b > c > d$  (b)  $b > c > d > a$   
 (c)  $b > c > a > d$  (d)  $c > b > a > d$

43. On catalytic reduction ( $\text{H}_2/\text{Pt}$ ) how many alkenes will give *n*-butane?

- (a) 1 (b) 2  
 (c) 3 (d) 4

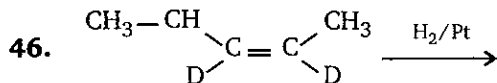
44. On catalytic reduction ( $\text{H}_2/\text{Pt}$ ) how many alkenes will give 2-methylbutane?

- (a) 1 (b) 2  
 (c) 3 (d) 4



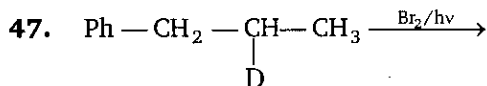
How many dichloro products are formed in the above reaction (including stereoisomers)?

- (a) 5 (b) 6  
(c) 7 (d) 9



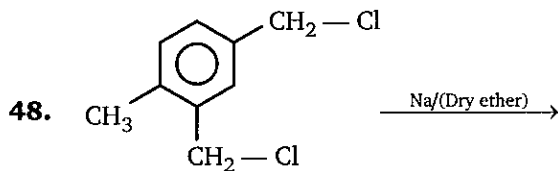
Product of the above reaction will be :

- (a) Racemic mixture (b) Diastereomers  
(c) Meso (d) Constitutional isomers

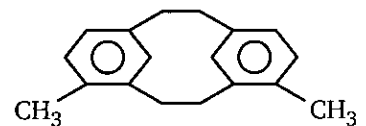
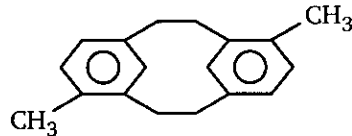
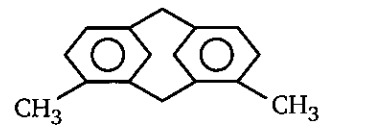


Product of the above reaction will be :

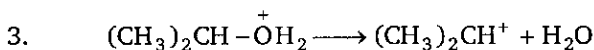
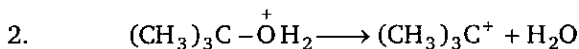
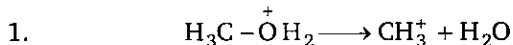
- (a) Diastereomers (b) Racemic mixture  
(c) Meso (d) Constitutional isomers



Products obtained in above Wurtz reaction is :

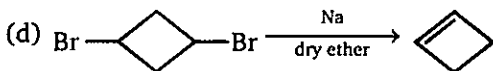
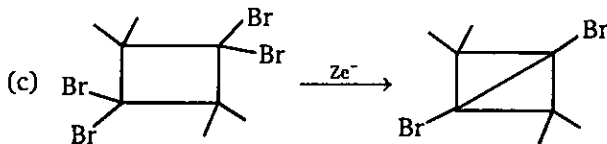
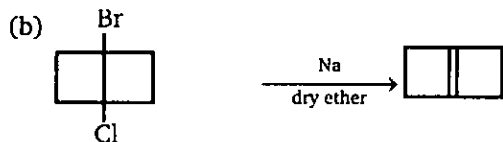
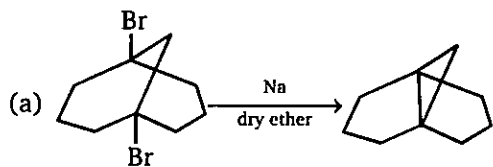
- (a)  (b)   
(c)  (d) Both (a) and (b)

49. Rank the transition states that occur during the following reaction steps in order of increasing stability (least  $\rightarrow$  most stable) :



- (a)  $1 < 2 < 3$  (b)  $2 < 3 < 1$   
(c)  $1 < 3 < 2$  (d)  $2 < 1 < 3$

50. Which of the following does not represent major product of that reaction ?



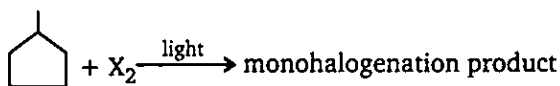
ANSWERS — LEVEL 1

1.	(d)	2.	(b)	3.	(b)	4.	(b)	5.	(b)	6.	(d)	7.	(b)	8.	(a)
9.	(b)	10.	(d)	11.	(c)	12.	(c)	13.	(b)	14.	(c)	15.	(c)	16.	(b)
17.	(d)	18.	(d)	19.	(c)	20.	(a)	21.	(c)	22.	(b)	23.	(a)	24.	(a)
25.	(c)	26.	(c)	27.	(c)	28.	(c)	29.	(a)	30.	(c)	31.	(b)	32.	(b)
33.	(c)	34.	(d)	35.	(b)	36.	(b)	37.	(a)	38.	(c)	39.	(b)	40.	(a)
41.	(d)	42.	(c)	43.	(c)	44.	(c)	45.	(c)	46.	(a)	47.	(a)	48.	(d)
49.	(c)	50.	(d)												



### 1. Comprehension

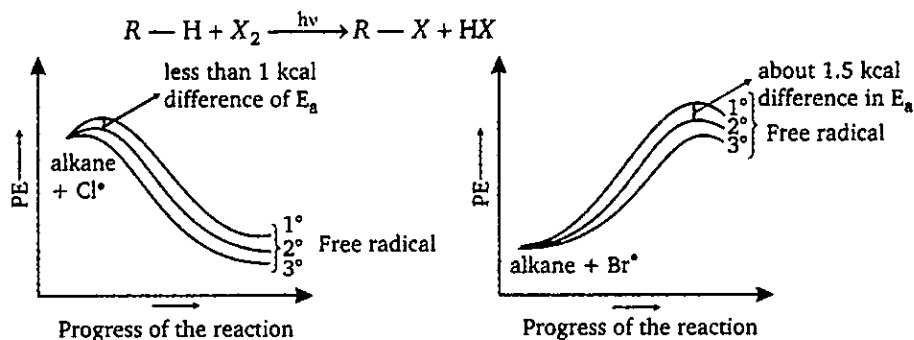
For the given question (1, 2, 3), consider the following reaction.



- A. Light is involved in which step of the reaction :
- (a) Initiation only (b) Termination only  
(c) Propagation only (d) Propagation and Termination
- B. Which halogen will give the best yield of a single monohalogenation product ?
- (a)  $\text{F}_2$  (b)  $\text{Cl}_2$  (c)  $\text{Br}_2$  (d)  $\text{I}_2$
- C. How many monohalo derivatives are possible (excluding stereoisomers) ?
- (a) 3 (b) 4 (c) 5 (d) 6

### 2. Comprehension

Halogenation is a substitution reaction, where halogen replaces one or more hydrogens of hydrocarbon.



*Chlorination is exothermic and transition state resembles with products*

*Bromination is endothermic and transition state resembles with products*

Chlorine free radical make  $1^\circ$ ,  $2^\circ$ ,  $3^\circ$  radicals with almost equal ease, whereas bromine free radicals have a clear preference for the formation of tertiary free radicals. So, bromine is less reactive, and more selective whereas chlorine is less selective and more reactive.

The relative rate of abstraction of hydrogen by  $\text{Br}^\bullet$  is

$$3^\circ > 2^\circ > 1^\circ$$

(1600) (82) (1)

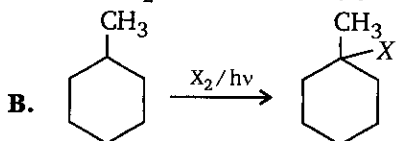
The relative rate of abstraction of hydrogen by  $\text{Cl}^\bullet$  is :

$$3^\circ > 2^\circ > 1^\circ$$

(5) (3.8) (1)

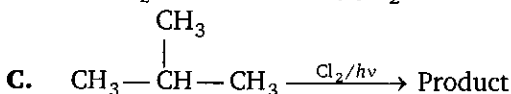
Consider the above argument and answer A to G :

- A. 1-halo-2,3-dimethyl butane will be obtained in better yields, if halogen is :  
 (a) Br<sub>2</sub> (b) Cl<sub>2</sub> (c) I<sub>2</sub> (d) Can't be predicted



Above product will be obtained in better yield if X is

- (a) Cl<sub>2</sub> (b) I<sub>2</sub> (c) Br<sub>2</sub> (d) Can't be predicted

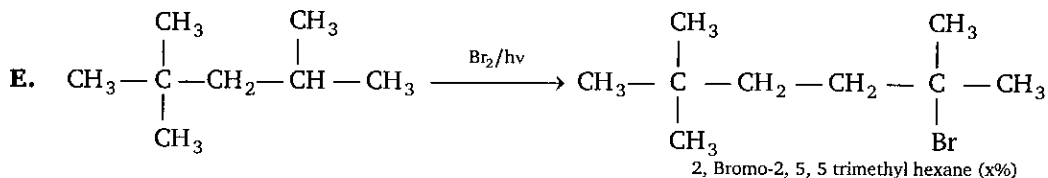


Major product in the above reaction is :

- (a)  $\text{CH}_3 - \overset{\text{CH}_3}{\underset{|}{\text{CH}}} - \text{CH}_2 - \text{Cl}$  (b)  $\text{CH}_3 - \overset{\text{CH}_3}{\underset{\text{Cl}}{|}{\text{CH}}} - \text{CH}_3$   
 (c)  $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{Cl}$  (d)  $\text{CH}_3 - \overset{\text{CH}_3}{\underset{\text{Cl}}{|}{\text{CH}}} - \text{CH}_2 - \text{CH}_3$

- D. Which of the following will give five monochloro products, when allowed to react with Cl<sub>2</sub> in presence of sun light (excluding stereoisomers) ?

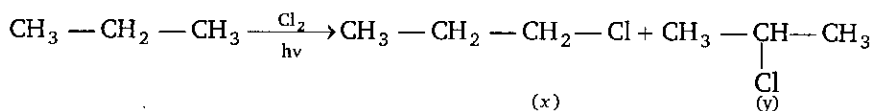
- (a) n-pentane (b) Iso-pentane (c) 2-methyl-pentane (d) 3-methyl pentane



What is the value of x (% yield of product)?

- (a) 18 % (b) 82 % (c) 90 % (d) 60 %

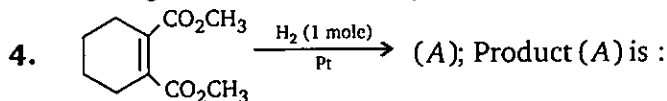
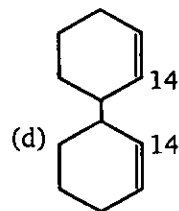
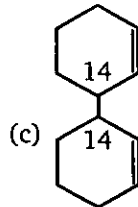
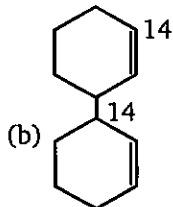
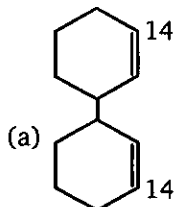
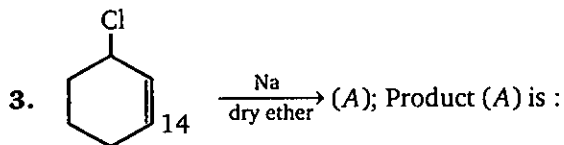
- F. What would be the product ratio x/y in the chlorination of propane if all the hydrogen were abstracted at equal rate ?



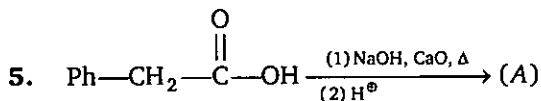
- (a)  $\frac{1}{3}$  (b)  $\frac{3}{1}$  (c)  $\frac{9}{1}$  (d)  $\frac{1}{9}$

- G. How many dichloro products (including stereoisomers) will be formed when R-2-chloropentane reacts with Cl<sub>2</sub> in presence of UV radiation ?

- (a) 5 (b) 6 (c) 7 (d) 8

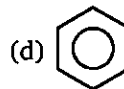


- (a) Meso compound (b) Racemic mixture (c) Diastereomers (d) Optically active




Product (A) is :

- (a)  $\text{Ph}-\text{CO}_2\text{H}$  (b)  $\text{Ph}-\text{CH}_2-\text{OH}$  (c)  $\text{Ph}-\text{CH}_3$



6. Match the column I with column II and with column III.

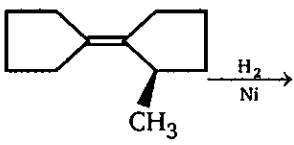
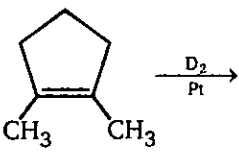
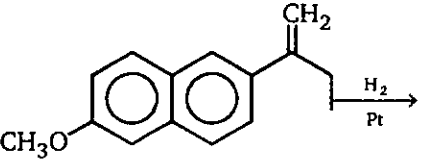
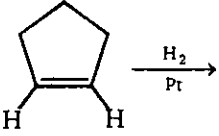
Column (I)		Column (II)		Column (III)	
Compound		Mono-chloro products		Monochloro products.	
		(excluding stereoisomerism)		(including stereoisomerism)	
(a)		(p)	1	(w)	1
(b)	$\text{CH}_3-\underset{\text{CH}_3}{\text{CH}}-\text{CH}_2-\text{CH}_3$	(q)	2	(x)	3
(c)	$\begin{array}{c} \text{CH}_3 \text{ CH}_3 \\   \quad   \\ \text{CH}_3-\text{C}-\text{C}-\text{CH}_3 \\   \quad   \\ \text{CH}_3 \text{ CH}_3 \end{array}$	(r)	3	(y)	5
(d)	$\text{CH}_3-\text{CH}_2-\text{CH}_2-\text{CH}_3$	(s)	4	(z)	6

7.

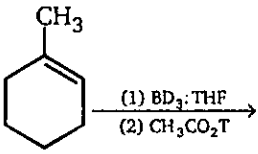
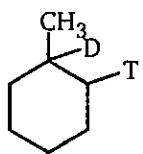
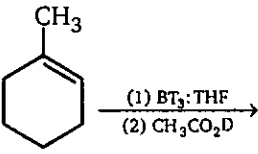
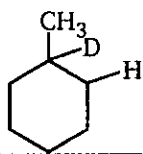
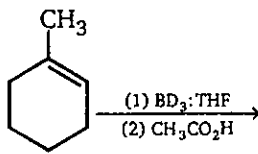
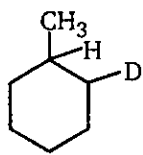
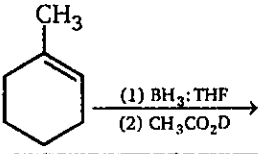
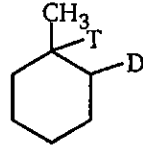
A.	$R\text{-}2\text{-chloropentane} \xrightarrow[h\nu]{\text{Cl}_2}$	Optically active di-chloro products ( $P$ )
B.	$\square \xrightarrow[h\nu]{\text{Cl}_2}$	Optically active dichloro products ( $Q$ )
C.	$R\text{-}2\text{-chlorobutane} \xrightarrow[h\nu]{\text{Cl}_2}$	Optically active di-chloroproducts ( $R$ )

Sum  $P + Q + R$  is :

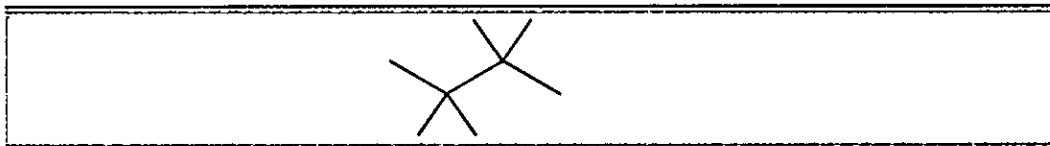
8. Match the column I and II.

Column (I)		Column (II)	
Reaction		Type of Reaction	
(a)		(p)	Meso compound
(b)		(q)	Diastereomers
(c)		(r)	Racemic
(d)		(s)	Optically inactive due to absence of chiral center

## 9. Match the column :

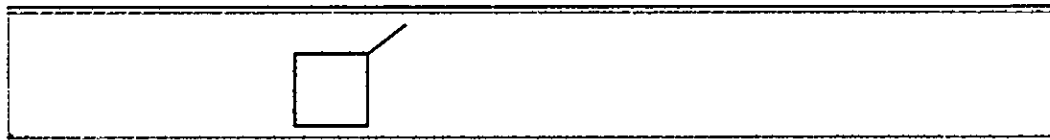
Column (I)		Column (II)	
Reaction		Product	
(a)		(p)	
(b)		(q)	
(c)		(r)	
(d)		(s)	

10. How many distinct monochlorinated products, (including stereoisomers) may be obtained when the alkane shown below is heated in the presence of  $\text{Cl}_2$  ?



- (a) 1                      (b) 2                      (c) 3                      (d) 4                      (e) 6

11. How many distinct monochlorinated products, (including stereoisomers) may be obtained when the alkane shown below is heated in the presence of  $\text{Cl}_2$  ?

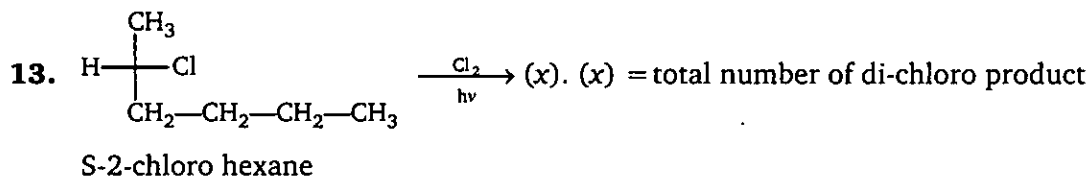


- (a) 2                      (b) 4                      (c) 5                      (d) 6                      (e) 8



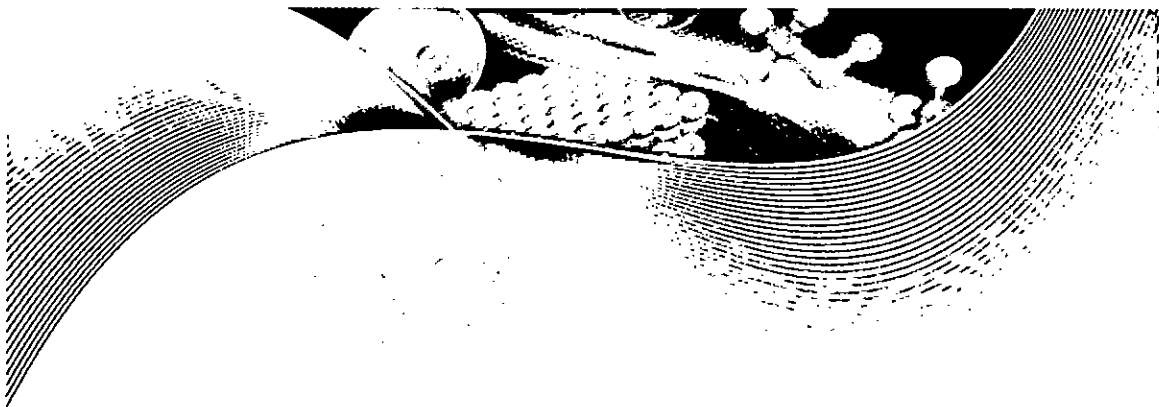
12. Match the column :

Column (I)		Column (II)	
	Wurtz reaction		Number of dimerization product
(a)	$\text{CH}_3 - \text{Cl} \xrightarrow[\text{dry ether}]{\text{Na}} \rightarrow$	(p)	5
(b)	$\text{CH}_3 - \text{Cl} + \text{CH}_3 - \text{CH}_2 - \text{Cl} \xrightarrow[\text{dry ether}]{\text{Na}} \rightarrow$	(q)	6
(c)	$\text{CH}_3 - \text{Cl} + \text{CH}_3 - \text{CH}_2 - \text{Cl}$ $+ \text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{Cl} \xrightarrow[\text{dry ether}]{\text{Na}} \rightarrow$	(r)	3
(d)	$\text{H}_2\text{C} = \text{CH} - \text{CH} = \text{CH} - \text{CH}_2 - \text{Cl}$ $+ \text{CH}_3 - \text{CH}_2 - \text{Cl} \xrightarrow[\text{dry ether}]{\text{Na}} \rightarrow$	(s)	1



## ANSWERS — LEVEL 2

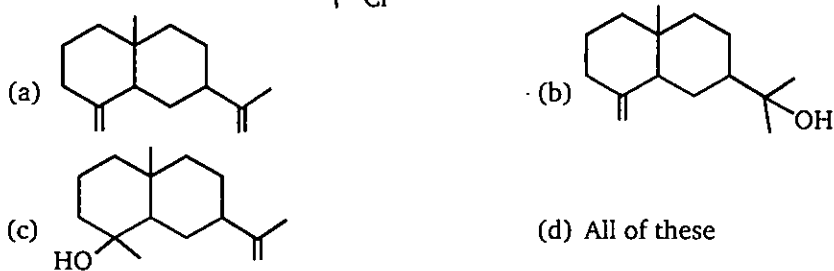
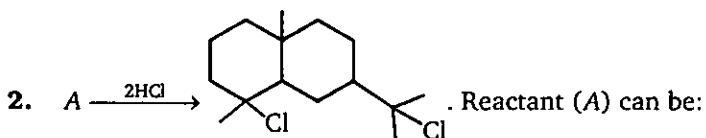
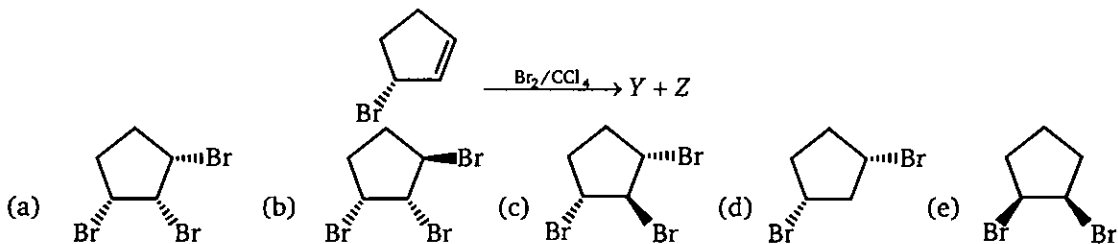
1. A - a; B - c; C - b
2. A - b; B - c; C - a; D - c; E - c; F - b; G - c
3. a, b, c
4. a
5. c
6. a - q - x; b - s - z; c - p - w; d - q - x
7.  $P + Q + R = 10$
8. a - q; b - p; c - r; d - s
9. a - p; b - s; c - q; d - r
10. a
11. e
12. a - s; b - r; c - p; d - q
13. 9

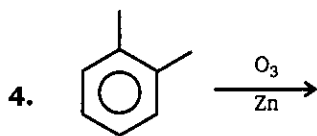
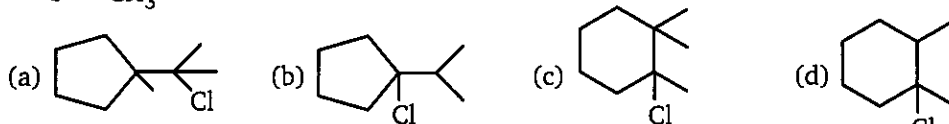
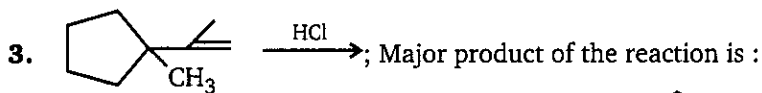


# 4B HYDROCARBONS (ALKENES)

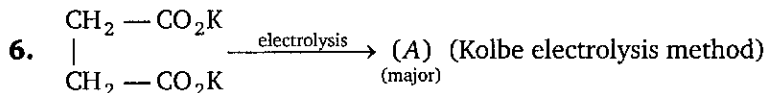
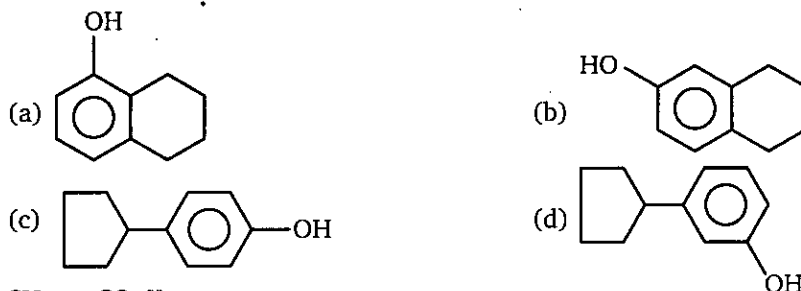
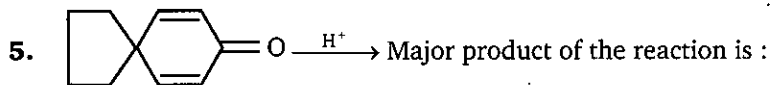
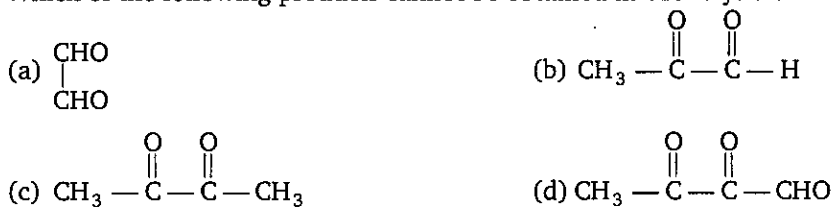
## LEVEL 1

1. (R)-3-bromocyclopentene (shown below) reacts with  $\text{Br}_2/\text{CCl}_4$  to form two products, Y and Z, Y is not optically active (does not rotate plane-polarized light). What is the structure of Y?

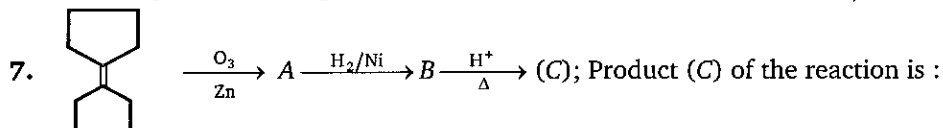


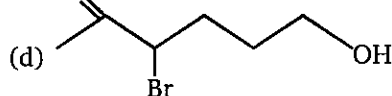
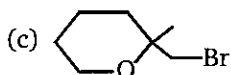
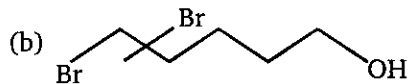
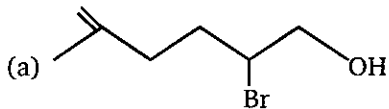
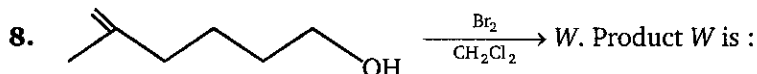


Which of the following products cannot be obtained in ozonolysis of *o*-xylene?

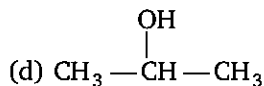
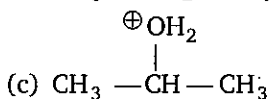
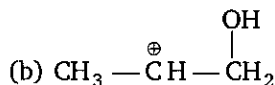
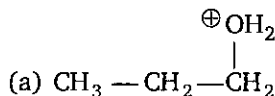


Product (A) of the reaction is :

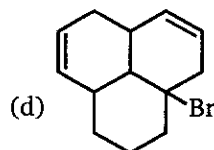
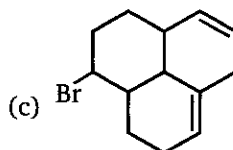
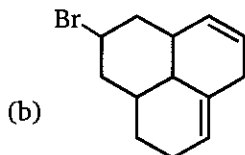
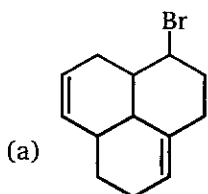
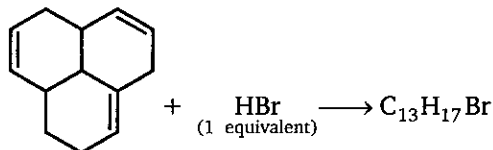




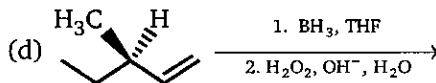
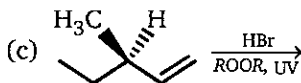
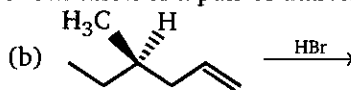
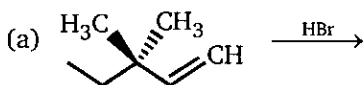
9. The reaction of propene with  $\text{H}_3\text{O}^+$  will proceed with which of the following intermediates ?



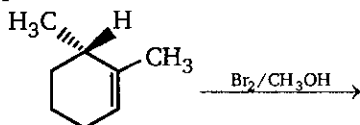
10. Which of the following bromides is the major product of the reaction shown below, assuming that there are no carbocation rearrangement ?

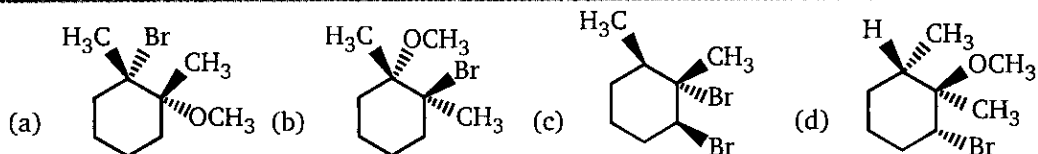


11. Which of the following reactions results in the formation of a pair of diastereomers ?

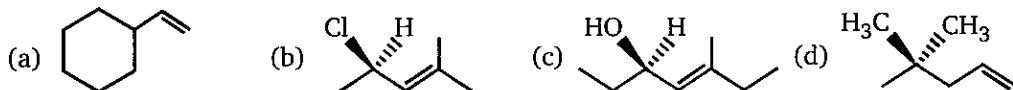


12. What is a likely product of the reaction shown ?

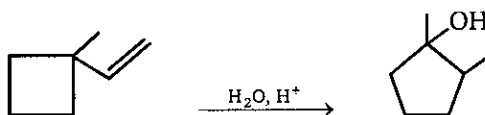




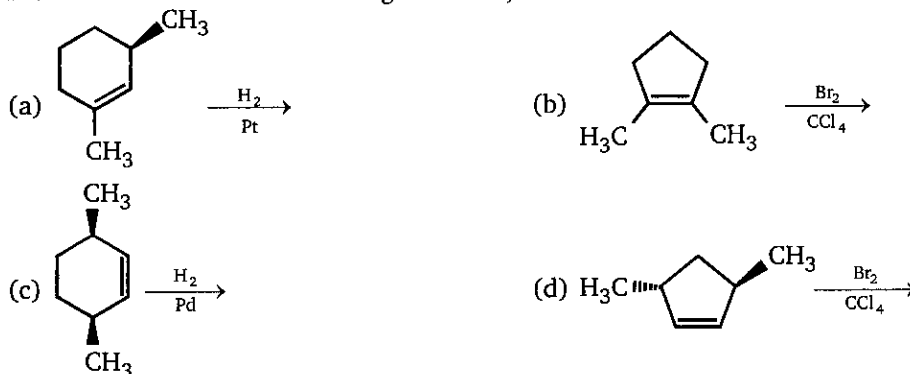
13. Which of the following, when undergoing addition of HBr, will form ONLY a pair of diastereomers ?



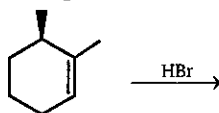
14. How many transition states and intermediates will be formed during the course of following reaction ?



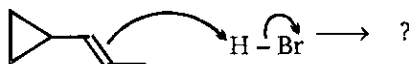
- (a) 3 transition states and 3 intermediates (b) 4 transition states and 3 intermediates  
(c) 3 transition states and 2 intermediates (d) 5 transition states and 4 intermediates
15. Product of which of the following reactions, is racemic mixture ?

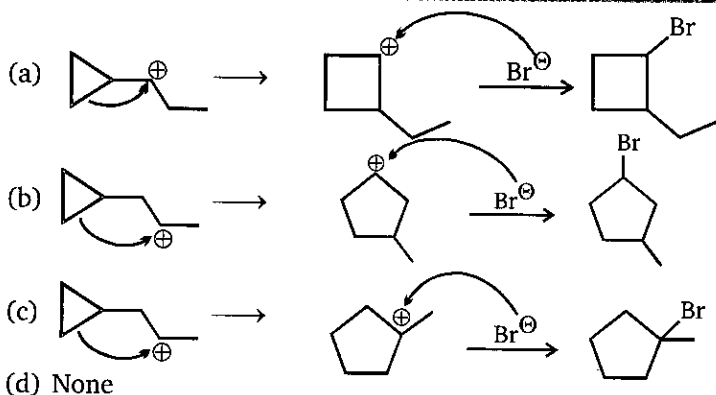


16. The product(s) of the following reaction can best be described as :

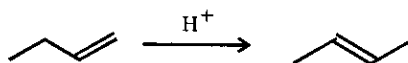


- (a) a racemic mixture (b) a single enantiomer  
(c) a pair of diastereomers (d) an achiral molecule
17. Taking into account the stability of various carbocations and, as well as the rules governing mechanisms of carbocation rearrangements, which reaction is most likely to occur during the given reaction ?

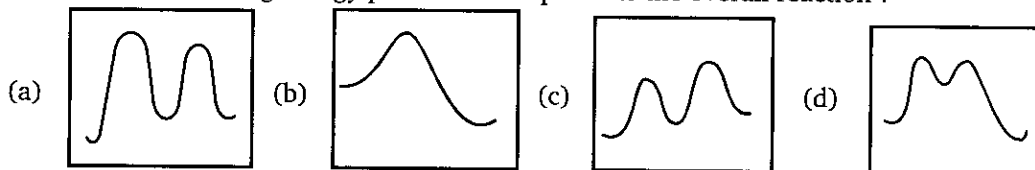




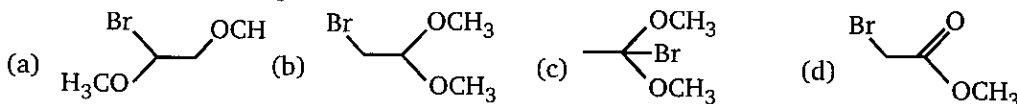
18. Consider the following reaction in which the intermediate carbocation loses  $H^+$  to give the final product ?



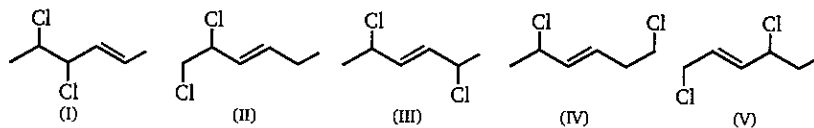
Which of the following energy profiles best represents the overall reaction ?



19. Methyl vinyl ether,  $H_2C = CH - OCH_3$ , reacts with  $Br_2/CH_3OH$ . If methanol is reacting as water would, and if this reaction follows a typical mechanism of electrophilic addition, what would be the expected product ?

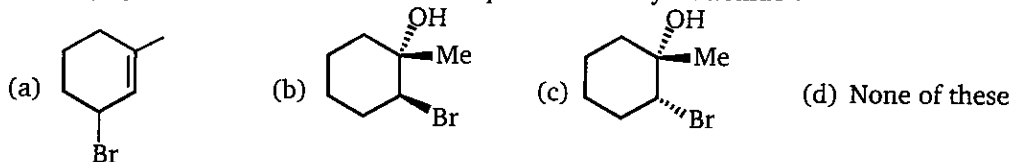


20. 2, 4-hexadiyne ( $C_6H_6$ ) is allowed to react with Li in  $NH_3(liq)$ . The product obtained is treated with 1 equivalent of  $Cl_2$  in  $CCl_4$ . Which of the following constitutional isomers are possible products ?

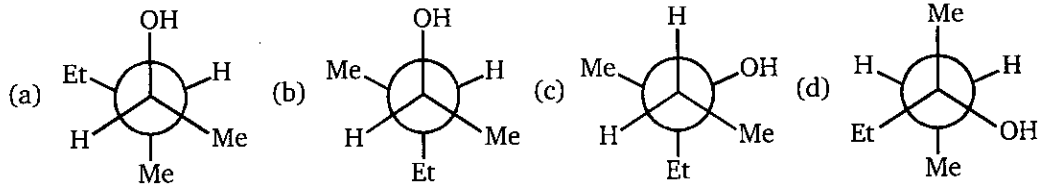


- (a) I and II  
(b) II and III  
(c) I and V  
(d) I and III

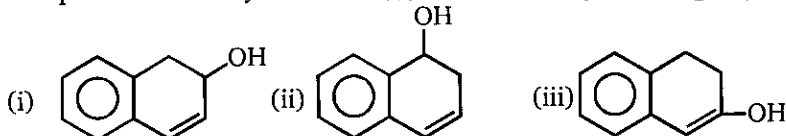
21. Which of the following is the best stereochemical representation when reaction between 1-methylcyclohexene and NBS react in aqueous dimethyl sulfoxide ?



22. Which of the following is among the major products of the reaction of (E)-3-methyl-2-pentene with  $\text{BH}_3$  in THF followed by the addition of  $\text{H}_2\text{O}_2/\text{HO}^-$ ?

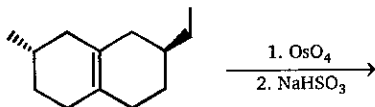


23. Compare rate of dehydration of (i), (ii) and (iii) by conc.  $\text{H}_2\text{SO}_4$ .



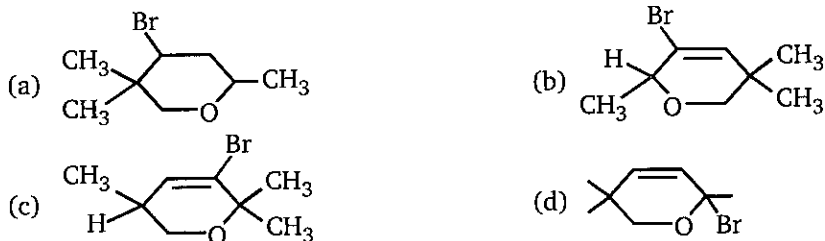
- (a) (i) > (iii) > (ii)      (b) (i) > (ii) > (iii)  
 (c) (ii) > (i) > (iii)      (d) (ii) > (iii) > (i)

24. How many products will be formed in this reaction ?

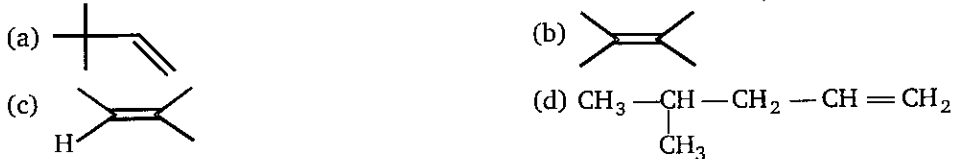


- (a) 10      (b) 2  
 (c) 3      (d) 4

25. (A). Product (A) of the reaction is:

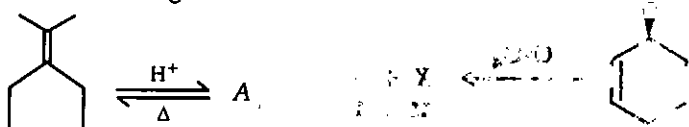


26.  $\text{CH}_3-\overset{\text{CH}_3}{\underset{\text{CH}_3}{\text{C}}}-\text{H} + \text{H}_2\text{C}=\text{CH}_2 \xrightarrow[2.5^\circ\text{C}]{\text{HF}}$  (A); (A) is:

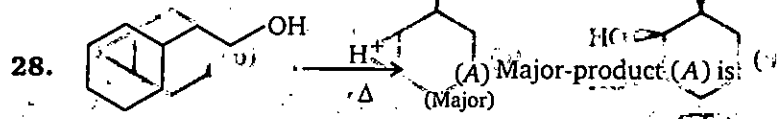




27. Predict the product (A) of the following reaction



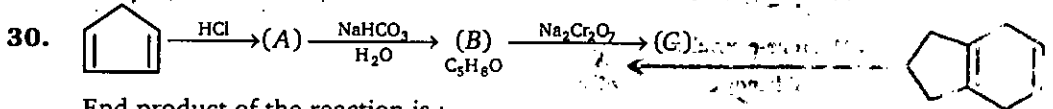
- (a) (b) (c) (d)



- (a) (b) (c) (d)

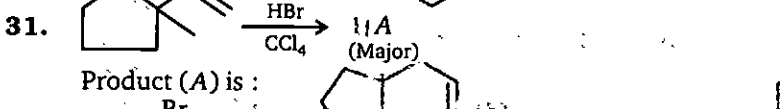
29. Di-imide ( $\text{N}_2\text{H}_4$ ) is used to reduce double bond of:

(a) (b) (c) (d)

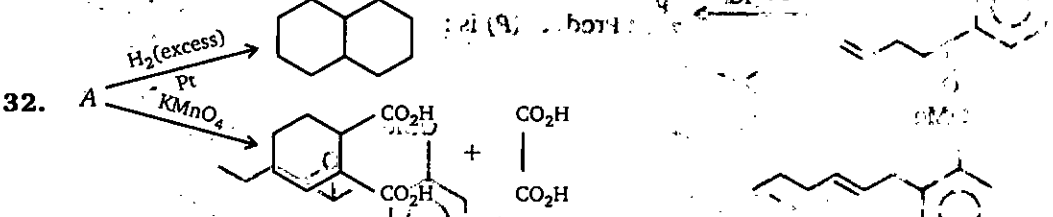


End product of the reaction is :

- (a) (b) (c) (d)

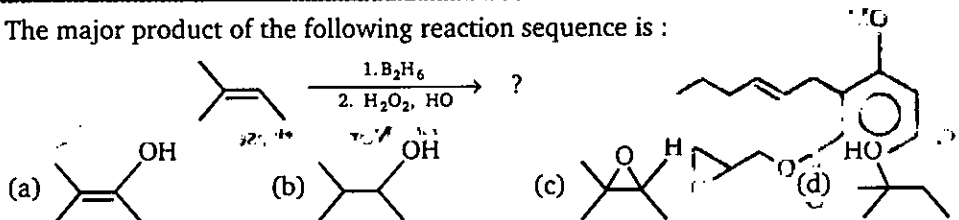


- Product (A) is :
- (a) (b) (c) (d)

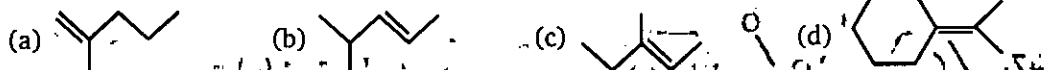


- Compound (A) is :
- (a) (b) (c) (d)

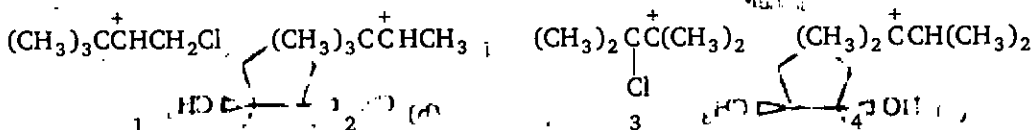
40. The major product of the following reaction sequence is :



41. Which one of the following compounds gives acetone  $(\text{CH}_3)_2\text{C}=\text{O}$  as one of the product of its ozonolysis ?



42. Addition of HCl to 3, 3-dimethyl-1-butene yields two products, one of which has a rearranged carbon skeleton. Among the following carbocations, select the possible intermediates in that reaction ?



- (a) 1, 2 (b) 1, 3 (c) 1, 4 (d) 2, 3  
(e) 2, 4

43. Conversion of cyclohexene to cyclohexanol can be conveniently achieved by :

- (a)  $\text{NaOH} + \text{H}_2\text{O}$  (b)  $\text{Br}_2 - \text{H}_2\text{O}$   
(c) hydroboration, oxidation (d) hydroboration hydrolysis

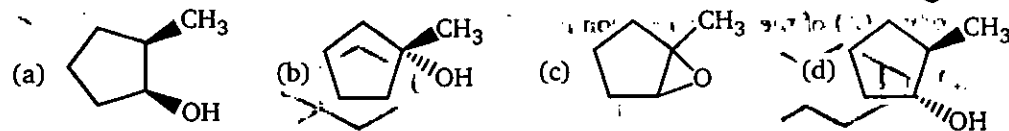
44. *Trans*-cyclohexane-1,2-diol can be obtained by the reaction of cyclohexene with :

- (a)  $\text{KMnO}_4$  (b)  $\text{OsO}_4$   
(c) peroxy formic acid /  $\text{H}_3\text{O}^+$  (d)  $\text{SeO}_2$

45. Bromination of (*E*)-2-butenedioic acid gives

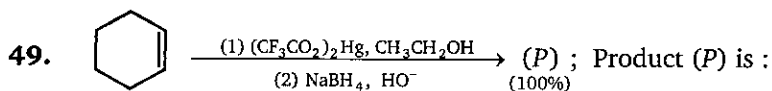
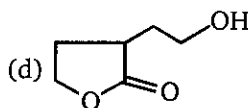
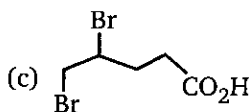
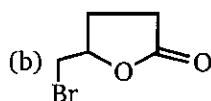
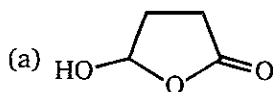
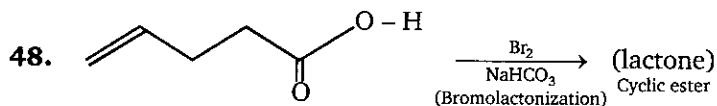
- (a) (2*R*, 3*S*)-2, 3-dibromosuccinic acid  
(b) (2*R*, 3*R*)-2, 3-dibromosuccinic acid  
(c) a mixture of (2*R*, 3*R*) and (2*S*, 3*S*)-2, 3-dibromosuccinic acid  
(d) (2*S*, 3*S*)-2, 3-dibromosuccinic acid

46. The major product formed during the reaction of 1-methyl cyclopentene with  $\text{CH}_3\text{CO}_3\text{H}$  is

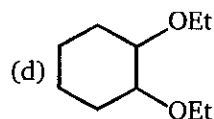
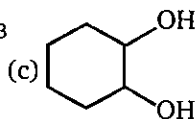
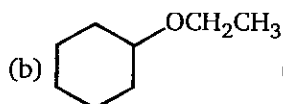
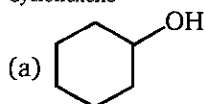


47.  $\begin{array}{c} \text{CH}-\text{CO}_2\text{H} \\ || \\ \text{CH}-\text{CO}_2\text{H} \end{array} \xrightarrow[\text{(two mole)}]{\text{NaOH}} (\text{A}) \xrightarrow[\text{(B)}]{\text{electrolysis}} (\text{B})$ ; Product (B) of the reaction is :

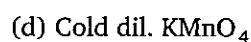
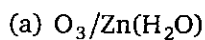
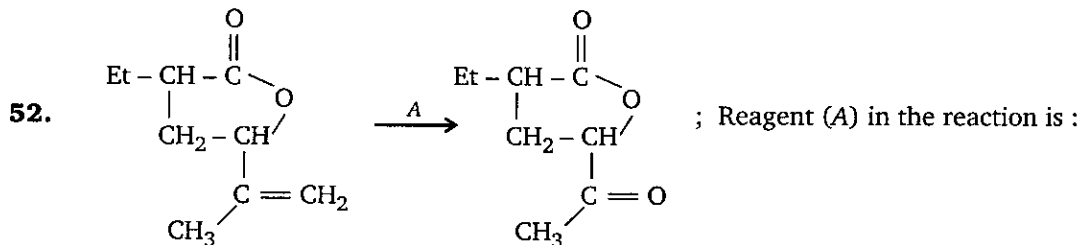
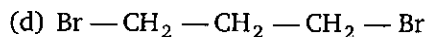
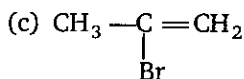
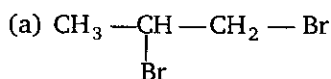
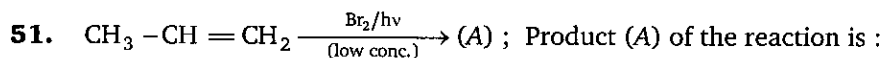
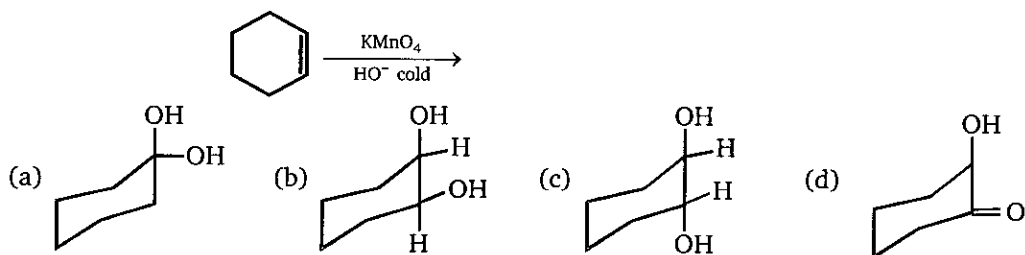
(a)  $\text{CH}_3-\text{CH}_3$  (b)  $\text{H}_2\text{C}=\text{CH}_2$   
(c)  $\text{H}-\text{C}\equiv\text{C}-\text{H}$  (d)  $\text{CH}_2=\text{CH}-\text{CH}=\text{CH}_2$

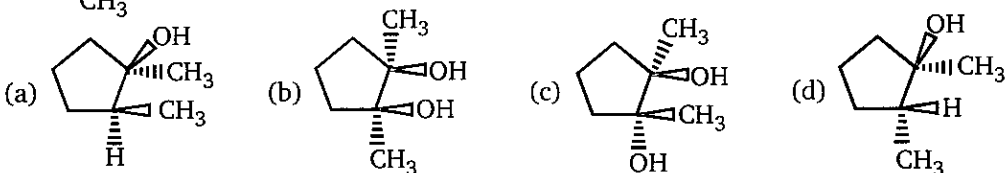
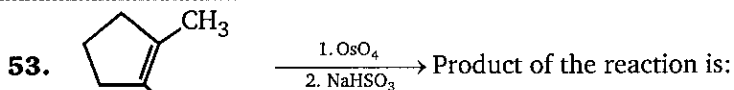


Cyclohexene



50. What is the major product expected from the following reaction ?





54. Which compound is a possible product from addition of  $\text{Br}_2$  to 1-butene ?



55. Addition of  $\text{Br}_2$  to *cis*-2-butene would give a product which is:

- (a) achiral (b) racemic  
 (c) meso (d) optically active

56. Addition of  $\text{Br}_2$  to *trans*-2-butene would give a product which is:

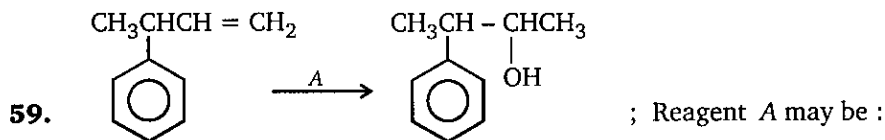
- (a) achiral (b) racemic (c) meso (d) optically active

57. Addition of  $\text{OsO}_4$  to cyclopentene would give a product which is:

- (a) achiral (b) racemic (c) meso (d) optically active

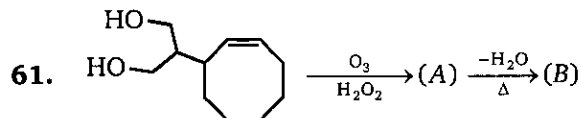
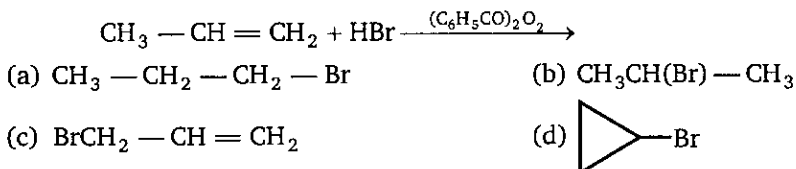
58. Addition of  $\text{BH}_3$  followed by  $\text{H}_2\text{O}_2$  to *trans*-2-butene would give a product which is:

- (a) achiral (b) racemic (c) meso (d) optically active

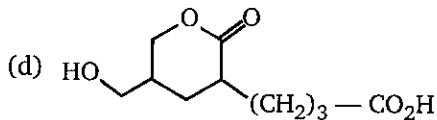
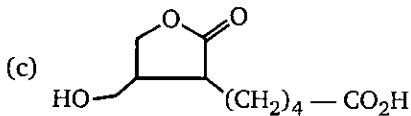
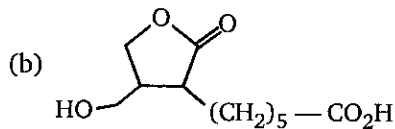
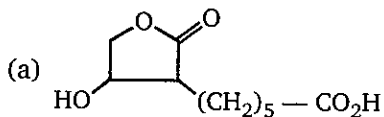


- (a)  $\text{H}_2\text{O}/\text{H}^+$  (b)  $\text{BH}_3 \cdot \text{THF}/\text{H}_2\text{O}_2 - \text{OH}^-$   
 (c)  $\text{Hg}(\text{OCOCH}_3)_2 \cdot \text{THF}/\text{NaBH}_4 \cdot \text{NaOH}$  (d) All are possible

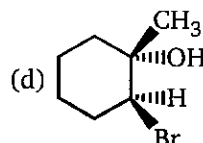
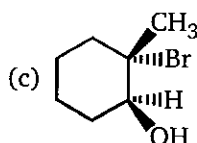
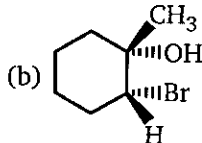
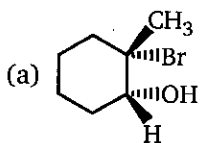
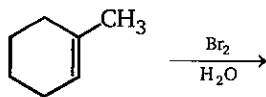
60. The major product of the following reaction is :



Identify (B) :



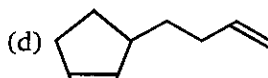
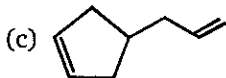
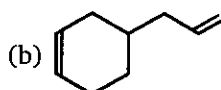
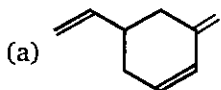
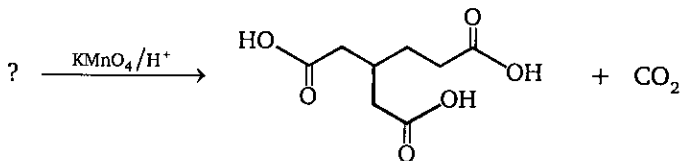
62. Which of the following is a major product of the reaction shown below?



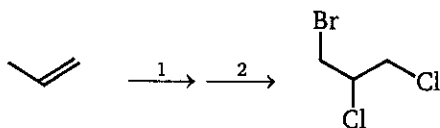
63. In methyl alcohol solution, bromine reacts with ethylene (ethene) to yield  $\text{BrCH}_2\text{CH}_2\text{OCH}_3$  in addition to 1, 2-dibromoethane because

- (a) the methyl alcohol solvates the bromine
- (b) the ion formed initially may react with  $\text{Br}^-$  or  $\text{CH}_3\text{OH}$
- (c) this is a free radical reaction
- (d) the reaction follows Markovnikov's rule

64. Which of the following compound was the starting material for the oxidation shown below?



65. Which series of reactions will achieve the following transformation?



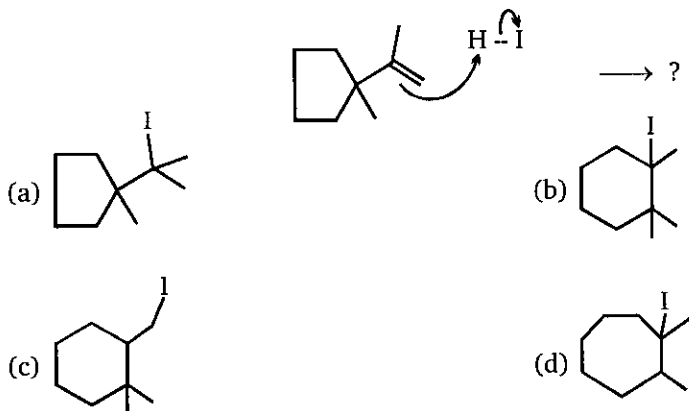
- 1
- (a)  $\text{Cl}_2/\text{CCl}_4$
- (c)  $\text{Cl}_2/\text{CCl}_4$

- 2
- (b)  $\text{Br}_2$
- (d)  $\text{NBS}/h\nu$

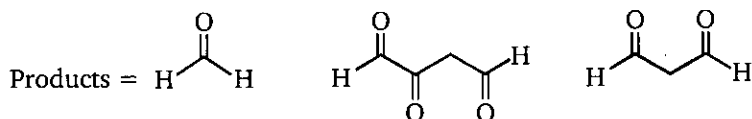
- 1
- (b)  $\text{HBr}$
- (d)  $\text{NBS}/h\nu$

- 2
- (a)  $\text{Cl}_2/\text{CCl}_4$
- (c)  $\text{Cl}_2/\text{CCl}_4$

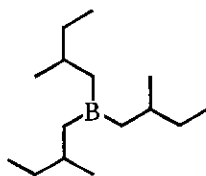
66. Taking into account the stability of various cycloalkanes and carbocations, as well as the rules governing mechanisms of carbocation rearrangements, what is the most likely product of this reaction ?



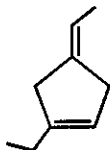
67. A triene is treated with ozone followed by zinc in acetic acid to give the following three products. What is the structure of the triene ?



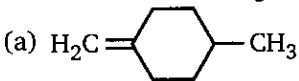
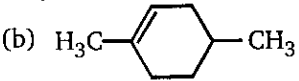
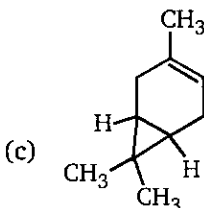

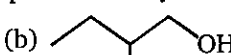
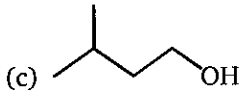

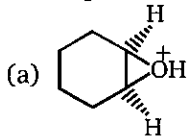
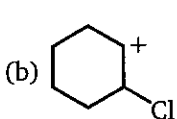
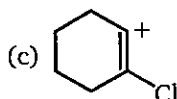
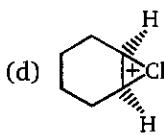
68. Which of the following compound would yield trialkylborane shown below when treated with  $\text{BH}_3/\text{THF}$  ?



- (a) 2-methylbut-1-ene (b) 2-methylbut-2-ene  
 (c) 3-methylbut-1-ene (d) 3-methylbut-1-yne
69. If the following compound is treated with Pd/C in excess of hydrogen gas, how many stereoisomers of the product will be obtained ?

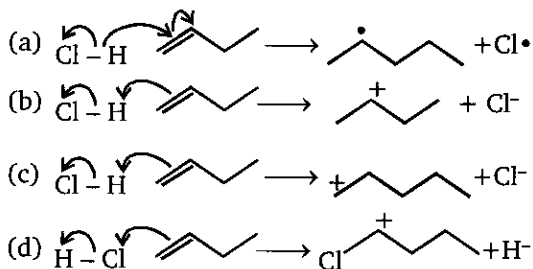




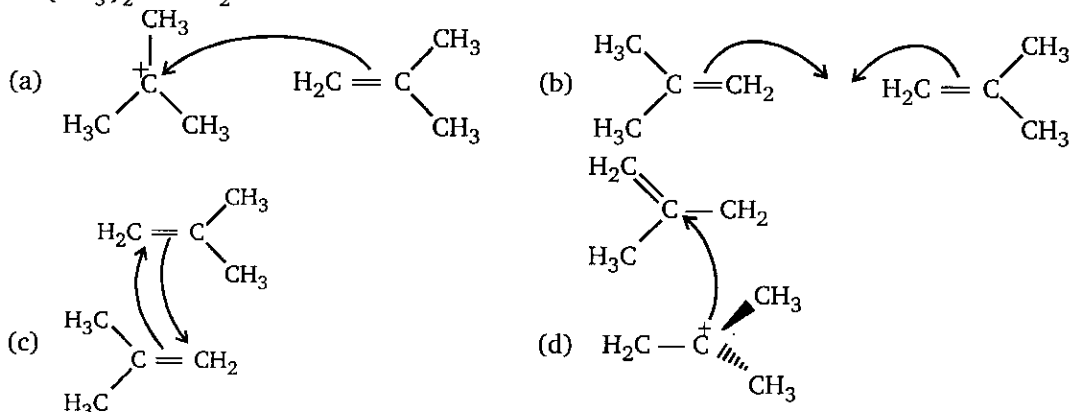
75. When 2-butyne is treated with Pd - BaSO<sub>4</sub>; the product formed will be :  
 (a) *cis*-2-butene (b) *trans*-2-butene (c) 1-butene (d) 2-hydroxy butane
76. In the reaction,  $\text{CH}_3\text{C} \equiv \text{C} - \text{CH}_3 \xrightarrow[\text{(ii) Zn/H}_2\text{O}]{\text{(i) X}} \text{CH}_3 - \underset{\text{O}}{\underset{\text{||}}{\text{C}}} - \underset{\text{O}}{\underset{\text{||}}{\text{C}}} - \text{CH}_3$ , X is :  
 (a) HNO<sub>3</sub> (b) O<sub>2</sub> (c) O<sub>3</sub> (d) KMnO<sub>4</sub>
77. Which of the following alkene on catalytic hydrogenation given *cis* and *trans*-isomer ?  
 (a)  (b)   
 (c)  (d) all of these
78. In the reaction of hydrogen bromide with an alkene (in the absence of peroxides), the first step of the reaction is the ..... to the alkene.  
 (a) fast addition of an electrophilic (b) slow addition of an electrophile  
 (c) fast addition of a nucleophilic (d) slow addition of a nucleophile
79. Which of the following alcohols cannot be prepared from hydration of an alkene ?  
 (a)  (b)   
 (c)  (d) 
80. Which of the species shown below is the most stable form of the intermediate in the electrophilic addition of Cl<sub>2</sub> in water to cyclohexene to form a halohydrin ?  
 (a)  (b)   
 (c)  (d) 
81. The reaction,  $(\text{CH}_3)_2\text{C} = \text{CH}_2 + \text{Br}^\bullet \longrightarrow (\text{CH}_3)_2\dot{\text{C}} - \text{CH}_2\text{Br}$   
 is an example of a/an ..... step in a radical chain reaction.  
 (a) initiation (b) termination  
 (c) propagation (d) heterolytic cleavage



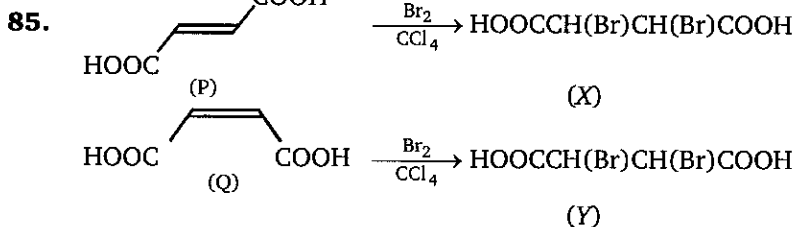
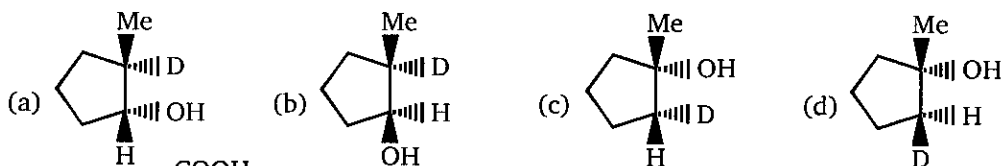
82. Which of the following most accurately describes the first step in the reaction of hydrogen chloride with 1-butene ?



83. Which of the following best describes the flow of electrons in the acid-catalyzed dimerization of  $(\text{CH}_3)_2\text{C}=\text{CH}_2$  ?



84. Hydroboration of 1-methylcyclopentene using  $\text{B}_2\text{D}_6$ , followed by treatment with alkaline hydrogen peroxide, gives

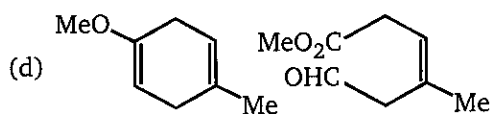
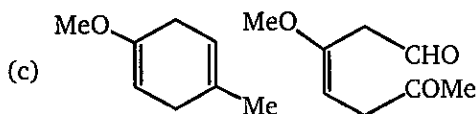
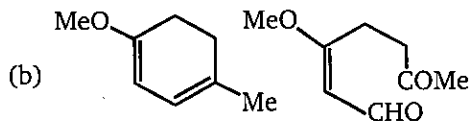
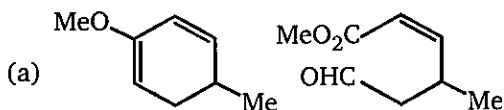
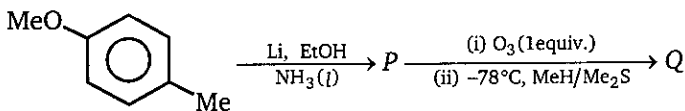


The correct statements with respect to the above pair of reactions are that

- (I) the reactions are stereospecific  
 (II) (X) is erythro and (Y) is threo isomer  
 (III) (X) is threo and (Y) is erythro isomer  
 (IV) each of (P) and (Q) gives a mixture of (X) and (Y)
- (a) I and II      (b) I and III      (c) I and IV

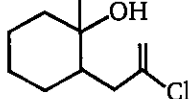
(d) II and IV

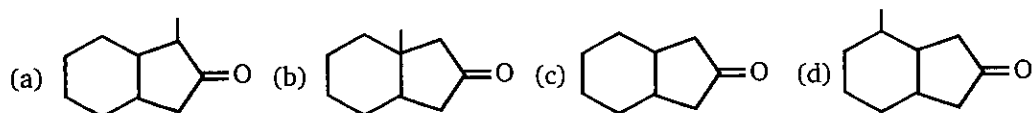
86. The products *P* and *Q* in the following sequence of reactions, are

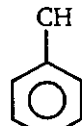


87. 4-Pentenoic acid when treated with  $\text{I}_2$  and  $\text{NaHCO}_3$  gives :

- (a) 4, 5-diiodopentanoic acid (b) 5-iodomethyl-dihydrofuran-2-one  
(c) 5-iodo-tetrahydropyran-2-one (d) 4-pentenolyiodide

88.   $\xrightarrow[\text{H}_2\text{O}]{\text{H}_2\text{SO}_4, 0^\circ\text{C}}$  (A)  $\xrightarrow{-\text{HCl}}$  (B); Product (B) of the reaction is:



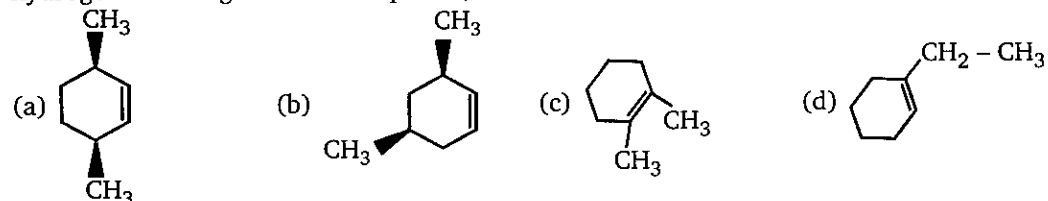
89.   $\xrightarrow[\text{CCl}_4]{\text{Br}_2}$  (A)  $\xrightarrow[\text{(ii) NaNH}_2]{\text{(i) alc.KOH}}$  (B)  $\xrightarrow[\text{(ii) CH}_3\text{-Cl}]{\text{(i) NaNH}_2}$  (C), Product (C) is :

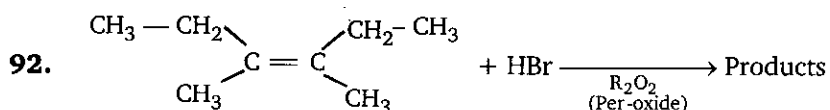
- (a)  $\text{Ph}-\text{C}\equiv\text{CNa}$  (b)  $\text{Ph}-\text{CH}_2-\text{C}\equiv\text{CH}$   
(c)  $\text{Ph}-\text{C}\equiv\text{C}-\text{CH}_3$  (d)  $\text{Ph}-\text{CH}=\text{C}=\text{CH}_2$

90. Which of the following will give a mixture of *cis* and *trans*-1,4-dimethyl cyclohexane, when undergo catalytic hydrogenation ?



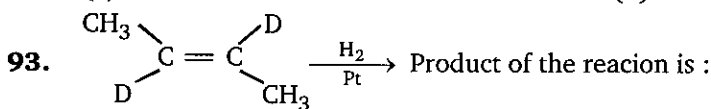
91. An optically active compound *A* with molecular formula  $\text{C}_8\text{H}_{14}$  undergoes catalytic hydrogenation to give meso compound, the structure of (*A*) is :



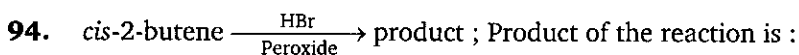


How many products will be formed in above reaction ?

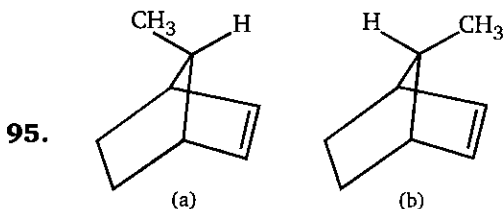
- (a) 2 (b) 4  
 (c) 3 (d) 6



- (a) Racemic (b) Diastereomers  
 (c) Meso (d) Pure enantiomers

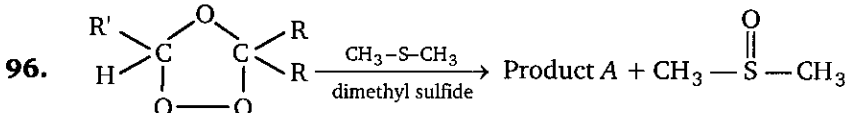


- (a) Racemic (b) Diastereomer  
 (c) Meso (d) E and Z isomer



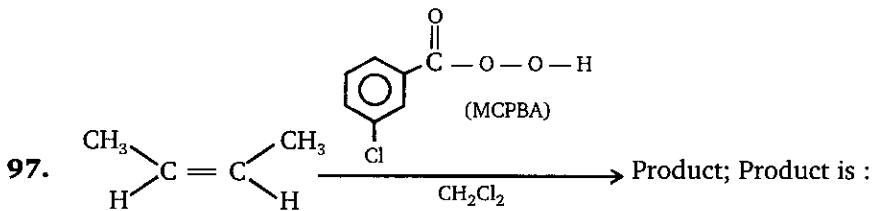
Rate of reaction towards reduction using (H<sub>2</sub>/Pt) :

- (a)  $a > b$  (b)  $a = b$   
 (c)  $b > a$  (d) Reduction of given molecule is not possible

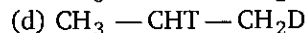
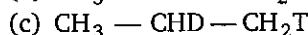
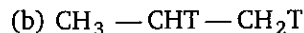
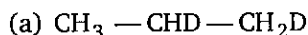
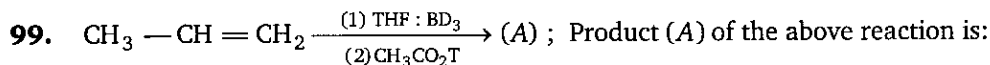
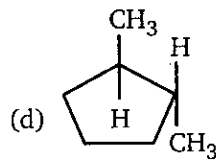
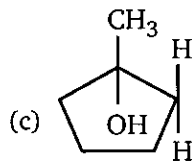
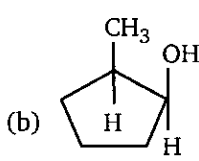
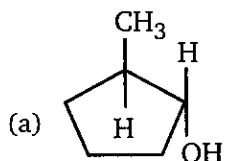
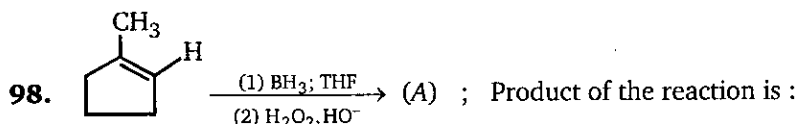
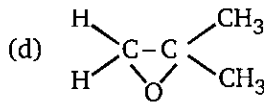
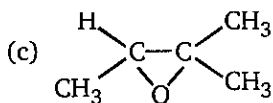
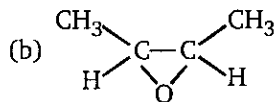
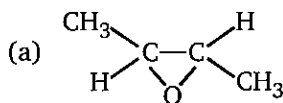


Product A of the above reaction is :

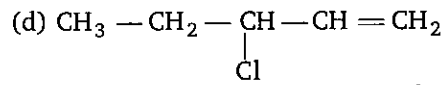
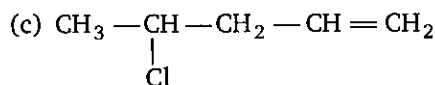
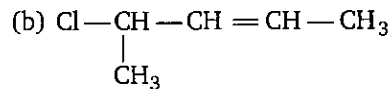
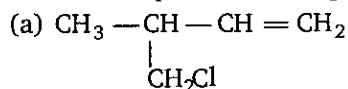
- (a)  $\text{R} - \overset{\text{O}}{\parallel} - \text{R}$  (b)  $\text{R}' - \text{CHO}$   
 (c)  $\text{R} - \text{CO}_2\text{H}$  (d) both (a) and (b)



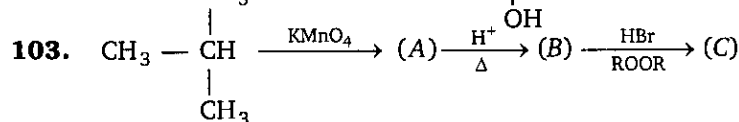
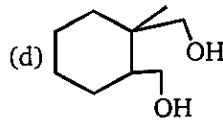
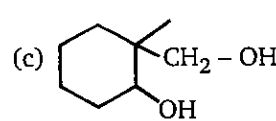
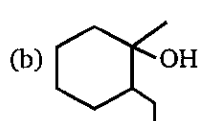
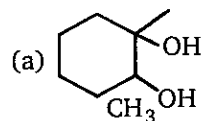
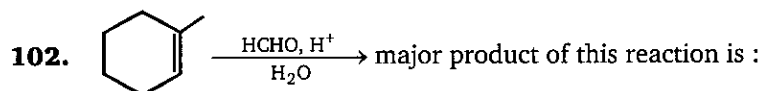
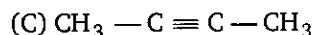
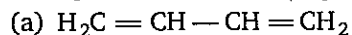
MCPBA  $\longrightarrow$  Metachloroperbenzoic acid



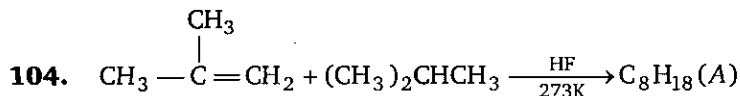
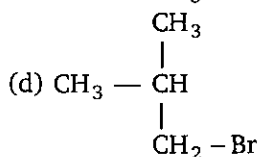
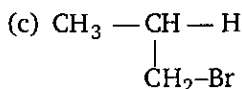
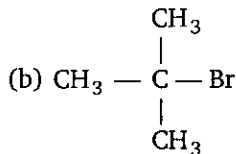
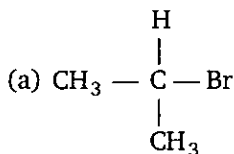
100. Optically active isomer (A) of  $\text{C}_5\text{H}_9\text{Cl}$  on treatment with one mole of  $\text{H}_2$  gives an optically inactive compound (B) compound (A) will be :



101. An organic compound  $\text{C}_4\text{H}_6$  on ozonolysis give  $\text{HCHO}$ ,  $\text{CO}_2$ ,  $\text{CH}_3\text{CHO}$ . Compound will be :



Product (C) in the above reactions is :



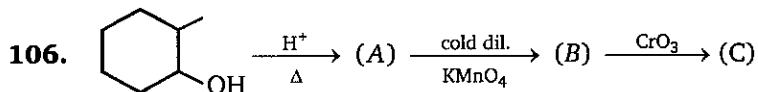
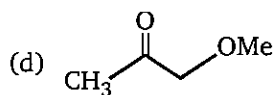
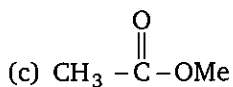
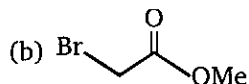
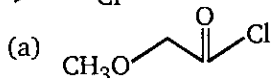
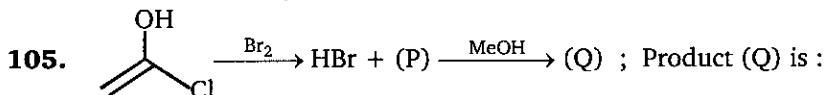
Unknown (A) in the above reaction is :

(a) 2, 2, 3-trimethyl pentane

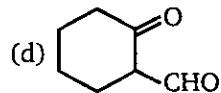
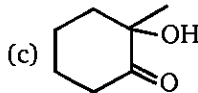
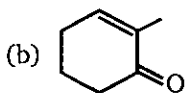
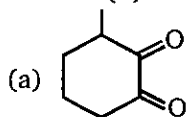
(b) 2, 2, 4-trimethyl pentane

(c) 2, 2-dimethyl hexane

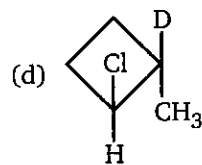
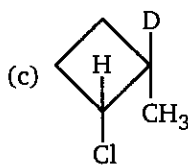
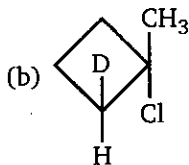
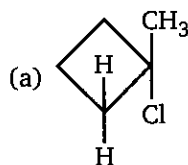
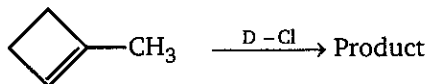
(d) *n*-octane



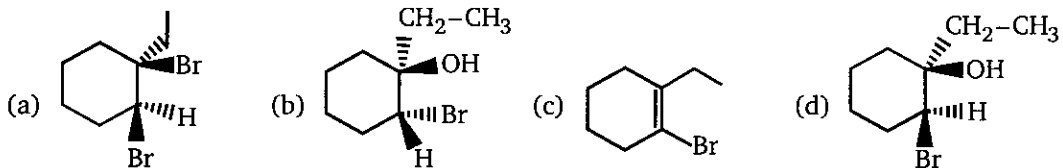
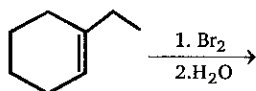
Product (C) of the reaction is:



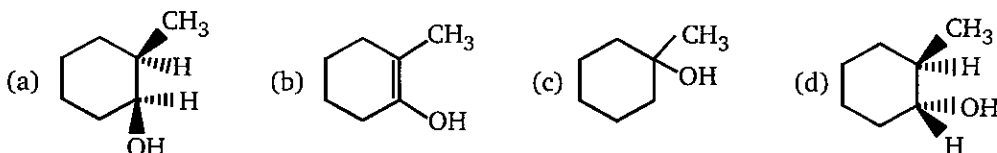
107. What is the major product expected from the following reaction ?



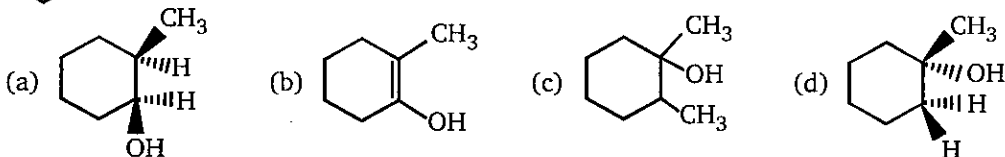
108. Choose the correct product of this reaction :



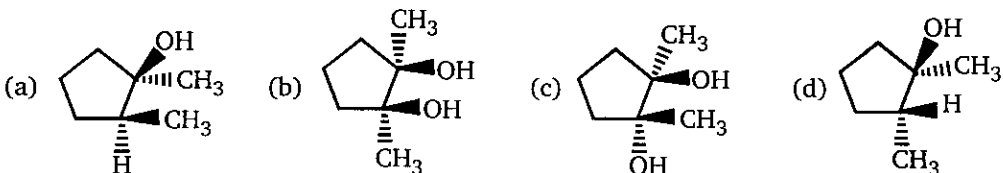
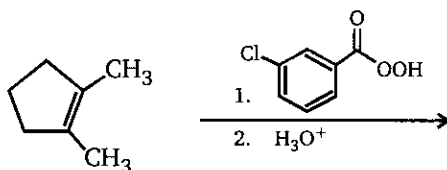
109.  $\xrightarrow[2. \text{H}_2\text{O}_2/\text{OH}^-]{1. \text{BH}_3/\text{THF}}$  A; Product A is:



110.  $\xrightarrow[2. \text{NaBH}_4]{1. \text{Hg}(\text{OAc})_2, \text{H}_2\text{O}}$  Product; Product is :



111. Choose the correct product of the following reactions :

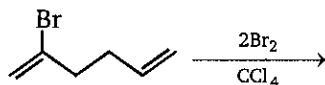


112. How many stereoisomeric tetrabromides will be formed in the following reaction ?



- (a) 2 (b) 3 (c) 4 (d) 6

113. How many stereoisomeric pentabromides will be formed in the following reaction ?



- (a) 2 (b) 3  
(c) 4 (d) None of these

114.  $\text{CH}_3\text{CH}_2\text{CH}=\text{CH}_2 \xrightarrow[\text{peroxide}]{\text{HCl}} (\text{A}) \xrightarrow[\Delta]{\text{EtONa}} (\text{Z})$  (major)

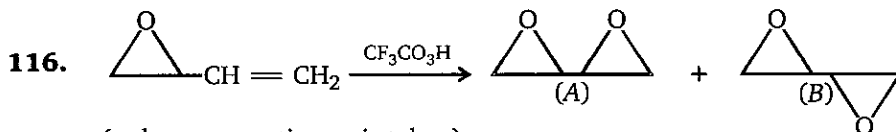
Identify (Z) in the above sequence of reactions :

- (a)  (b)   
(c)  (d) 

115.  $\begin{matrix} \text{CH}_3 - \text{CH} - \text{CO}_2\text{K} \\ | \\ \text{CH}_3 - \text{CH} - \text{CO}_2\text{K} \end{matrix} \xrightarrow{\text{electrolysis}} (\text{A})$  (Major)

Major product (A) of the above reaction :

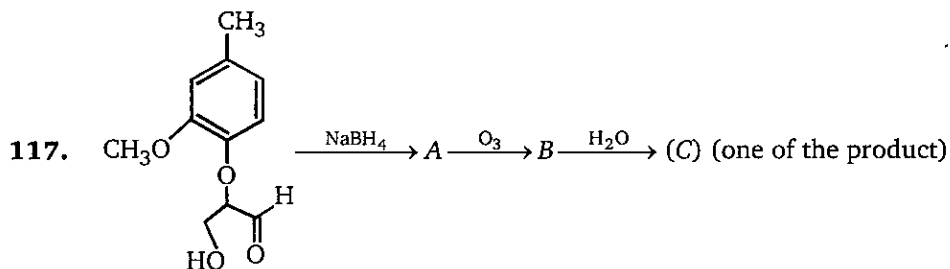
- (a)  (b)   
(c)  (d) 



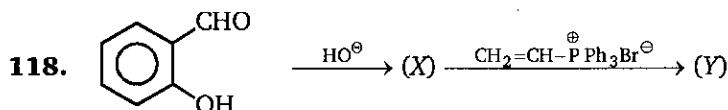
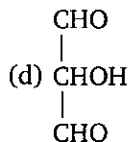
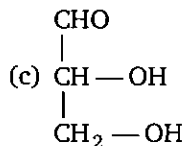
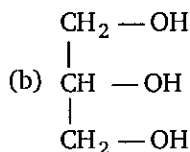
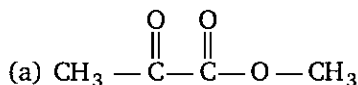
(only one enantiomer is taken)

Which of the following statement is correct about A and B ?

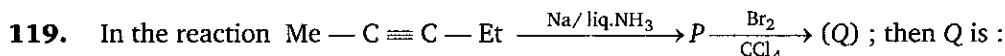
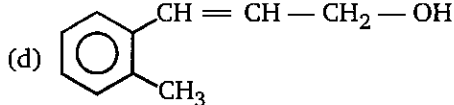
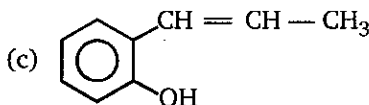
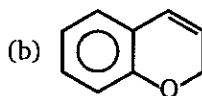
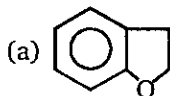
- (a) A and B are mixture of diastereomers  
(b) A and B are mixture of enantiomers  
(c) A and B are optically active  
(d) B is racemic mixture



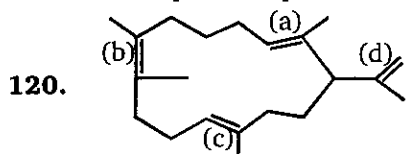
Identify the product (C):



Product (Y) of the above reaction is :



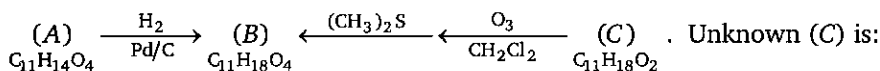
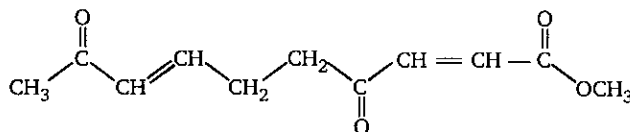
- (a) A pure compound which is optically inactive due to internal compensation  
 (b) A binary mixture which is optically inactive due to external compensation  
 (c) A binary mixture which is optically active  
 (d) A pure compound which is optically inactive due to absence of chiral centre



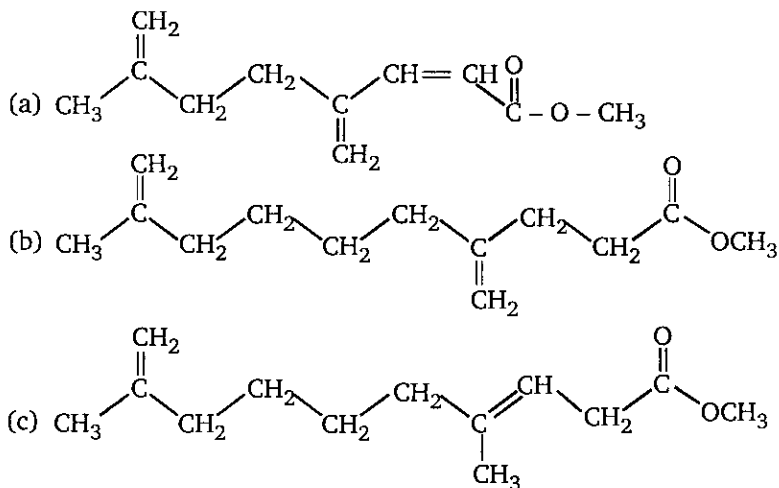
Which ( $\pi$ -bond) will reduce first, when above compound undergoes catalytic hydrogenation ?

- (a) a                      (b) b                      (c) c                      (d) d

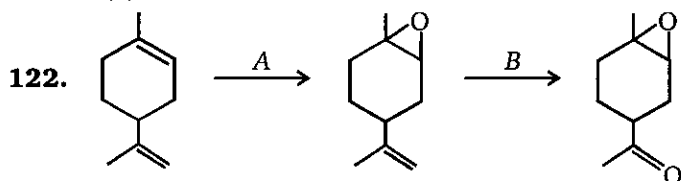
121. Compound A, which is a degradation product of the antibiotic vermiculine has following structure







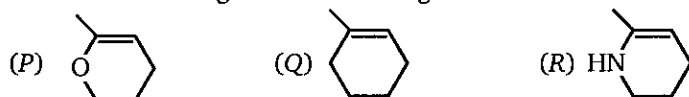
(d) None of these



Reagent (A) and (B) in above reaction are :

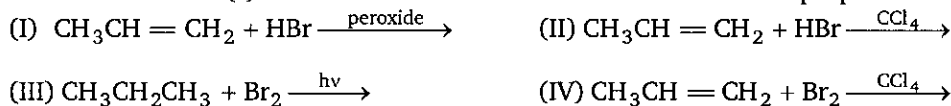
- (a)  $A = \text{RCO}_3\text{H}$ ,  $B = \text{H}_2\text{O}_2$       (b)  $A = \text{RCO}_3\text{H}$ ,  $B = \text{HIO}_4$   
 (c)  $A = \text{RCO}_3\text{H}$ ,  $B = \text{O}_3$       (d)  $A = \text{O}_3$ ,  $B = \text{RCO}_3\text{H}$

123. Rank the following in the increasing order of rate of reaction with HBr .



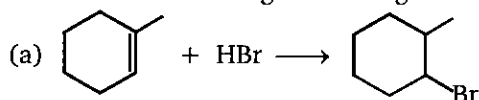
- (a)  $R > P > Q$       (b)  $R > Q > P$   
 (c)  $P > R > S$       (d)  $P > S > R$

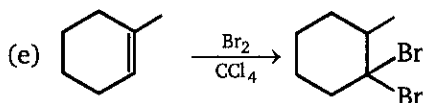
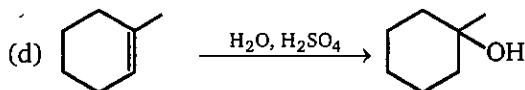
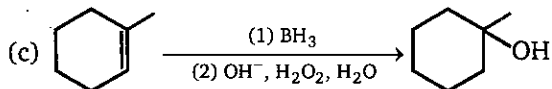
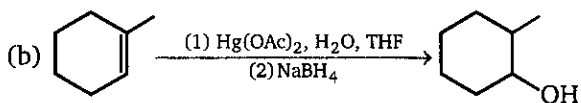
124. Select the reaction(s) that would result in the formation of 2-bromopropane.



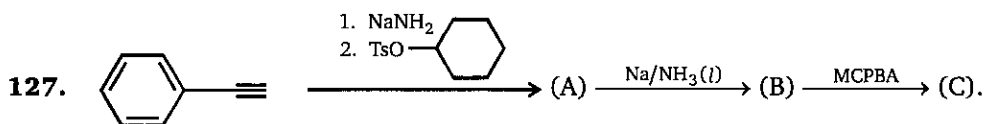
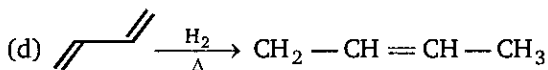
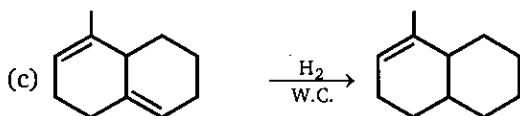
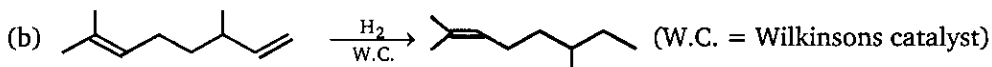
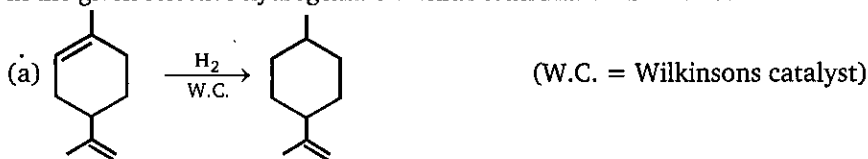
- (a) I and III      (b) II and III  
 (c) I, II, and III      (d) I, II and III

125. Which of the following reactions generates the major product ? Ignore stereoisomerism.

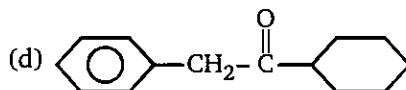
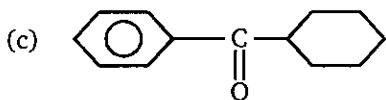
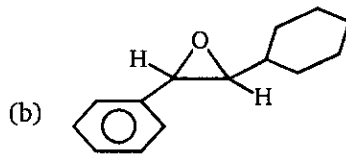
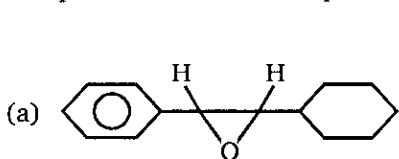


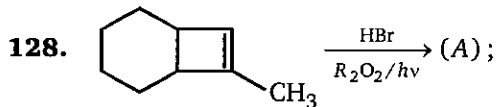


126. In the given selective hydrogenation which combination is incorrect ?

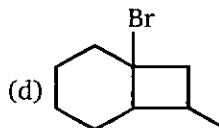
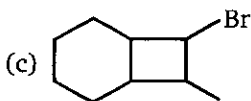
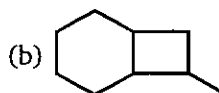
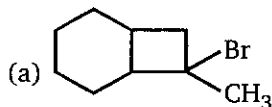


Compound (C) in above sequence of reaction is :

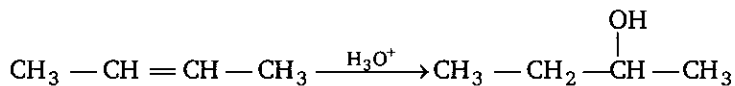




Major product (A) is :



129. In the reaction given below, the product would be :



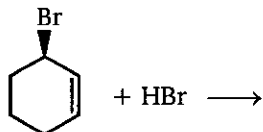
(a) a mixture of diastereomers

(b) optically active

(c) optically pure enantiomer

(d) a racemic mixture

130. Surprisingly, the reaction shown below goes through classical carbocation. What is the major product of this reaction ?



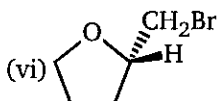
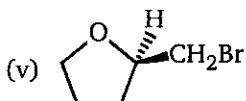
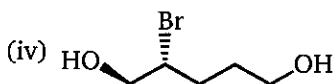
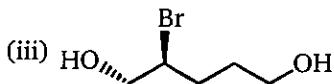
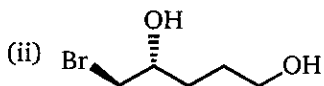
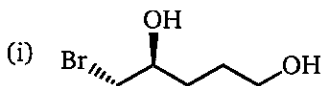
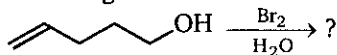
(a) *trans*-1, 3-dibromocyclohexane

(b) *cis*-1, 3-dibromocyclohexane

(c) *trans*-1, 2-dibromocyclohexane

(d) *cis*-1, 2-dibromocyclohexane

131. The major product of the reaction given below is :



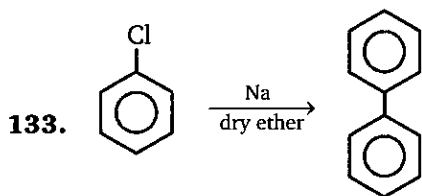
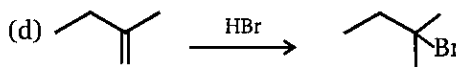
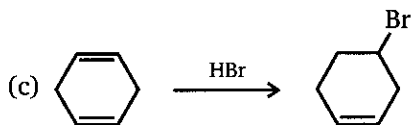
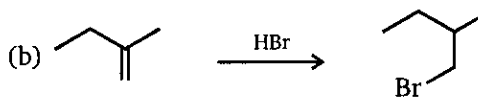
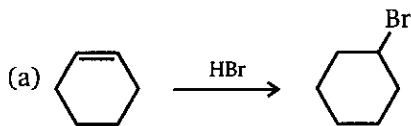
(a) (i) and (ii)

(b) (iii) and (iv)

(c) (v) and (vi)

(d) none of these

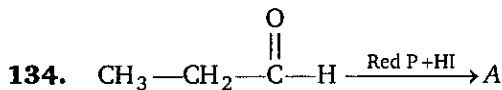
132. Which reaction will occur at the fastest rate ?



Above reaction is known as :

- (a) Wurtz reaction  
(c) Fittig reaction

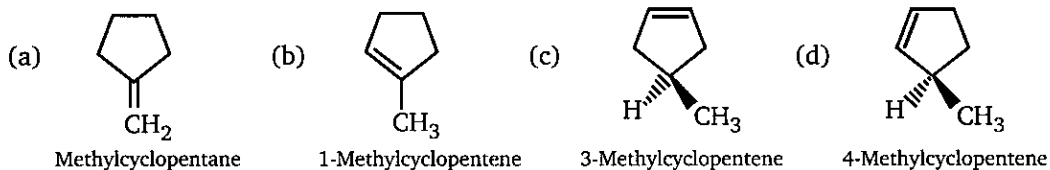
- (b) Wurtz fittig reaction  
(d) Kolbe electrolysis



Product A is :

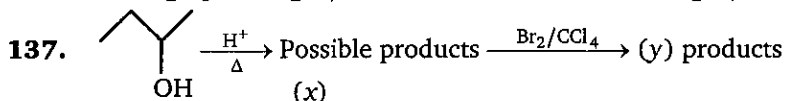
- (a) propane                      (b) propanol                      (c) propanoic acid                      (d) propene

135. Which of the following compound give diastereomers when treated with  $\text{Br}_2$  in  $\text{CCl}_4$ ?



136. A mixture of  $\text{C}_2\text{H}_6$ ,  $\text{C}_2\text{H}_4$  and  $\text{C}_2\text{H}_2$  is bubbled through alkaline solution of copper (I) chloride, contained in Wouff's bottle. The gas coming out is :

- (a) original mixture                      (b)  $\text{C}_2\text{H}_6$   
(c)  $\text{C}_2\text{H}_6$  and  $\text{C}_2\text{H}_4$  mixture                      (d)  $\text{C}_2\text{H}_4$  and  $\text{C}_2\text{H}_2$



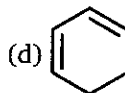
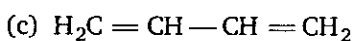
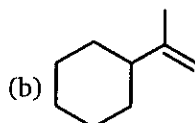
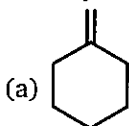
The number of possible products for x and y is :

- (a) 2, 4                      (b) 3, 5  
(c) 3, 6                      (d) 3, 4

138. Select the incorrect statement :

- (a) Bromine is more selective and less reactive  
 (b) Chlorine is less selective and more reactive  
 (c) Benzyl free radical is more stable than 2° free radical  
 (d) Vinyl free radical more stable than allyl free radical

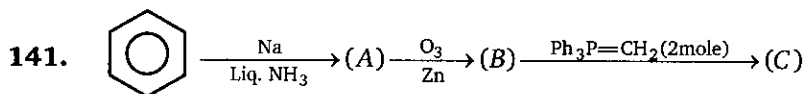
139. Which of the following compound does not evolve CO<sub>2</sub> gas, when undergo oxidative ozonolysis ?



140. *cis*-3-hexene  $\xrightarrow{(a)}$  meso 3,4-hexanediol  
*trans*-3-hexene  $\xrightarrow{(b)}$  meso 3,4-hexanediol.

Choose pair of reagent (a, b) for above conversions.

- (a) Cold KMnO<sub>4</sub>, OsO<sub>4</sub> (b) Cold KMnO<sub>4</sub>, RCO<sub>3</sub>H/H<sub>3</sub>O<sup>⊕</sup>  
 (c) RCO<sub>3</sub>H/H<sub>3</sub>O<sup>⊕</sup>, cold KMnO<sub>4</sub> (d) None of these

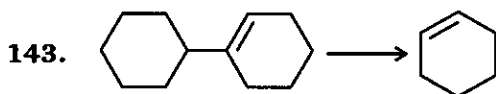


Product (C) of the above reaction is :

- (a) 1,3-hexadiene (b) 1,4-pentadiene  
 (c) 1,3-butadiene (d) 1,3-heptadiene

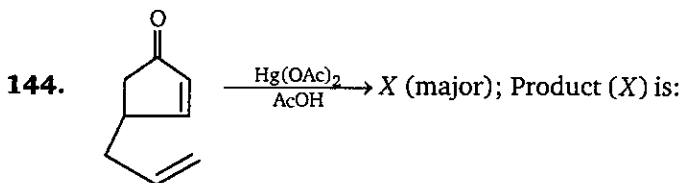
142. How many carbon-hydrogen bond orbitals are available for overlap with the vacant *p*-orbital in ethyl carbocation ?

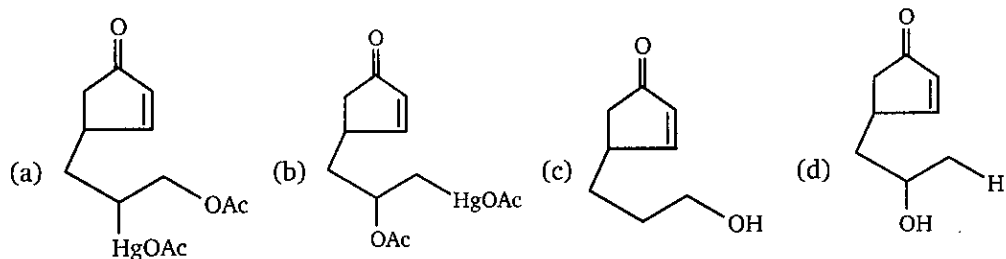
- (a) 0 (b) 3 (c) 5 (d) 6



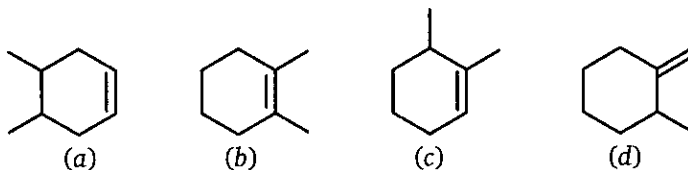
To achieve above conversion, the reagents used will be :

- (a) O<sub>3</sub>/H<sub>2</sub>O<sub>2</sub>, HO<sup>-</sup>/Δ (b) HBr, alc. KOH, O<sub>3</sub>, LiAlH<sub>4</sub>, H<sup>+</sup>/Δ  
 (c) HBr, *t*-BuOK, O<sub>3</sub>, KMnO<sub>4</sub>, Δ (d) HCl, KMnO<sub>4</sub> (cold), H<sup>+</sup>/Δ



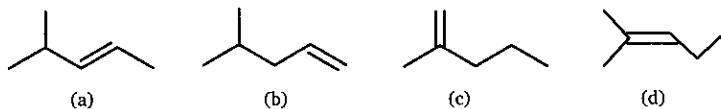


145. Decreasing order of heat evolved upon catalytic hydrogenation of given reactants with a  $H_2$  (Pd/C) is :



- (a)  $b > c > a > d$  (b)  $d > a > c > b$  (c)  $d > c > a > b$  (d)  $c > b > c > d$

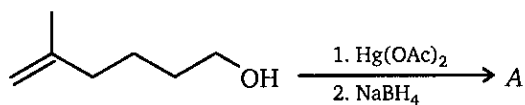
146.



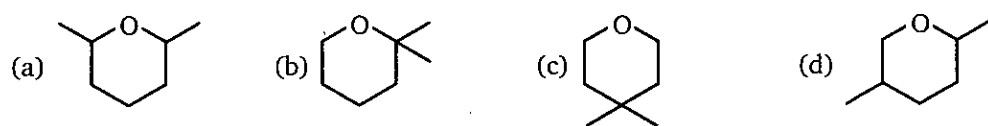
The correct order of heat of hydrogenation of given molecules is :

- (a)  $d > c > a > b$  (b)  $d > c > b > a$   
 (c)  $b > a > c > d$  (d)  $d > a > c > b$

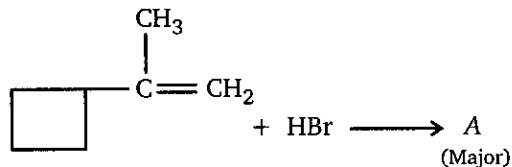
147.



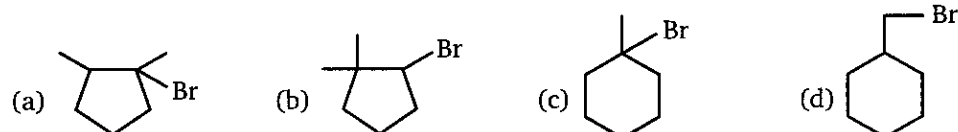
Product (A) of the above reaction is :



148.

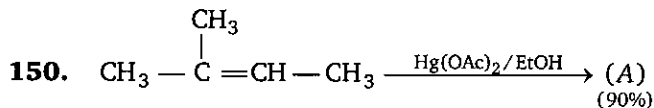


Product (A) is :

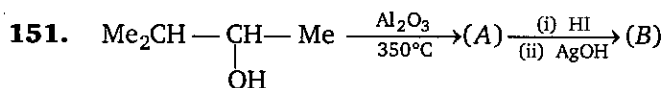
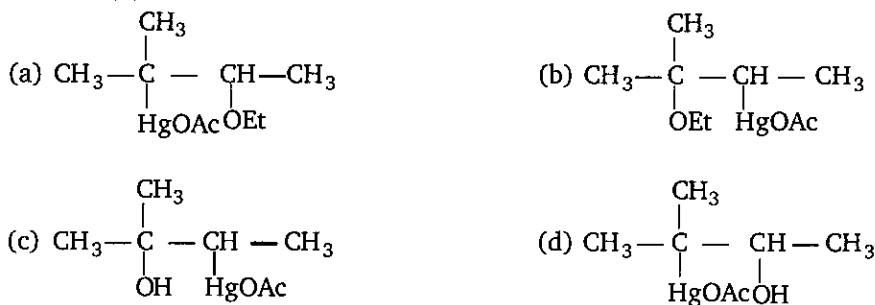




- (a) Racemic mixture  
 (b) Diastereomers  
 (c) Meso  
 (d) Optically inactive due to absence of chiral center



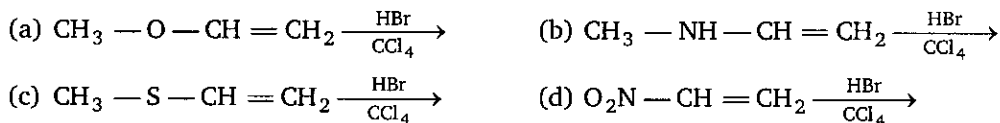
Product (A) of the above reaction is :



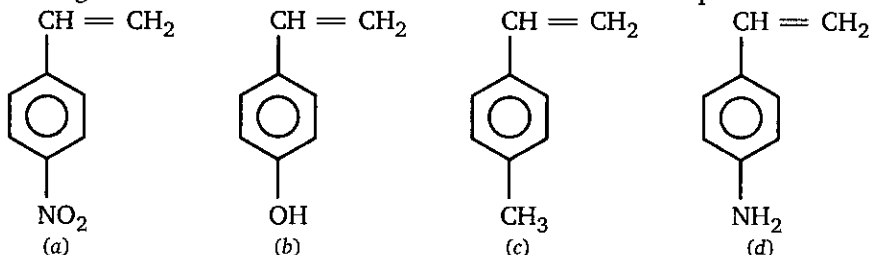
Product (B) of above reaction :

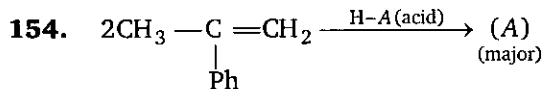
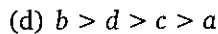
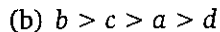
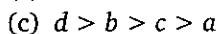
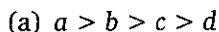


152. In which of the following reaction, Markownikoff's rule is violated ?

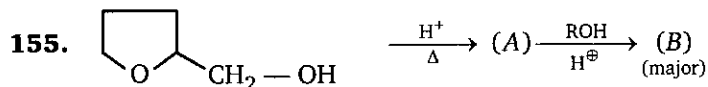
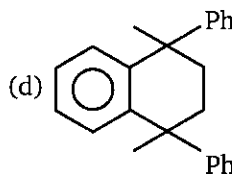
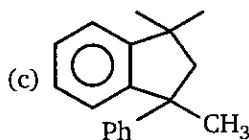
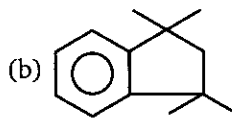
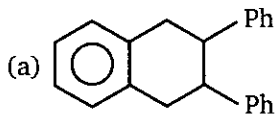


153. Decreasing order of rate of reaction of molecules towards electrophilic addition reaction is :

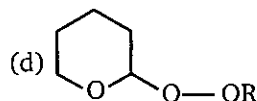
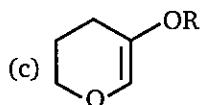
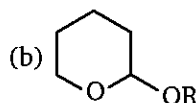
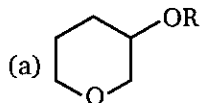




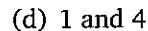
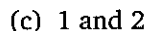
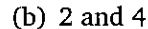
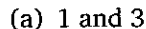
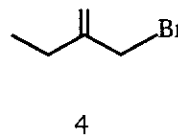
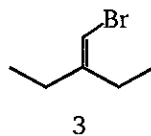
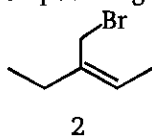
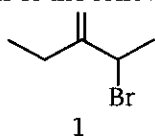
Product (A) is :



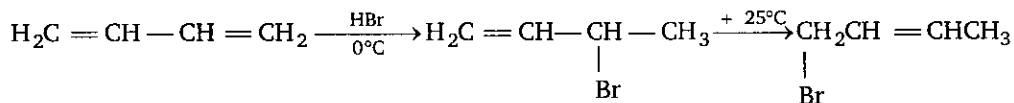
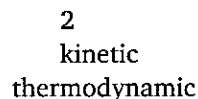
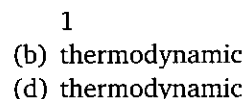
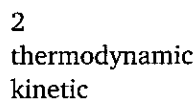
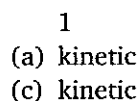
Product (B) of the above reaction is :



156. Which of the following compounds gives the same carbocation on ionization ?

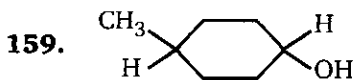
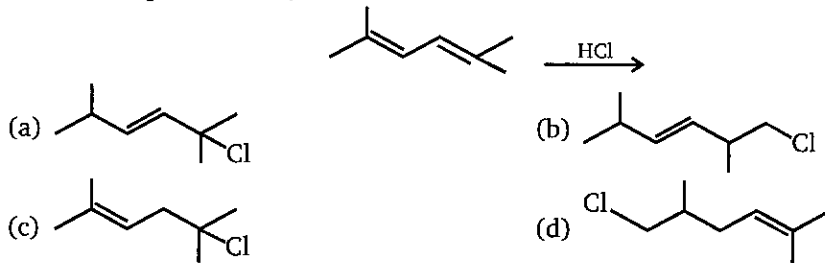


157. For the following reactions the major products are shown :

These provide an example of 1 control at low temperature and 2 control at higher temperature.

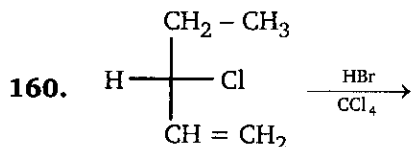


158. What is the product of 1, 4-addition in the reaction shown below ?



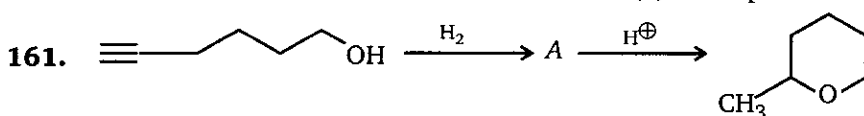
Dehydration of the above compound will give :

- (a) meso product (b) racemic mixture  
(c) diastereomer (d) optically pure enantiomer



What is stereochemistry of product ?

- (a) Racemic mixture (b) Optically inactive  
(c) Diastereomers (d) Meso product

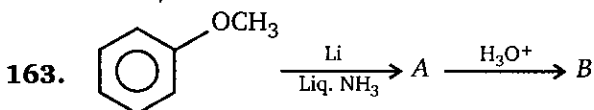


End product formed in the above reaction is :

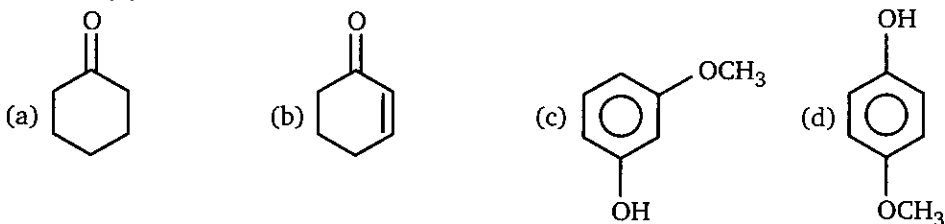
- (a) Optically active (b) Racemic (c) Meso (d) Diastereomer

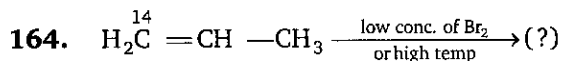
162. How many moles of  $\text{BH}_3$  are needed to react completely with 2 mole of 1-pentene in hydroboration-oxidation reaction ?

- (a) 2 mole (b) 3 mole  
(c) 2/3 mole (d) 3/2 mole



Product (B) in the above reaction is :



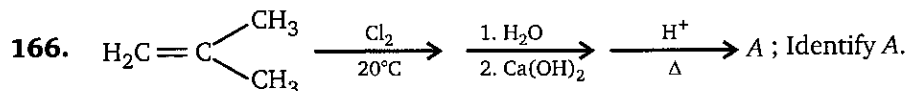


Product of the above reaction is :

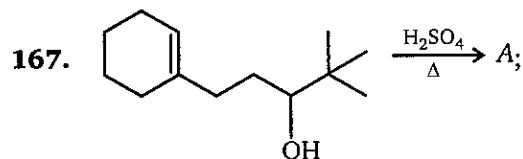
- (a)  $\text{H}_2\text{C}^{14}=\text{CH}-\text{CH}_2-\text{Br}$  (b)  $\text{H}_2\text{C}=\text{C}^{\text{H}}-\text{CH}_2^{14}-\text{Br}$   
 (c)  $\begin{array}{c} \text{CH}_2^{14} \\ | \\ \text{Br} \end{array} - \begin{array}{c} \text{CH} \\ | \\ \text{Br} \end{array} - \text{CH}_3$  (d) both (a) and (b)

165. In which of the following reactions 1,3-butadiene will be obtained as a major product ?

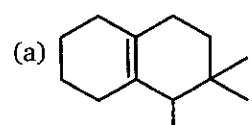
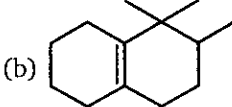
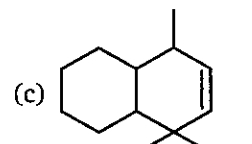
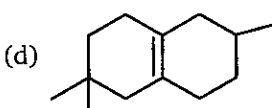
- (a)  $\text{Br}-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{Br} \xrightarrow[\text{(CH}_3\text{)}_3\text{COH}]{\text{(CH}_3\text{)}_3\text{COK (2mole)}}$   
 (b)  $\text{HO}-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{OH} \xrightarrow{\text{Conc. H}_2\text{SO}_4}$   
 (c)  $\text{H}_2\text{C}=\text{CH}-\text{C}\equiv\text{CH} \xrightarrow[\text{Ni}_2\text{B}]{\text{H}_2(1\text{mole})}$   
 (d) All of these

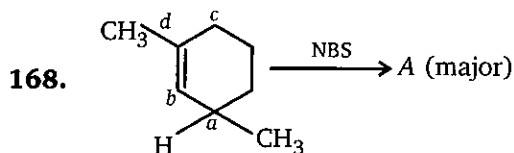


- (a)  $\begin{array}{c} \text{CH}_3 \\ | \\ \text{CH}_3-\text{C}-\text{CH}_2 \\ \diagup \quad \diagdown \\ \text{O} \end{array}$  (b)  $\begin{array}{c} \text{CH}_3-\text{CH}-\text{CHO} \\ | \\ \text{CH}_3 \end{array}$   
 (c)  $\begin{array}{c} \text{O} \\ || \\ \text{CH}_3-\text{C}-\text{CH}_2-\text{CH}_3 \end{array}$  (d)  $\begin{array}{c} \text{CH}_3 \\ | \\ \text{CH}_3-\text{C}=\text{CH}_2 \end{array}$



Product (A) is :

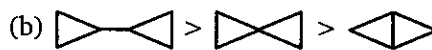
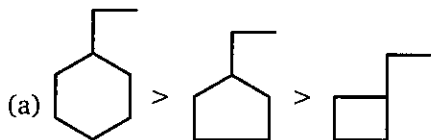
- (a)  (b)   
 (c)  (d) 



Bromination take place at :

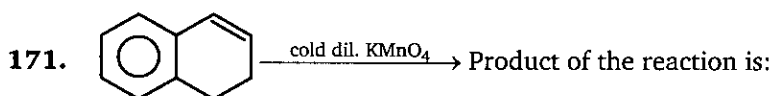
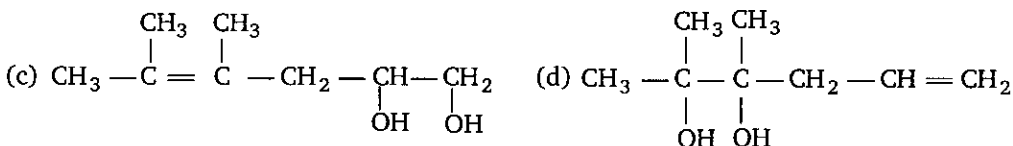
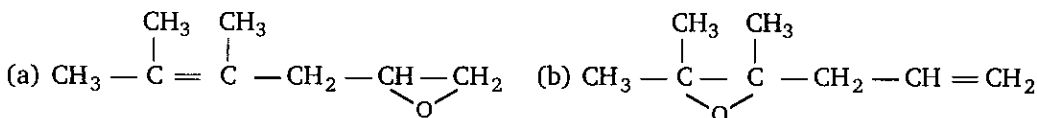
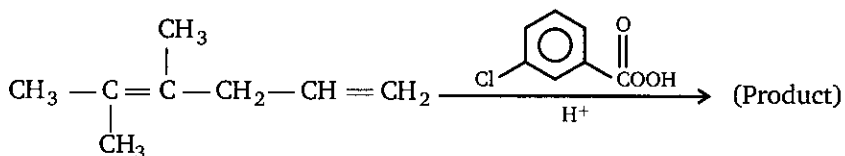
- (a) a (b) b (c) c (d) d

169. Which is incorrect statement about heats of combustion ?

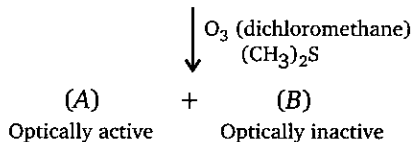
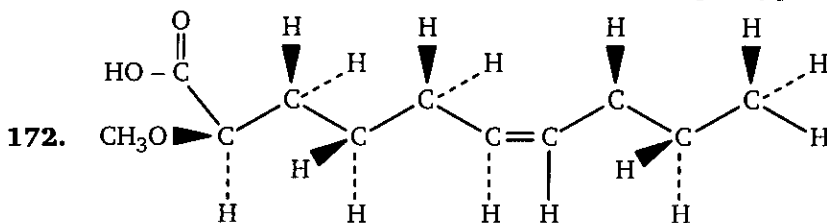


(c) Iso-butene > *trans*-2-butene > 1-butene (d) *n*-Hexane < *n*-Heptane < *n*-Octane

170. Predict the major product of the reaction.

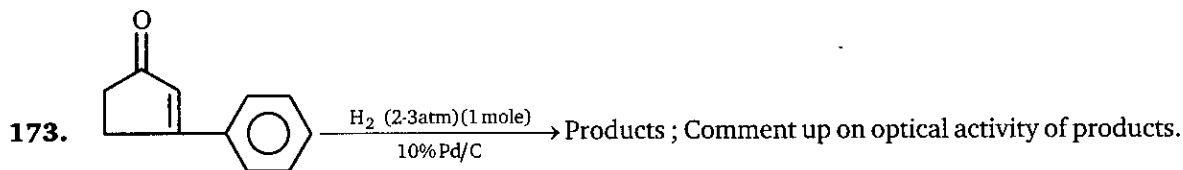


- (a) Meso compound (b) Enantiomeric pair  
(c) Diastereomers (d) Optically pure enantiomer

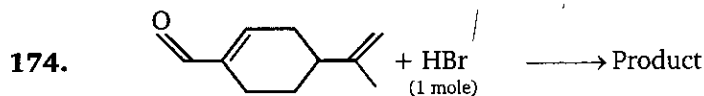


Product (A) of above reaction is:

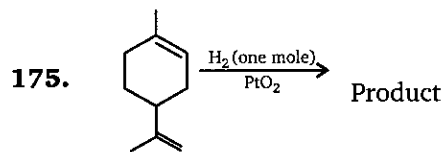
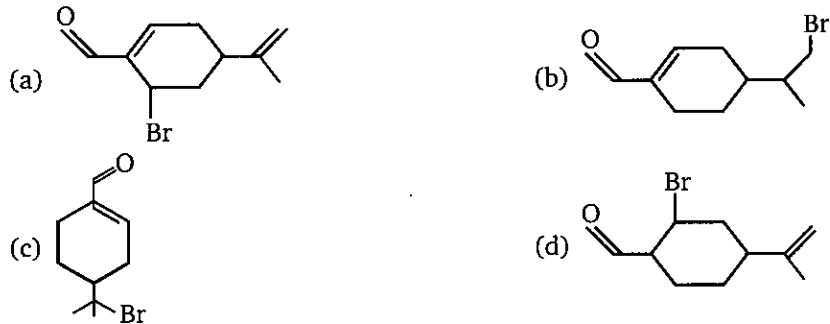
- (a)  $\text{CH}_3\text{O}-\underset{\text{CO}_2\text{H}}{\text{CH}}-\underset{\text{CO}_2\text{H}}{\text{CH}_2}-\text{CH}_2-\text{CHO}$
- (b)  $\text{CH}_3\text{O}-\text{CH}_2-\underset{\text{CO}_2\text{H}}{\text{CH}}-\text{CH}_2-\text{CO}_2\text{H}$
- (c)  $\text{CH}_3\text{O}-\underset{\text{CO}_2\text{H}}{\text{CH}}-\text{CH}_2-\text{CH}_2-\text{CO}_2\text{H}$
- (d)  $\text{CH}_3\text{O}-\underset{\text{CO}_2\text{H}}{\text{CH}}-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CHO}$



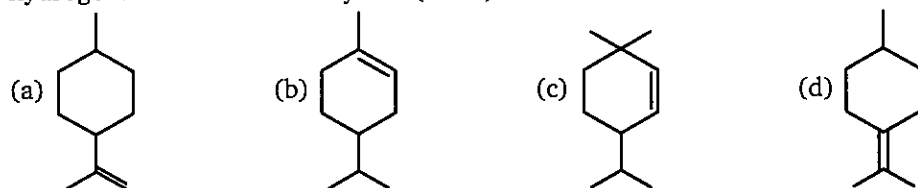
- (a) Diastereomers (b) Racemic mixture (c) Meso (d) Optically pure enantiomer

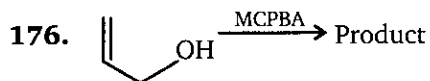


Addition of a mineral acid to an olefin bond leads to major product, Identify it:



In polyenes that contain differently substituted (C=C) double bonds, it is possible to hydrogenate chemoselectively one (C=C) double bond. Product is :

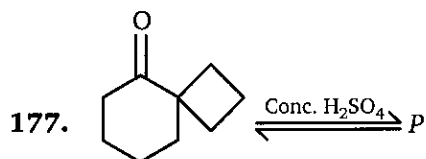




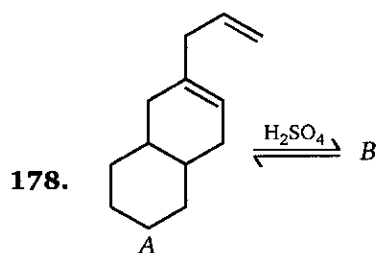
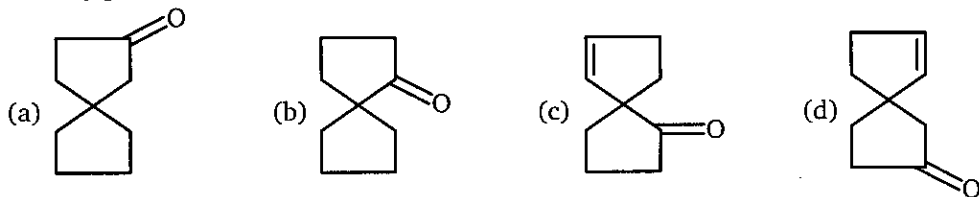
(MCPBA  $\rightarrow$  meta-chloro perbenzoic acid)

Stereochemistry of the product of above reaction is :

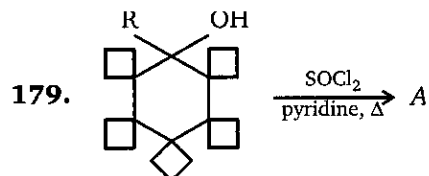
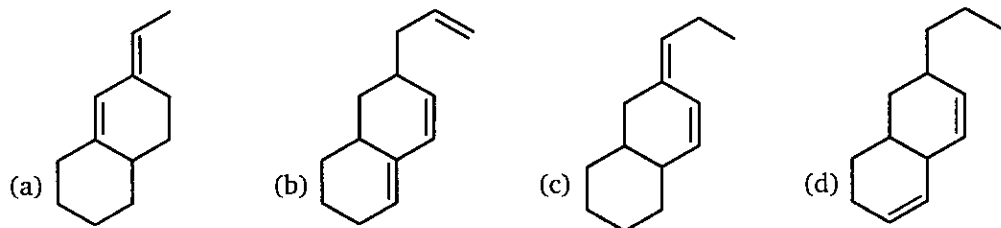
- (a) Meso (b) Racemic  
(c) Diastereomers  
(d) Optically inactive due to absence of chiral center.



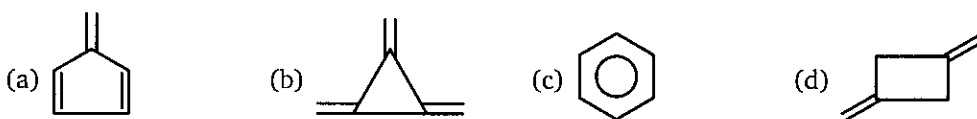
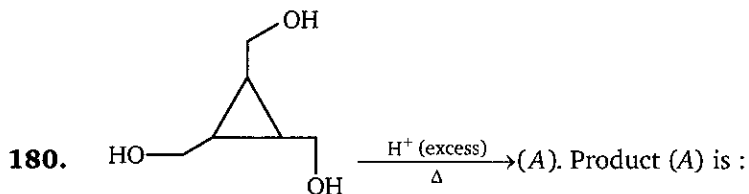
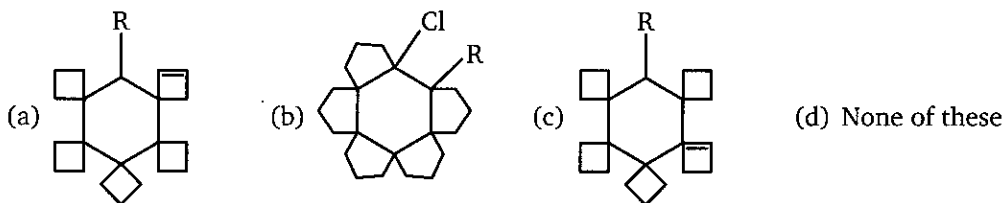
Identify product (P).



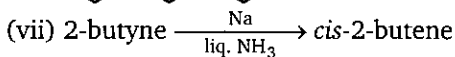
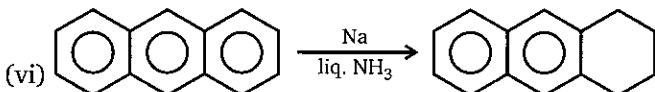
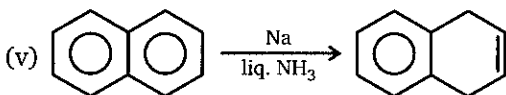
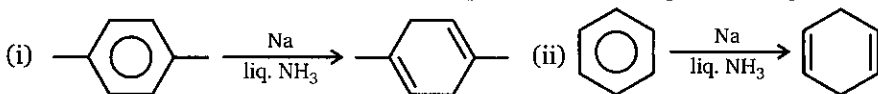
A isomerise to B on addition of traces of acid  $H_2SO_4$ . Compound (B) is :



Product (A) of the reaction is :



181. Which of the following reactions do not represent the major product of given Birch reductions ?

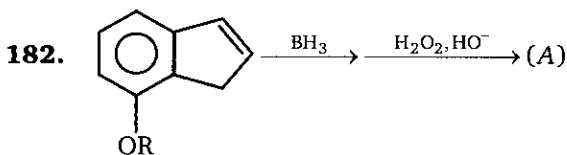


(a) (i), (iii), (vi)

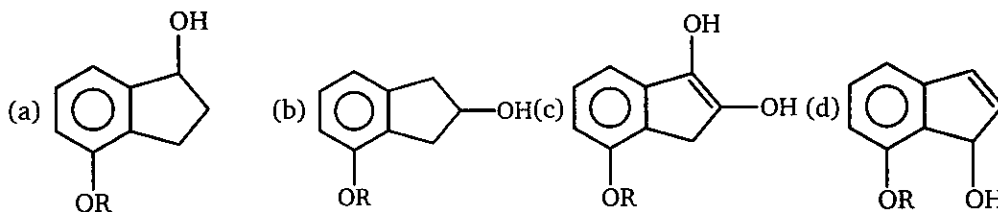
(b) (iv), (vi), (vii)

(c) (iv), (v), (vi)

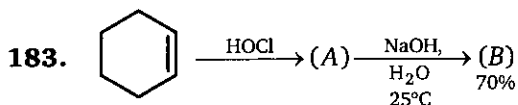
(d) (i), (ii), (v), (vii)



Product (A) is:

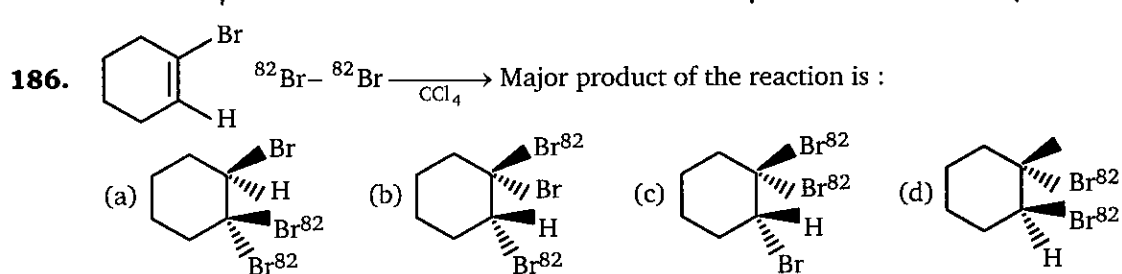
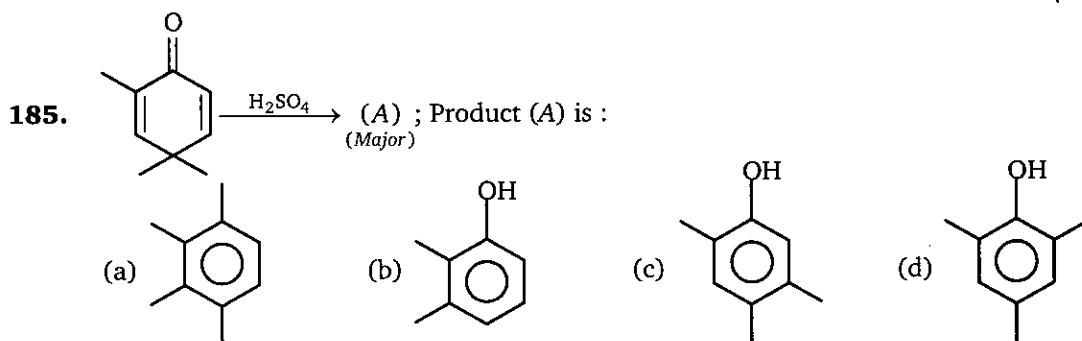
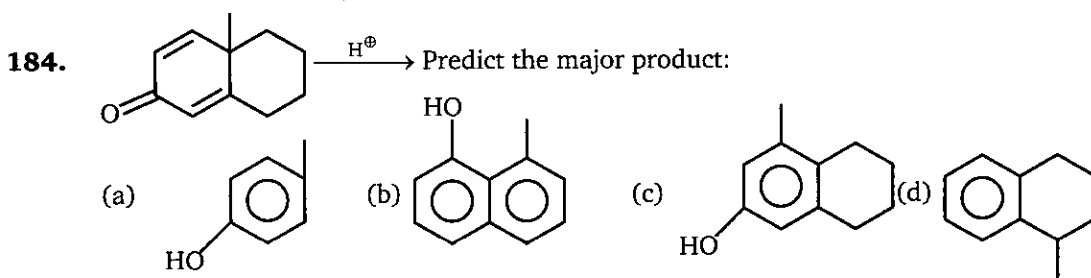


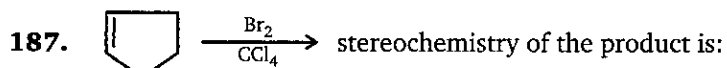
**Hint :** Think carefully about the relative stabilization of developing positive charge, when the double bond reacts with an electrophile.



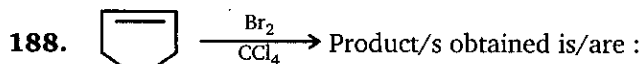
Correct statement about above reaction is:

- |  |                               |
|--|-------------------------------|
| (a) $A = \text{cis-2-chlorocyclohexanol}$ ,    | $B = \text{cyclohexeneoxide}$ |
| (b) $A = \text{trans-2-chloro cyclohexanol}$ , | $B = \text{anti-diol}$        |
| (c) $A = \text{trans-2-chlorocyclohexanol}$ ,  | $B = \text{cyclohexeneoxide}$ |
| (d) $A = \text{cis-2-chlorocyclohexanol}$ ,    | $B = \text{anti-diol}$        |

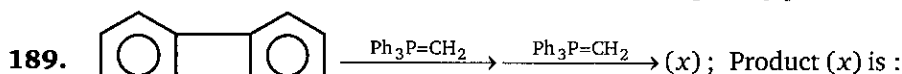


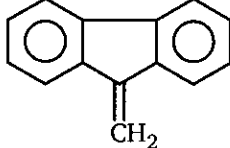
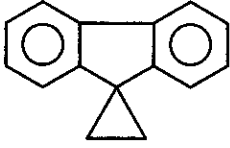
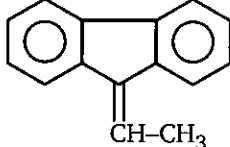
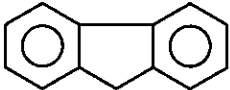


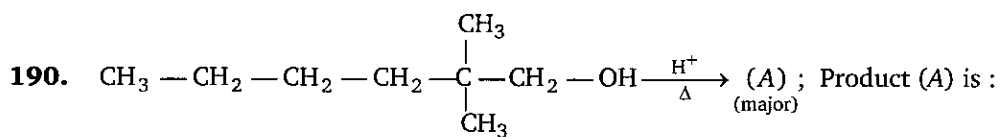
- (a) Diastereomers (b) Racemic mixture  
(c) Meso (d) Pure Enantiomers



- (a) Diastereomers (b) Racemic  
(c) Meso (d) Optically pure enantiomers

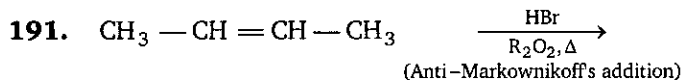


- (a)  (b)   
(c)  (d) 



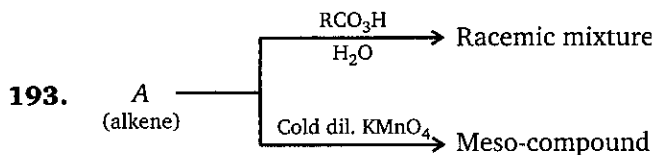
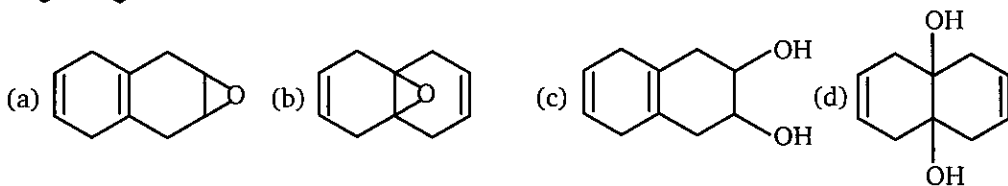
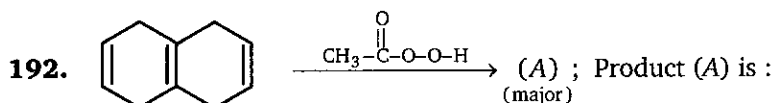
- (a)  $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{CH}_2 - \underset{\text{CH}_3}{\text{C}} = \text{CH} - \text{CH}_3$   
(b)  $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{CH}_2 - \text{CH} = \text{C} \begin{cases} \text{CH}_3 \\ \text{CH}_3 \end{cases}$   
(c)  $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{CH}_2 - \underset{\text{CH}_3}{\text{C}} = \text{CH}_2$   
(d)  $\text{CH}_3 - \text{CH}_2 - \underset{\text{CH}_3}{\text{CH}} - \text{CH}_2 - \underset{\text{CH}_3}{\text{C}} = \text{CH}_2$





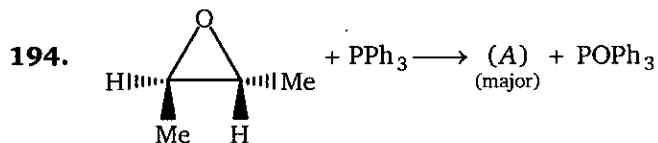
Comment on optical activity of the products:

- (a) Racemic (b) Diastereomer  
 (c) Meso (d) Optically pure enantiomer



Alkene (A) will be :

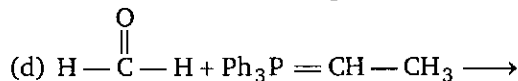
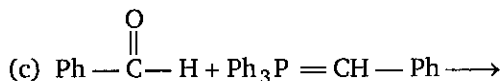
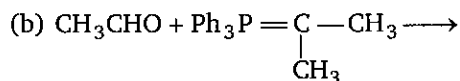
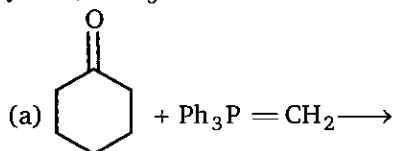
- (a) *cis*-2-pentene (b) *cis*-2-hexene  
 (c) *cis*-4-octene (d) *trans*-2-hexene



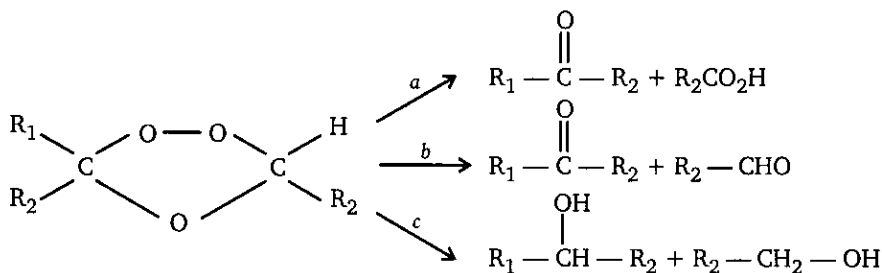
Product (A) is

- (a) *trans*-2-butene (b) *cis*-2-butene (c) 1-butene (d) Iso-butene

195. In which of the following reactions, two products will be formed other than phosphonium ylide ( $\text{POPh}_3$ )

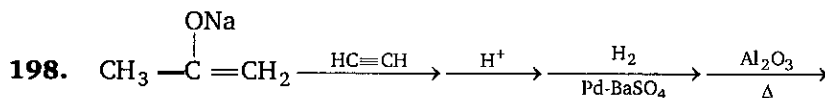
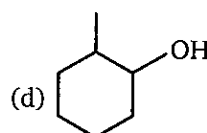
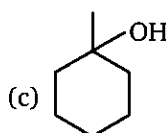
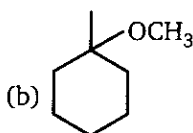
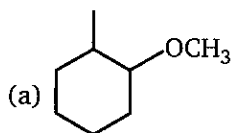
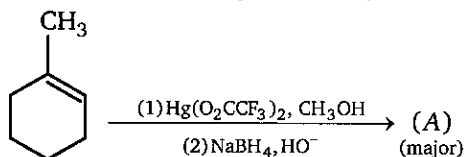


196. To carry out the given conversions, select the correct option:

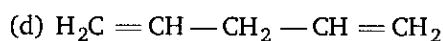
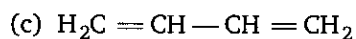
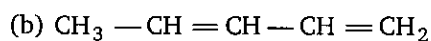
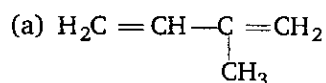


- (a)  $a = \text{Ag}_2\text{O}$ ,  $b = \text{Zn}/\text{CH}_3\text{CO}_2\text{H}$ ,  $c = \text{LiAlH}_4$   
 (b)  $a = \text{H}_2\text{O}_2$ ,  $b = \text{CH}_3 - \text{S} - \text{CH}_3$ ,  $c = \text{NaBH}_4$   
 (c) Both (a) and (b)  
 (d) None of these

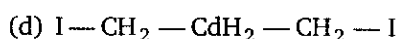
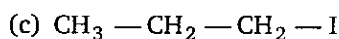
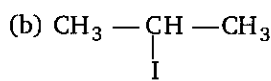
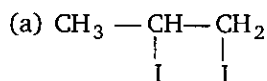
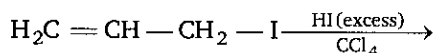
197. The product (A) of given alkoxymercuration de-mercuration is :



End product of the reaction is :



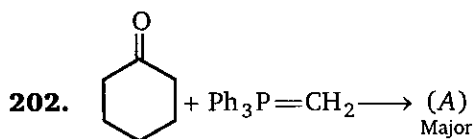
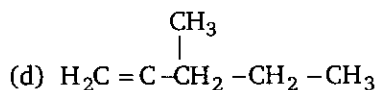
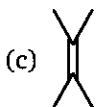
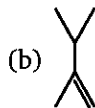
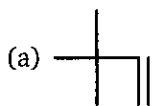
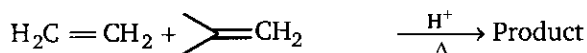
199. Major product of the given reaction is :



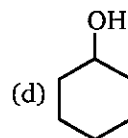
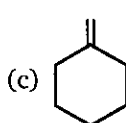
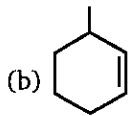
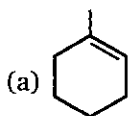
200. The rate constant for a reaction can be increased by a the stability of the reactant or by b the stability of the transition state. Select the correct choice for *a* and *b*.

- (a) decreasing, decreasing                      (b) increasing, decreasing  
(c) decreasing, increasing                      (d) increasing, increasing

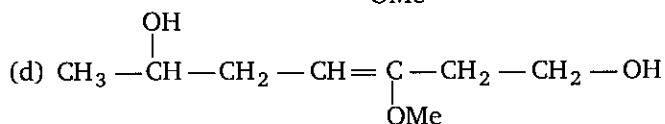
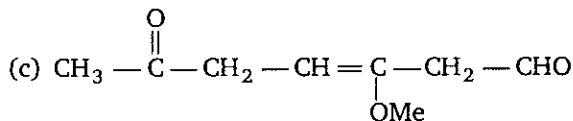
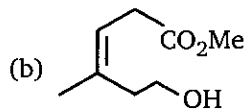
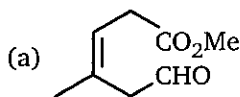
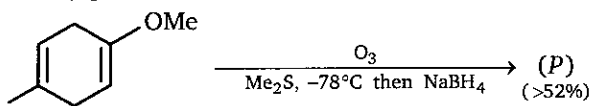
201. Major product of the given reaction is :

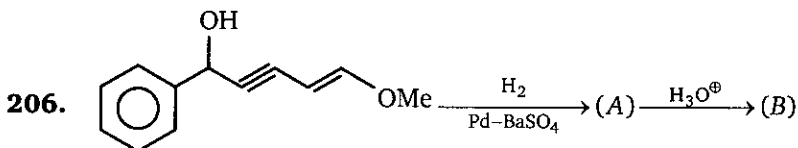
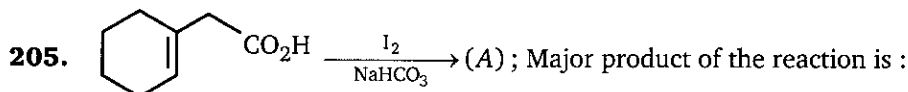
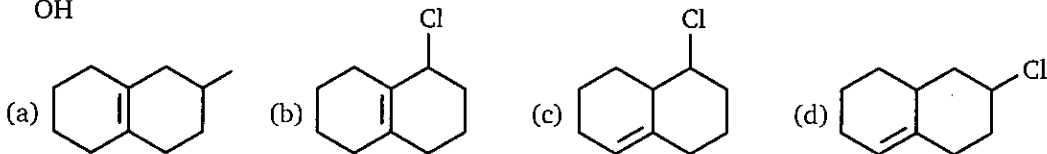
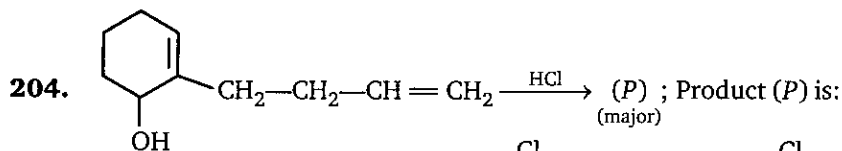


Major product (A) is :

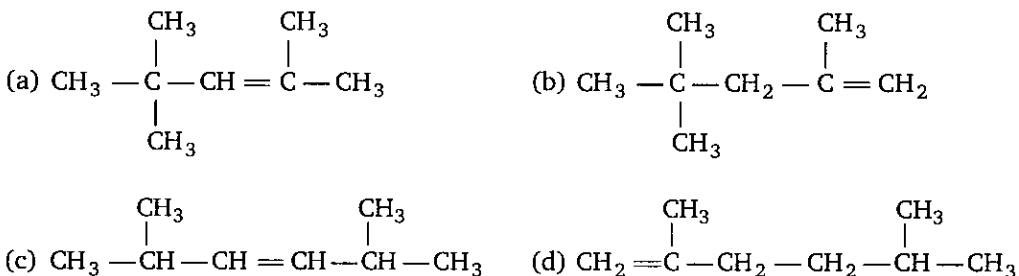
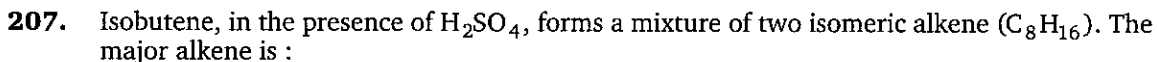
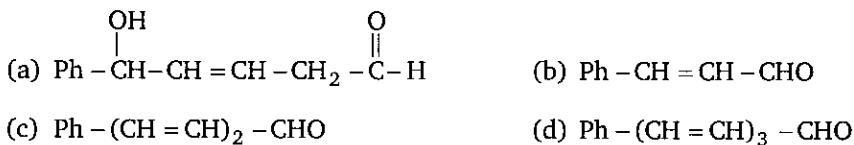


203. In the given reaction, only one alkene undergo preferential oxidation by electrophilic ozone. Identify product (P) of the given reaction:

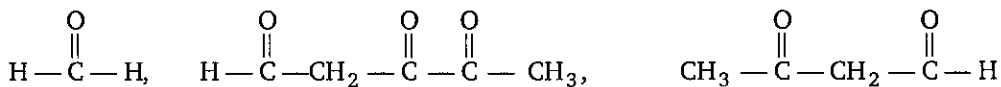




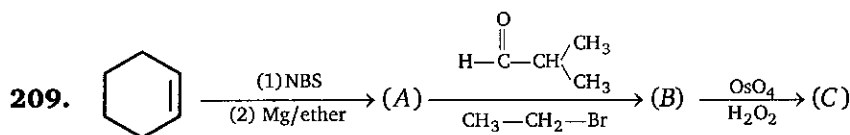
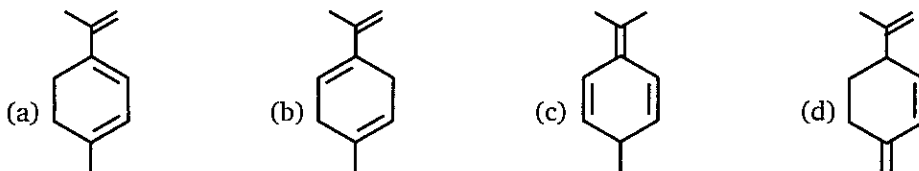
Product (B) is :



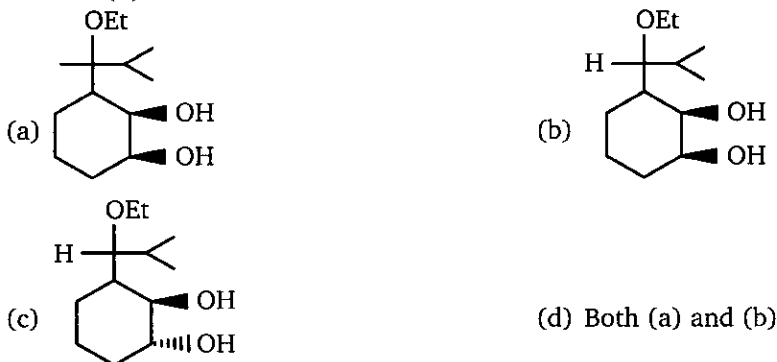
208. An unknown alkene (A) reacts with 3 mole of  $H_2$  gas in presence of platinum catalyst to form 1-isopropyl-4-methyl cyclohexane. When unknown alkene (A) is ozonized and reduced, following product are obtained



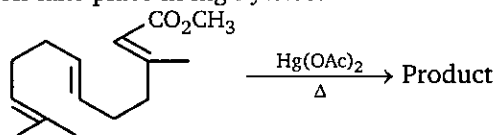
The alkene (A) is :



Product (C) is

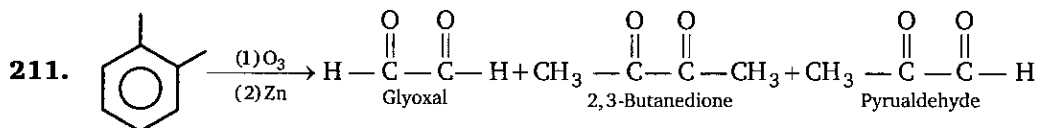
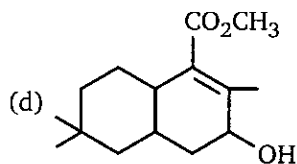
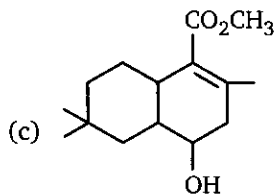


210. The following reaction take place in high yields.



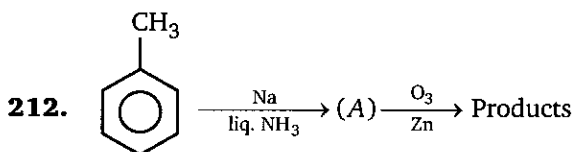
Use your knowledge of alkene chemistry to predict a product even though you have never seen this reaction before





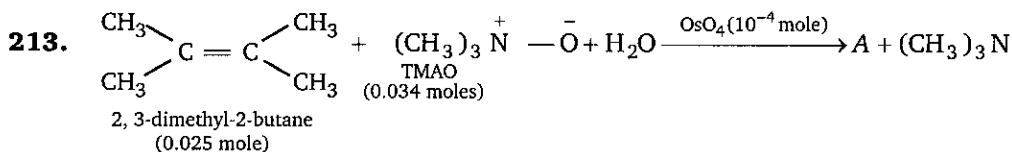
What is the ratio of glyoxal to pyruvaldehyde obtained in the above reaction ?

- (a) 1 : 3 (b) 3 : 1  
(c) 3 : 2 (d) 2 : 3



Which of the following product cannot be obtained in above reaction ?

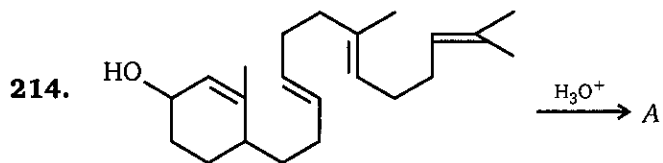
- (a)  $H-C(=O)-CH_2-C(=O)-H$  (b)  $CH_3-C(=O)-CH_2-C(=O)-H$   
(c)  $CH_3-CH(CHO)-C(=O)-H$  (d) None of these



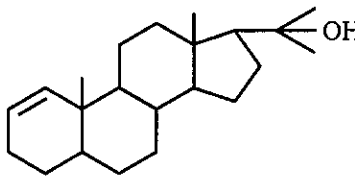
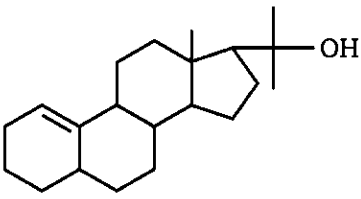
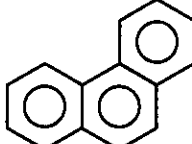
(TMAO  $\rightarrow$  trimethyl amine - N - oxide)

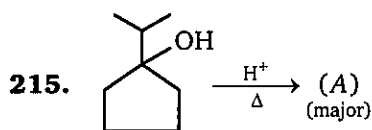
Product (A) is :

- (a) (b)   
(c)  $CH_3-C(=O)-CH_3$  (d)  $CH_3-C(=O)-C(CH_3)_3$



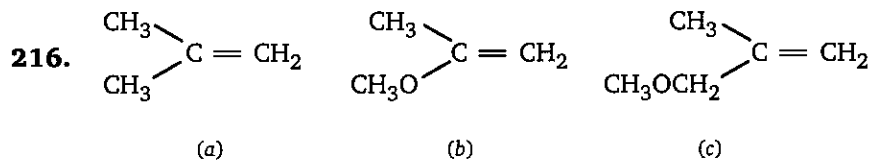
Product (A) of the reaction is :

- (a) 
- (b) 
- (c) 
- (d) None of these



Product (A) is :

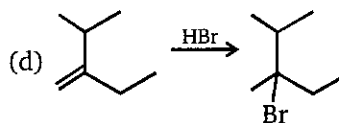
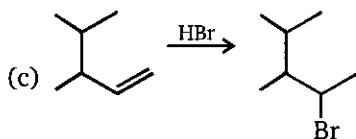
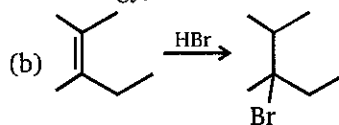
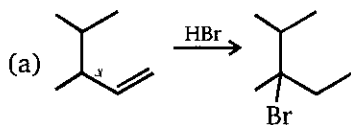
- (a) 
- (b) 
- (c) 
- (d) 



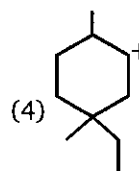
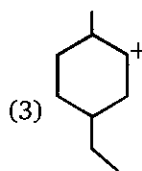
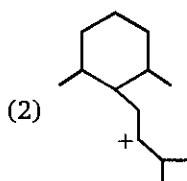
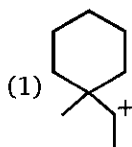
Arrange the above in the decreasing order of reactivity towards HBr :

- (a)  $a > b > c$
- (b)  $b > a > c$
- (c)  $b > c > a$
- (d)  $a > c > b$

217. Which reaction has the lowest  $\Delta G^\ddagger$  or (Activation-Energy)?



218. Which of the following will rearrange ?



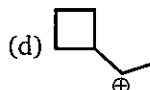
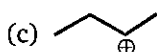
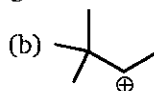
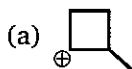
(a) 1

(b) 1 and 3

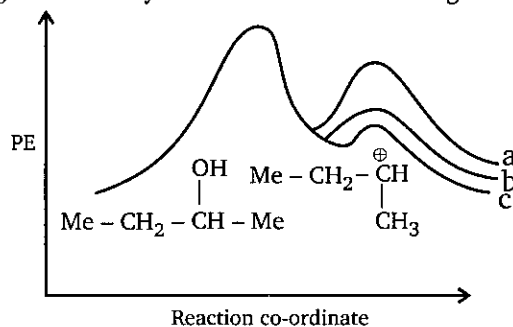
(c) All

(d) 1, 2, 4,

219. Which of the following is most likely to undergo a favorable hydride shift ?



220. Energy profile diagram for dehydration of 2-butanol using conc.  $\text{H}_2\text{SO}_4$  is given below :



Product (b) of above reaction is :

(a) 1-butene

(b) *cis*-2-butene

(c) *trans*-2-butene

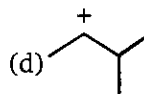
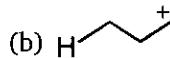
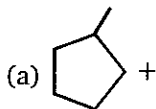
(d) *iso*-butene



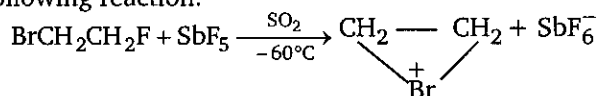
221. How many alkene on catalytic hydrogenation given isopentane as a product ?

- (a) 2 (b) 3  
(c) 4 (d) 5

222. Which of the following would not rearrange to a more stable form ?

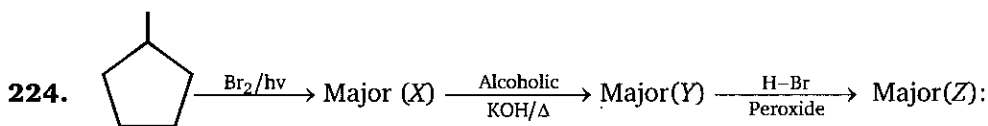


223. Consider the following reaction.

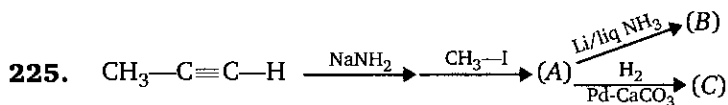
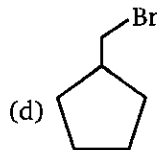
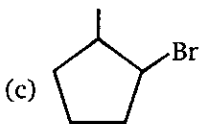
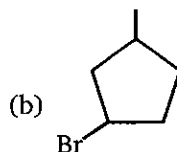
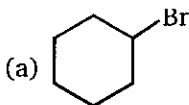


In this reaction  $\text{SbF}_5$  acts as:

- (a) an acid (b) a base  
(c) a nucleophile (d) an electrophile



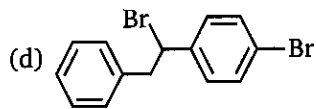
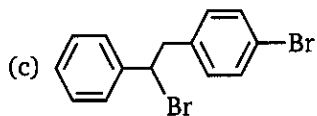
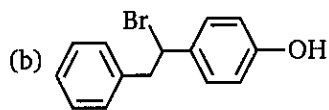
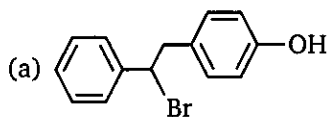
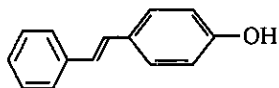
Product (Z) is:



Relation between (B) and (C) is:

- (a) Enantiomer (b) Diastereomer  
(c) Geometrical isomer (d) Meso

226. The reaction of HBr with the following compound would produce :



227. is an example of:

(a) Nucleophilic addition

(b) Nucleophilic substitution

(c) Electrophilic addition

(d) Electrophilic substitution

(e) Free radical substitution





1. **Reagents**

A. HCl	B. Br <sub>2</sub>	C. Hg(OAc) <sub>2</sub> in H <sub>2</sub> O	D. B <sub>2</sub> H <sub>6</sub> (BH <sub>3</sub> ) in ether
E. H <sub>2</sub> O <sub>2</sub>	F. KMnO <sub>4</sub> in H <sub>2</sub> O	G. HOBr	H. NaBH <sub>4</sub>

In each reagent box write a letter designating the best reagent and condition selected from the above list of reagents.

Reactant	Reagent	Product
$(\text{CH}_3)_2\text{CHCH}=\text{CH}_2$ 3-methyl-1-butene	(i) <input type="checkbox"/>	$(\text{CH}_3)_2\text{CHCH}(\text{Cl})\text{CH}_3$ 2-Chloro-3-methyl butane
	(ii) <input type="checkbox"/>	$(\text{CH}_3)_2\text{CHCHBrCH}_2\text{Br}$ 1,2-dibromo-3-methyl butane
	(iii) <input type="checkbox"/>	$(\text{CH}_3)_2\text{CHCHOHCH}_2\text{Br}$ 1, bromo-3-methyl 2-butanol
	(iv) <input type="checkbox"/>	$(\text{CH}_3)_2\text{CHCH}(\text{OH})\text{CH}_3$ 3-methyl-2-butanol
	(v) <input type="checkbox"/>	$(\text{CH}_3)_2\text{CHCH}(\text{OH})\text{CH}_2\text{OH}$ 3-methyl-1,2-butanediol

2. **Propene** ( $\text{CH}_3-\text{CH}=\text{CH}_2$ ) can be transformed to compounds (a to j) listed in the left-hand column.

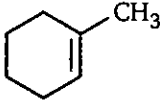
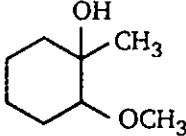
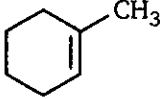
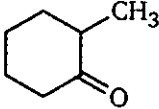
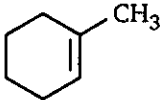
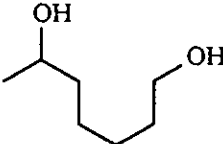
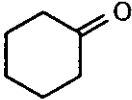
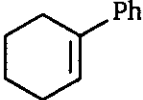

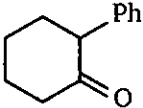
Write letter designating the reagent, you believe will achieve desired transformation. In the case of a multi step sequence write the reagent in the order they are to be used.

Desired Product	No. of Steps	Write options	Reagent List
a. $\text{CH}_3\text{CHBrCH}_2\text{Br}$	one	A.	Hg(OAc) <sub>2</sub> in H <sub>2</sub> O
b. $(\text{CH}_3)_2\text{CHOH}$	two	B.	B <sub>2</sub> H <sub>6</sub> in THF

c.	$\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$	two		C.	$\text{NaBH}_4$ in alcohol
d.	$\text{CH}_3\text{COCH}_3$	three		D.	$\text{Br}_2$ in $\text{CH}_2\text{Cl}_2$
e.	$\text{CH}_3\text{CH}_2\text{CHO}$	three		E.	$\text{H}_2\text{O}_2$ in aqueous base
f.	$\text{CH}_3\text{CH}(\text{OH})\text{CH}_2\text{Br}$	one		F.	$\text{HOBr}$ (NBS in aqueous acetone)
g.	$(\text{CH}_3)_2\text{CHBr}$	one		G.	$\text{HBr}$ in $\text{CH}_2\text{Cl}_2$
h.	$\text{CH}_3\text{CH}(\text{OH})\text{CH}_2\text{OH}$	two		H.	$\text{OsO}_4$ in ether
i.	$\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{Cl}$	three		I.	Thionyl chloride ( $\text{SOCl}_2$ )
j.	$\text{CH}_3 - \text{C} \equiv \text{CH}$	two		J.	$\text{NaHSO}_3$ in aqueous acetone
				K.	$\text{NaOH}$ in alcohol and reflux
				L.	$\text{NaNH}_2$ (strong base)

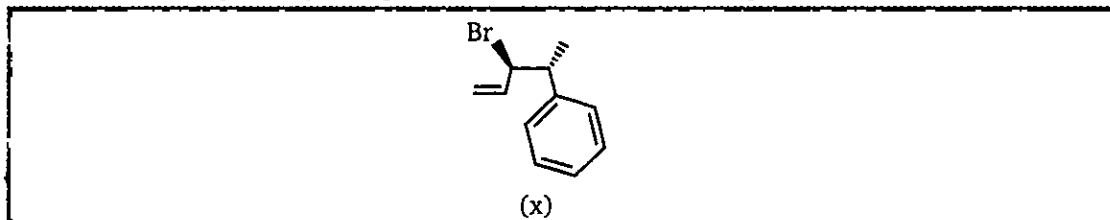
3. In each reaction box write a single letter designating the best reagent and condition selected from the list at bottom of the page.

(F.S., → first step, S.S → second step, T.S. → third step)

Reaction	Reactant	Options	Product
1.		$\xrightarrow[\text{S.S. } \square]{\text{F.S. } \square}$	
2.		$\xrightarrow[\text{T.S. } \square]{\text{S.S. } \square, \text{F.S. } \square}$	
3.		$\xrightarrow[\text{S.S. } \square]{\text{F.S. } \square}$	
4.		$\xrightarrow[\text{S.S. } \square]{\text{F.S. } \square}$	
5.		$\xrightarrow[\text{T.S. } \square]{\text{S.S. } \square, \text{F.S. } \square}$	

A. $\text{NaBH}_4/\text{alcohol}$	B. $\text{Ph}-\text{CO}_3\text{H}/\text{CH}_2\text{Cl}_2$	C. PCC	D. $\text{CH}_3\text{ONa}/\text{CH}_3\text{OH}$
E. $\text{B}_2\text{H}_6$ in THF	F. $\text{H}_2\text{O}_2/\text{aq. NaOH}$	G. $\text{H}_3\text{PO}_4$ & heat	H. $\text{AlCl}_3/\text{C}_6\text{H}_6$
I. $\text{O}_3$ in $\text{CH}_2\text{Cl}_2$	J. $\text{Br}_2$ in $\text{CH}_2\text{Cl}_2$	K. 20% KOH & heat	L. $\text{Ph}-\text{Li}/\text{ether}$

4. Match the reagents a-j with products A-J. There is one best product for each reaction.



The molecule (x) is the starting material for all reactions in problem. Do the ones you know first and then tackle the rest by deductive reasoning

Products		Reagents	Option
<b>A</b>	<b>B</b>	(a) H <sub>2</sub> O heat, pH 7	
<b>C</b>	<b>D</b>	(b)	
<b>E</b>	<b>F</b>	(c) tBuOK, polar aprotic solvent	
<b>G</b>	<b>H</b>	(d) (1) O <sub>3</sub> , ether (2) H <sub>2</sub> O, NaOH, H <sub>2</sub> O <sub>2</sub>	
<b>I</b>	<b>J</b>	(e) Br <sub>2</sub> , CCl <sub>4</sub>	
<b>K</b>	<b>L</b>	(f) NBS, hv, CCl <sub>4</sub>	
<b>M</b>	<b>N</b>	(g) (1) H <sub>3</sub> O(+) (2) NaOH, H <sub>2</sub> O	
<b>O</b>	<b>P</b>	(h) (1) BH <sub>3</sub> , ether (2) H <sub>2</sub> O <sub>2</sub>	
<b>Q</b>	<b>R</b>	(i) (1) OsO <sub>4</sub> (2) NaOH, H <sub>2</sub> O	
<b>S</b>	<b>T</b>	(j) H <sub>2</sub> /Pd/C(EtOH)	

## 5. Match the column:

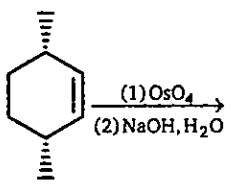
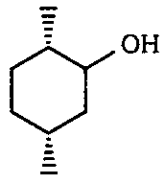
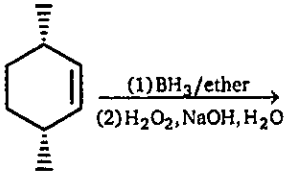
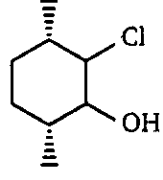
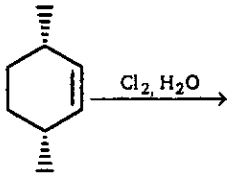
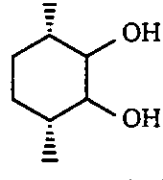
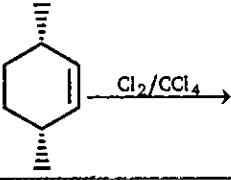
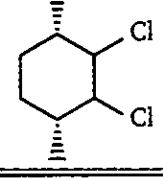
Column (I)		Column (II)	
(a)	$\text{CH}_3-\text{C}\equiv\text{C}-\text{CH}_3$	(p)	<i>cis</i> -product with $\text{H}_2/\text{Pd} - \text{BaSO}_4$
(b)	$\text{CH}_3-\text{CH}_2-\text{C}\equiv\text{CH}$	(q)	<i>Trans</i> -product with $\text{Na}/\text{liq. NH}_3$
(c)	$\text{CH}_3-\text{C}\equiv\text{CH}$	(r)	White with amm. $\text{AgNO}_3$
(d)	$\text{CH}_3-\text{C}\equiv\text{C}-\text{Et}$	(s)	$\text{H}_2$ gas with $\text{Na}$

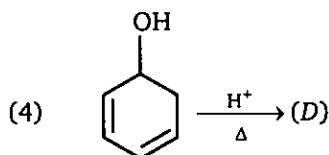
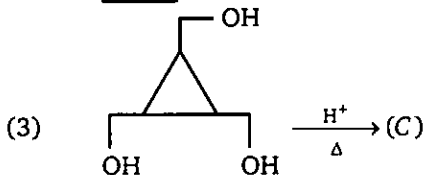
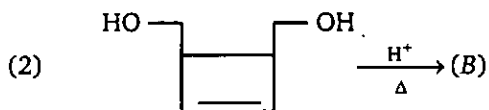
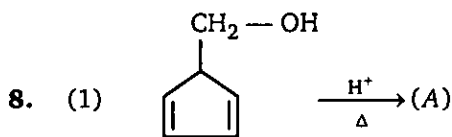


6. Match the column I with column II and with column III (Matrix).

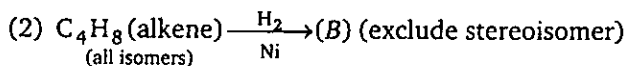
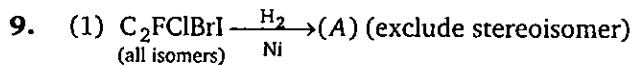
Column-I		Column- II		Column- III	
Reaction		Nature of product formed		Number of chiral center present in product. (Consider only one isomer in case of racemic mixture or Diastereomer)	
(a)		(p)	Racemic mixture	(w)	0
(b)		(q)	Meso	(x)	1
(c)		(r)	Diastereomer	(y)	2
(d)		(s)	Vicinal dihalide	(z)	3

## 7. Match the column I and II.

Column (I)		Column (II)	
	Reaction		Product
(a)		(p)	
(b)		(q)	
(c)		(r)	
(d)		(s)	



Sum of molecular mass of A, B, C, D (i.e. A + B + C + D) is equal to :



Total number of products A and B (i.e. A + B) is equal to :

10.

Reaction 1	Reaction 2
$  \begin{array}{c}  CH_3 \\    \\  H - C - Br \\    \\  CH \\     \\  CH \\    \\  H - C - Br \\    \\  CH_3  \end{array}  \xrightarrow[CCl_4]{(cis) Br_2} (P)  $	$  \begin{array}{c}  CH_3 \\    \\  H - C - Br \\    \\  CH \\     \\  CH \\    \\  H - C - Br \\    \\  CH_3  \end{array}  \xrightarrow[CCl_4]{(trans) Br_2} (Q)  $
Reaction 3	Reaction 4
$  \begin{array}{c}  CH_3 \\    \\  H - C - Br \\    \\  CH \\     \\  CH \\    \\  CH_3  \end{array}  \xrightarrow[CCl_4]{(cis) Br_2} (R)  $	$  \begin{array}{c}  CH_3 \\    \\  H - C - Br \\    \\  CH \\     \\  CH \\    \\  CH_3  \end{array}  \xrightarrow[CCl_4]{(trans) Br_2} (S)  $

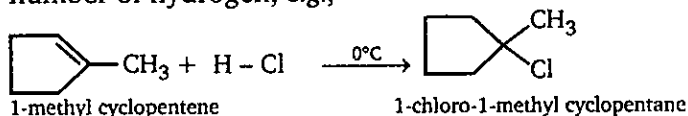
Sum of products P, Q, R, S (i.e. P + Q + R + S) is equal to :

## 11. Comprehension

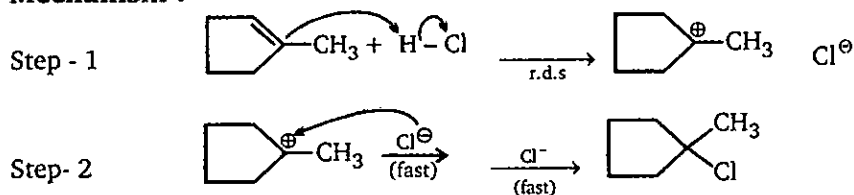
Vladimir Markovnikov rule :

Alkenes undergo electrophilic addition reactions. It is triggered by the acid acting as an electrophile toward  $\pi$ -electrons of the double bond.

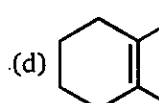
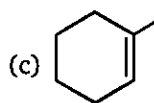
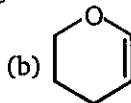
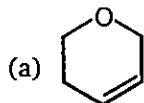
Markovnikov's rule states that when an unsymmetrically substituted alkene reacts with a hydrogen halide, the hydrogen atom adds to the carbon that has the greater number of hydrogen, e.g.,



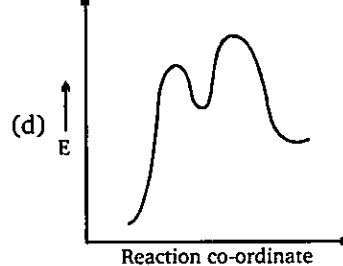
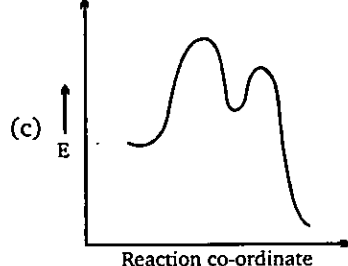
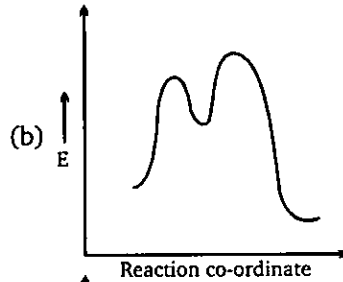
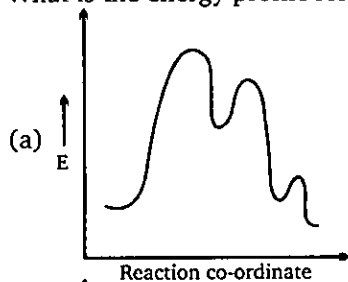
**Mechanism :**



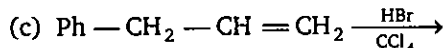
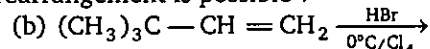
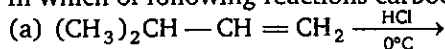
A. Which of the following is most reactive toward Markovnikov addition ?



B. What is the energy profile for the given reaction ?

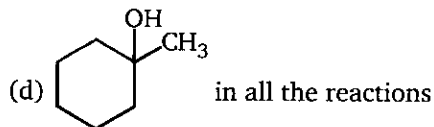
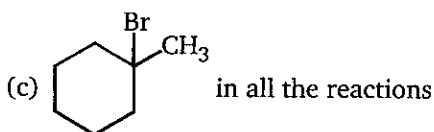
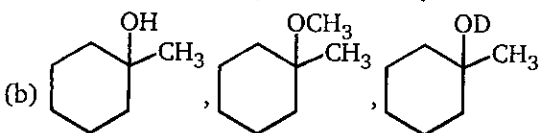
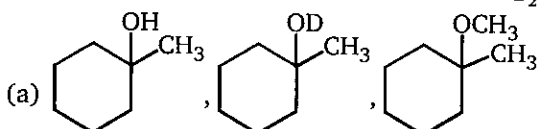
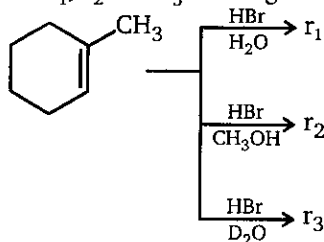


C. In which of following reactions carbocation rearrangement is possible ?

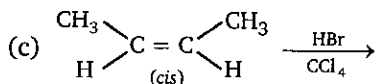
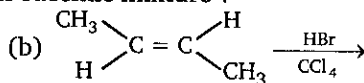
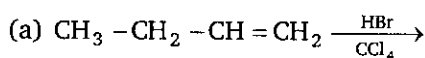


(d) All of these

D. Identify the major products  $r_1$ ,  $r_2$  and  $r_3$  in the given reactions.

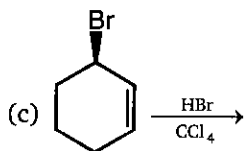
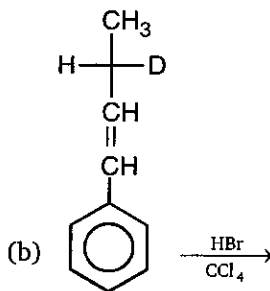
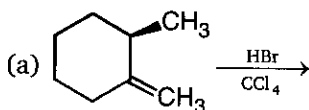


E. In which of the following reactions, product is racemic mixture ?



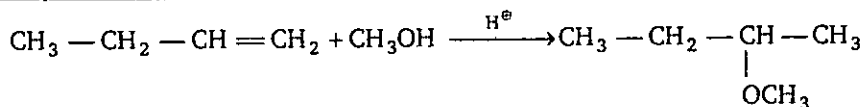
(d) All of these

F. In which of the following reactions, diastereomers will be formed ?



(d) All of these

## 12. Comprehension



Consider the above reaction and answer A to E.

- A.** What is electrophile in first step ?  
 (a)  $\text{CH}_3^\oplus$  (b)  $\text{H}^\oplus$   
 (c)  $\text{CH}_3 - \text{CH}_2 - \text{CH}^\oplus - \text{CH}_3$  (d)  $\text{HO}^\oplus$
- B.** What is nucleophile in first step ?  
 (a)  $\text{CH}_3\text{OH}$  (b) 1-butene  
 (c)  $\text{H}_2\text{O}$  (d)  $\text{CH}_3 - \text{O} - \text{CH}_3$
- C.** What is electrophile in second step ?  
 (a)  $\text{CH}_3^\oplus$  (b)  $\text{H}^\oplus$   
 (c)  $\text{CH}_3 - \text{CH}_2 - \text{CH}^\oplus - \text{CH}_3$  (d)  $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{CH}_2^\oplus$
- D.** What is nucleophile in second step ?  
 (a)  $\text{CH}_3 - \text{CH}_2 - \text{CH} = \text{CH}_2$  (b)  $\text{CH}_3\text{OH}$   
 (c)  $\text{H}_2\text{O}$  (d)  $\text{CH}_3 - \text{O} - \text{CH}_3$
- E.** Which step is rate determining step ?  
 (a) attack of nucleophile  $\text{CH}_3\text{OH}$  (b) attack of electrophile  $\text{H}^\oplus$   
 (c) attack of nucleophile  $\text{H}_2\text{O}$  (d) attack of electrophile  $\text{CH}_3^\oplus$

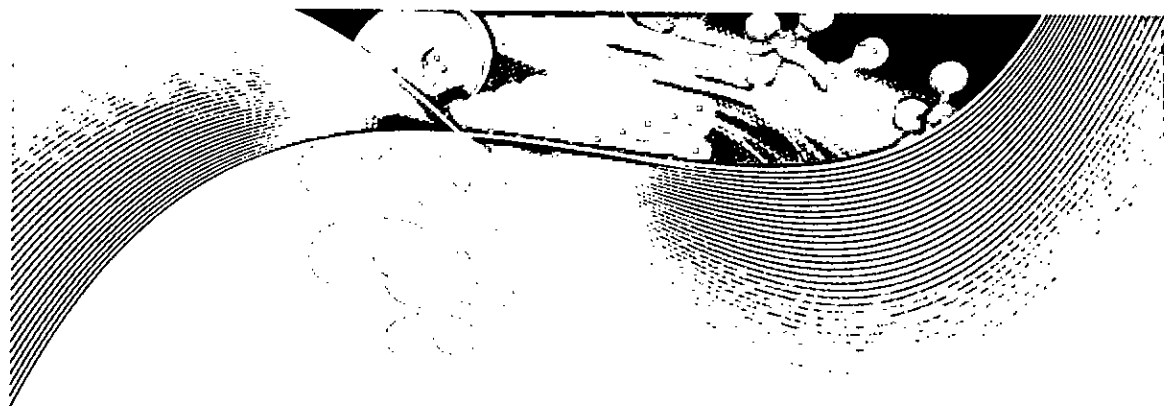
## 13. Match the column I and II :

Column (I)		Column (II)	
Conversion		Reagent	
(a)		(p)	$\text{SO}_2\text{Cl}_2 / h\nu$ (2 equivalent)
(b)		(q)	NBS (2 equivalent)
(c)		(r)	NBS then $\text{SO}_2\text{Cl}_2/h\nu$
(d)		(s)	$\text{SO}_2\text{Cl}_2 / h\nu$ then NBS

## ANSWERS — LEVEL 2

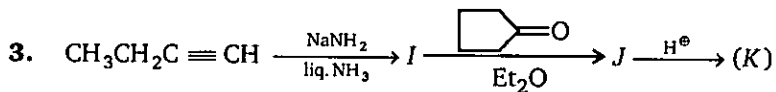
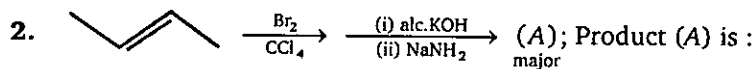
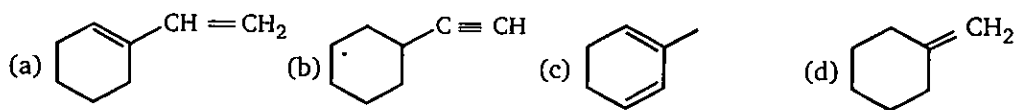
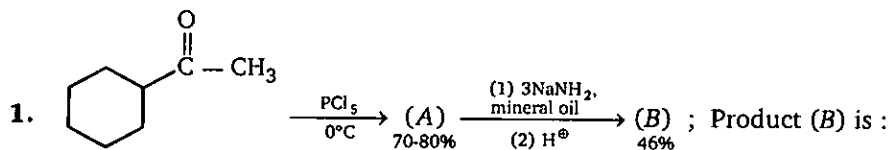
1. (i) - A; (ii) - B; (iii) - G; (iv) - C; (v) - F
2. a - D; b - A, C; c - B, E; d - A, C, F; e - B, E, F; f - F; g - G; h - I, K; i - B, E, I; j - D, L
3. Reaction 1 : B, D;            Reaction 2 : E, F, C            Reaction 3 : I, A  
       Reaction 4 : L, G            Reaction 5 : B, L, C
4. a - C; b - D; c - A; d - F; e - I; f - J; g - E; h - H; i - B; j - G
5. a - p, q; b - r, s; c - r, s; d - p, q
6. a - r, s - z; b - p, s - y; c - p, s - y; d - q, s - y
7. a - r; b - p; c - q; d - s
8.  $A + B + C + D = 312$
9.  $A + B = 5$
10.  $P + Q + R + S = 8$
11. A - b; B - c; C - d; D - b; E - d; F - d
12. A - b; B - b; C - c; D - b; E - b
13. a - q; b - p; c - s; d - r



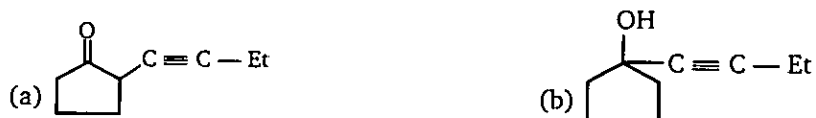


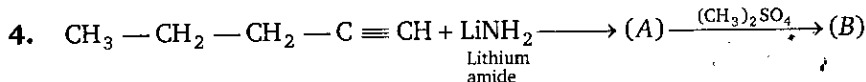
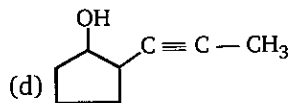
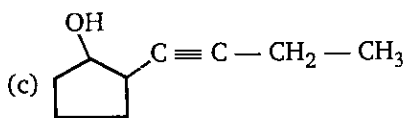
# 4C HYDROCARBONS (ALKYNES)

## LEVEL-1

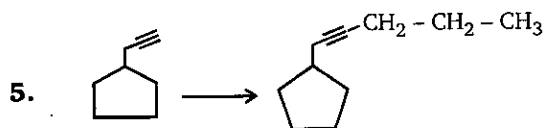
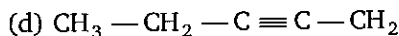
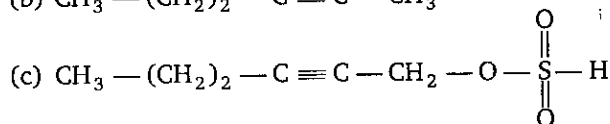
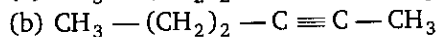
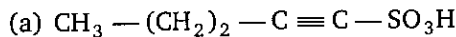


Product (K) of the above reaction is :

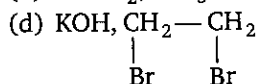
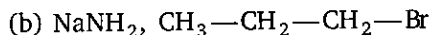
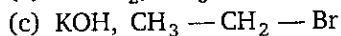
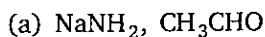




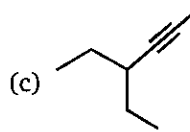
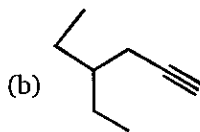
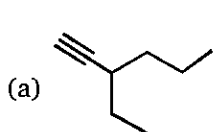
Give the structural formula of compound (B) :



; This conversion can be achieved by :

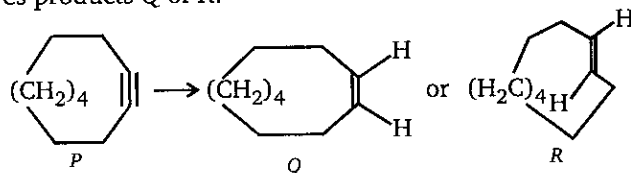


6. Which alkyne will give 3-ethylhexane on catalytic hydrogenation ?

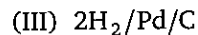
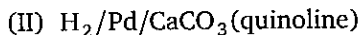
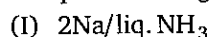


(d) All of these

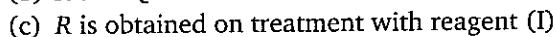
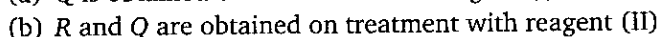
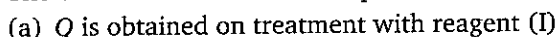
7. Reactant P gives products Q or R.



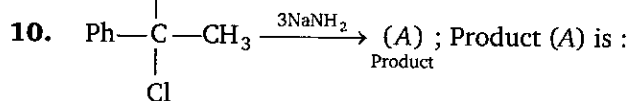
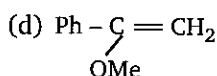
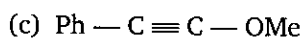
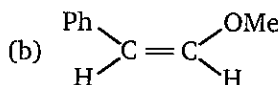
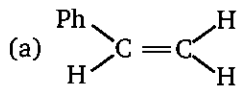
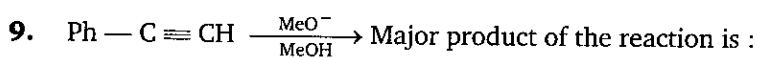
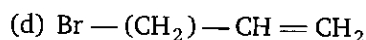
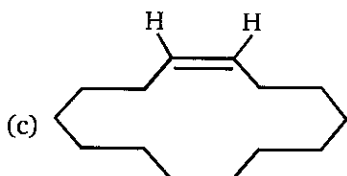
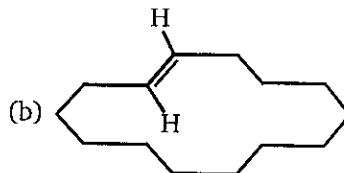
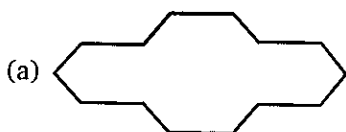
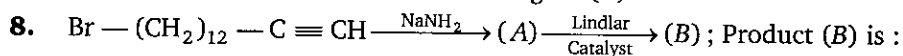
The possible reagents are :



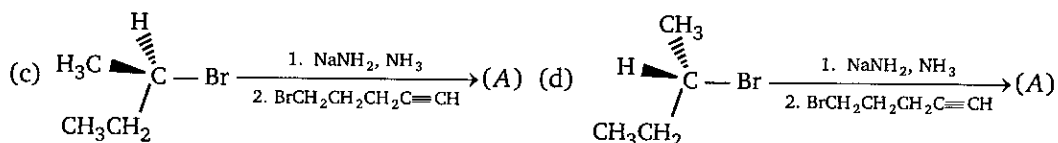
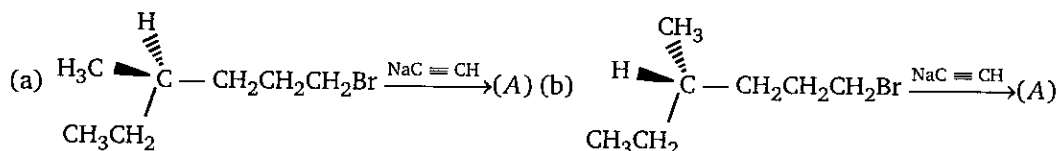
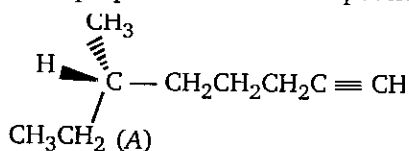
The correct statement with respect to the above conversion is/are :



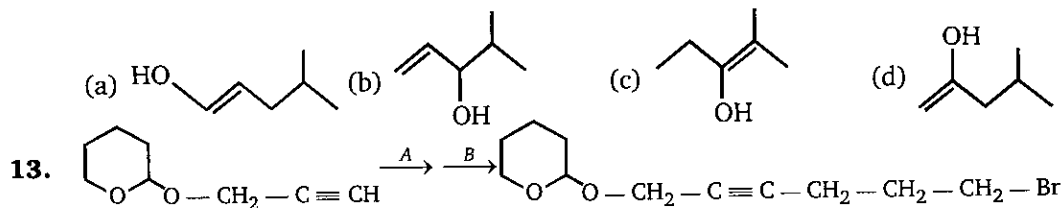
(d) R is obtained on treatment with reagent (II)



11. Which combination is best for preparation of the compound (A) shown below ?

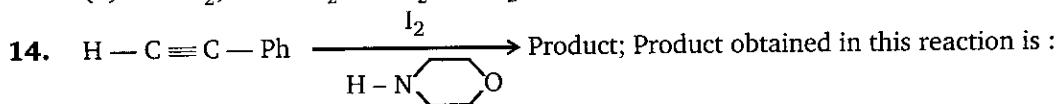


12. Which one of the following is the intermediate in the preparation of a ketone by hydration of an alkyne in the presence of sulfuric acid and mercury (II) sulphate ?

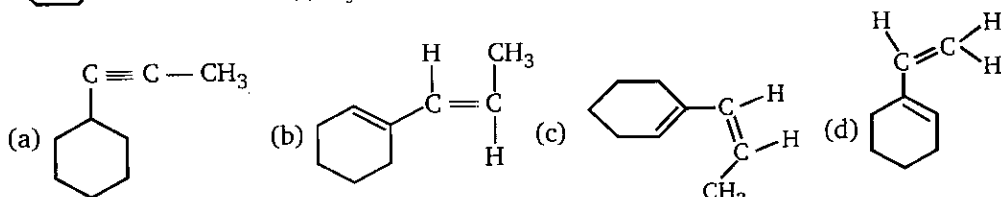
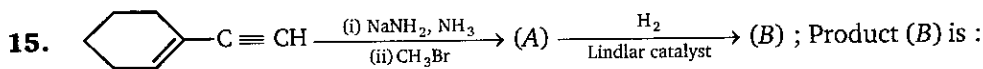


To carry out above conversion, (A) and (B) respectively, are :

- (a)  $\text{NaNH}_2, \text{Cl}-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{Br}$   
 (b)  $\text{NaNH}_2, \text{F}-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{Br}$   
 (c)  $\text{NaNH}_2, \text{I}-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{Br}$   
 (d)  $\text{NaNH}_2, \text{I}-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{I}$

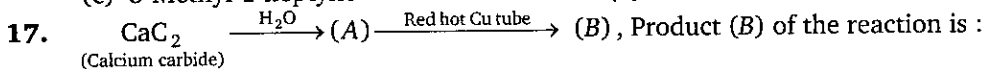


- (a)  $\text{Ph}-\underset{\text{I}}{\text{C}}=\text{CH}-\text{I}$  (b)  $\text{Ph}-\underset{\text{I}}{\text{CH}}-\text{CH}_2-\text{I}$   
 (c)  $\text{Ph}-\text{C}\equiv\text{C}-\text{I}$  (d)  $\text{I}-\text{C}\equiv\text{C}-\text{H}$



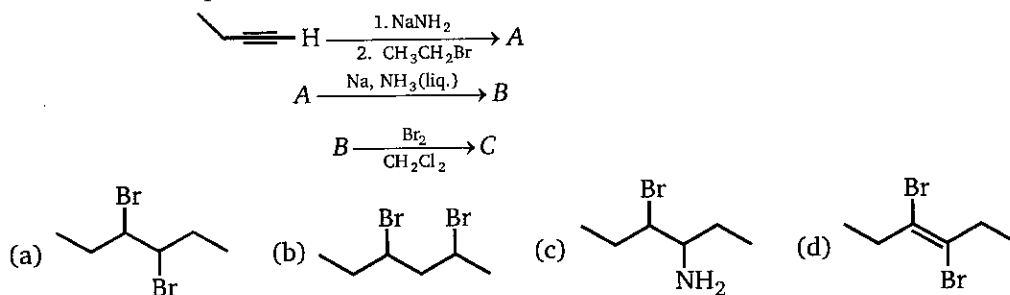
16. Which of the following alkyne on treatment with  $\text{H}_2$  (2 mole) / Pt gives an optically inactive compound ?

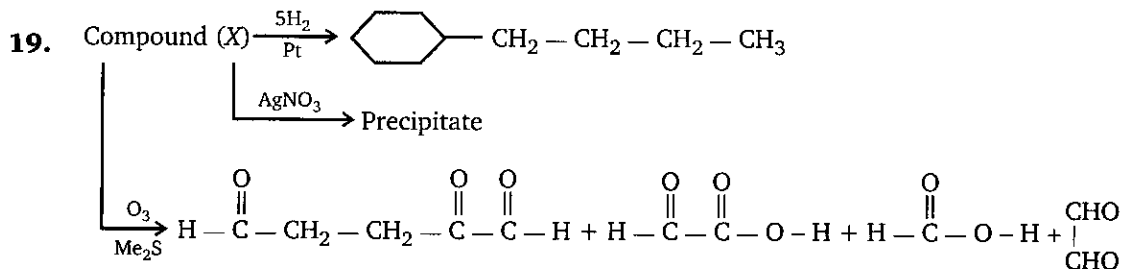
- (a) 3-Methyl-1-pentyne (b) 4-Methyl-1-hexyne  
 (c) 3-Methyl-1-heptyne (d) None of the above







- (a) Toluene (b) Ethyl-benzene (c) Benzene (d) Butyne

18. What is the final product, C, of the following reaction sequence ?





Compound (X) will be :

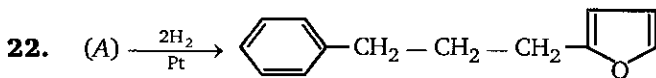
- (a)  - CH = CH - C ≡ CH
- (b)  = CH - CH<sub>2</sub> - C ≡ CH
- (c)  = CH - CH<sub>2</sub> - C ≡ CH
- (d)  = C = CH - C ≡ CH

20. Choose the sequence of steps that describes the best synthesis of 1-butene from ethanol :

- (a) (1) NaC ≡ CH ; (2) H<sub>2</sub>, Lindlar Pd  
 (b) (1) NaC ≡ CH ; (2) Na, NH<sub>3</sub>  
 (c) (1) HBr, heat ; (2) NaC ≡ CH ; (3) H<sub>2</sub>, Lindlar Pd  
 (d) (1) HBr, heat ; (2) KOC(CH<sub>3</sub>)<sub>3</sub>, DMSO ; (3) NaC ≡ CH ; (4) H<sub>2</sub>, Lindlar catalyst

21. Which alkyne yields butanoic acid (CH<sub>3</sub>CH<sub>2</sub>CH<sub>2</sub>CO<sub>2</sub>H) as the only organic product on treatment with ozone followed by the hydrolysis ?

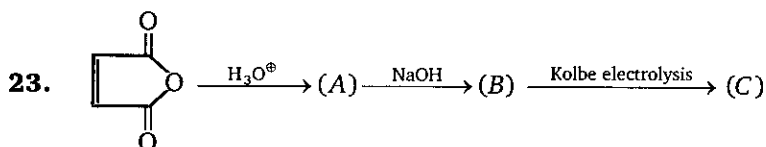
- (a) 1-Butyne                      (b) 4-Octyne                      (c) 1-Pentyne                      (d) 2-Hexyne



Carlina oxide

Unit of unsaturation in compound (A) ?

- (a) 7                                      (b) 8                                      (c) 9                                      (d) 10



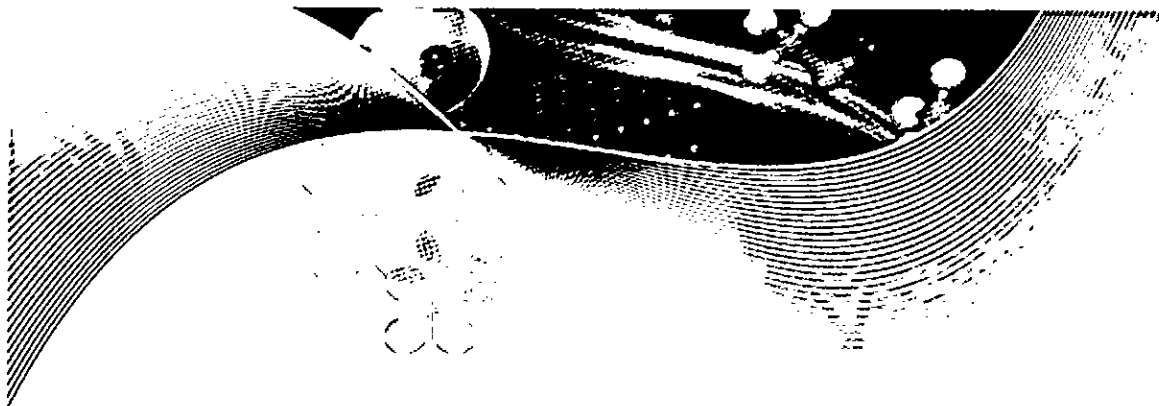
Product (C) of above reaction is:

- (a) H<sub>2</sub>C = CH<sub>2</sub>                                      (b) CH<sub>3</sub> - C ≡ C - CH<sub>3</sub>  
 (c) HC ≡ CH                                      (d) CH<sub>3</sub> - CH = CH - CH<sub>3</sub>

24. To convert 1-butyne to 1-D-butanol, one would carry out the following steps :

- (I) Sodium amide, then D<sub>2</sub>O  
 (II) Disiamylborane, then hydrogen peroxide/sodium hydroxide  
 (III) The transformation can not be carried out with the indicated reagents.  
 (a) I, followed by II    (b) II, followed by I    (c) III                                      (d) II





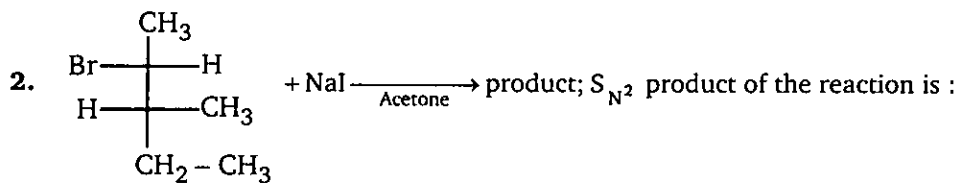
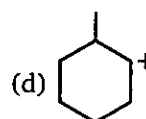
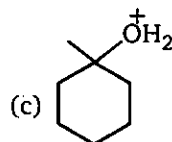
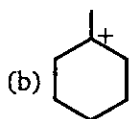
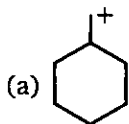
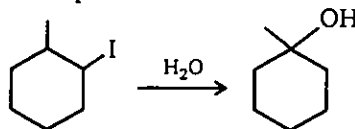
# 5A

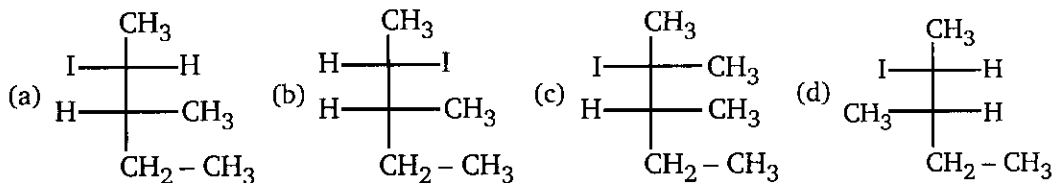
## ALKYL HALIDES

### Substitution Reactions ( $S_{N1}$ , $S_{N2}$ , $S_{Nl}$ )



1. Which of the following is not expected to be intermediate of the following reaction ?

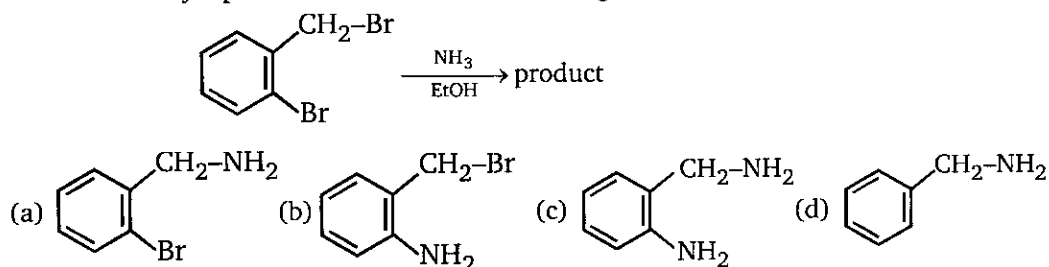




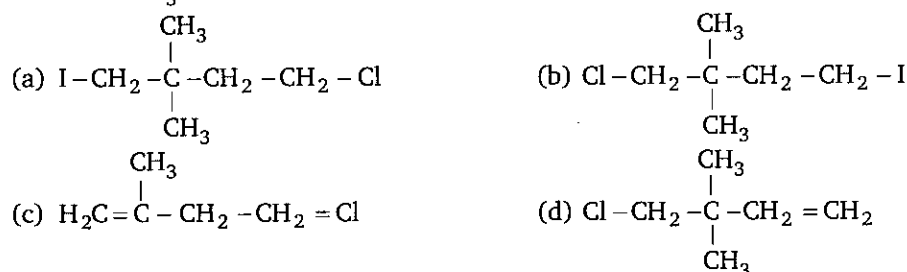
3. Rate of  $S_N2$  will be negligible in :



4. What is the major product obtained in the following reaction ?

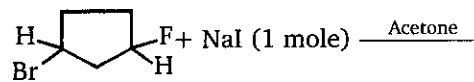


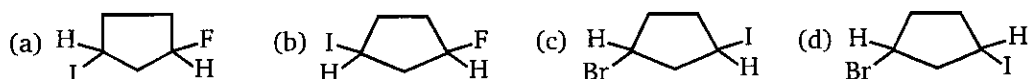
5.  $\text{Cl}-\text{CH}_2-\overset{\text{CH}_3}{\underset{\text{CH}_3}{\text{C}}}-\text{CH}_2-\text{CH}_2-\text{Cl} + \text{I}^- \xrightarrow{\text{DMF}}$  product; Major product of this reaction is:



6. Which of the following expressions is representative of the rate law for a  $S_N2$  reaction ?

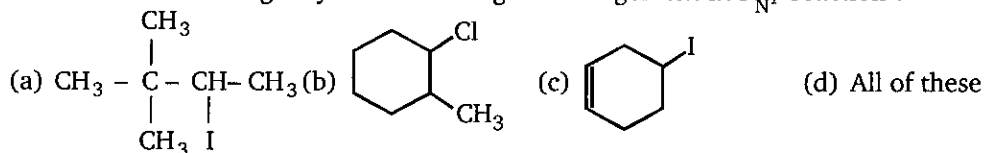
- (a) Rate =  $k$  [electrophile] (b) Rate =  $k$  [electrophile] [nucleophile]  
 (c) Rate =  $k$  [nucleophile]<sup>2</sup> (d) Rate =  $k$  [electrophile]<sup>2</sup>

7.  + NaI (1 mole)  $\xrightarrow{\text{Acetone}}$  (A) ; Major product of this reaction is :

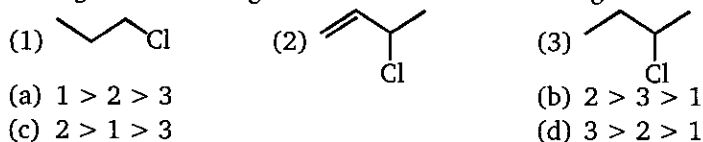




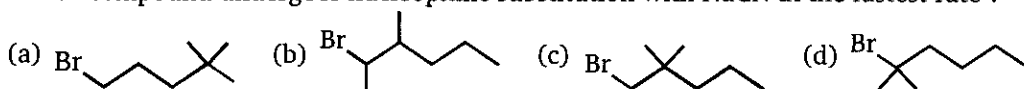
8. Which of the following alkyl halide undergo rearrangement in  $S_N1$  reaction ?



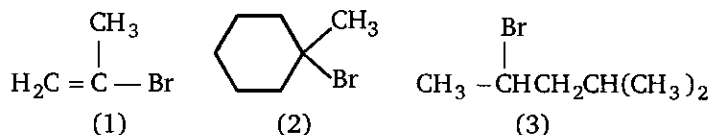
9. Arrange the following three chlorides in decreasing order towards  $S_N1$  reactivity.



10. Which compound undergoes nucleophilic substitution with NaCN at the fastest rate ?



11. Rank the following in order of decreasing rate of solvolysis with aqueous ethanol (fastest  $\rightarrow$  slowest)

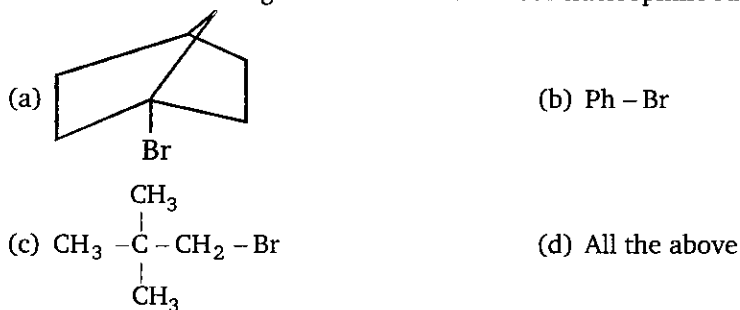


- (a)  $2 > 1 > 3$  (b)  $1 > 2 > 3$   
 (c)  $2 > 3 > 1$  (d)  $1 > 3 > 2$

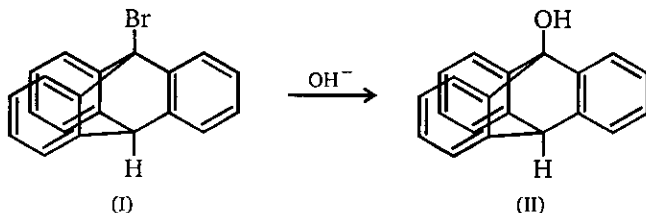
12. The reaction of 4-bromobenzyl chloride with sodium cyanide in ethanol leads to the formation of :

- (a) 4-bromobenzyl cyanide (b) 4-cyanobenzyl chloride  
 (c) 4-cyanobenzyl cyanide (d) 4-bromo-2-cyanobenzyl chloride

13. Which of the following reactant will not favour nucleophilic substitution reaction ?



14.



Conversion of I to II :

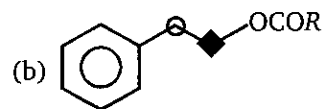
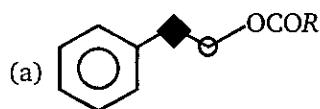
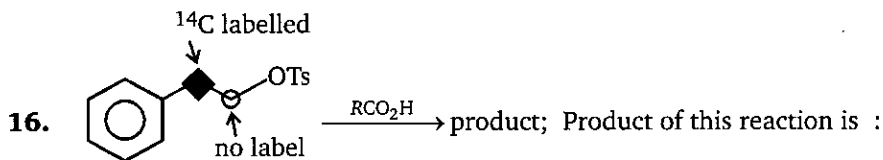
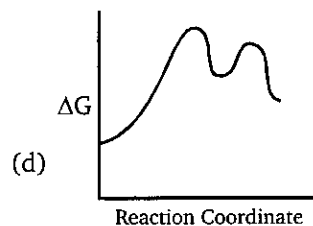
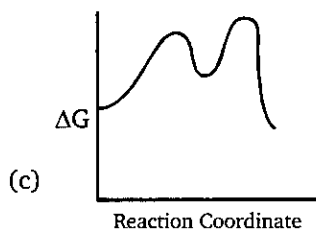
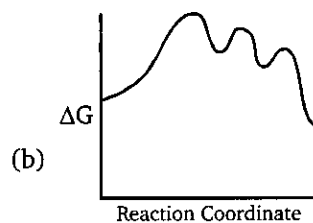
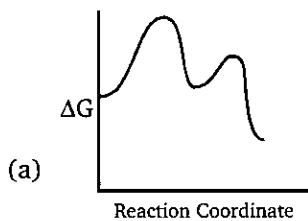
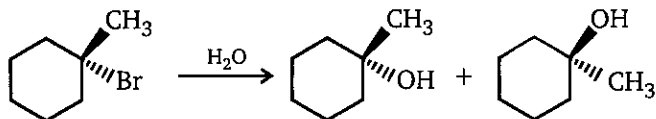
(a) takes place by  $S_{N1}$

(b) takes place by  $S_{N2}$

(c) takes place both by  $S_{N1}$  and  $S_{N2}$

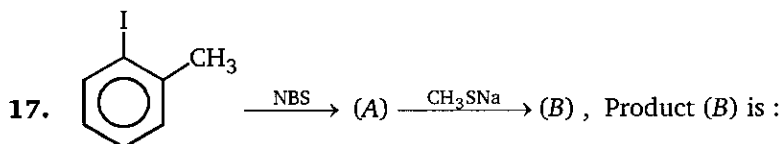
(d) does not take place

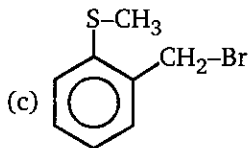
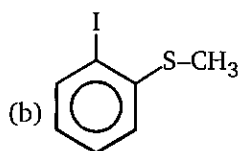
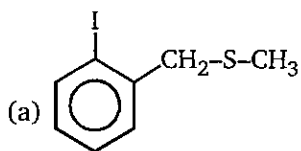
15. Which is the correct reaction coordinate diagram for the following solvolysis reaction ?



(c) both (a) and (b)

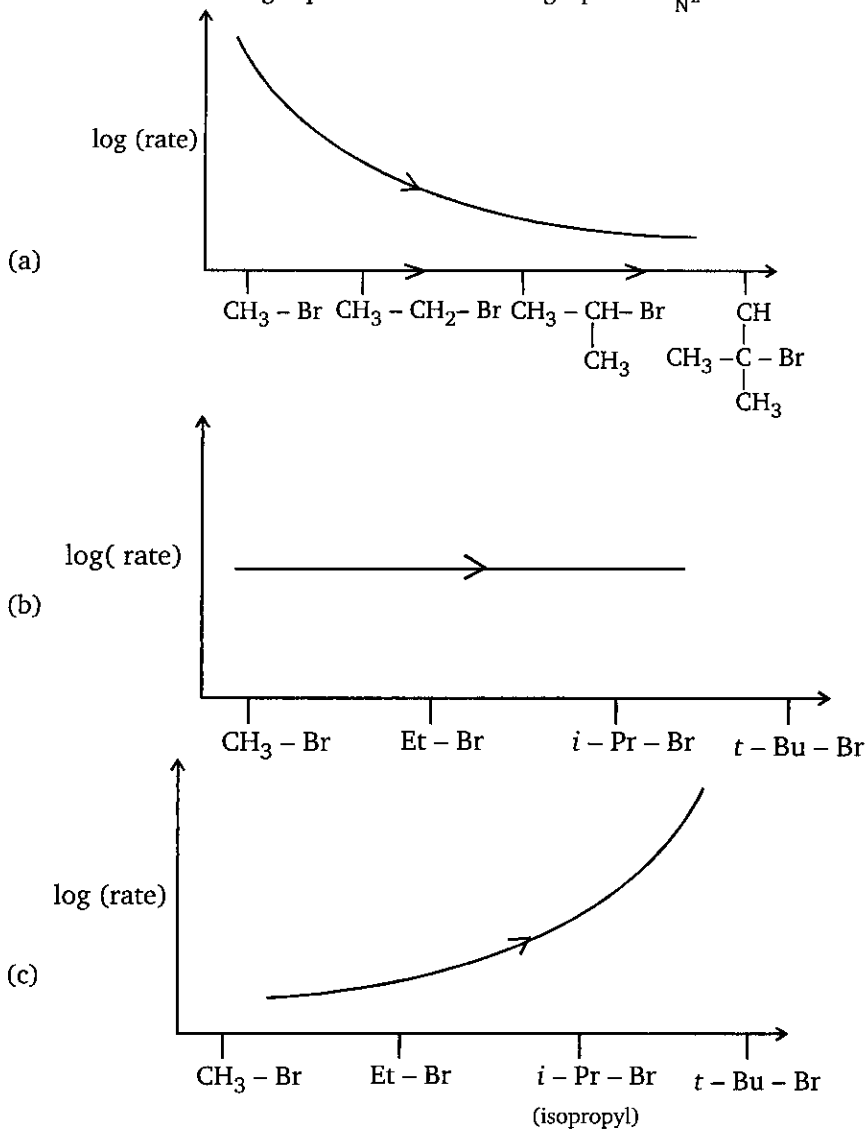
(d) None of these



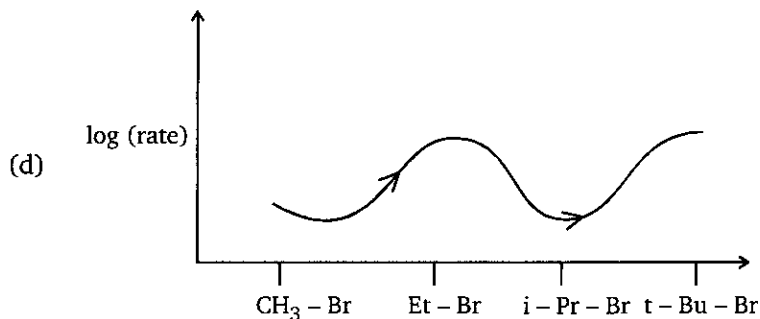


(d) None of these

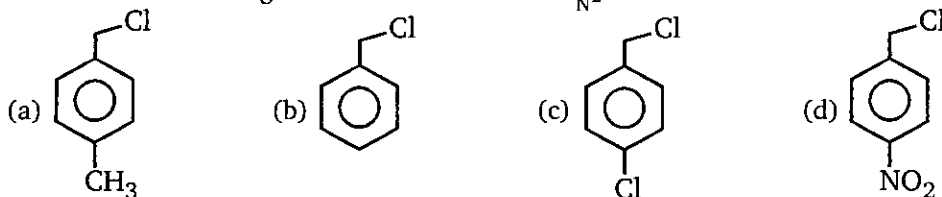
18. Which of the following represents the correct graph for  $S_N2$  reaction ?



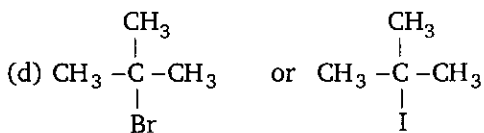
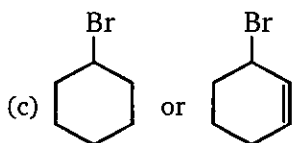
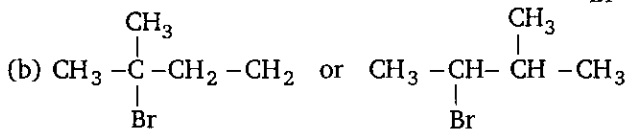
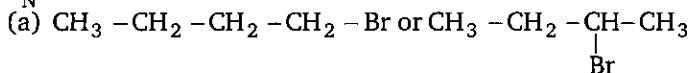




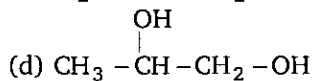
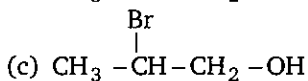
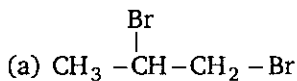
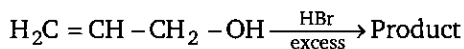
20. Which of the following is most reactive toward  $S_N2$  reaction ?



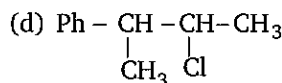
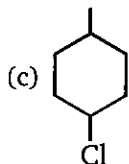
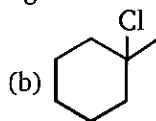
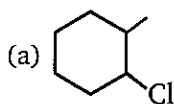
21. Among the given pairs, in which pair first compound reacts faster than second compound in  $S_N1$  reaction ?



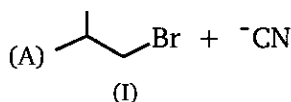
22. What is the major product of the following reaction ?



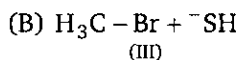
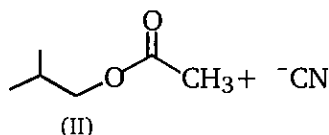
23.  $S_{N1}$  and  $S_{N2}$  products are same with (excluding stereoisomer) :



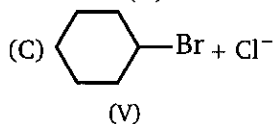
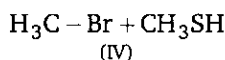
24. Consider the nucleophilic attacks given below. Select in each pair that shows the greater  $S_{N2}$  reaction rate.



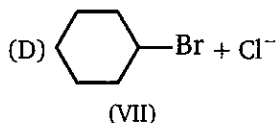
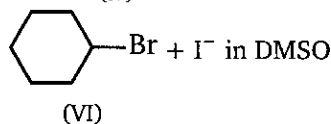
or



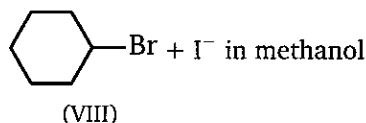
or



or



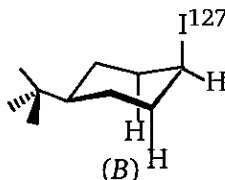
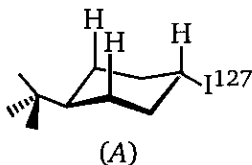
or



- A B C D  
(a) (I) ; (IV) ; (VI) ; (VIII)  
(c) (I) ; (III) ; (V) ; (VIII)

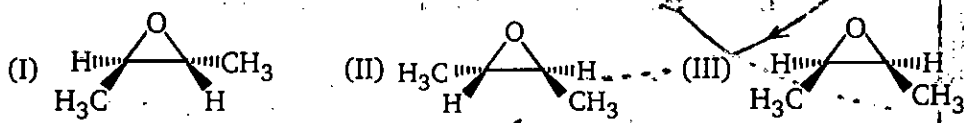
- A B C D  
(b) (II) ; (III) ; (V) ; (VIII)  
(d) (I) ; (III) ; (V) ; (VII)

25. Which of the two stereoisomers of 4*t*-butylcyclohexyl iodide ( $^{127}\text{I}^-$ ) will undergo  $S_{N2}$  substitution with  $^{128}\text{I}^-$  faster, and why ?



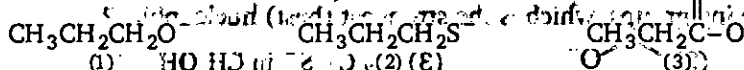
- (a) A will react faster because it is the more stable of the two isomers  
(b) A will react faster because it will yield a more stable product, and the transition state for both reactions is of the same energy  
(c) A will react faster because the approach of  $^{128}\text{I}^-$  can depart unhindered.  
(d) B will react faster because it is less stable than A, and the transition state for both reactions is of the same energy

26. (Z)-2-Butene reacts with Br<sub>2</sub>/H<sub>2</sub>O. The resulting bromohydrin when treated with methoxide in methanol undergoes an intramolecular S<sub>N</sub>2 reaction. Taking into consideration the stereochemical consequences of the reaction mechanism involved, choose the final product(s) of these transformations.



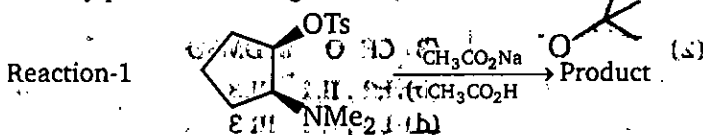
- (a) (I) only  
 (b) (II) only  
 (c) (III) only  
 (d) Equal amounts of (I) and (II)

27. Rank the following species in order of decreasing nucleophilicity in a polar protic solvent (most → least nucleophilic):



- (a) 3 > 1 > 2      (b) 2 > 3 > 1      (c) 1 > 3 > 2      (d) 2 > 1 > 3

28. Identify products of the given reactions:



- (a) CN(C)C1CCC(C1)C(=O)OC + CN(C)C1CCC(C1)C(=O)OC + enantiomer  
 (b) CN(C)C1CCC(C1)C(=O)OC + CN(C)C1CCC(C1)C(=O)OC + enantiomer  
 (c) single product is obtained in both the reactions  
 (d) single product is obtained in both the reactions

38. In the given pairs of alkyl-halide, in which pair the first compound is more reactive than second compound toward  $S_N2$  reaction?

- (a)  $(CH_3)_2CHBr$  or  $CH_3-CH_2-CH_2-Br$
- (b)  $CH_3-CH_2-CH_2-Br$  or  $CH_3-CH_2-CH_2-I$
- (c)  $Ph-Br$  or  $CH_3-CH_2-CH_2-Br$

29. (d)  $CH_2=CH-CH_2-Cl$  or  $H_2C=CH-Cl$

39. In the given pair of reaction in which pair the second reaction is more reactive than first toward  $S_N2$  reaction?

- (a)  $CH_3-CH_2-Cl + CH_3-CH_2-O^- \rightarrow Et-O-Et$  (or)  $CH_3-CH_2-Cl + CH_3-CH_2-O^- \rightarrow Et-O-Et$
- (b)  $CH_3-CH_2-Cl + EtO^- \rightarrow Et-O-Et$  (or)  $CH_3-CH_2-Cl + EtO^- \rightarrow Et-O-Et$
- (c)  $CH_3-CH_2-Cl + EtS^- \rightarrow CH_3-CH_2-S-Et$  (or)  $CH_3-CH_2-Cl + EtS^- \rightarrow CH_3-CH_2-S-Et$
- (d)  $CH_3-CH_2-Cl + EtS^- \rightarrow CH_3-CH_2-S-Et$  (or)  $CH_3-CH_2-Cl + EtS^- \rightarrow CH_3-CH_2-S-Et$

30. In each of the following groups, which is the most reactive toward  $S_N2$  reaction?

- (1)  $Et-Cl + CH_3O^- \rightarrow Et-O-CH_3$
- (2)  $Et-Cl + CH_3O^- \rightarrow Et-O-CH_3$
- (3)  $H_3C-S^-$  in  $CH_3OH$
- (4)  $NH_2$  in DMF

40. Among the following pair of reactions in which pair the second reaction is more reactive than first in  $S_N2$  reaction?

- (a)  $Me_3CCl + H_2O \rightarrow Me_3COH + Cl^-$  (or)  $Me_3CBr + H_2O \rightarrow Me_3COH + Br^-$
- (b)  $Me_3CCl + CH_3OH \rightarrow Me_3COCH_3 + Cl^-$  (or)  $Me_3CBr + CH_3OH \rightarrow Me_3COCH_3 + Br^-$

41. Which is a true statement concerning the transition state of an  $S_N2$  reaction?

- (a) Closely resembles a carbocation intermediate
- (b) The electrophile is responsible for the reaction
- (c) Lower is energy than the starting materials
- (d) Involves both the nucleophile and electrophile

42. Increasing the concentration of a nucleophile in a typical  $S_N2$  reaction by a factor of 10 will cause the reaction rate to:

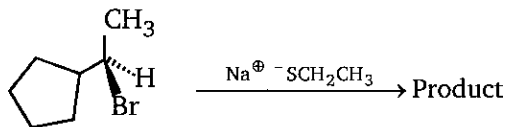
- (a) increase by a factor of 10
- (b) increase by a factor of  $10^2$
- (c) decrease by a factor of 10
- (d) remain about the same

43. Decreasing the concentration of an electrophile in a typical  $S_N2$  reaction by a factor of 3 will cause the reaction rate to:

- (a) increase by a factor of 3
- (b) increase by a factor of  $3^2$
- (c) decrease by a factor of 3
- (d) remain about the same



44. Increasing the concentration of an electrophile in a typical  $S_N2$  reaction by a factor of 3 and the concentration of the nucleophile by a factor of 3 will change the reaction rate to :
- (a) increase by a factor of 6                      (b) increase by a factor of 9  
 (c) decrease by a factor of 3                      (d) remain about the same
45. Consider the following reaction and select the best choice that represents the reaction.

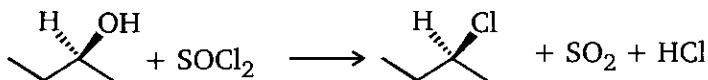


- (a)
- (b)
- (c)
- (d)

46. Product; Identify the product.

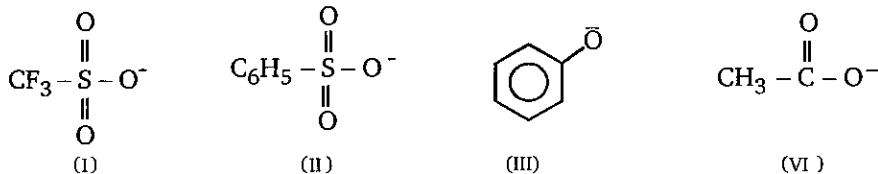
- (a)
- (b)
- (c)
- (d)

47. The reaction ,



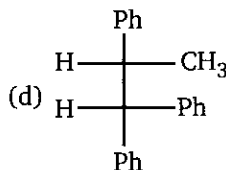
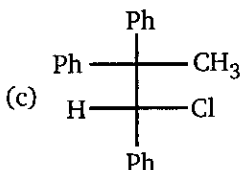
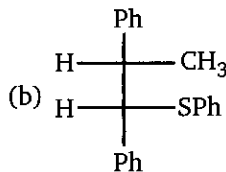
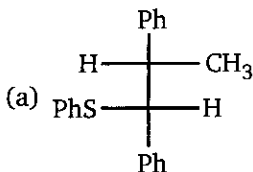
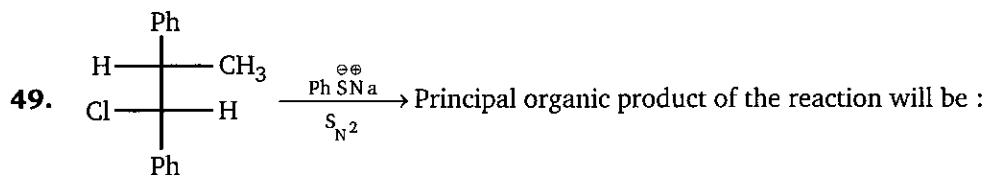
proceeds by the..... mechanism.

- (a)  $S_Ni$                       (b)  $S_N2$                       (c)  $S_E2$                       (d)  $S_N1$
48. Consider the following anions.



When attached to  $sp^3$ -hybridized carbon, their leaving group ability in nucleophilic substitution reaction decreases in the order :

- (a) I > II > III > IV    (b) I > II > IV > III    (c) IV > I > II > III    (d) IV > III > II > I

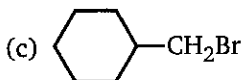
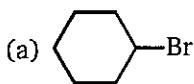


50. Reaction of *R*-2-butanol with *p*-toluenesulphonyl chloride in pyridine followed by reaction with LiBr gives:

- (a) *R*-2-butyl bromide  
(c) *R*-2-butyl tosylate

- (b) *S*-2-butyl tosylate  
(d) *S*-2-butyl bromide

51. The compound which undergoes  $S_N1$  reaction most rapidly is :

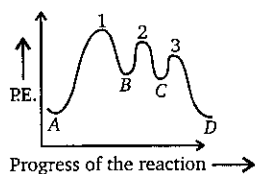
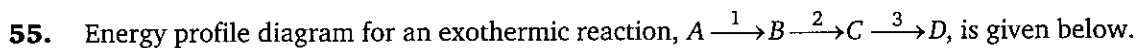
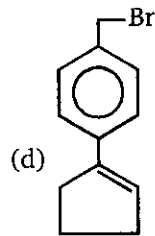
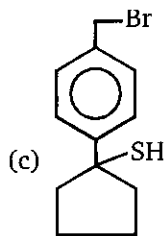
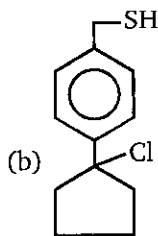
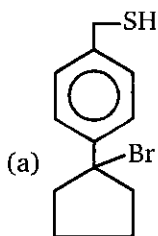
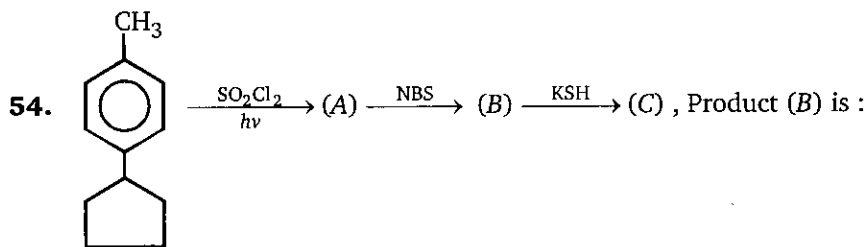


52. Addition of KI accelerates the hydrolysis of primary alkyl halides because :

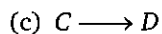
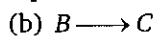
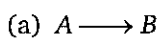
- (a) KI is soluble in organic solvents  
(b) the iodide ion is a weak base and a poor leaving group  
(c) the iodide ion is a strong base  
(d) the iodide ion is a powerful nucleophile as well as a good leaving group

53. Which of the following phrases are not correctly associated with  $S_N1$  reaction ?

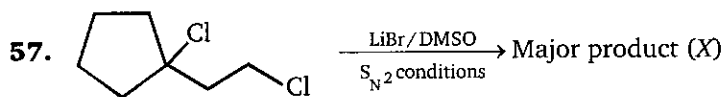
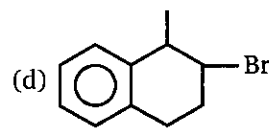
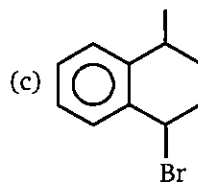
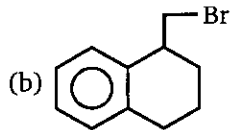
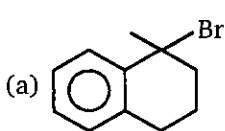
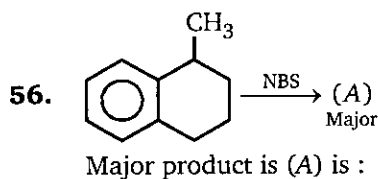
- (1) Rearrangement is possible  
(2) Rate is affected by polarity of solvent  
(3) The strength of the nucleophile is important in determining rate  
(4) The reactivity series is tertiary > secondary > primary  
(5) Proceeds with complete inversion of configuration
- (a) 3, 5  
(b) 5 only  
(c) 2, 3, 5  
(d) 3 only



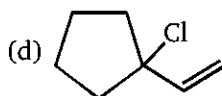
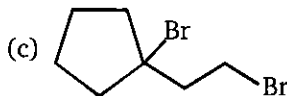
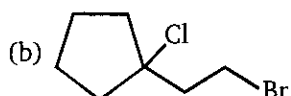
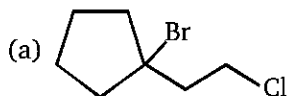
The rate determining step of the reaction is :



(d) can not predict



The product X is :



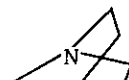
58. Relative rate of reaction of the following amine with methyl iodide is:



(A)



(B)



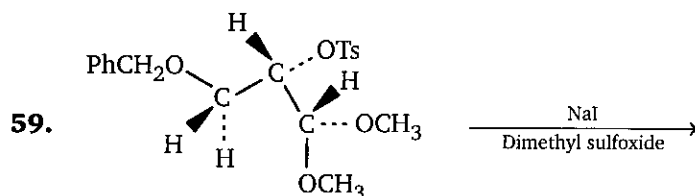
(C)

(a)  $A > B > C$

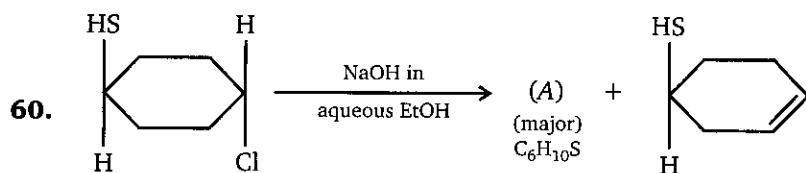
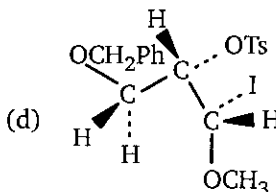
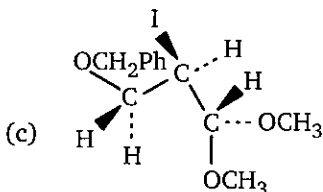
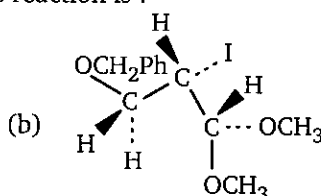
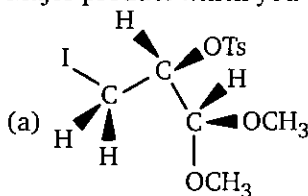
(b)  $A > C > B$

(c)  $B > C > A$

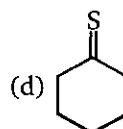
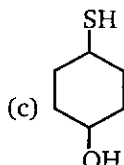
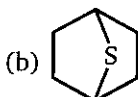
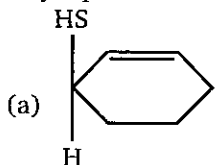
(d)  $B > A > C$

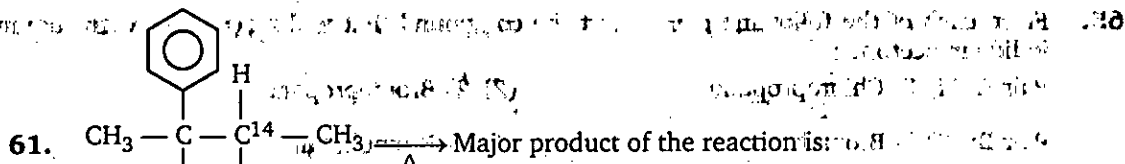


Major product which you expect in the above reaction is :



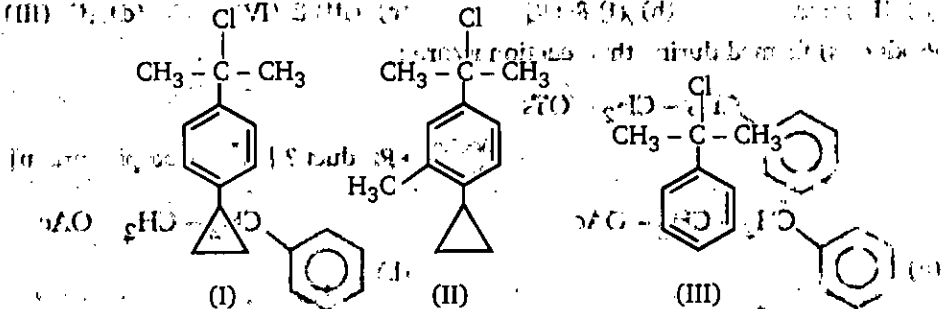
Major product of the above reaction is :



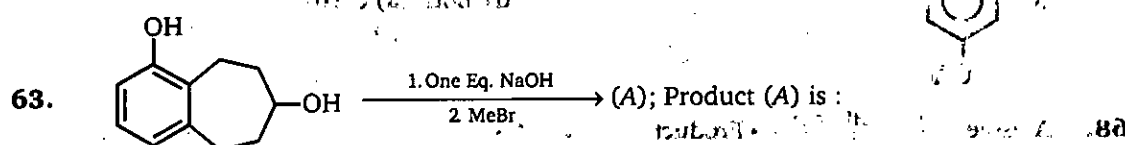


- (a) CC(C)=C1=CC=CC=C1 (b) CC(C)C=C  
 (c) CC(C)=C1=CC=CC=C1 (d) CC(C)=C1=CC=CC=C1

62. The decreasing order of reactivity of the compounds given below towards solvolysis under identical conditions is:



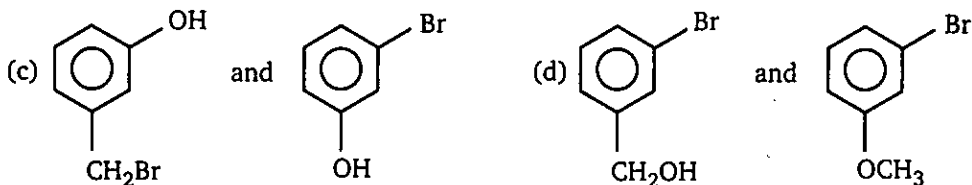
- (a) II > III > I (b) I > II > III (c) III > II > I (d) II > I > III



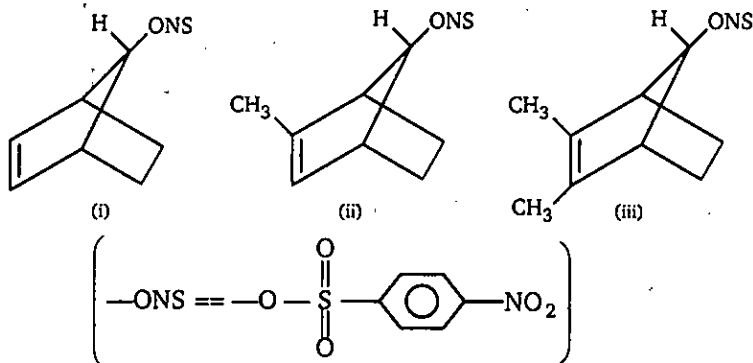
- (a) COc1ccc2c(c1)CCCCC2O (b) Oc1ccc2c(c1)CCCCC2OC (c) Oc1ccc2c(c1)CCCCC2OC (d) None of these

64. (R)-2-octyl tosylate is solvolyzed in water under ideal S<sub>N</sub>1 conditions. The product(s) will be:

- (a) R-2-octanol and S-2-octanol in a 1 : 1 ratio  
 (b) R-2-octanol and S-2-octanol in a 1.5 : 1 ratio  
 (c) R-2-octanol only  
 (d) S-2-octanol only

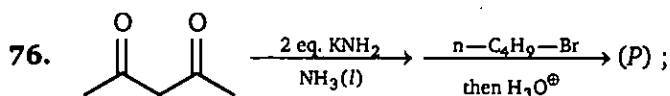


75. Relative rate of reaction with  $H_2O$ .

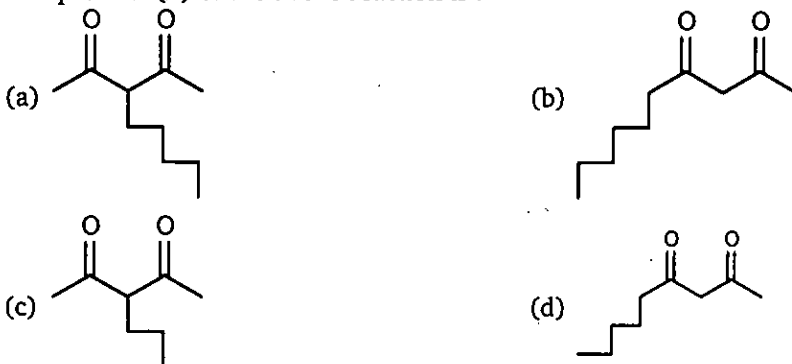


(a) (i) > (ii) > (iii)  
(c) (iii) > (ii) > (i)

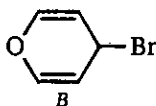
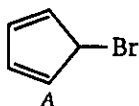
(b) (ii) > (i) > (iii)  
(d) (iii) > (i) > (ii)



End product (P) of the above reaction is :

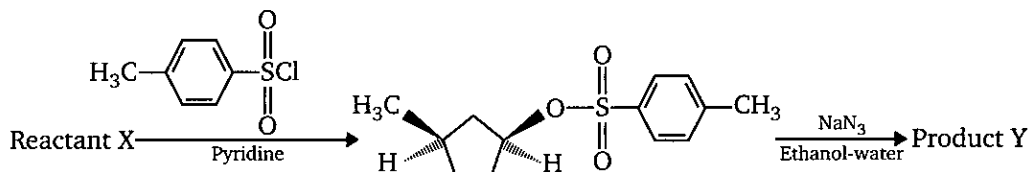


77. Which of the following statements is correct regarding the rate of hydrolysis of the compounds (A) and (B) by  $S_N1$  reaction ?



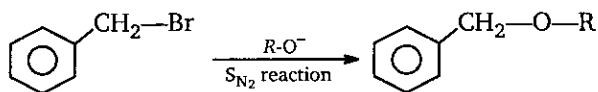
- (a) A reacts faster than B                      (b) B reacts faster than A  
 (c) Both A and B reacts at the same rate      (d) Neither A nor B reacts

78. What are reactant X and product Y in the following sequence of reactions ?



- |     | Reactant X | Product Y |
|-----|------------|-----------|
| (a) |            |           |
| (b) |            |           |
| (c) |            |           |
| (d) |            |           |

79. Transition state of given  $S_N2$  is :



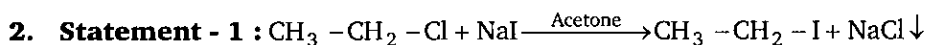
- |     |  |     |  |
|-----|--|-----|--|
| (a) |  | (b) |  |
|-----|--|-----|--|







1. **Statement-1** : Nucleophilicity order in polar-protic solvent is  $I^- < Br^- < Cl^- < F^-$   
**Statement-2** : Due to bigger size of  $I^-$  it is less solvated in polar-protic solvent.
- (a) Statement-1 is true, statement-2 is true and statement-2 is correct explanation for statement-1.  
 (b) Statement-1 is true, statement-2 is true and statement-2 is NOT the correct explanation for statement-1.  
 (c) Statement-1 is true, statement-2 is false.  
 (d) Statement-1 is false, statement-2 is true.

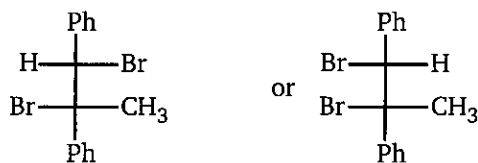


**Statement- 2** : Acetone is polar-protic solvent and solubility order of sodium halides decreases dramatically in order  $NaI > NaBr > NaCl$ . The last being virtually insoluble in this solvent and a  $1^\circ$  and  $2^\circ$  chloro alkane in acetone is completely driven to the side of Iodoalkane by the precipitation reaction.

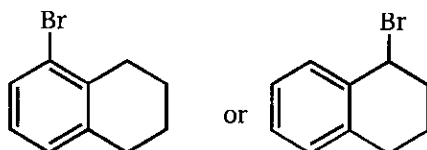
- (a) Statement-1 is true, Statement-2 is true and Statement-2 is correct explanation for statement-1.  
 (b) Statement-1 is true, Statement-2 is true and Statement-2 is Not the correct explanation for statement-1.  
 (c) Statement-1 is true, Statement-2 is false.  
 (d) Statement-1 is false, Statement-2 is true.
3. Encircle whichever of the following :
- (a) is the stronger nucleophile (aprotic solvent) :  $F^-$  or  $I^-$   
 (b) is the stronger nucleophile (protic solvent) :  $F^-$  or  $I^-$   
 (c) is the stronger base :  $F^-$  or  $I^-$   
 (d) is the stronger nucleophile (protic solvent) :  $NH_3$  or  $NH_2NH_2$   
 (e) is the better leaving group :  $CH_3COO^-$  or  $CH_3SO_3^-$
4. Encircle whichever of the following :

- (a) undergoes an  $S_{N2}$  reaction more rapidly,  $CH_3 - Br$  or  $CH_3 - \overset{\text{Br}}{\underset{|}{\text{C}}} - CH_3$
- (b) undergoes an  $S_{N1}$  reaction more rapidly,  $CH_3 - Br$  or  $CH_3 - \overset{\text{Br}}{\underset{|}{\text{C}}} - CH_3$
- (c) undergoes an  $E_2$  reaction to give (Z)-1,2-diphenylpropene :  $\text{Ph} \begin{array}{l} \diagdown \\ \text{C} \\ \diagup \end{array} = \begin{array}{l} \diagup \\ \text{C} \\ \diagdown \end{array} \begin{array}{l} \text{Ph} \\ \text{CH}_3 \end{array}$
- $\begin{array}{c} \text{Ph} \\ | \\ \text{H} - \text{C} - \text{Br} \\ | \\ \text{H} - \text{C} - \text{CH}_3 \\ | \\ \text{Ph} \end{array}$ 
                         
  $\text{or}$ 
                         
  $\begin{array}{c} \text{Ph} \\ | \\ \text{Br} - \text{C} - \text{H} \\ | \\ \text{H} - \text{C} - \text{CH}_3 \\ | \\ \text{Ph} \end{array}$

(d) reacts with NaI to give (Z)-1,2-diphenylpropene :



(e) undergoes an  $S_{N1}$  reaction more rapidly,



5. Encircle whichever of the following :

(a) undergoes an  $S_{N2}$  reaction more rapidly : or

(b) undergoes an  $E_1$  reaction more rapidly : or

(c) undergoes an  $S_{N1}$  reaction more rapidly: or

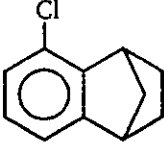
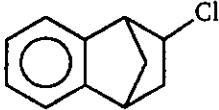
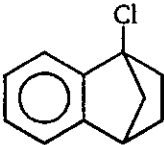
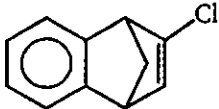
(d) undergoes an  $S_{N2}$  reaction more rapidly: or

(e) undergoes an  $E_2$  reaction more rapidly : or

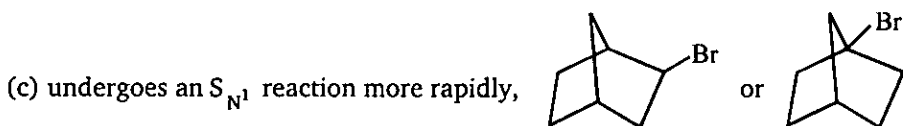
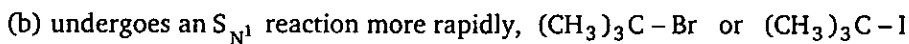
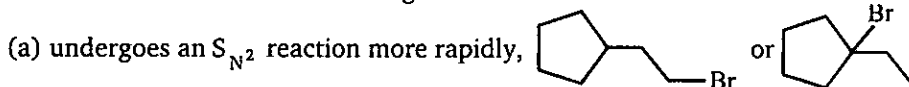
## 6. Match the column :

Alkyl halide			Relative rate ( $S_{N1}$ )		Relative rate ( $S_{N2}$ )
(a)	$\text{CH}_3 - \text{Br}$	(p)	1	(w)	1200
(b)	$\text{CH}_3 - \text{CH}_2 - \text{Br}$	(q)	1.05	(x)	40
(c)	$\begin{array}{c} \text{CH}_3 - \text{CH} - \text{Br} \\   \\ \text{CH}_3 \end{array}$	(r)	11	(y)	16
(d)	$\begin{array}{c} \text{CH}_3 \\   \\ \text{CH}_3 - \text{C} - \text{Br} \\   \\ \text{CH}_3 \end{array}$	(s)	1,200,000	(z)	1

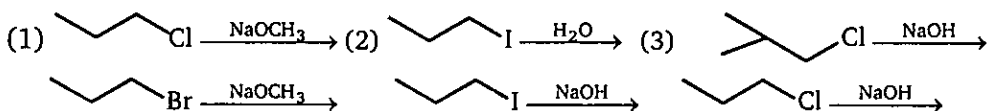
## 7. Matrix :

Column (I)		Column (II)	
Compound		Type of reaction	
(a)		(p)	$S_{N1}$ reaction can take place
(b)		(q)	$S_{N2}$ reaction can take place
(c)		(r)	$S_{N1}$ is not possible
(d)		(s)	$S_{N2}$ is not possible

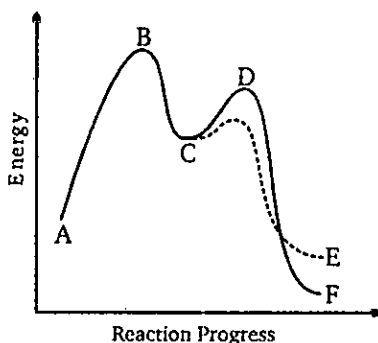
8. Encircle whichever of the following :



9. Reactivity : Circle the reaction that reacts FASTER by  $S_{N2}$  in each pair :



10. Consider the potential energy diagram given below



(X) Name the positions A-D

(Y) Answer the following questions .

(i) Both reaction pathways are : EXOTHERMIC or ENDOTHERMIC

(ii) Which step is the rate determining step (RDS) ? B or D

(iii) Which product is most stable ? E or F

(iv) In accordance with Hammonds postulate, exothermic reactions tend to have

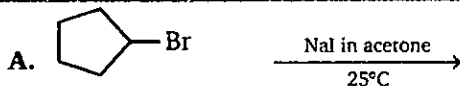
(a) early transition states that are reactant - like

(b) late transition states that are reactant-like

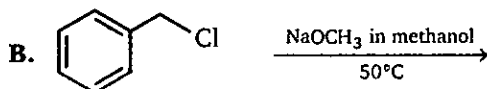
(c) early transition states that are product-like

(d) late transition states that are product-like.

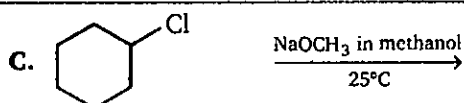
11. Select whether the following combinations of reactants will react by substitution ( $S_{N1}$  or  $S_{N2}$  mechanism), elimination ( $E_1$  or  $E_2$  mechanism)



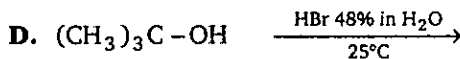
- (a)  $S_{N1}$       (b)  $S_{N2}$       (c)  $E_1$       (d)  $E_2$



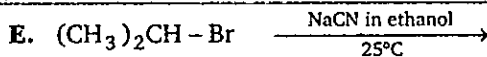
- (a)  $S_{N1}$       (b)  $S_{N2}$       (c)  $E_1$       (d)  $E_2$



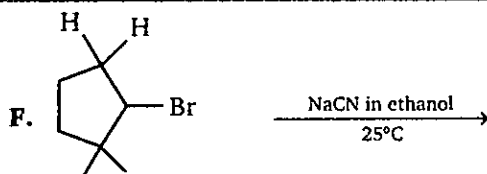
- (a)  $S_{N1}$       (b)  $S_{N2}$       (c)  $E_1$       (d)  $E_2$



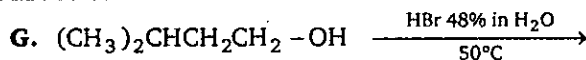
- (a)  $S_{N1}$       (b)  $S_{N2}$       (c)  $E_1$       (d)  $E_2$



- (a)  $S_{N1}$       (b)  $S_{N2}$       (c)  $E_1$       (d)  $E_2$

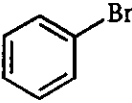
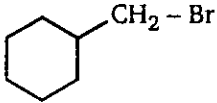
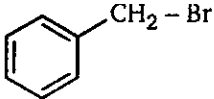
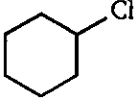
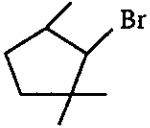
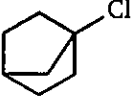


- (a)  $S_{N1}$       (b)  $S_{N2}$       (c)  $E_1$       (d)  $E_2$



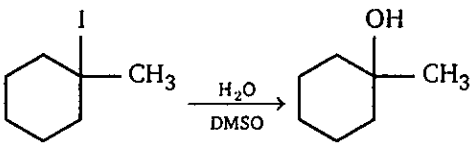
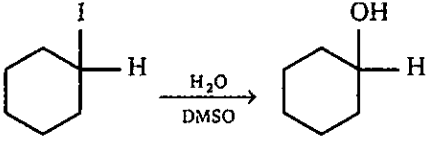

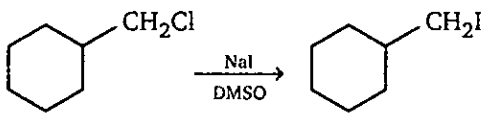

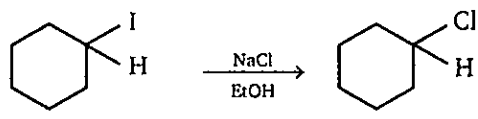
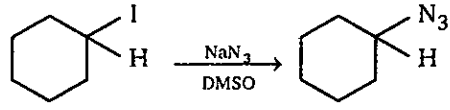
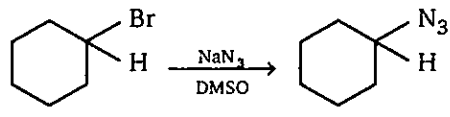
- (a)  $S_{N1}$       (b)  $S_{N2}$       (c)  $E_1$       (d)  $E_2$

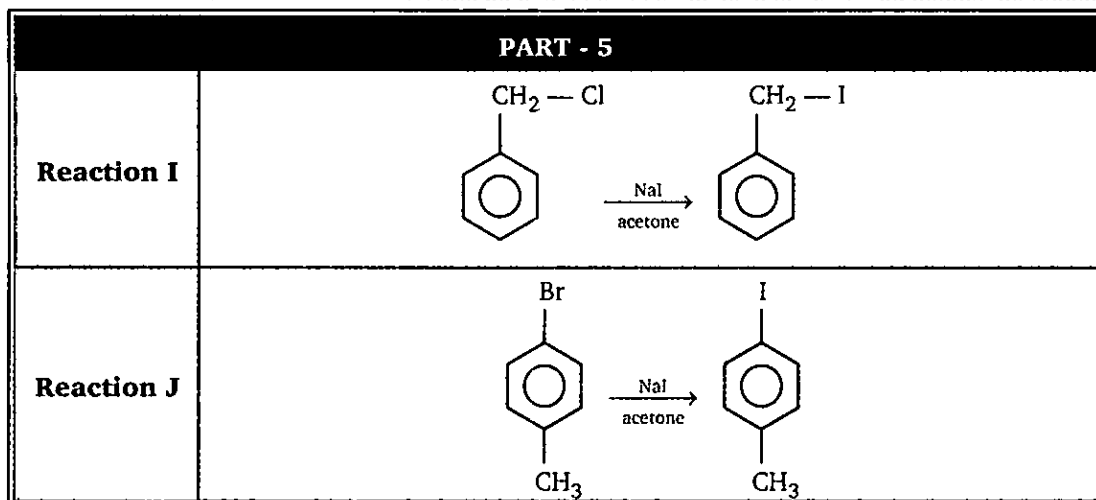
12. Examine the ten structural formulas shown in fig. & select that satisfy each of the following conditions. Write one or more (a through j) in each answer box.

(a)		(b)	$\begin{array}{c} \text{CH}_3 \\   \\ \text{H}_3\text{C}-\text{C}-\text{Cl} \\   \\ \text{CH}_3 \end{array}$	(c)	
(d)	$\text{CH}_3-\text{I}$	(e)		(f)	
(g)	$\begin{array}{c} \text{CH}_3 \\   \\ \text{H}_3\text{C}-\text{C}-\text{CH}_2-\text{Cl} \\   \\ \text{CH}_3 \end{array}$	(h)	$\begin{array}{c} \text{H}_2\text{C}=\text{C}-\text{CH}_2-\text{Cl} \\   \\ \text{CH}_3 \end{array}$	(i)	
(j)					

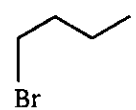
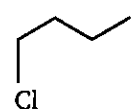
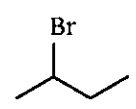
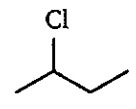
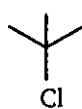
- A. Which compounds give an  $\text{S}_{\text{N}}2$  substitution reaction on treatment with alcoholic  $\text{NaSH}$  ?
- B. Which compounds give an  $\text{E}_2$  elimination reaction on treatment with alcoholic  $\text{KOH}$  ?
- C. Which compounds do not react under either of the previous reaction conditions ?

13. Select which reaction from the following reaction pairs will occur faster.

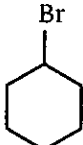
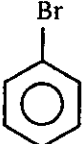
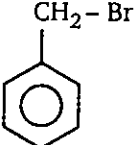
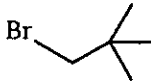
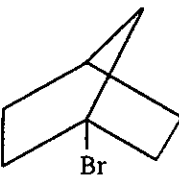
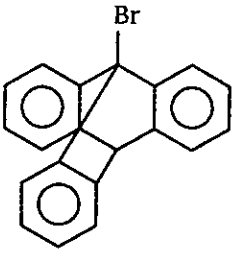
PART - 1	
Reaction A	
Reaction B	
PART - 2	
Reaction C	
Reaction D	
PART - 3	
Reaction E	
Reaction F	
PART - 4	
Reaction G	
Reaction H	



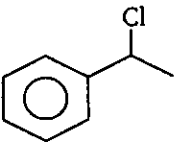
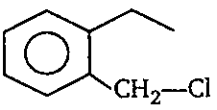
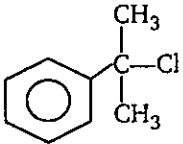
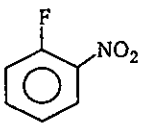
14. Tick your answer in the given box.

Alkyl Halide		2-D Structure	Expect $S_N2$ (at a reasonable rate)	
<b>(a)</b>	1-Bromobutane		<input type="checkbox"/>	Yes
			<input type="checkbox"/>	No
<b>(b)</b>	1-Chlorobutane		<input type="checkbox"/>	Yes
			<input type="checkbox"/>	No
<b>(c)</b>	2-Bromobutane		<input type="checkbox"/>	Yes
			<input type="checkbox"/>	No
<b>(d)</b>	2-Chlorobutane		<input type="checkbox"/>	Yes
			<input type="checkbox"/>	No
<b>(e)</b>	2-Chloro-2-methyl propane		<input type="checkbox"/>	Yes
			<input type="checkbox"/>	No

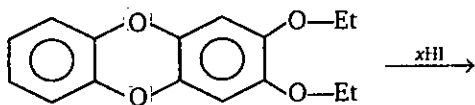


(f)	Bromocyclohexane		Yes
			No
(g)	Bromobenzene		Yes
			No
(h)	Benzyl bromide		Yes
			No
(i)	1-Bromo-2,2-dimethyl propane		Yes
			No
(j)	Bicyclo compound		Yes
			No
(k)	1-bromotriptycene		Yes
			No

15. Match the column

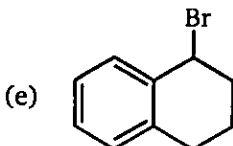
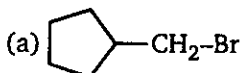
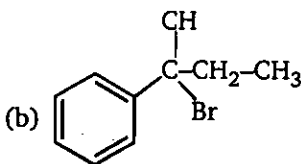
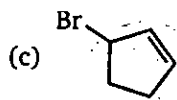
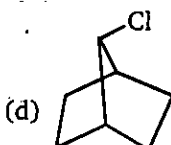
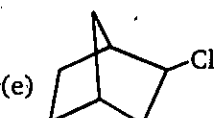
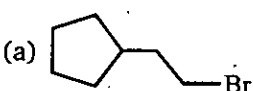
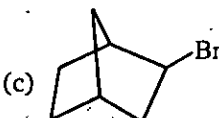



Column-I		Column-II	
(a)		(p)	It will undergo Nucleophilic Substitution reaction
(b)		(q)	It will undergo $E_2$ reaction
(c)		(r)	It will undergo $E_1$ reaction
(d)		(s)	It will undergo $S_N2$ reaction
		(t)	It will undergo $S_N1$ reaction

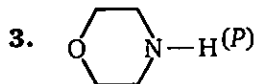
16.



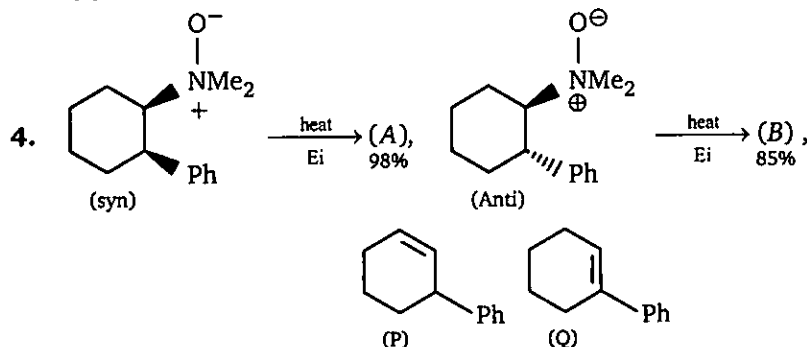
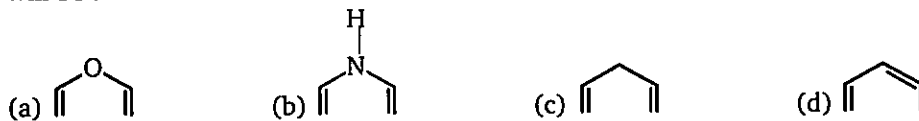
How many (x) moles of HI consumed?

ANSWERS — LEVEL 2

- d
- c The reaction is Finkelstein reaction.
- (a)  $F^-$ ; (b)  $I^-$ ; (c)  $F^-$ ; (d)  $NH_2-NH_2$ ; (e)  $CH_3SO_3$
- (a)  $CH_3 - Br$  (b)  $CH_3 - \overset{Br}{\underset{|}{CH}} - CH_3$  (c)  $\begin{array}{c} Ph \\ | \\ H - C - Br \\ | \\ H - C - CH_3 \\ | \\ Ph \end{array}$
- (d)  $\begin{array}{c} Ph \\ | \\ H - C - Br \\ | \\ Br - C - CH_3 \\ | \\ Ph \end{array}$  (e) 
- (a)  (b)  (c) 
- (d)  (e) 
- a - p, w; b - q, x; c - r, y; d - s, z
- a - r, s; b - p, q; c - r, s; d - r, s
- (a)  (b)  $(CH_3)_3C - I$  (c) 
- (1)  (2)  (3) 
- (X) A- reactants, B-transition state, C-Inter mediate, D- transition state  
(Y) (i) exothermic (ii) B (iii) F (iv) a

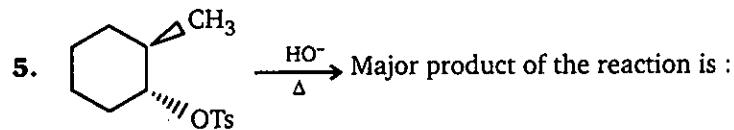


when (P) undergoes Hoffmann exhaustive methylation (twice) then the product obtained will be :

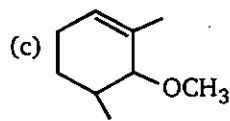
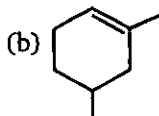
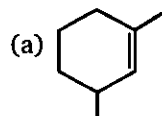
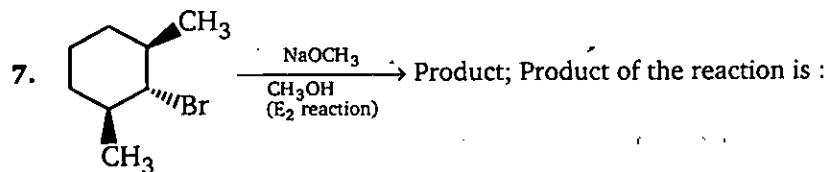
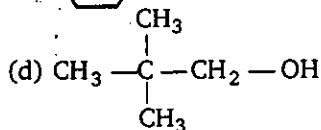
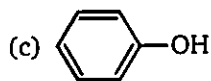
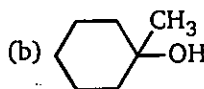
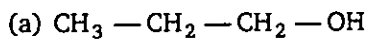


Product (A) & (B) of the above reaction is :

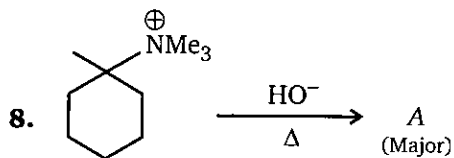
- (a)  $A = P, B = P$  (b)  $A = Q, B = Q$  (c)  $A = P, B = Q$  (d)  $A = Q, B = P$



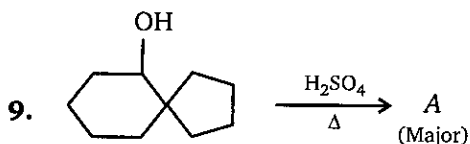
6. Which of these dehydrates most easily ?



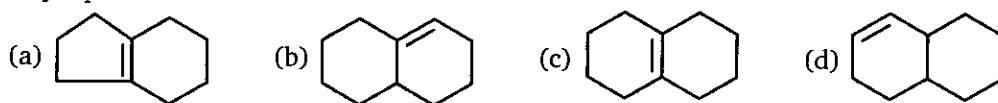
(d) No reaction



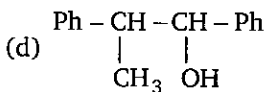
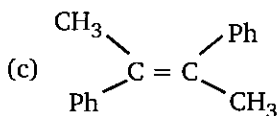
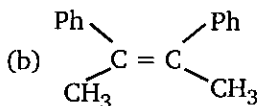
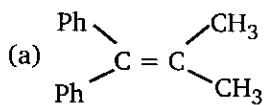
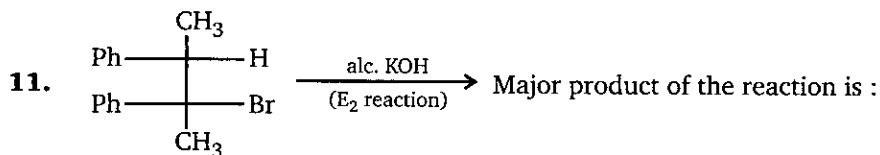
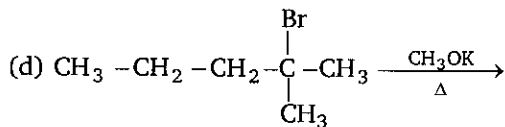
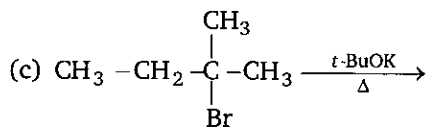
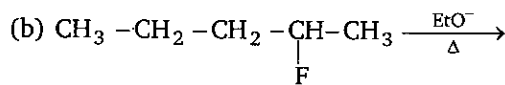
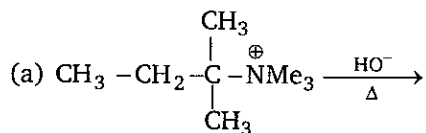
Major product A is :



Major product A is :



10. In which of the following reaction Saytzeff alkene is major product ?



12. The conversion of 2, 3-dibromobutane to 2-butene with Zn is :

(a) Redox reaction

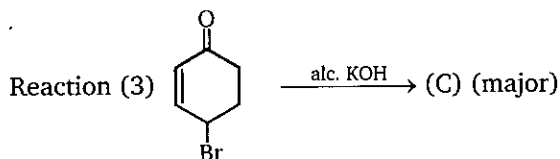
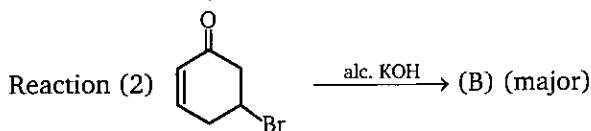
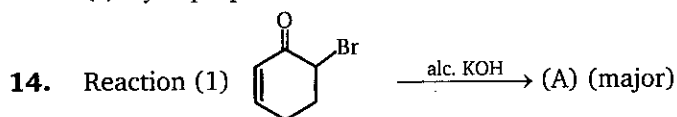
(b)  $\alpha$ -Elimination

(c)  $\beta$ -Elimination

(d) Both  $\alpha$ -elimination and redox reaction

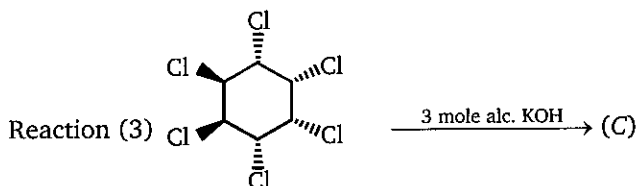
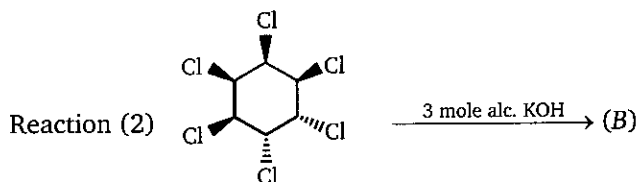
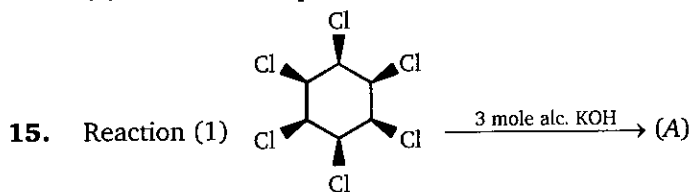
13. 1, 3-Dibromopropane is heated with zinc dust in ether. The product formed is :

- (a) propene  
(b) propane  
(c) cyclopropane  
(d) 3-bromopropane



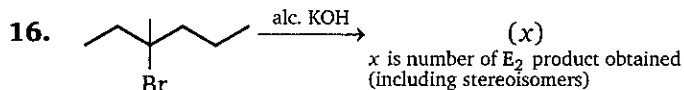
Product obtained in above reactions (1), (2) & (3) is :

- (a) A = B but C is different  
(b) A = C, but B is different  
(c) B = C, but A is different  
(d) A = B = C all product are identical



Product obtained in above reactions (1), (2) & (3) is :

- (a) A = B, C is different  
(b) A = C, B is different  
(c) B = C, A is different  
(d) A = B = C is same



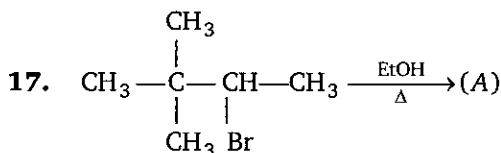
Find (x).

(a) 3

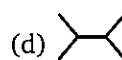
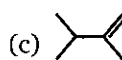
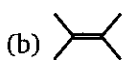
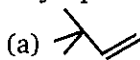
(b) 4

(c) 5

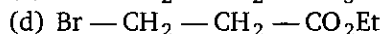
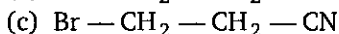
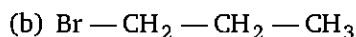
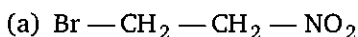
(d) 6



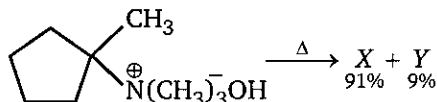
Major product (A) is :



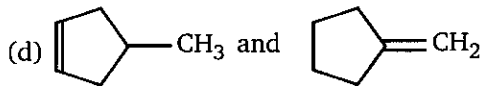
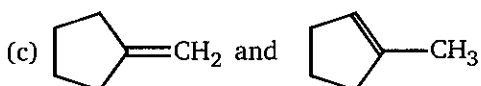
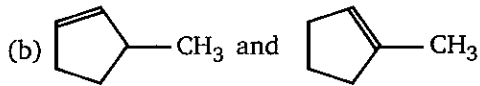
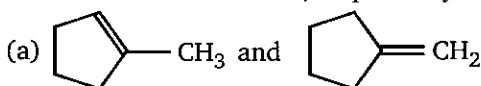
18. Which one of the following compound will be least susceptible to elimination of hydrogen bromide ?



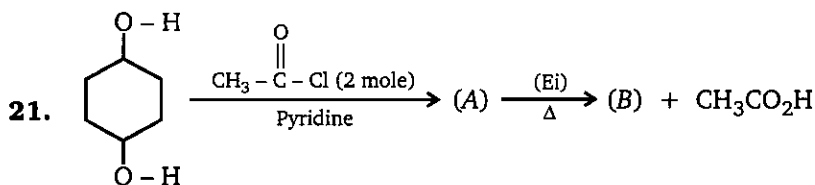
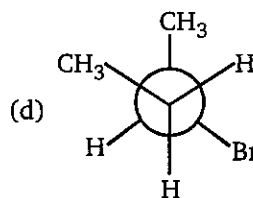
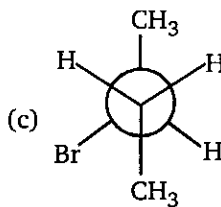
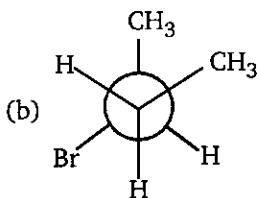
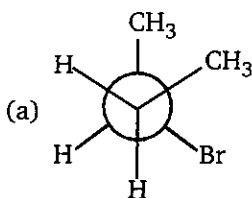
19. Two alkenes, X(91% yield) and Y(9% yield) are formed when the following compound is heated.



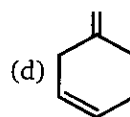
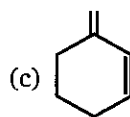
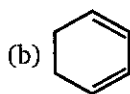
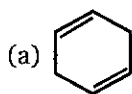
The structures of X and Y, respectively are :



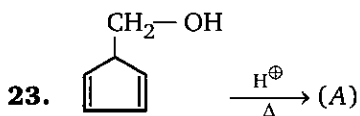
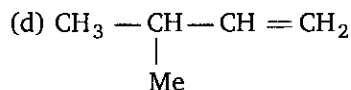
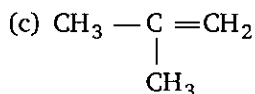
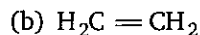
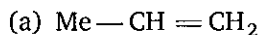
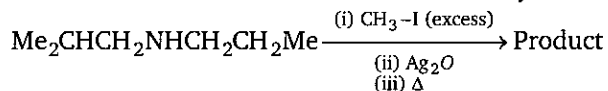
20. In the dehydrohalogenation of 2-bromobutane; which conformation leads to the formation of *cis*-2-butene ?



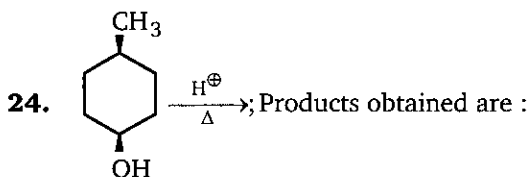
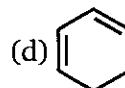
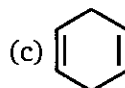
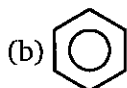
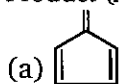
Product (B) of given reaction is:



22. What product will be formed from Hoffmann exhaustive methylation of following compound?



Product (A) is :

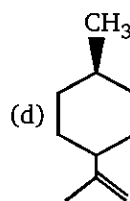
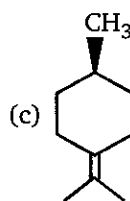
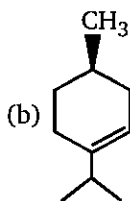
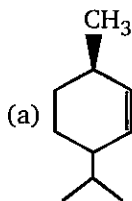
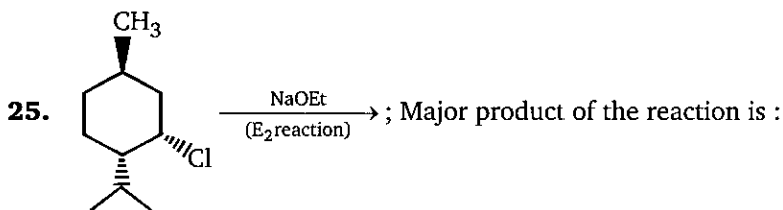


(a) Racemic

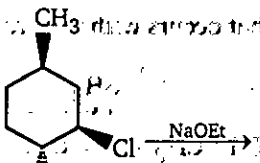
(b) Diastereomers

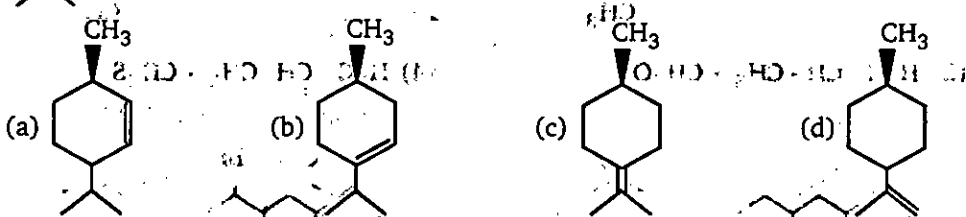
(c) G.I

(d) Positional isomers

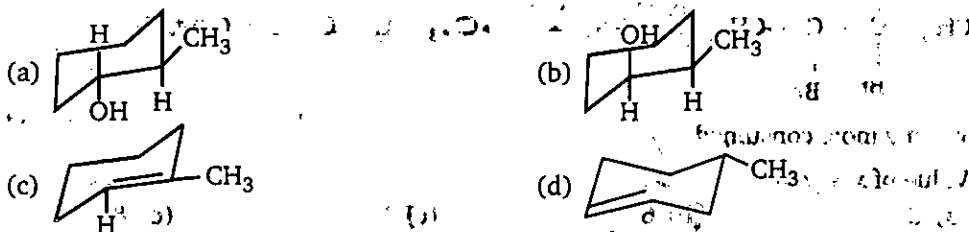
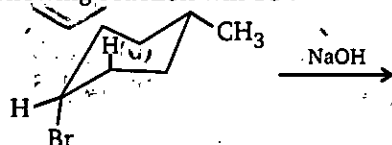




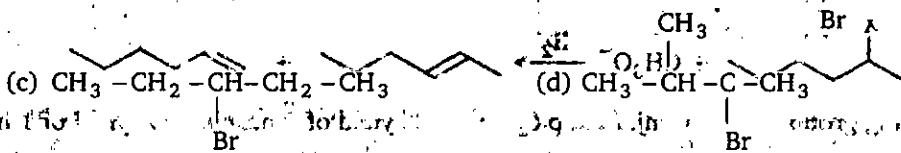
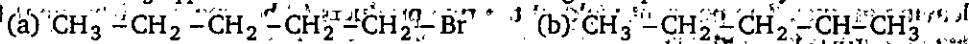
26.  Major product of the reaction is :



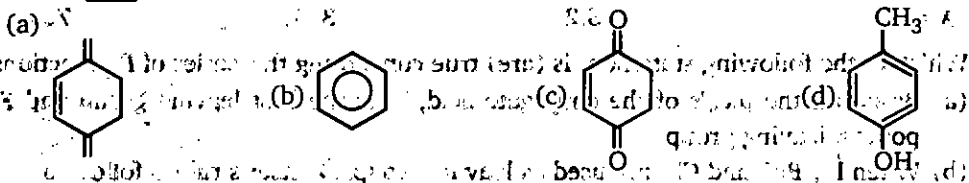
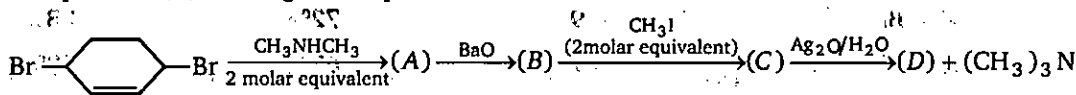
27. The  $E_2$  product of the following reaction will be ?



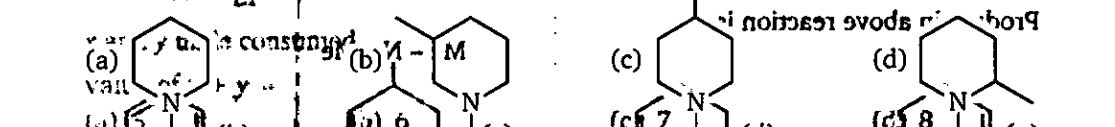
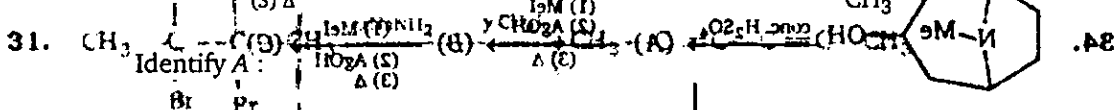
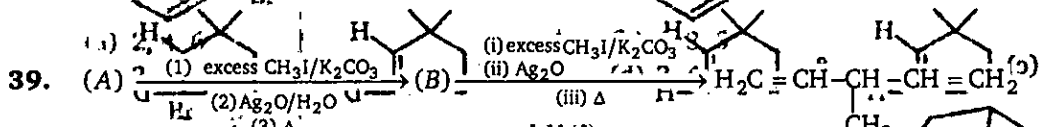
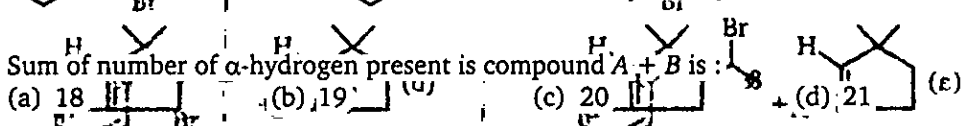
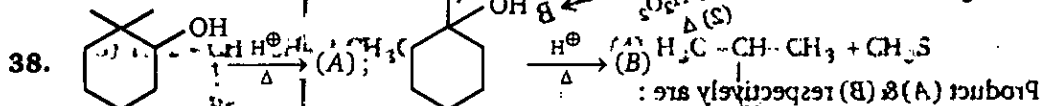
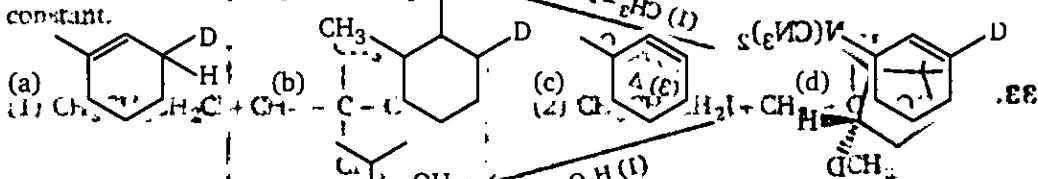
28. An alkyl halide  $C_5H_{11}Br$  on treatment with alc. KOH give 2-pentene only. The halide will be



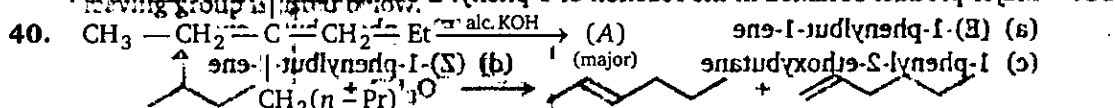
29. End product (D) in the given sequence is:



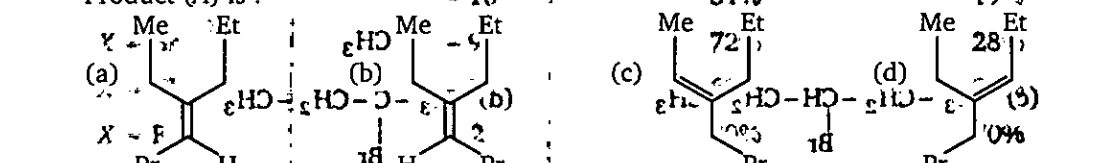
30. For each of the following pairs of  $E_1$  OH reactions, select the one that occurs with the greater rate constant.



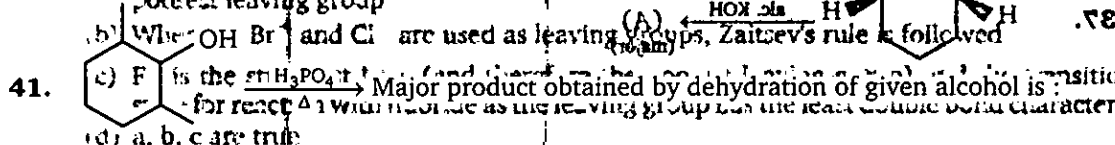
37. The major product obtained in the reaction of 1-phenyl-2-propyne with  $\text{H}_2$  is:

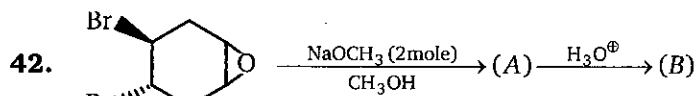
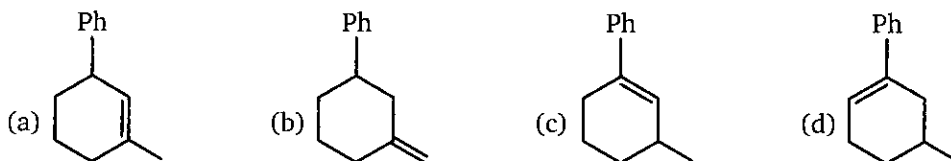


36. Which of the following allylic halides give most complex mixture of products in an  $E_2$  reaction?

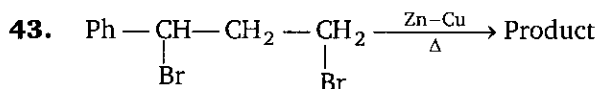
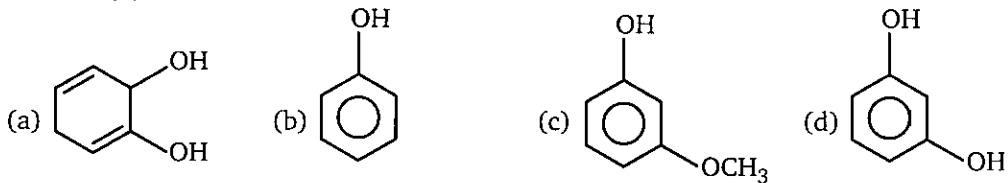


41. Which of the following statements (are) true concerning this series of reactions?

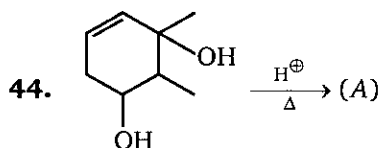
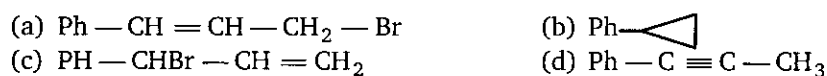




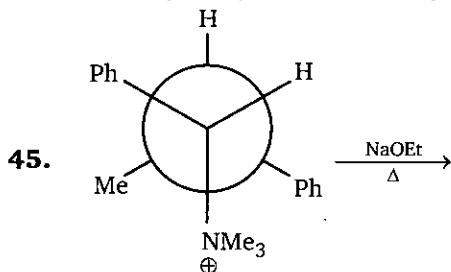
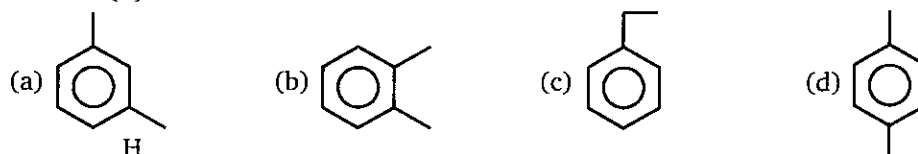
Product (B) of above reaction is :



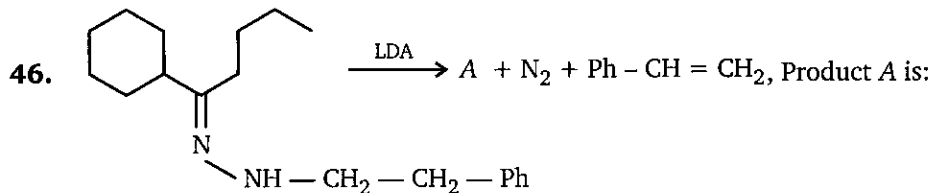
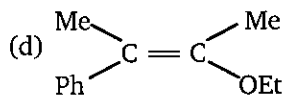
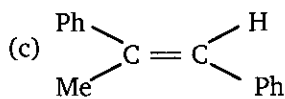
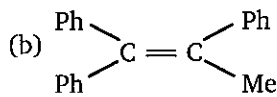
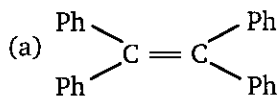
Product of the above reaction is :



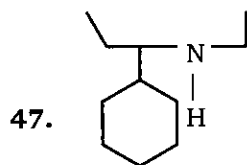
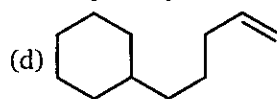
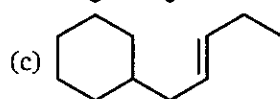
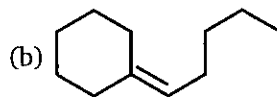
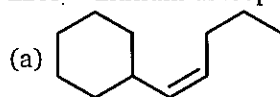
Product (A) is :



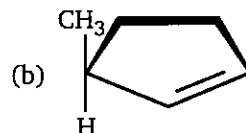
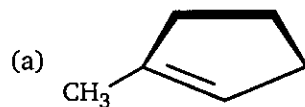
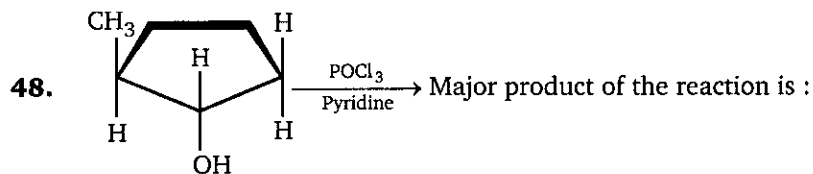
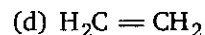
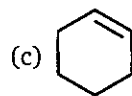
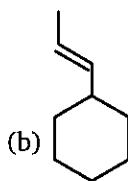
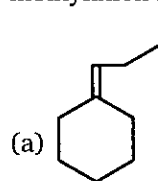
Major product of the above reaction is :

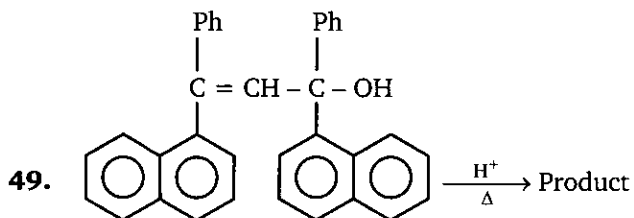
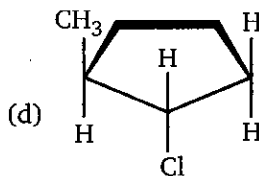
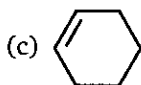


LDA = Lithium di-isopropyl amide



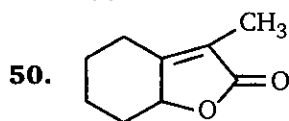
Major product of the reaction, when the given compound undergoes Hoffmann exhaustive methylation is :



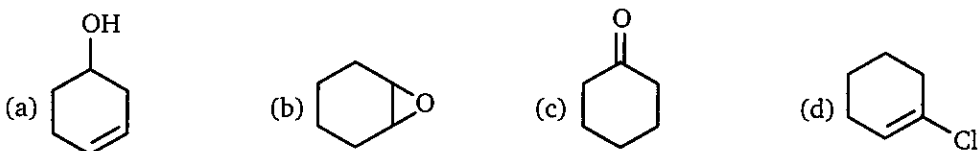
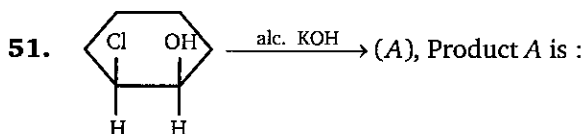
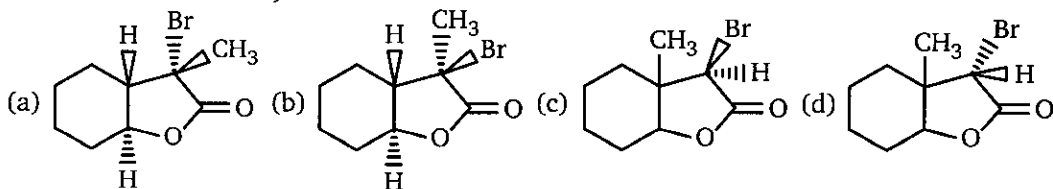


Stereochemistry of the product is :

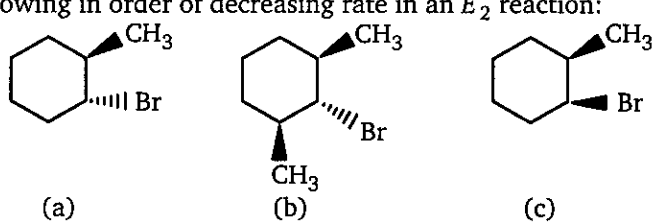
- (a) Meso compound  
 (b) Racemic mixture  
 (c) Diastereomer  
 (d) Optically pure enantiomers



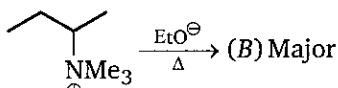
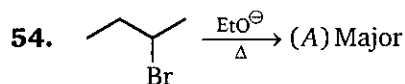
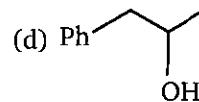
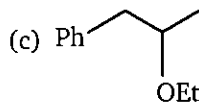
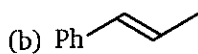
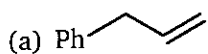
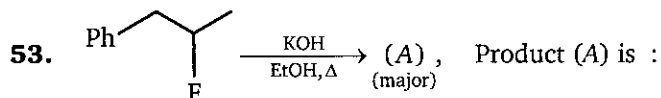
Which of the following reactant is used to obtain above compound (A). (Assume that  $\text{EtO}^-$  is used in all the reaction)



52. Rank the following in order of decreasing rate in an  $E_2$  reaction:



- (a)  $a > b > c$   
 (b)  $c > a > b$   
 (c)  $c > b > a$   
 (d)  $b > a > c$



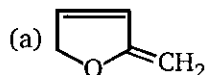
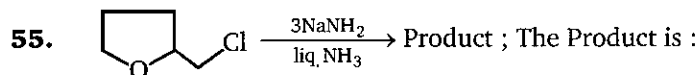
Relation between (A) and (B) is :

(a) G.I.

(b) Positional isomer

(c) Enantiomer

(d) Chain isomer

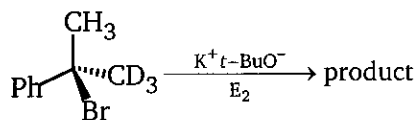


(b)  $\text{HC} \equiv \text{C} - (\text{CH}_2)_3 \text{ONa}$

(c)  $\text{NaC} \equiv \text{C} - (\text{CH}_2)_3 \text{ONa}$

(d)  $\text{H} - \text{C} \equiv \text{C} - (\text{CH}_2)_3 \text{OH}$

56. Which best describes the product of the following reaction ?



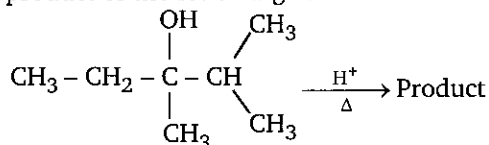
(a) Absolute configuration has been inverted

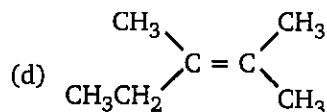
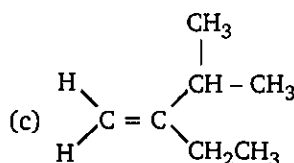
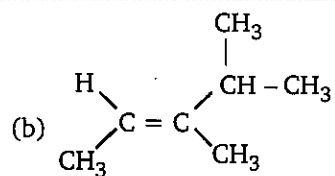
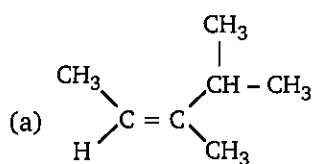
(b) Absolute configuration has been retained

(c) Racemization (loss of absolute configuration) has occurred

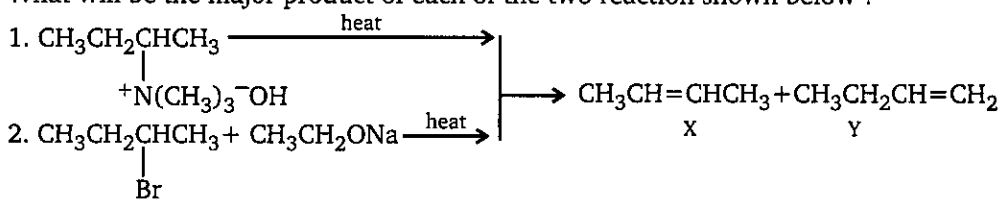
(d) Loss of chirality has occurred (the product is achiral)

57. What is the major product of the following reaction ?





58. What will be the major product of each of the two reaction shown below ?

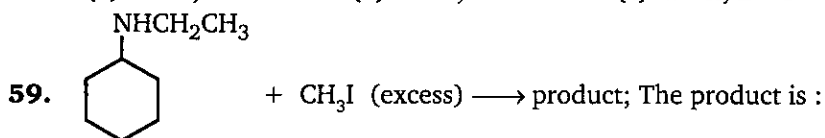


(a) 1 - X, 2 - X

(b) 1 - Y, 2 - X

(c) 1 - X, 2 - Y

(d) 1 - Y, 2 - Y

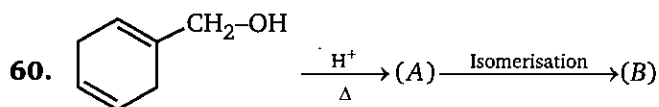


(a) a primary amine

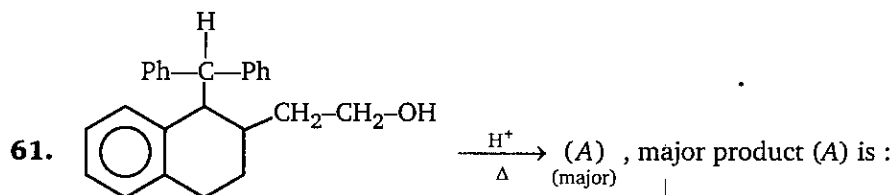
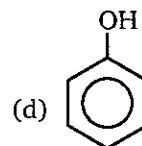
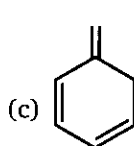
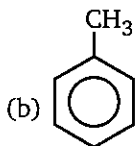
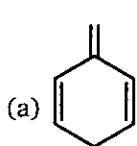
(b) a tertiary amine

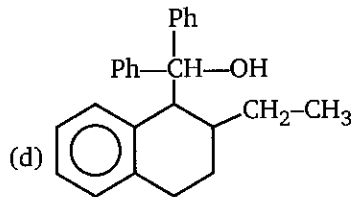
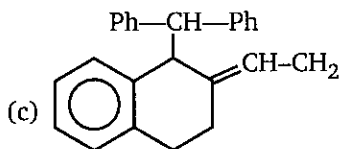
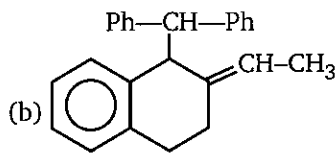
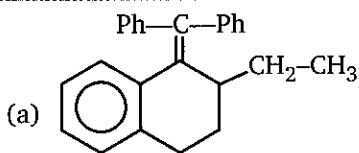
(c) a secondary amine

(d) a quaternary ammonium salt

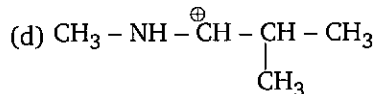
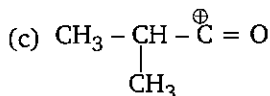
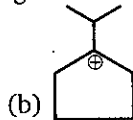
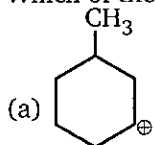


(A) on heating isomerizes to (B). What is the structure of (B) ?

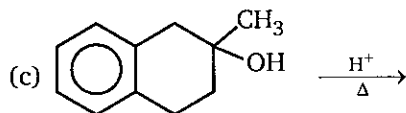
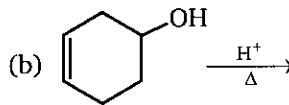
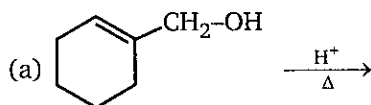




62. Which of the following carbocation will undergo rearrangement ?

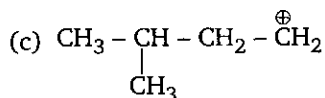
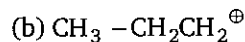
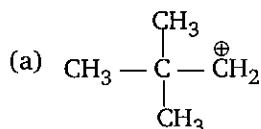


63. In which of the following reaction resonance stabilized product will form ?



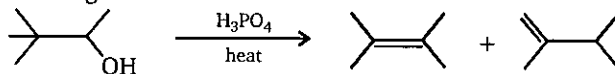
(d) All of these

64. In which of following reaction rearrangement take place with change in carbon skeleton ?



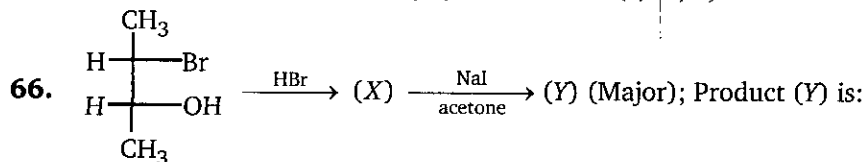


65. Consider the following reaction :

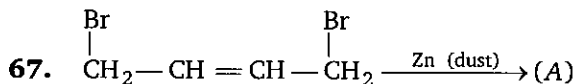


Which response contains all the correct statement about this process ?

- (1) Dehydration (2) E<sub>2</sub> mechanism  
 (3) Carbon skeleton migration (4) Most stable alkene will form  
 (5) Single-step reaction
- (a) 1, 3 (b) 1, 2, 3 (c) 1, 2, 5 (d) 1, 3, 4

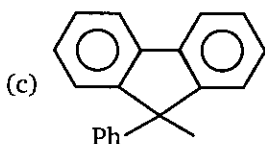
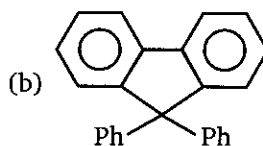
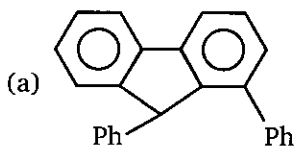
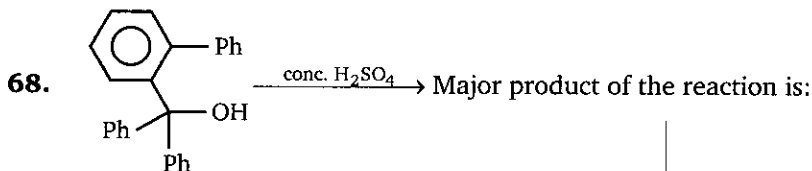


- (a) *cis*-2-butene (b) *trans*-2-butene  
 (c) 1-butene (d) Iso-butene

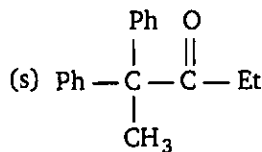
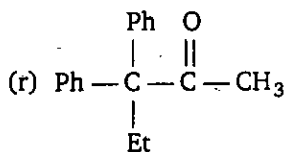
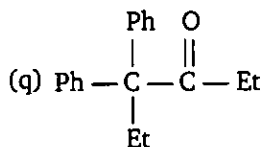
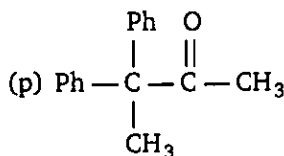
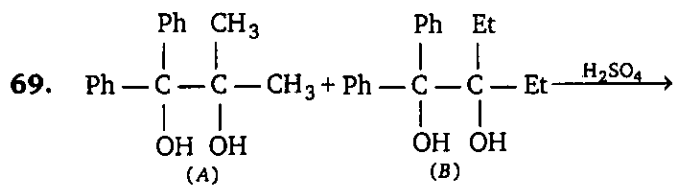


Above reaction is an example of 1,4-elimination. Predict the product.

- (a) CH<sub>3</sub> — CH = C = CH<sub>2</sub> (b) CH<sub>3</sub> — C ≡ C — CH<sub>3</sub>  
 (c) CH<sub>3</sub> — CH<sub>2</sub> — C ≡ CH (d) H<sub>2</sub>C = CH — CH = CH<sub>2</sub>



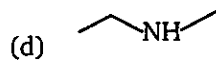
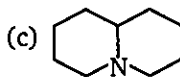
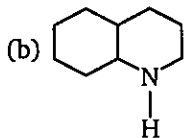
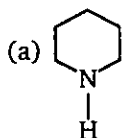
(d) None of these



When (A) and (B) reacts with  $\text{H}_2\text{SO}_4$  products obtained are :

- (a) p, q, r, s      (b) p, q      (c) p, q, r      (d) p, q, s

70. Which of the following compound gives even number of Hoffmann's exhaustive methylation and elimination?



### ANSWERS — LEVEL 1

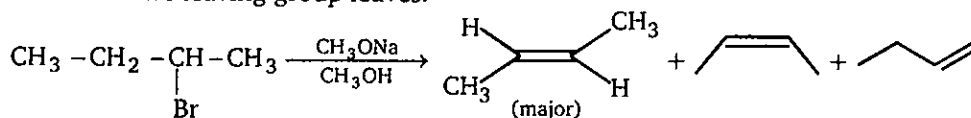
1.	(d)	2.	$\begin{matrix} A-a \\ B-d \end{matrix}$	3.	(a)	4.	(c)	5.	(b)	6.	(b)	7.	(d)	8.	(b)
9.	(c)	10.	(d)	11.	(c)	12.	(c)	13.	(c)	14.	(d)	15.	(d)	16.	(c)
17.	(b)	18.	(b)	19.	(c)	20.	(a)	21.	(b)	22.	(a)	23.	(b)	24.	(a)
25.	(b)	26.	(a)	27.	(d)	28.	(c)	29.	(b)	30.	(c)	31.	(d)	32.	(d)
33.	(a)	34.	(a)	35.	(a)	36.	(b)	37.	(c)	38.	(c)	39.	(c)	40.	(c)
41.	(c)	42.	(b)	43.	(b)	44.	(b)	45.	(c)	46.	(a)	47.	(d)	48.	(b)
49.	(b)	50.	(a)	51.	(c)	52.	(b)	53.	(b)	54.	(b)	55.	(c)	56.	(d)
57.	(d)	58.	(b)	59.	(d)	60.	(b)	61.	(a)	62.	(b)	63.	(d)	64.	(a)
65.	(d)	66.	(b)	67.	(d)	68.	(b)	69.	(b)	70.	(a,b)				

## LEVEL - 2

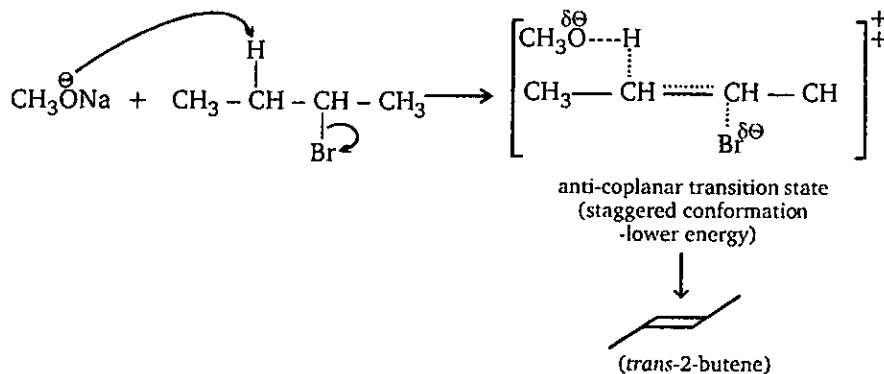
## 1. Comprehension

$E_2$  reaction  $\rightarrow$  Elimination bimolecular

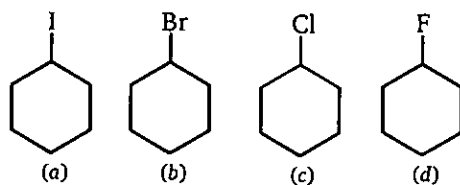
In the general mechanism of the  $E_2$  reaction a strong base abstract a proton on a carbon atom adjacent to the one of the leaving group. As the base abstracts a proton, a double bond forms and the leaving group leaves.



**Mechanism :**

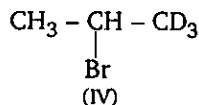
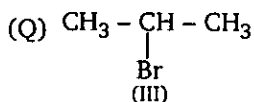
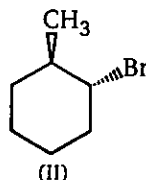
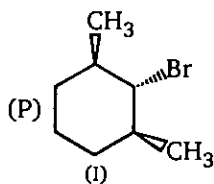


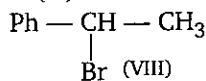
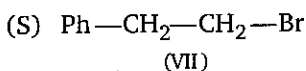
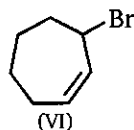
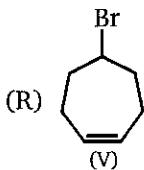
A. Identify the rate of reaction of given compounds in  $E_2$  reaction:



(a)  $a > b > c > d$     (b)  $a > c > b > d$     (c)  $b > a > c > d$     (d)  $b > d > a > c$

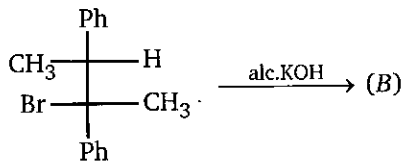
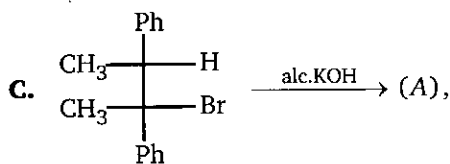
B. In given pairs, which compound is more reactive toward  $E_2$  reaction:





- (a) P - II, Q - III, R - VI, S - VII  
(c) P - I, Q - III, R - VI, S - VII

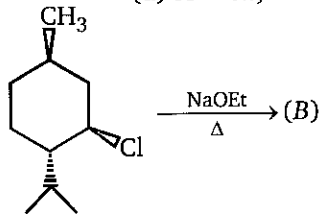
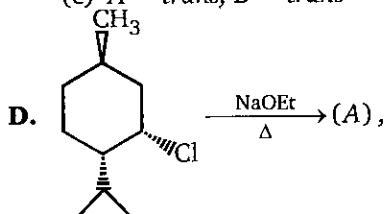
- (b) P - II, Q - III, R - VI, S - VI  
(d) P - I, Q - II, R - V, S - VIII



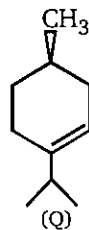
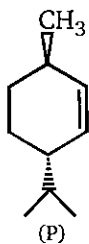
Product (A) and (B) are :

- (a) A = cis, B = cis  
(c) A = trans, B = trans

- (b) A = trans, B = cis  
(d) A = cis, B = trans

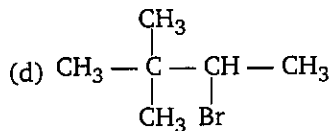
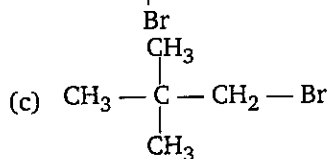
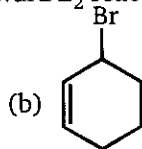
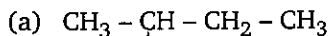


Select the products (A) and (B) from the compounds (P) and (Q) given below:



- (a) A = P, B = P      (b) A = Q, B = Q      (c) A = Q, B = P      (d) A = P, B = Q

E. Which of the following compound is inert toward  $E_2$  reaction.



## 2. Match the column :

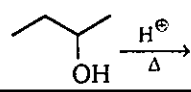
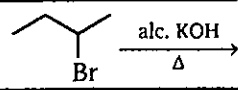
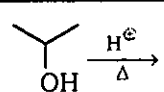
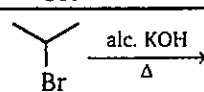
Column (I)		Column (II)	
$E_2$ reaction (elimination bimolecular)		No. of possible products. (including stereoisomerism)	
(a)		(p)	0
(b)		(q)	1
(c)		(r)	2
(d)		(s)	3

## 3. Match the Column :

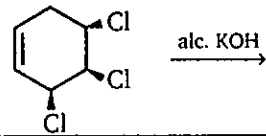
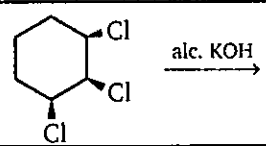
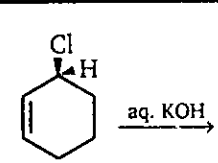
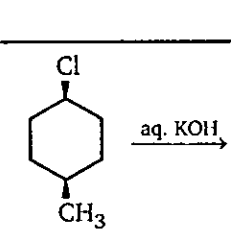
HEM = Hoffmann exhaustive methylation followed by elimination.

Column (I)		Column (II)	
Reaction		Product	
(a)		(p)	$H_2C = CH - CH_2 - CH = CH_2$
(b)		(q)	$H_2C = CH - CH_2 - CH_2 - CH = CH_2$
(c)		(r)	$H_2C = CH - CH_2 - \overset{\overset{CH_3}{ }}{C} = CH_2$
(d)		(s)	$H_2C = CH - \overset{\overset{CH_3}{ }}{CH} - CH = CH_2$

## 4. Match the column :

Column (I)		Column (II)	
(a)		(p)	Product are Diastereomers
(b)		(q)	Carbocation is intermediate
(c)		(r)	2nd order reaction
(d)		(s)	1st order reaction

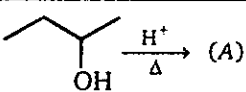
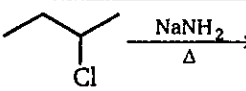
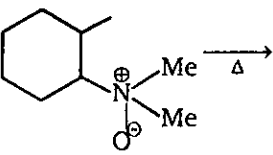
## 5. Match the column :

Column (I)		Column (II)	
(a)		(p)	Optically active product
(b)		(q)	Optically inactive product
(c)		(r)	2nd order reaction
(d)		(s)	unimolecular reaction

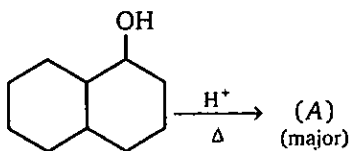
## 6. Match the column :

Column (I)		Column (II)	
E <sub>2</sub> reactions (elimination bimolecular)		Number of products (including stereoisomerism)	
(a)	$\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{CH}_2 - \text{Br} \xrightarrow{\text{alc. KOH}}$	(p)	1
(b)	$\begin{array}{c} \text{CH}_3 - \text{CH} - \text{CH}_2 - \text{CH}_3 \\   \\ \text{Br} \end{array} \xrightarrow{\text{alc. KOH}}$	(q)	2
(c)	$\begin{array}{c} \text{CH}_3 \\   \\ \text{CH}_3 - \text{C} - \text{CH}_2 - \text{CH}_3 \\   \\ \text{Br} \end{array} \xrightarrow{\text{alc. KOH}}$	(r)	3
(d)	$\begin{array}{c} \text{Ph} - \text{CH}_2 - \text{CH} - \text{CH}_2 - \text{CH}_3 \\   \\ \text{Br} \end{array}$	(s)	4

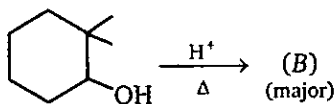
## 7. Match the column :

Column (I)		Column (II)	
(a)	 $\xrightarrow[\Delta]{\text{H}^+} \text{(A)}$	(p)	E <sub>1</sub>
(b)	 $\xrightarrow[\Delta]{\text{NaNH}_2}$	(q)	E <sub>2</sub>
(c)	$\text{CH}_3 - \overset{\text{O}}{\parallel}{\text{C}} - \text{CH}_2 - \underset{\text{Br}}{\text{CH}} - \text{CH}_3 \xrightarrow[\Delta]{\text{EtONa}}$	(r)	Ei (elimination intramolecular)
(d)	 $\xrightarrow{\Delta}$	(s)	E <sub>1</sub> CB

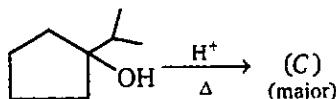
13. Reaction-1



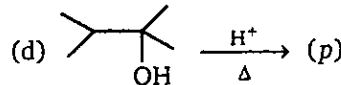
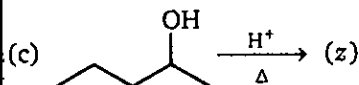
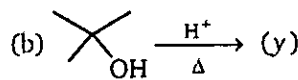
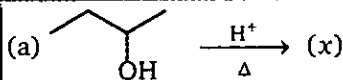
Reaction-2



Reaction-3

Sum of  $\alpha$ -hydrogen (A + B + C) =

14.



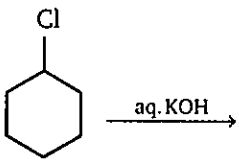
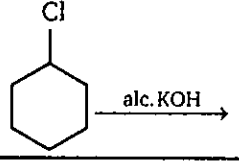
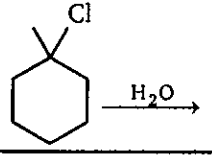
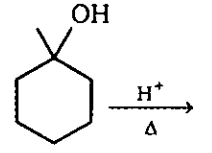
Total number of products obtained in above reactions including minor products is (including stereoisomer)

15. Match the column (I) and (II).

Column (I)		Column (II)	
Reaction		Type of Reaction	
(a)	R-2-chlorobutane $\xrightarrow[\text{acetone}]{\text{KSH}}$	(p)	$S_N1$
(b)	R-2-chlorobutane $\xrightarrow[\text{EtOH}]{\text{EtO}^-\text{Na}^+}$	(q)	$S_N2$
(c)	2-bromo-2-methylpropane $\xrightarrow{\text{H}_2\text{O}}$	(r)	$E_1$
(d)	2-butanol $\xrightarrow[\Delta]{\text{H}_2\text{SO}_4}$	(s)	$E_2$

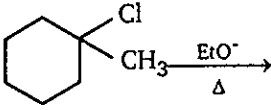


16. Match the column (I) and (II).

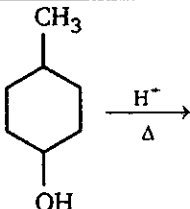
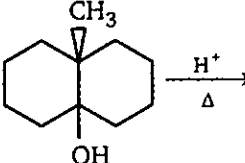
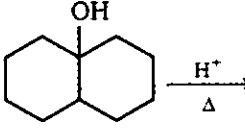
Column (I)		Column (II)	
	Reaction		Type of Reaction
(a)	 <p style="text-align: center;"> <chem>C1CCC(CC1)Cl</chem> <math>\xrightarrow{\text{aq. KOH}}</math> </p>	(p)	$S_N1$
(b)	 <p style="text-align: center;"> <chem>C1CCC(CC1)Cl</chem> <math>\xrightarrow{\text{alc. KOH}}</math> </p>	(q)	$S_N2$
(c)	 <p style="text-align: center;"> <chem>CC1(Cl)CCCCC1</chem> <math>\xrightarrow{\text{H}_2\text{O}}</math> </p>	(r)	$E_1$
(d)	 <p style="text-align: center;"> <chem>CC1(O)CCCCC1</chem> <math>\xrightarrow[\Delta]{\text{H}^+}</math> </p>	(s)	$E_2$

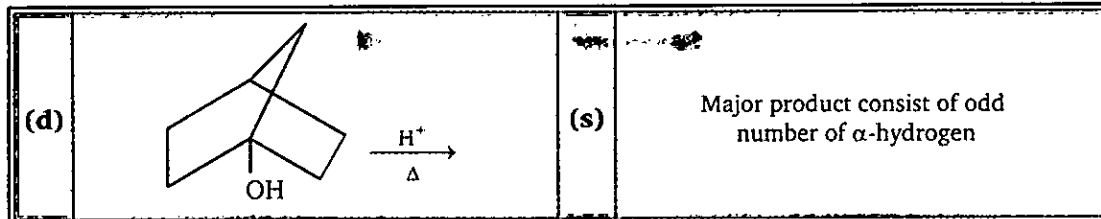
17. Select whether the following reagent combination will result in elimination or substitution reactions leading to the major product.

Reaction	Substitution	Elimination
(a) $\text{CH}_3 - \overset{\text{CH}_3}{\underset{\text{H}}{\text{C}}} - \text{Cl} \xrightarrow[\text{H}_2\text{O}]{\text{K}^+ \text{ } ^-\text{OC}(\text{CH}_3)_3}$		
(b) $\text{CH}_3 - \overset{\text{CH}_3}{\underset{\text{CH}_3}{\text{C}}} - \text{OH} \xrightarrow[\Delta]{\text{H}_2\text{SO}_4}$		

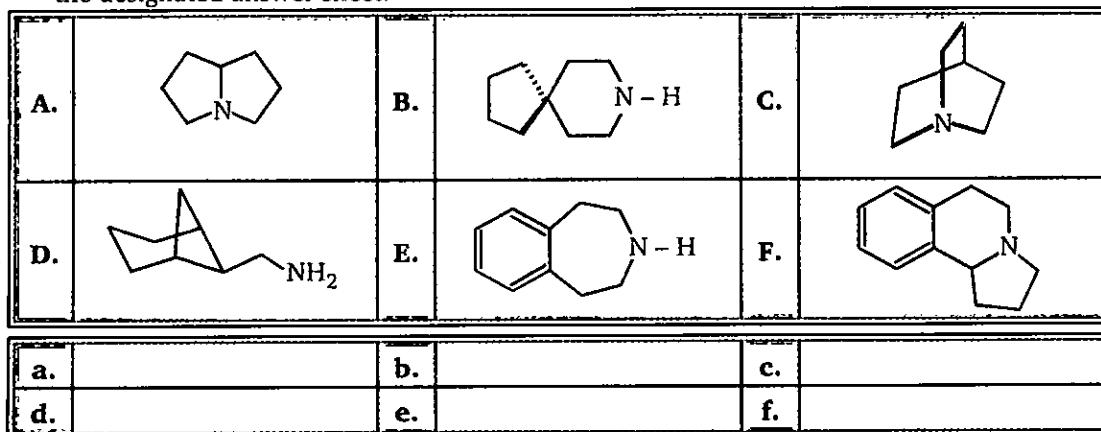
(c)	$\text{CH}_3 - \overset{\text{Cl}}{\underset{ }{\text{CH}}} - \text{CH}_2 - \text{CH}_3 \xrightarrow{\text{alc-KOH}}$		
(d)	$\text{CH}_3 - \overset{\text{CH}_3}{\underset{\text{H}}{\text{C}}} - \text{I} \xrightarrow{\ominus \text{NaN}_3}$		
(e)			
(f)	$\text{CH}_3 - \overset{\text{CH}_3}{\underset{\text{CH}_3}{\text{C}}} - \text{Cl} \xrightarrow{\text{H}_2\text{O}}$		

## 18. Match the Column (I) and (II) (Matrix).

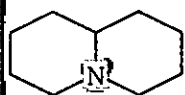
Column (I)		Column (II)	
Reaction		Comment on product	
(a)		(p)	Racemic mixture
(b)		(q)	Major product consist of even number of $\alpha$ -hydrogen
(c)		(r)	Will not undergo dehydration



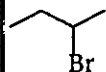
19. For each of the following amines (A through D), exhaustive methylation (treatment with excess methyl iodide), followed by Hoffmann elimination (heating with AgOH), repeated as necessary, removes the nitrogen atom in the form of trimethylamine. Indicate the number of repetitive Hoffmann eliminations required to remove the nitrogen by a number (1 to 4) in the designated answer sheet.



20.



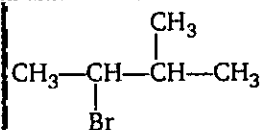
→  $x$  is total number of HEM (Hoffman Exhaustive Methylation and eliminations) to remove nitrogen from given compound.



$\xrightarrow{\text{alc.KOH}}$   $y$  is total number of possible  $E_2$  product (including stereoisomer)

Sum of  $x+y = ?$

21.

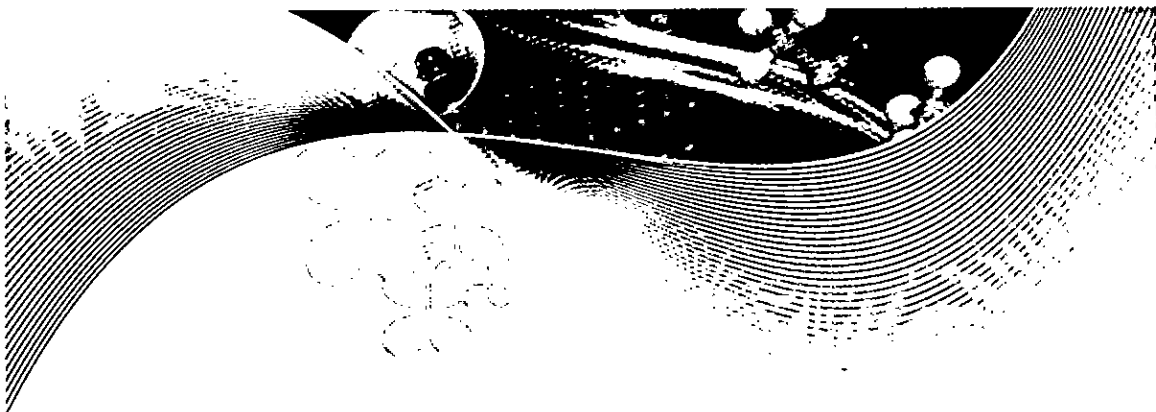


$\xrightarrow{\text{EtOH}}$  (x) ( $S_N1 + E_1$ ) products. ( including stereoisomer) consider all products

Total number of products are :

## ANSWERS — LEVEL 2

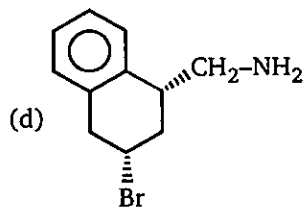
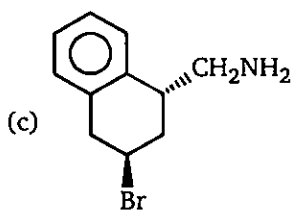
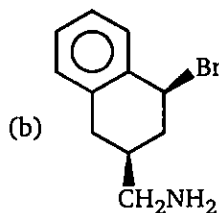
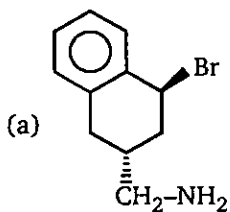
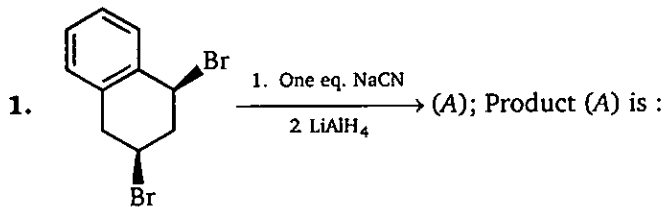
1. A - a; B - a; C - b; D - c; E - c;
2. a - s; b - r; c - q; d - p
3. a - s; b - r; c - q; d - p
4. a - p, q, s; b - p, r; c - q, s; d - r
5. a - p, r; b - p, r; c - p, r; d - q, r
6. a - p; b - r; c - q; d - s
7. a - p; b - q; c - s; d - r
8. a - p; b - q; c - r; d - s
9.  $X = 3, Y = 3, Z = 2, P = 0 \Rightarrow 3 + 3 + 2 + 0 = 8$
10.  $x = 3, y = 2, z = 3 \Rightarrow 3 + 2 + 3 = 8$
11. 32
12. 33
13. 28
14.  $x = 3, y = 1, z = 3, p = 2$   
Sum = 9
15. (a - q), (b - s), (c - p), (d - r)
16. (a - q), (b - s), (c - p), (d - r)
17. Substitution - d, f  
Elimination - a, b, c, e
18. a - p, q; b - p, q; c - q; d - r
19. a - 3; b - 2; c - 3; d - 1; e - 2; f - 3
20. 6
21. 6



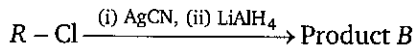
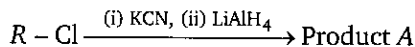
5C

## ALKYL HALIDES

LEVEL - 1

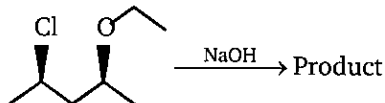


2. In the reactions given below,



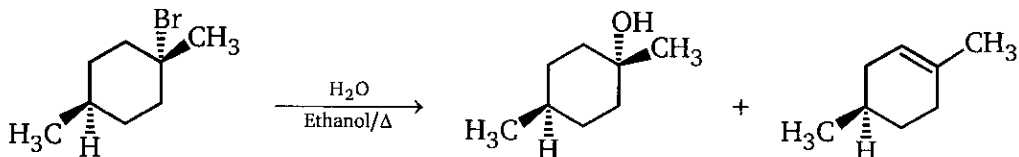
the compounds A and B are :

- (a) chain isomers (b) position isomers  
 (c) functional isomers (d) metamers
3. Which is the major product expected from the following  $S_N2$  reaction ?



- (a)
- (b)
- (c)
- (d)

4. Consider the following  $E_1/S_N1$  reaction :

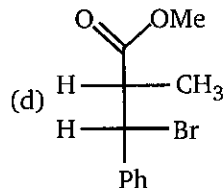
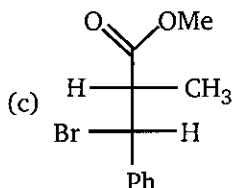
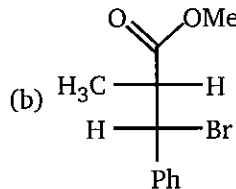
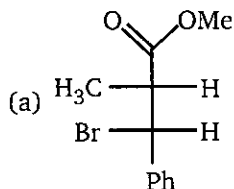
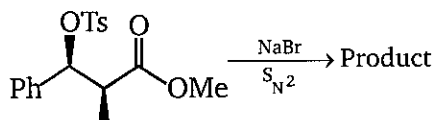


The missing product(s) is(are) :

- (1)
- (2)
- (3)
- (4)

- (a) 1 and 3 (b) 3 and 4 (c) 2 and 3 (d) 1, 2, 3 and 4

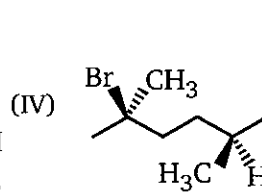
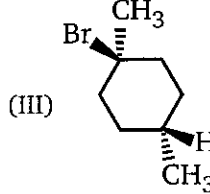
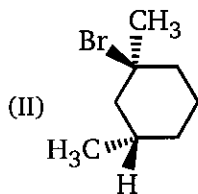
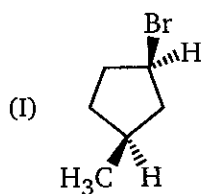
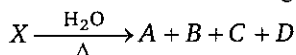
5. What is the product of the following  $S_N2$  reaction ?



6. Select the reagent that will yield the greater amount of substitution on reaction with  $\text{CH}_3-\text{CH}_2-\text{Br}$  :

- $\text{CH}_3\text{CH}_2\text{OK}$  in dimethyl sulfoxide (DMSO)
- $(\text{CH}_3)_3\text{COK}$  in dimethyl sulfoxide (DMSO)
- Both (a) and (b) will give comparable amounts of substitution
- Neither (a) nor (b) will give any amount of substitution

7. Under the specified conditions, substrate  $X$  undergoes substitution and elimination reactions to give products  $A-D$ .  $A$  and  $B$  are stereoisomers, but not enantiomers.  $C$  and  $D$  are enantiomers.  $A$  is not an isomer of  $C$ . Which of the following could be the starting material  $X$  ?

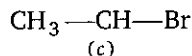
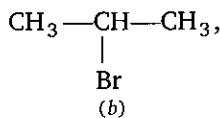
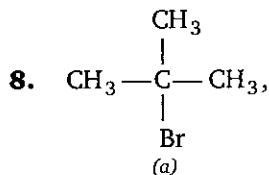


(a) (I)

(b) (II)

(c) (III)

(d) (IV)



Compare rate of  $E_2$  reaction :

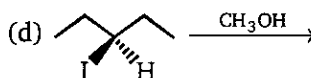
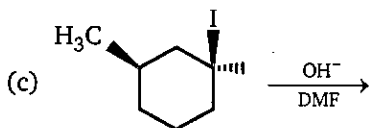
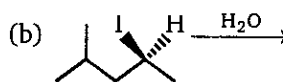
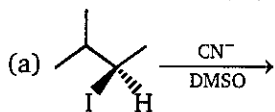
(a)  $c > b > a$

(b)  $a > b > c$

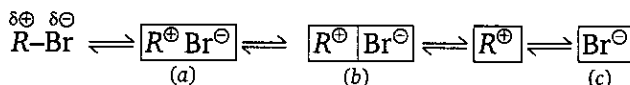
(c)  $b > a > c$

(d)  $c > a > b$

9. Which reaction results in the formation of a pair of enantiomers ?

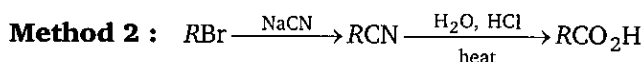
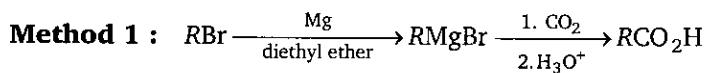


10. Rate limiting  $S_N1$  follows the sequence

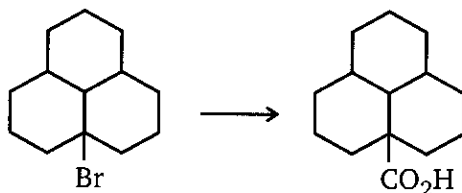


True statement about sequence on the basis of assumption that  $R$  contains 3 different groups is :

- (a) more stable carbocation, greater is in the proportion of racemization  
 (b) the more nucleophilic the solvent greater in the proportion of inversion  
 (c) In above sequence (b) represent separately solvated, pair of ions  
 (d) All of these
11. Compare the two methods shown for the preparation of carboxylic acids :



Which one of the following statements correctly describes this conversion ?



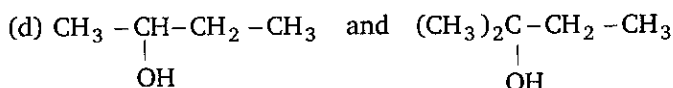
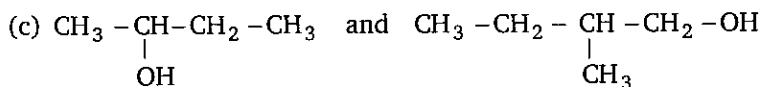
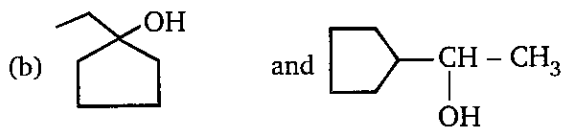
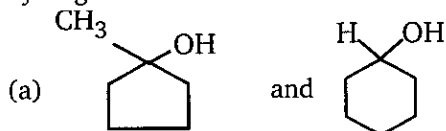
- (a) Both method 1 and method 2 are appropriate for carrying out this conversion  
 (b) Neither method 1 nor method 2 is appropriate for carrying out this conversion  
 (c) Method 1 will work well, but method 2 is not appropriate  
 (d) Method 2 will work well, but method 1 is not appropriate

12. Which of the following statements is true ?

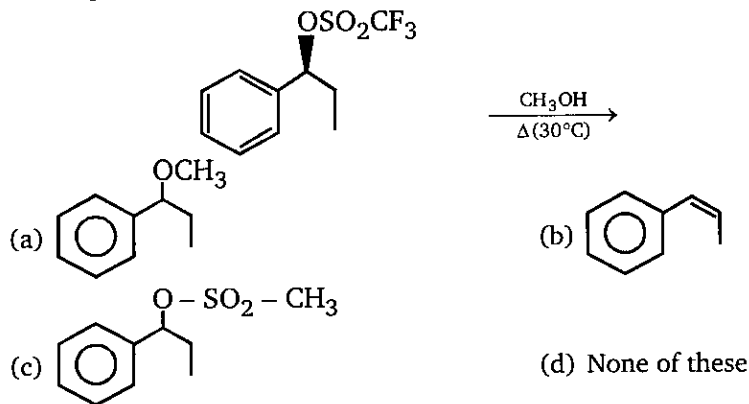
- (a)  $CH_3CH_2S^-$  is both a stronger base and more nucleophilic than  $CH_3CH_2O^-$   
 (b)  $CH_3CH_2S^-$  is a stronger base but is less nucleophilic than  $CH_3CH_2O^-$   
 (c)  $CH_3CH_2S^-$  is a weaker base but is more nucleophilic than  $CH_3CH_2O^-$   
 (d)  $CH_3CH_2S^-$  is both a weaker base and less nucleophilic than  $CH_3CH_2O^-$



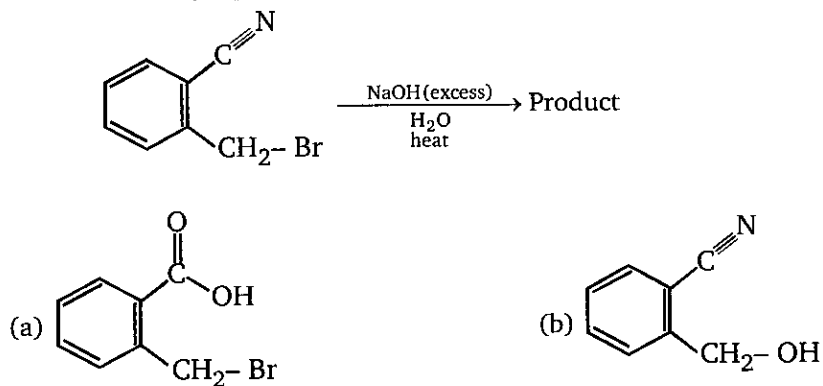
13. In the given pair of alcohols, in which pair second alcohol is more reactive than first towards hydrogen bromide ?

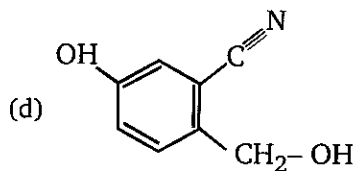
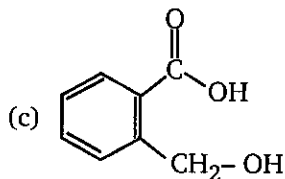


14. Which product would be expected to predominate in the given reaction ?

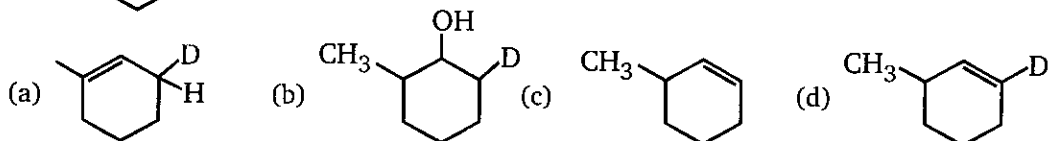
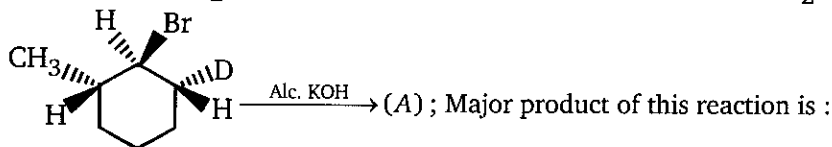
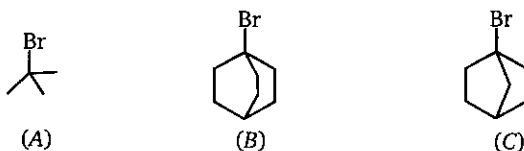


15. Which is the major product of the following reaction ?





16.

17. Rate of  $S_N2$  reaction is :

(a) (B) &gt; (A) &gt; (C)

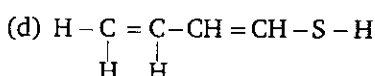
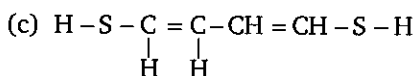
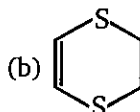
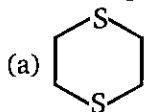
(b) (C) &gt; (A) &gt; (B)

(c) (A) &gt; (B) &gt; (C)

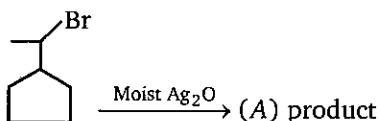
(d) (A) &gt; (C) &gt; (B)

18. 1,2-dichloro ethane +  $\text{NaSCH}_2\text{CH}_2\text{SNa} \longrightarrow \text{C}_4\text{H}_8\text{S}_2 + (P)$ 

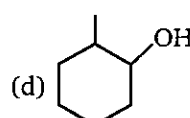
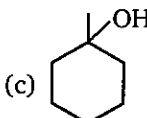
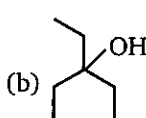
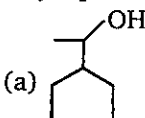
Unknown product (P) of the above reaction is :



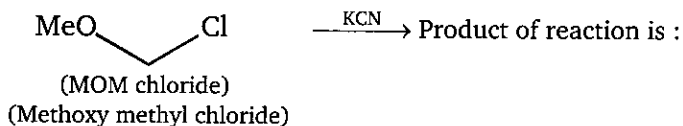
19.

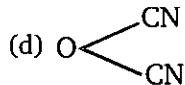
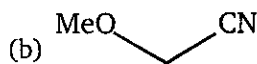
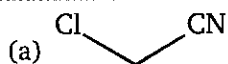


Major product (A) is :

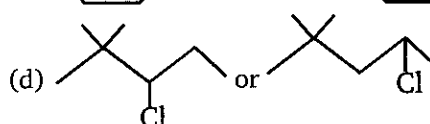
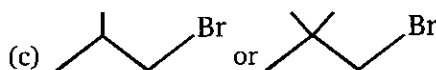
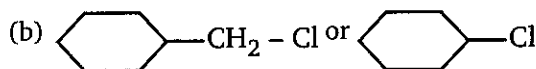
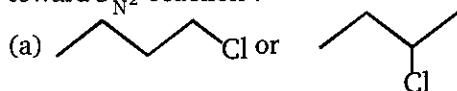


20.

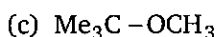
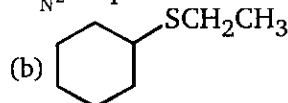
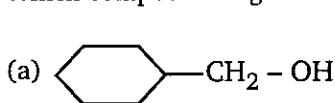




21. In the given pair of compound, in which pair the second compound is more reactive than first toward  $\text{S}_{\text{N}}2$  reaction ?

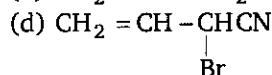
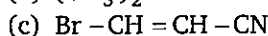
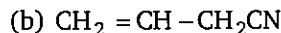
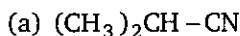


22. Which compound might be synthesized by the  $\text{S}_{\text{N}}2$  displacement of an alkyl-halide ?

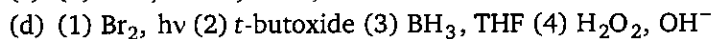
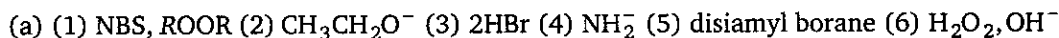
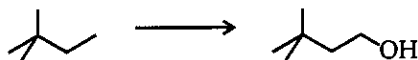


(d) All of these

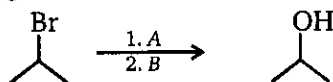
23. Identify C in the following series  $\text{C}_3\text{H}_7\text{I} \xrightarrow[\text{alc.}]{\text{KOH}} \text{A} \xrightarrow[\Delta]{\text{NBS}} \text{B} \xrightarrow[\text{alc.}]{\text{KCN}} \text{C}$ .



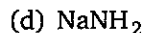
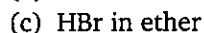
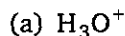
24. What sequence of reagents is required to accomplish the following transformation ?



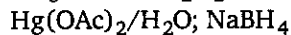
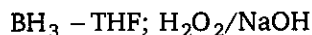
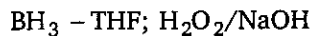
25. Which of the reagents shown below would accomplish the following transformations?



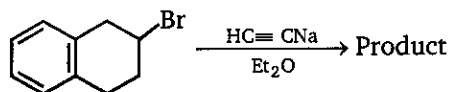
A

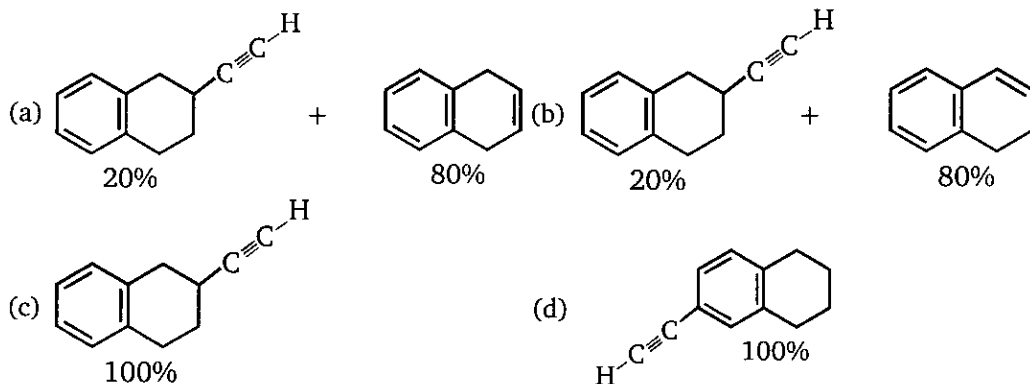


B

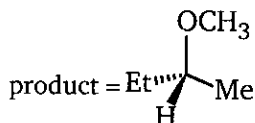


26. What are the products obtained from the following reaction ?





27. The back-side attack on 2-bromobutane by methoxide ( $\text{CH}_3\text{O}^-$ ) gives the product shown below. Which Fischer projection represents 2-bromobutane used as the reactant in this reaction ?



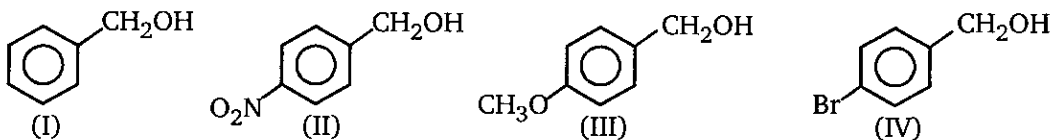
28. Consider the following statements :

- (1) Bridgehead halides are inert towards both  $\text{S}_{\text{N}}1$  and  $\text{S}_{\text{N}}2$  reactions (till one of the ring size is eight member ring)
- (2) The first step in both  $\text{S}_{\text{N}}1$  and  $\text{E}_1$  reactions is the same
- (3)  $\text{S}_{\text{N}}2$  reactions proceed with total retention of configuration
- (4)  $\text{E}_2$  eliminations are by the use of a solvent of low polarity and high concentration of a strong base

Which of the above statements are correct?

- (a) 1, 2 and 4 (b) 1 and 3  
(c) 2, 3 and 4 (d) 1, 2, 3 and 4

29. Consider the following alcohols :



The order of decreasing reactivities of these alcohols towards substitution with  $\text{HBr}$  is :

- (a) III > I > IV > II (b) III > I > II > IV  
(c) I > III > IV > II (d) I > III > II > IV

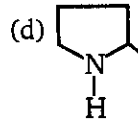
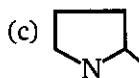
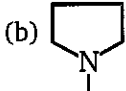
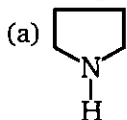
30. In solvolysis of 1,2-dimethyl propyl *p*-toluene sulfonate in acetic acid at 75°C, how many (alkene + substitution) products will be formed ?

- (a) 2 (b) 3 (c) 4 (d) 5

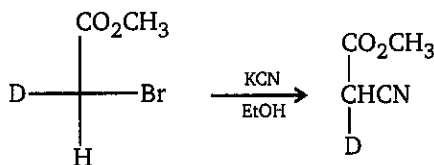
31. Benzotrichloride reacts with milk of lime to form :

- (a) Benzal (b) Benzoic acid (c) Benzyl alcohol (d) Phenol

32.  $\text{Br}-\text{CH}_2-(\text{CH}_2)_2-\text{CH}_2-\text{Br} + \text{CH}_3\text{NH}_2 \longrightarrow$  Product of the reaction is :

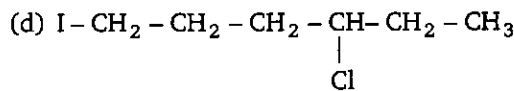
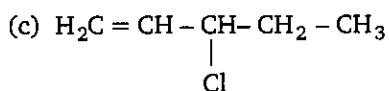
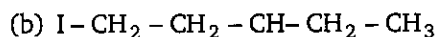
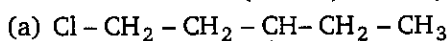


33. The configurations of the reactant and the product in the following reaction, respectively, are:

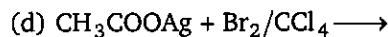
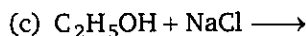
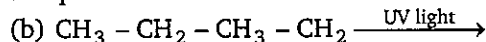
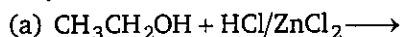


- (a) R, R (b) R, S (c) S, R (d) S, S

34. 1,4-dichlorohexane (1 mole) + NaI (1 mole)  $\xrightarrow{\text{Acetone}}$  Product of the reaction is :



35. Alkyl halides can be obtained by all methods except :



36. In order to prepare 1-chloropropane, which of the following reactants can be employed ?

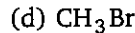
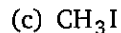
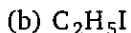
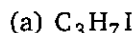
(a) Propene and HCl in the presence of peroxide

(b) Propene and  $\text{Cl}_2$  followed by treatment with aq. KOH

(c) Propanol-1 and  $\text{SOCl}_2$ /pyridine

(d) Any of the above can be used

37. Which alkyl halide has maximum density ?



38. Which of the following molecules would have a carbon-halogen bond most susceptible to nucleophilic substitution ?

(a) 2-fluorobutane

(b) 2-chlorobutane

(c) 2-bromobutane

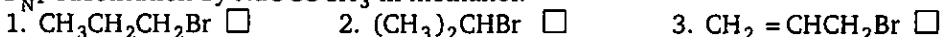
(d) 2-iodobutane



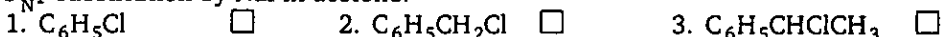


2. In each of the following sections three organic halogen compounds are listed. In the box given enter a number (1 to 3) indicating the order of reactivity of the designated (1 is most reactive and 3 is least).

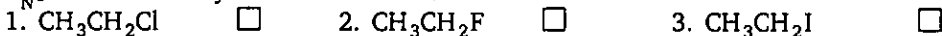
(a)  $S_N2$  substitution by  $\text{NaOCOCH}_3$  in methanol:



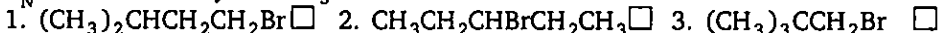
(b)  $S_N2$  substitution by  $\text{NaI}$  in acetone:



(c)  $S_N2$  substitution by  $\text{NaCN}$  in methanol:



(d)  $S_N2$  substitution by  $\text{NaSCH}_3$  in methanol:



3. Isobutyl alcohol (2-methyl-1-propanol),  $(\text{CH}_3)_2\text{CHCH}_2\text{OH}$ , can be transformed to each of the compounds (a through l) listed in the left-hand column. In each case the number of steps needed to accomplish the change is noted, and an answer box is provided for your reagent selections. Fourteen reagents (designated A through N) are listed in the right-hand column.

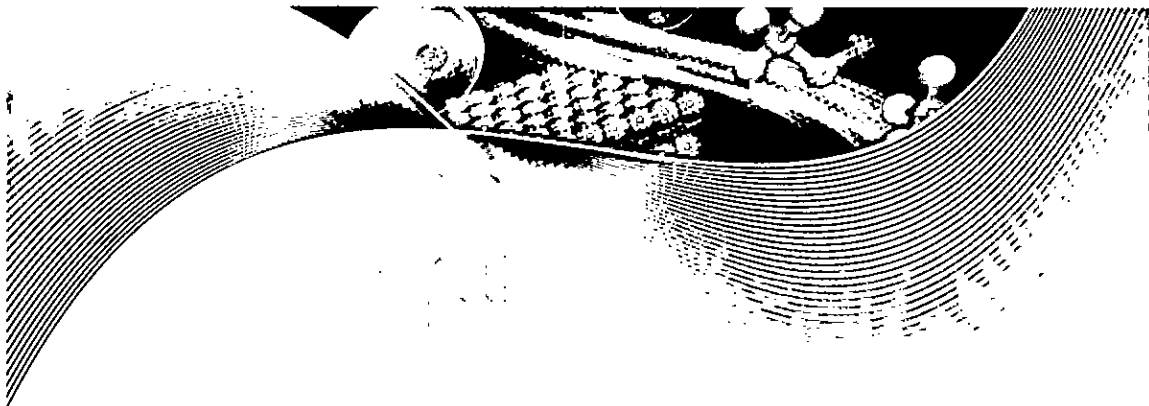
Write letters designating the reagent or reagents you believe will achieve the desired transformation in the box to the right of the product formula. In the case of a multi-step sequence write the reagents in the order they are to be used. In some cases you may wish to use a previously prepared compound as a reactant. If so, write the number (a to l) corresponding to the desired compound.

	Desired product	No. of Steps	Write Options	Reagent List
a.	$(\text{CH}_3)_2\text{CHCH}_2\text{Br}$	one		A. $\text{Hg}(\text{OAc})_2$ in $\text{H}_2\text{O}$
b.	$(\text{CH}_3)_2\text{C} = \text{CH}_2$	one		B. $\text{PBr}_3$ & heat
c.	$(\text{CH}_3)_2\text{CHCH} = \text{O}$	one		C. $\text{NaBH}_4$ in alcohol
d.	$(\text{CH}_3)_2\text{CHCO}_2\text{H}$	one		D. $\text{LiAlH}_4$ in THF (aqueous workup)
e.	$(\text{CH}_3)_3\text{CBr}$	two		E. $\text{NaCN}$ in alcohol
f.	$(\text{CH}_3)_2\text{CHCH}_2\text{C} \equiv \text{N}$	two		F. PCC in $\text{CH}_2\text{Cl}_2$
g.	$(\text{CH}_3)_2\text{CHCH}_2\text{OCOCH}_3$	one		G. Jones' reagent ( $\text{CrO}_3$ in $\text{H}_3\text{O}^+$ )
h.	$(\text{CH}_3)_2\text{CHCO}_2\text{C}_2\text{H}_5$	two		H. $\text{HBr}$ in $\text{CH}_2\text{Cl}_2$
i.	$(\text{CH}_3)_2\text{CHCH}_2\text{OCH}_2(\text{CH}_3)_2$	two		I. $\text{H}_3\text{PO}_4$ and heat
j.	$(\text{CH}_3)_2\text{COH}$	three		J. $(\text{CH}_3\text{CO})_2\text{O}$ + pyridine
k.	$(\text{CH}_3)_2\text{CHCH}_2\text{NH}_2$	three		K. $\text{NaN}_3$ in aqueous alcohol
l.	$(\text{CH}_3)_2\text{CHCH}_2\text{CH}_2\text{NH}_2$	two		L. $\text{C}_6\text{H}_5\text{CO}_3\text{H}$ in $\text{CH}_2\text{Cl}_2$ (peracid)
				M. $\text{NaH}$ in ether and heat
				N. $\text{C}_2\text{H}_5\text{OH}$ + acid catalyst & heat



## ANSWERS — LEVEL 2

- 1.
- |       | A | B | C | D | E | F | G | H | I | J |
|-------|---|---|---|---|---|---|---|---|---|---|
| (i)   | 2 | 2 | 2 | 1 | 1 | 1 | 6 | 2 | 2 | 6 |
| (ii)  | 2 | 2 | 2 | 1 | 1 | 5 | 6 | 2 | 2 | 6 |
| (iii) | 2 | 2 | 2 | 1 | 1 | 1 | 3 | 3 | 2 | 3 |
| (iv)  | 4 | 2 | 2 | 1 | 1 | 5 | 3 | 3 | 4 | 3 |
2.  $a - 3 > 1 > 2$ ;  $b - 2 > 3 > 1$ ;  $c - 3 > 1 > 2$ ;  $d - 1 > 2 > 3$
3.  $a - B$ ;  $b - I$ ;  $c - F$ ;  $d - G$ ;  $e - I, H$  or  $2 H$ ;  $f - B, E$  or  $I, E$ ;  $g - J$ ;  $h - G, N$  or  $4N$   
 $i - N, I$ ;  $j - I, A, C$  or  $2AC$  or  $ILD$  or  $2LD$ ;  $k - B, K, D$  or  $1KD$ ;  $l - B, E, D$  or  $1ED$  or  $6D$

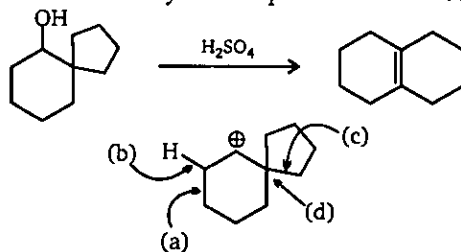


# 6

## ALCOHOL, ETHERS AND EPOXIDES

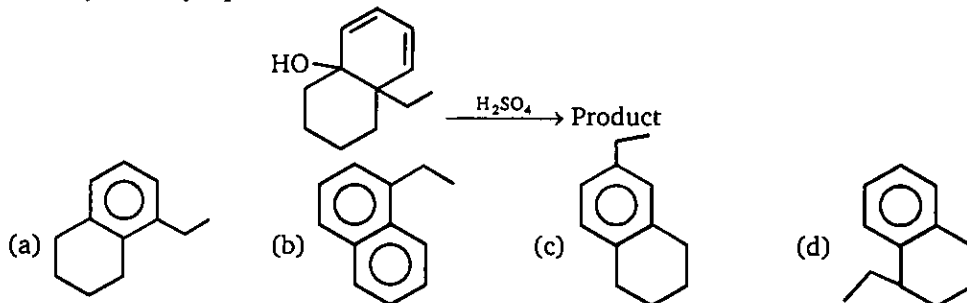


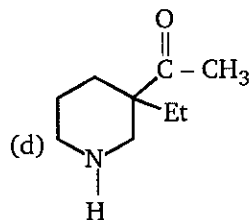
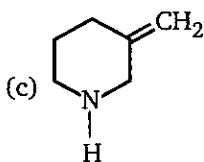
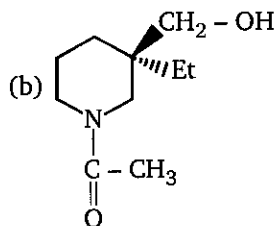
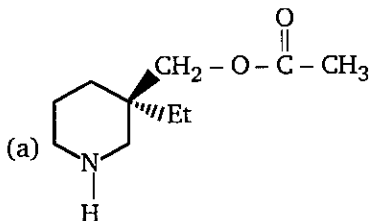
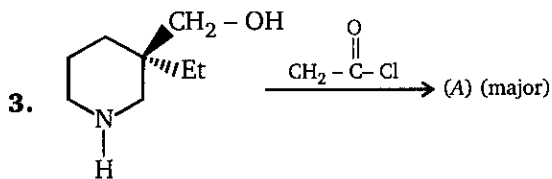
1. The following transformation involves a carbocation rearrangement. The carbocation is generated by protonation of the hydroxyl group, followed by the loss of water. Which bond has to migrate in the carbocation to yield the product indicated (after the deprotonation) ?



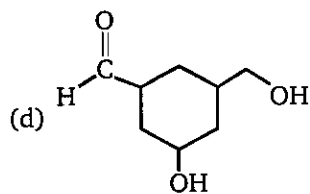
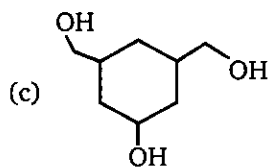
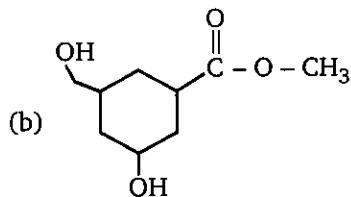
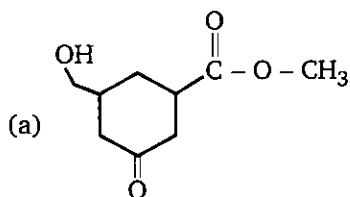
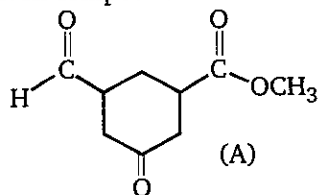
- (a) a                      (b) b                      (c) c                      (d) d

2. Identify the major product.

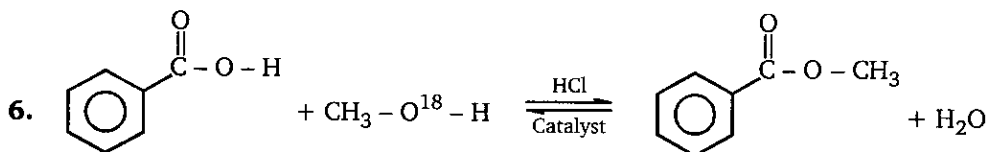
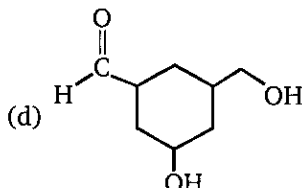
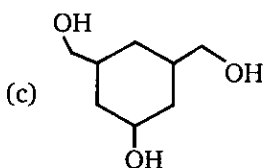
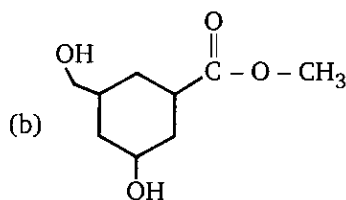
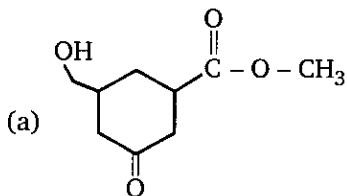




4. Predict the product when given compound reacts with  $\text{LiAlH}_4$  :



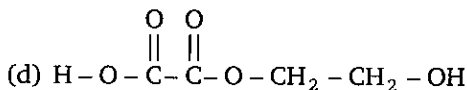
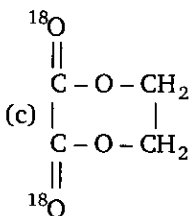
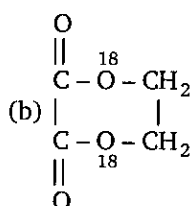
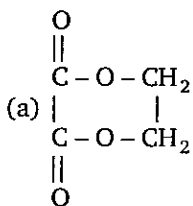
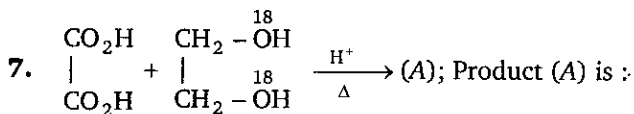
5. Predict the product when given compound (A, in the above question 4) reacts with  $\text{NaBH}_4$ .



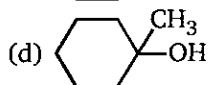
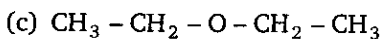
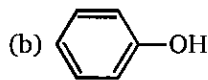
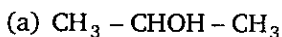
Methyl benzoate

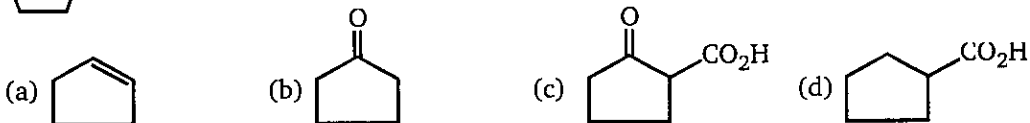
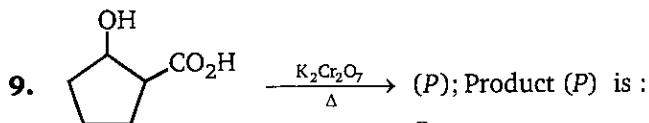
The labelled  $-\text{O}^{18}$  will be in :

- (a)  $\text{H}_2\text{O}$  (b) Methyl benzoate  
(c) Both (a) and (b) (d) Benzoic acid

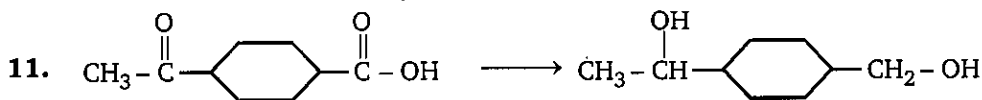
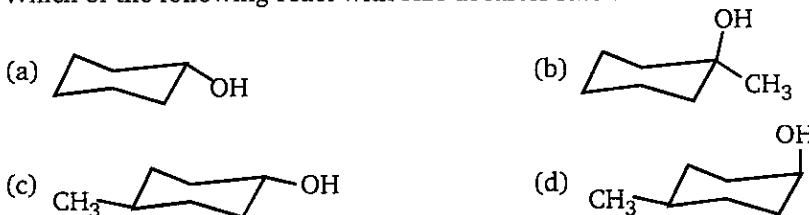


8. Which is oxidized most easily ?

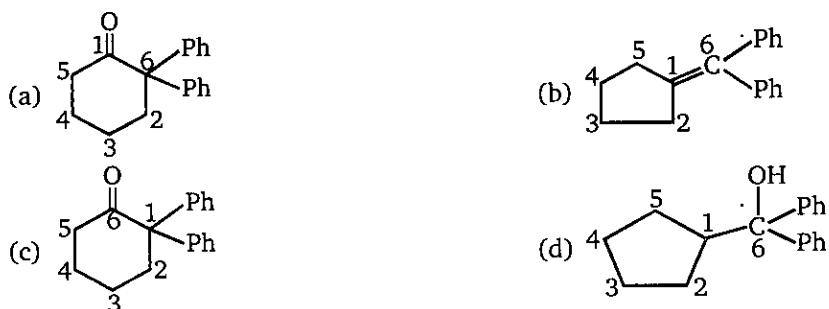
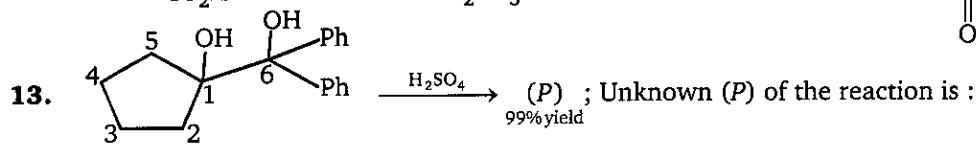
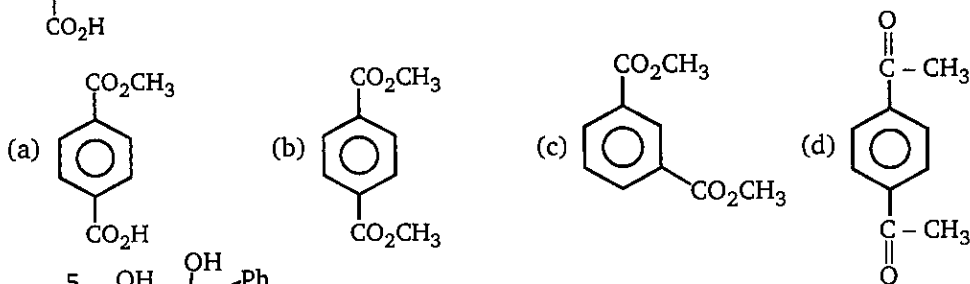
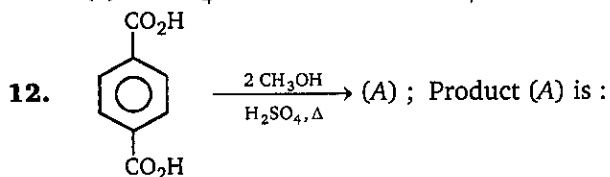




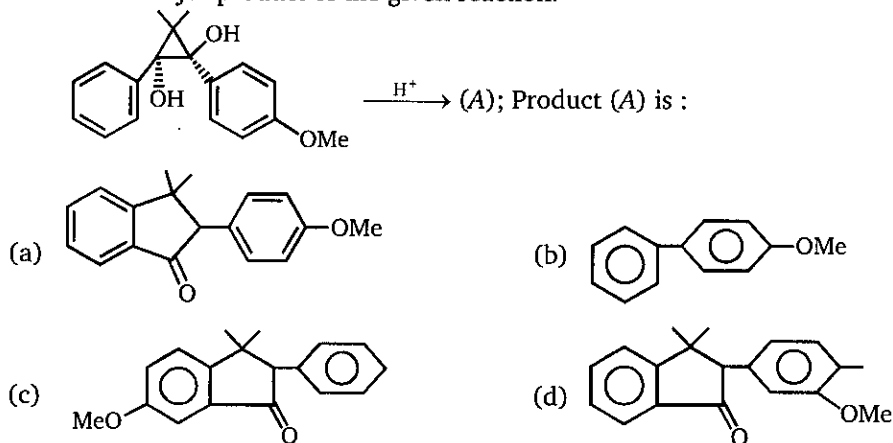
10. Which of the following react with HBr at faster rate ?



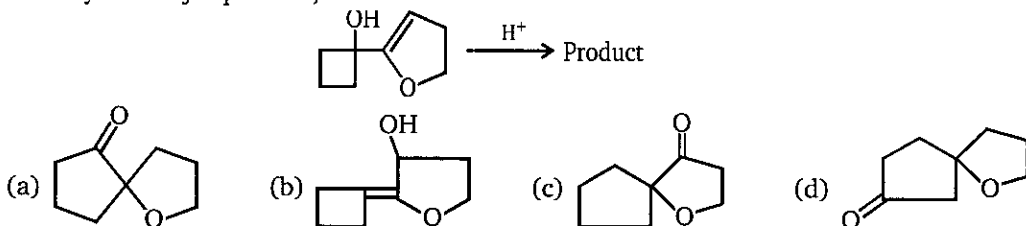
Above conversion can be done by :



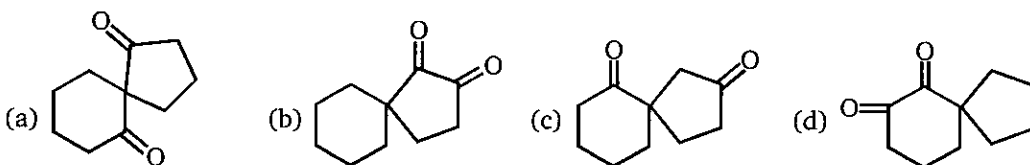
14. Predict the major product of the given reaction.



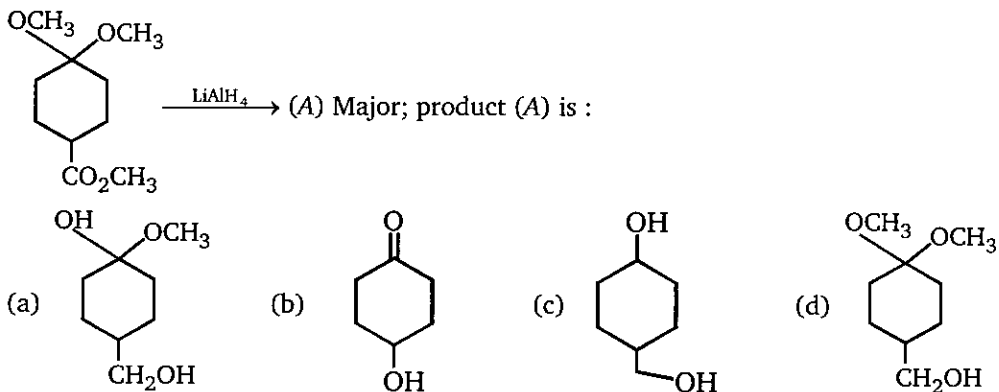
15. Identify the major product,

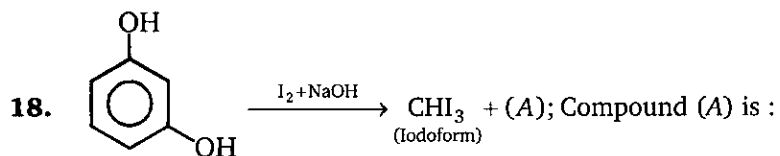


16.  $\xrightarrow{H^+}$  (A); Product (A) is :

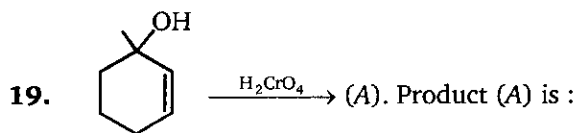
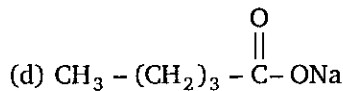
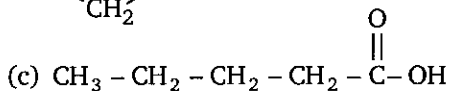
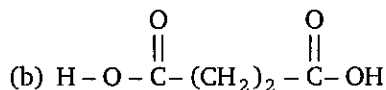
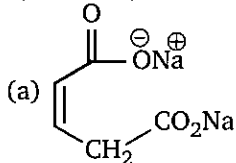


17.  $\xrightarrow{LiAlH_4}$  (A) Major; product (A) is :



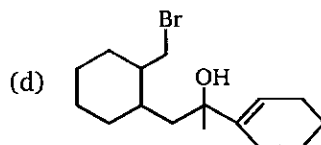
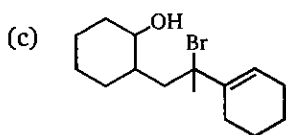
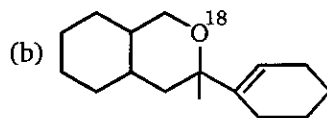
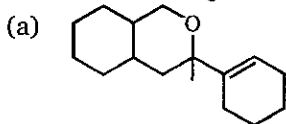
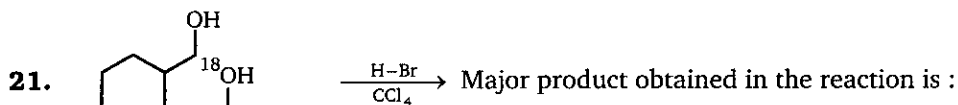
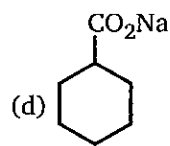
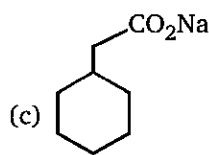
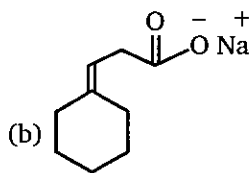
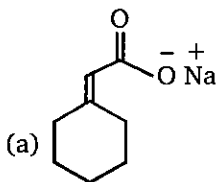
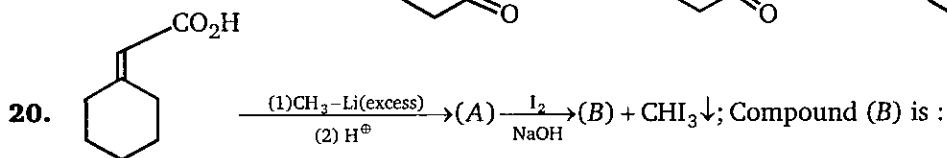
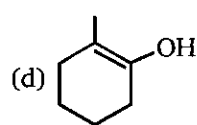
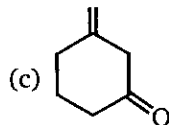
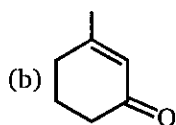


(Resorcinol)

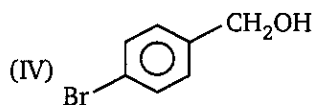
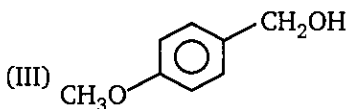
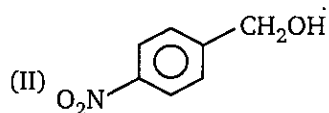
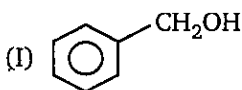


(3° alcohol)

(a) No reaction



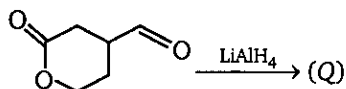
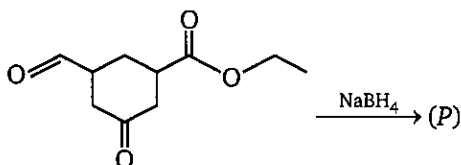
22. Consider the following alcohols,



The order of decreasing reactivities of these alcohols towards nucleophilic substitution with HBr is:

- (a) III > I > IV > II    (b) III > I > II > IV    (c) I > III > IV > II    (d) I > III > II > IV

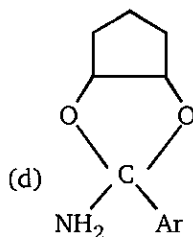
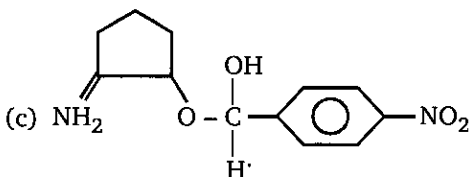
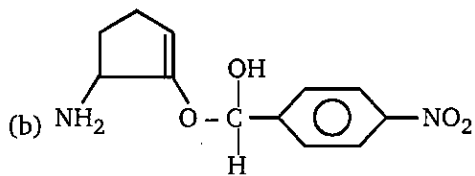
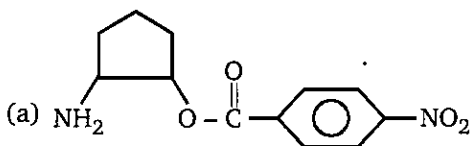
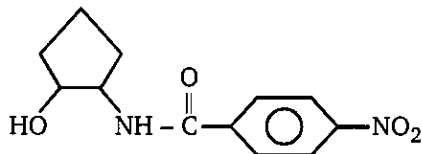
23.



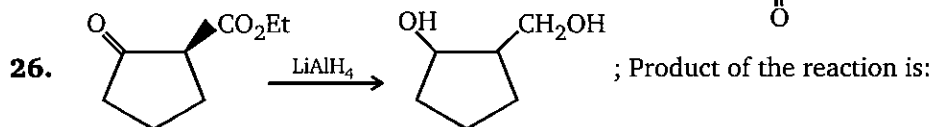
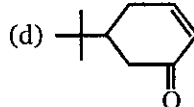
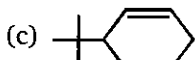
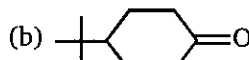
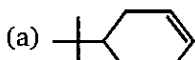
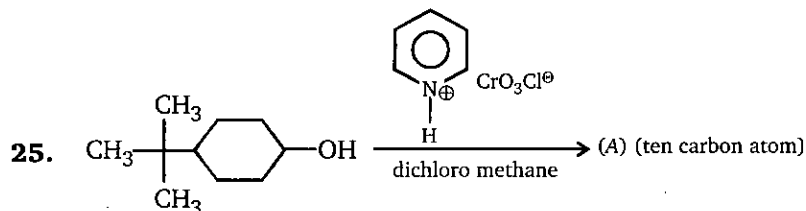
Sum of number of  $1^\circ$  alcoholic groups in product (P) and (Q) is:

- (a) 1                      (b) 2                      (c) 3                      (d) 5

24. In presence of dil. HCl, compound A is converted to a constitutional isomer (B), compound B is:





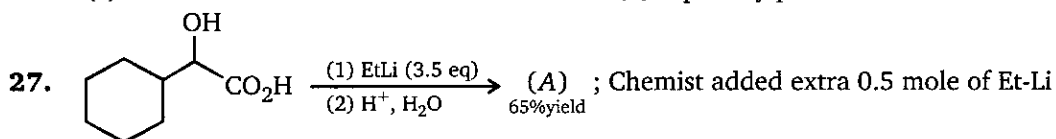


(a) Racemic

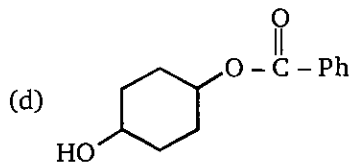
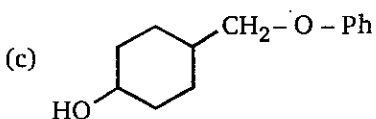
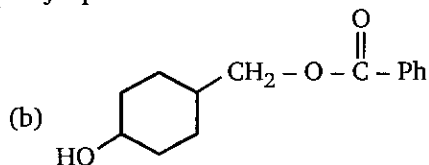
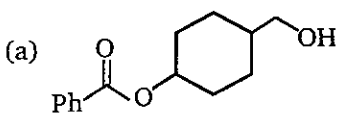
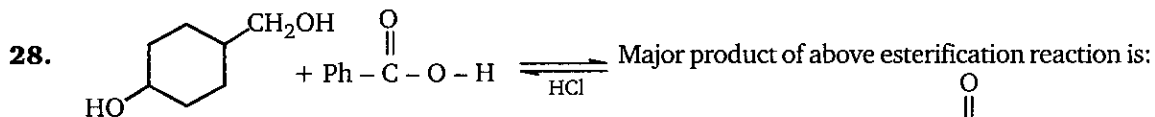
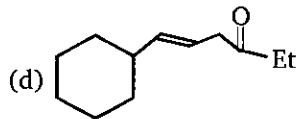
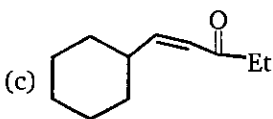
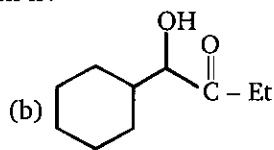
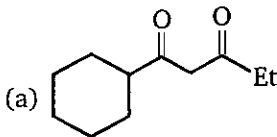
(b) Diastereomer

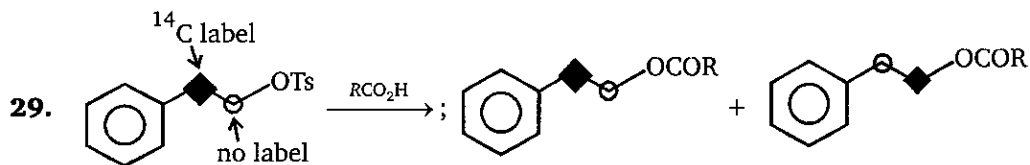
(c) Meso

(d) Optically pure



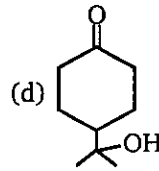
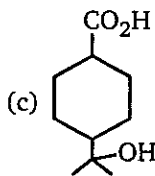
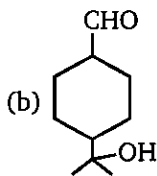
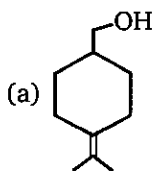
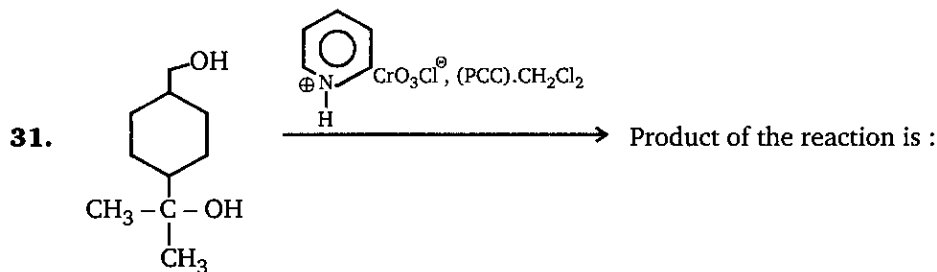
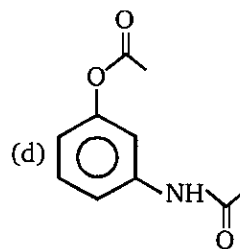
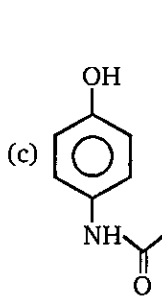
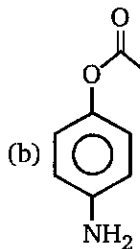
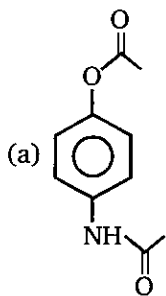
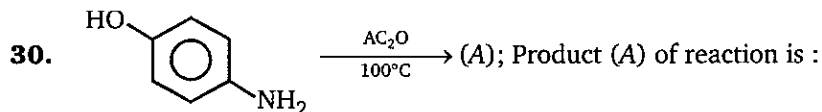
in above reaction to obtain product (A), which is?



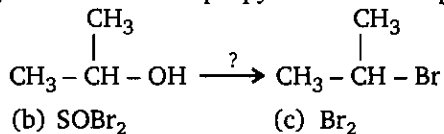
(a)  $S_N1$ (b)  $S_N2$ 

(c) SN — NGP

(d) SN — Ar

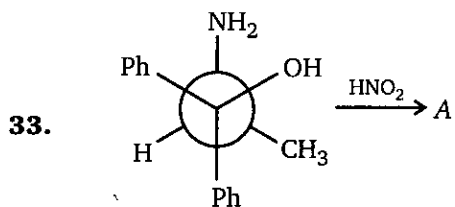


32. Which is the best reagent to convert isopropyl alcohol to isopropyl bromide ?

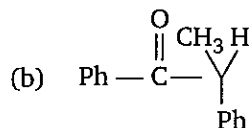
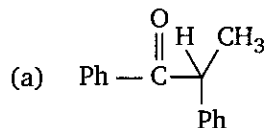


(a) HBr

(b)  $SOBr_2$ (c)  $Br_2$ (d)  $CH_3MgBr$

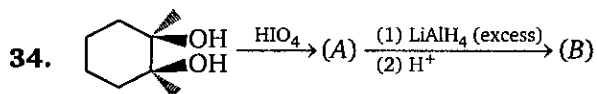


Major product obtained in the above reaction is :



(c) Racemic

(d) Diastereomers



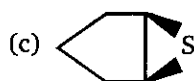
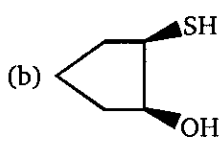
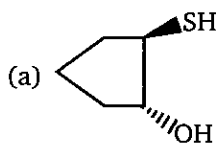
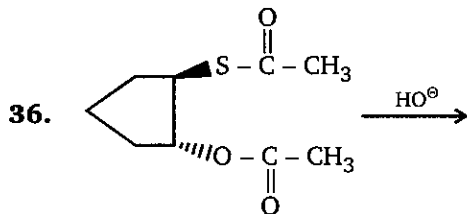
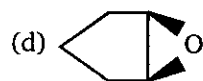
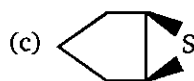
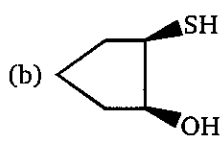
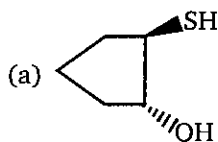
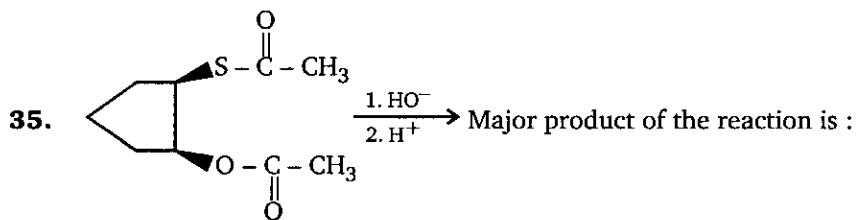
Total number of stereoisomers of product (B) will be:

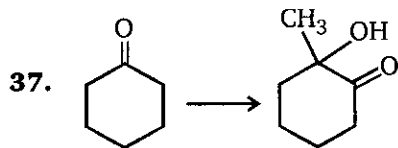
(a) 2

(b) 3

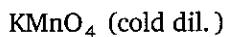
(c) 4

(d) 5





(1)



(2)



(3)



(4)

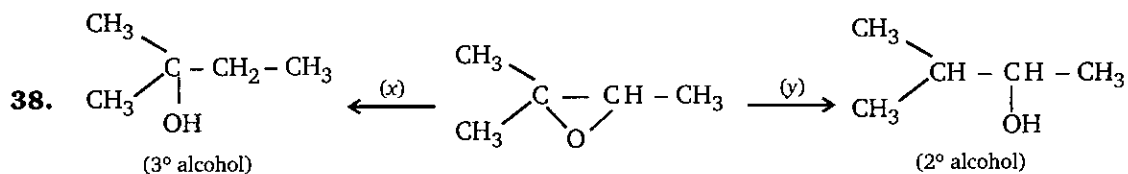
For the above conversion the correct order of reagents used is :

(a) 1 → 2 → 3 → 4

(b) 1 → 4 → 3 → 2

(c) 1 → 4 → 2 → 3

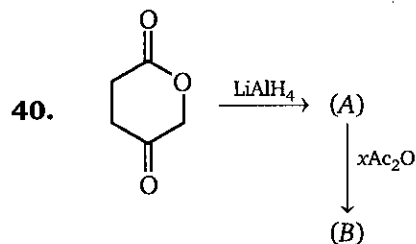
(d) 2 → 3 → 4 → 1



Find missing reagents.

(a)  $x = \text{LiAlH}_4, y = \text{NaBH}_4$ (b)  $x = \text{LiAlH}_4/\text{AlCl}_3, y = \text{LiAlH}_4$ (c)  $x = \text{LiAlH}_4, y = \text{LiAlH}_4/\text{AlCl}_3$ (d)  $x = \text{H}_2/\text{Ni}, y = \text{H}_2/\text{Pt}$ 

39. In solvolysis of 1, 2-dimethyl propyl p-toluene sulfonate in acetic acid at 75°C, (alkene + substitution products) will be formed by mechanism ?

(a)  $\text{S}_{\text{N}}2, \text{E}_2$ (b)  $\text{S}_{\text{N}}2, \text{E}_1$ (c)  $\text{S}_{\text{N}}1, \text{E}_2$ (d)  $\text{S}_{\text{N}}1, \text{E}_1$ 

$x$  = moles of anhydride consumed

(a) 1

(b) 2

(c) 3

(d) 4

41. Identify product when (*R*) - and (*S*) - 2 - butanol reacts with (*R,R*) tartaric acid in acidic medium.

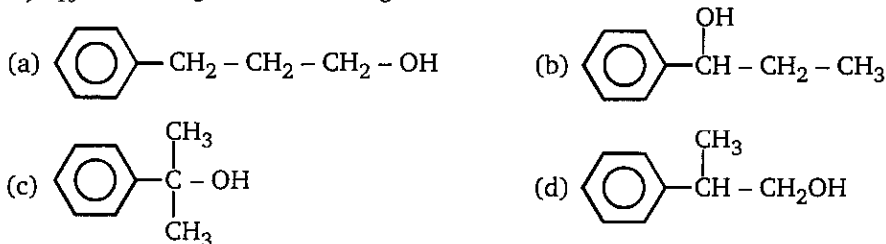
(a) Racemic

(b) Diastereomer

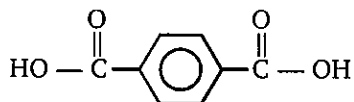
(c) Meso

(d) Pure enantiomer

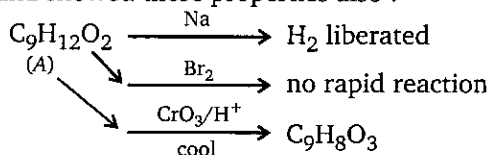
42. An alcohol of formula  $C_9H_{12}O$  reacts with  $Na_2Cr_2O_7$  to form a compound having formula  $C_9H_{10}O$ . The original alcohol might be :



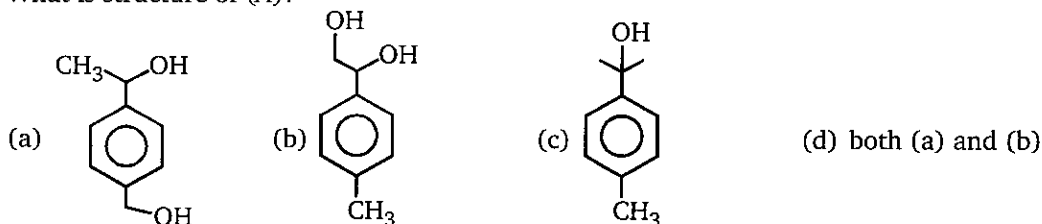
43. An optically active alcohol of formula  $C_9H_{12}O_2$  produced the following compound when refluxed with  $KMnO_4$ .



The original compound showed these properties also :



What is structure of (A)?



44. Which are not cleaved by  $HIO_4$ ?

I : glycerol

II : glycol

III : 1, 3-propenediol

IV : methoxy-2-propanol

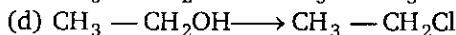
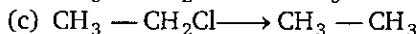
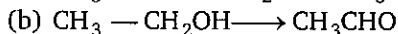
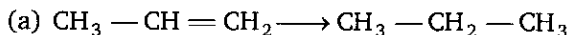
(a) I, II, III, IV

(b) I, II

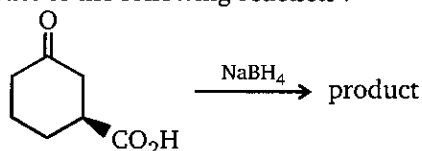
(c) II, III

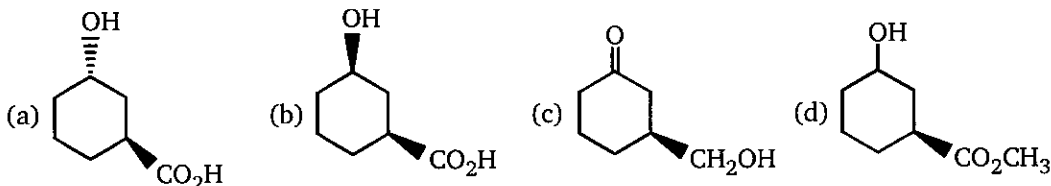
(d) III, IV

45. Which of the following reactions require an oxidising agent ?



46. What is the major product of the following reaction ?

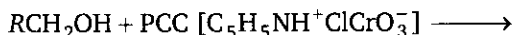




47. Which of the esters shown, after reduction with  $\text{LiAlH}_4$  and aqueous workup, will yield two molecules of only a single alcohol?

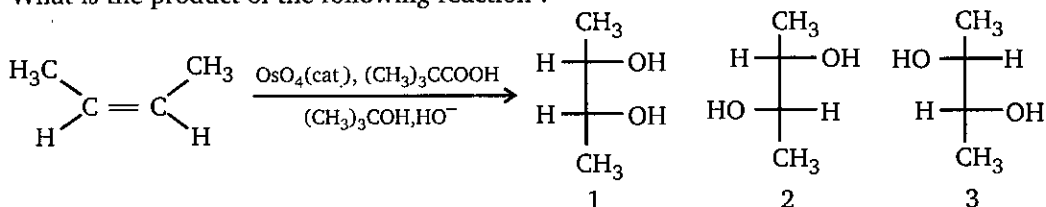
- (a)  $\text{CH}_3\text{CH}_2\text{CO}_2\text{CH}_2\text{CH}_3$  (b)  $\text{C}_6\text{H}_5\text{CO}_2\text{CH}_2\text{C}_6\text{H}_5$   
 (c)  $\text{C}_6\text{H}_5\text{CO}_2\text{C}_6\text{H}_5$  (d) None of these

48. For the following reaction, select the statement that best describes the change.



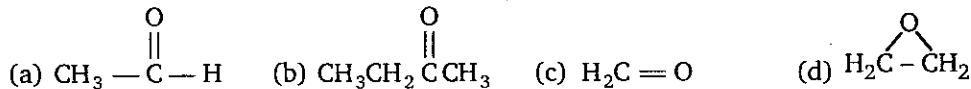
- (a) The alcohol is oxidized to an acid, and the Cr(VI) is reduced  
 (b) The alcohol is oxidized to an aldehyde, and the Cr(VI) is reduced  
 (c) The alcohol is reduced to an aldehyde, and the Cr(III) is oxidized  
 (d) The alcohol is oxidized to a ketone, and the Cr(VI) is reduced

49. What is the product of the following reaction?

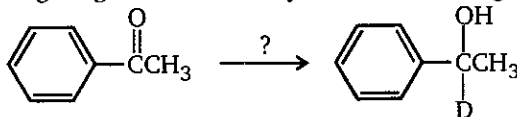


- (a) Only 1 (b) 1 : 1 mixture of 2 and 3  
 (c) Only 2 (d) 1 : 1 : 1 mixture of 1, 2, and 3

50. An organic compound *B* is formed by the reaction of ethylmagnesium iodide ( $\text{CH}_3\text{CH}_2\text{MgI}$ ) with a substance *A*, followed by treatment with dilute aqueous acid. Compound *B* does not react with PCC in dichloromethane. Identify *A*?

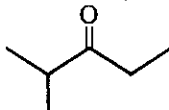


51. Which of the following reagents would carry out the following transformation? ( $\text{D} = {}^2\text{H}$ )



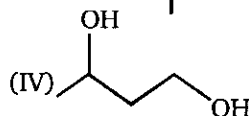
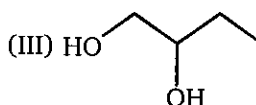
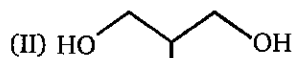
- (a)  $\text{NaBD}_4$  in  $\text{CH}_3\text{OH}$  (b)  $\text{LiAlH}_4$ , then  $\text{D}_2\text{O}$   
 (c)  $\text{NaBD}_4$  in  $\text{CH}_3\text{OD}$  (d)  $\text{LiAlD}_4$ , then  $\text{D}_2\text{O}$

52. Which sequence of steps describes the best synthesis of 2-methyl-3-pentanone?



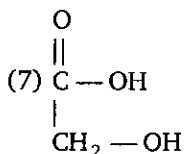
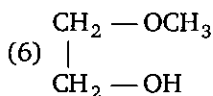
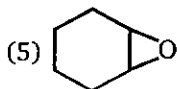
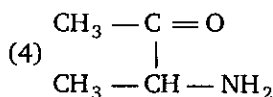
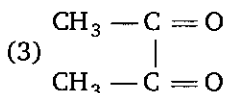
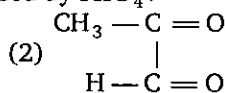
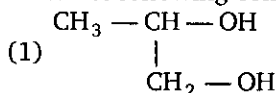
- (a) (1) 1-Propanol +  $(\text{CH}_3)_2\text{CHMgBr}$ , diethyl ether  
 (2)  $\text{H}_3\text{O}^+$   
 (3) PCC,  $\text{CH}_2\text{Cl}_2$
- (b) (1) 1-Propanol +  $\text{Na}_2\text{Cr}_2\text{O}_7$ ,  $\text{H}_2\text{SO}_4$ ,  $\text{H}_2\text{O}$ , heat  
 (2)  $\text{SOCl}_2$   
 (3)  $(\text{CH}_3)_2\text{CHCl}$ ,  $\text{AlCl}_3$
- (c) (1) 1-Propanol + PCC,  $\text{CH}_2\text{Cl}_2$   
 (2)  $(\text{CH}_3)_2\text{CHLi}$ , diethyl ether  
 (3)  $\text{H}_3\text{O}^+$   
 (4)  $\text{Na}_2\text{Cr}_2\text{O}_7$ ,  $\text{H}_2\text{SO}_4$ ,  $\text{H}_2\text{O}$ , heat
- (d) (1) 2-Propanol +  $\text{Na}_2\text{Cr}_2\text{O}_7$ ,  $\text{H}_2\text{SO}_4$ ,  $\text{H}_2\text{O}$ , heat  
 (2)  $\text{CH}_3\text{CH}_2\text{CH}_2\text{Li}$ , diethyl ether  
 (3)  $\text{H}_3\text{O}^+$   
 (4) PCC,  $\text{CH}_2\text{Cl}_2$

53. Diols (I-IV) which react with  $\text{CrO}_3$  in aqueous  $\text{H}_2\text{SO}_4$  and yield products that readily undergo decarboxylation on heating, are :

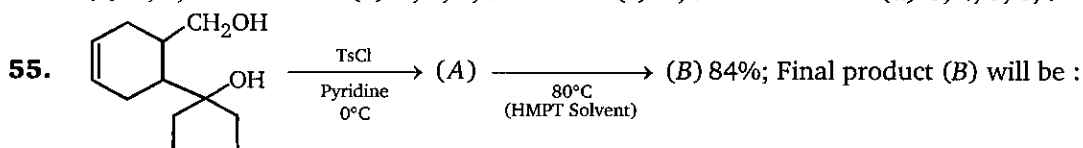


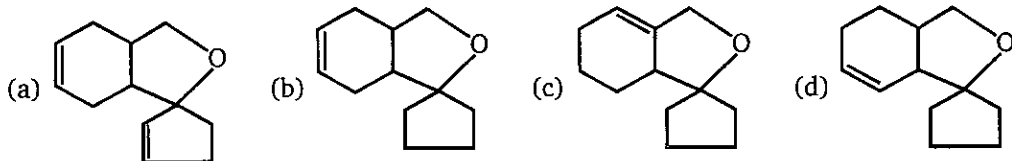
- (a) I and II                      (b) II and III                      (c) II and IV                      (d) I and IV

54. Which of the following compounds are not oxidized by  $\text{HIO}_4$ ?

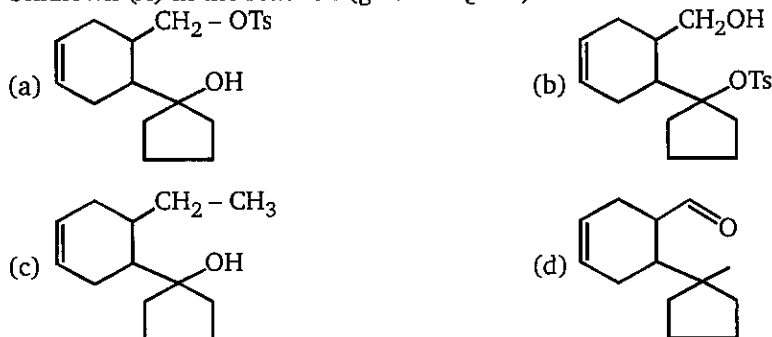


- (a) 5, 6, 7                      (b) 4, 5, 6, 7                      (c) 6, 7                      (d) 3, 4, 5, 6, 7





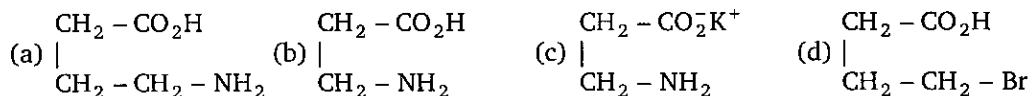
56. Unknown (A) in the reaction (given in Q. 55) is :



57. In the given table, identify the incorrect option. The digit in box indicate the moles of that substance.

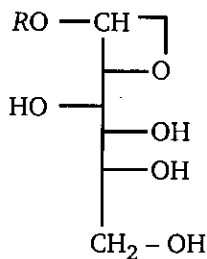
Reactant	$\text{HIO}_4$ consumed	$\text{HCO}_2\text{H}$ formed	$\text{HCHO}$ formed
(a) $\text{HO}-\text{CH}_2-\overset{\text{OH}}{\text{CH}}-\text{CH}_2-\text{OH}$	2	1	2
(b) $\text{R}-\overset{\text{OH}}{\text{CH}}-\overset{\text{OH}}{\text{CH}}-\overset{\text{OH}}{\text{CH}}-\text{CH}_2-\text{OH}$	3	2	1
(c) $\text{HO}-\text{CH}_2-\overset{\text{OCH}_3}{\text{CH}}-\text{CH}_2\text{OH}$	0	0	0
(d) $\text{HO}-\text{CH}_2-\overset{\text{OH}}{\text{CH}}-\overset{\text{OCH}_3}{\text{CH}_2}$	1	1	1

58. Succinic acid  $\xrightarrow{\Delta}$  (A)  $\xrightarrow[\Delta]{\text{NH}_3}$  (B)  $\xrightarrow[\text{KOH}]{\text{Br}_2}$  (C); Product (C) will be :

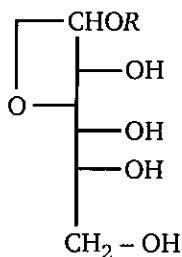




- 59A. Given are the structures of cyclic D-glucoside. Moles of  $\text{HIO}_4$  consumed with X and Y are ..... respectively:

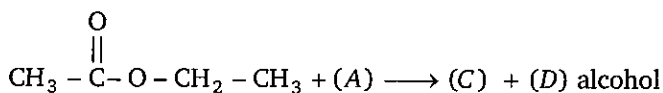


(X)

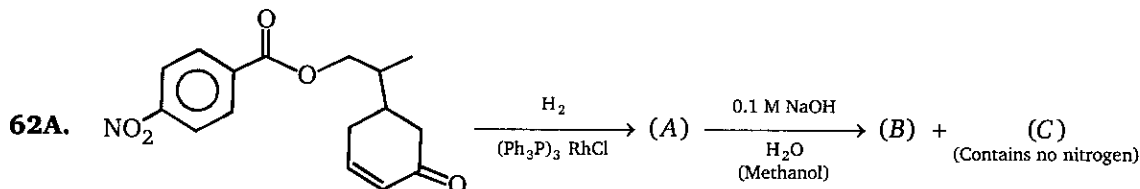
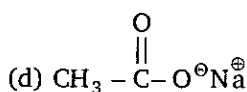
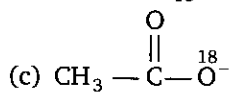
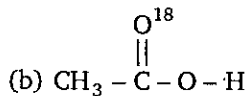
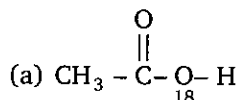


(Y)

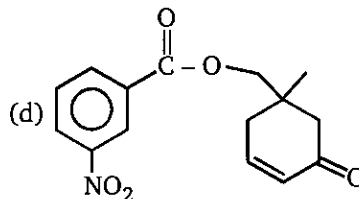
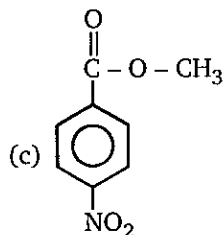
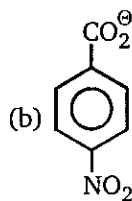
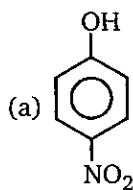
- (a) 2, 2  
 (b) 3, 3  
 (c) 2, 3  
 (d) 3, 2
- B. Moles of formic acid formed in X and Y respectively are:  
 (a) 1, 2  
 (b) 2, 1  
 (c) 2, 3  
 (d) 3, 2
- C. Moles of HCHO formed are:  
 (a) 1, 1  
 (b) 2, 2  
 (c) 1, 2  
 (d) 2, 1
60. In which of the following group, each member gives positive iodoform test ?  
 (a) methanol, ethanol, propanone  
 (b) ethanol, isopropanal, methanal  
 (c) ethanol, ethanal, isopropyl alcohol  
 (d) propanal, propanol-2, propanone
61.  $\text{H}_2\text{O}^{18} + \text{Na} \longrightarrow (\text{A}) + (\text{B})$   
 (base)



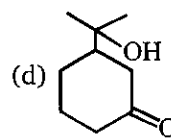
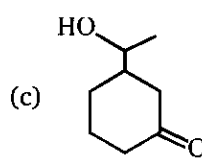
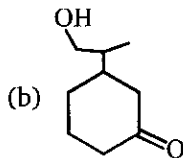
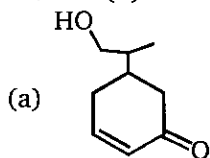
Product (C) of the reactions is:



Product (B) of the reaction is :



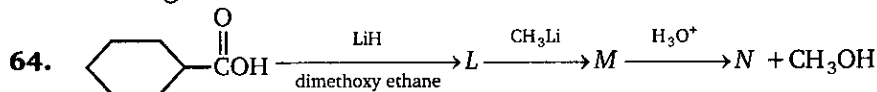
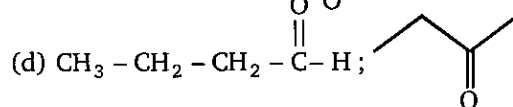
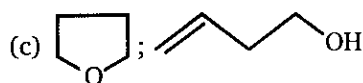
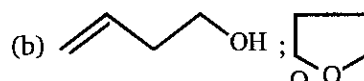
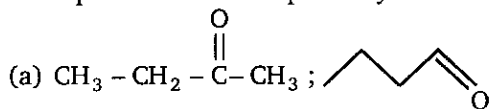
B. Product (C) of above reaction is :



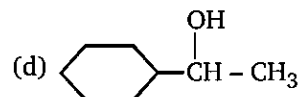
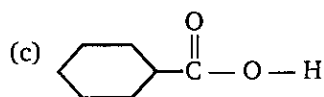
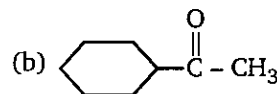
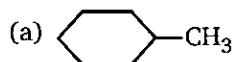
63. Two unknown compounds X and Y, both having molecular formula  $C_4H_8O$ , give following results with four chemical tests.

	Bromine	Na metal	Chromic acid	Lucas reagent
Compound X	decolourises	bubbles	Orange to Green	No reaction
Compound Y	No reaction	No reaction	No reaction	No reaction

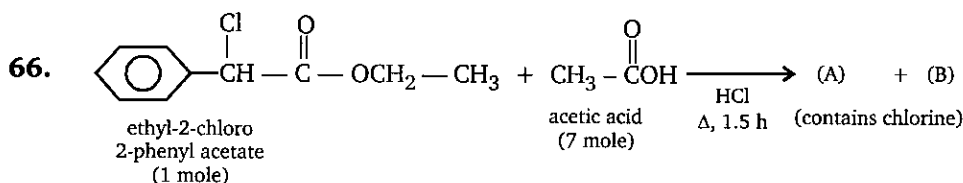
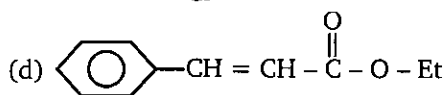
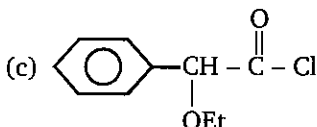
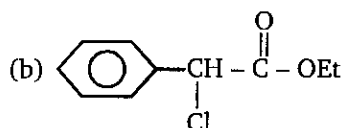
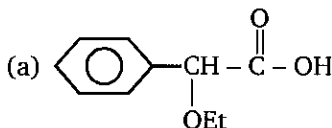
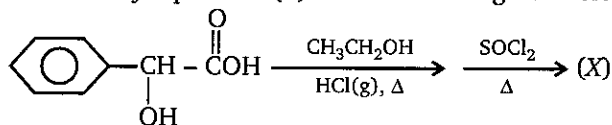
Compound X and Y respectively are :



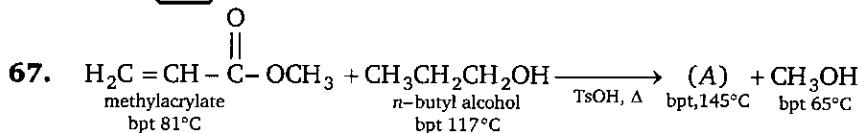
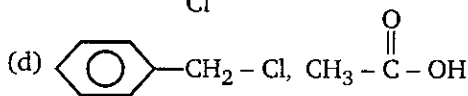
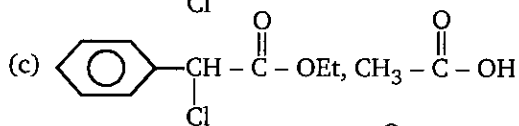
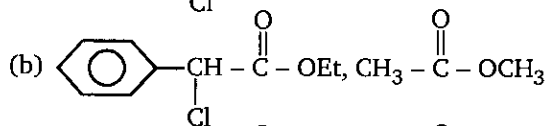
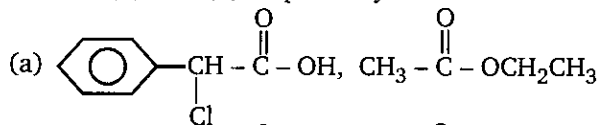
Product (N) is :



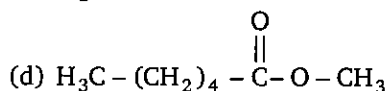
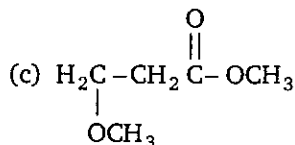
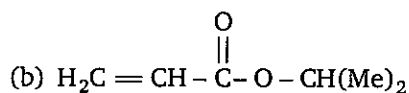
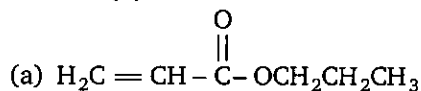
65. Assign the structure of major product (X) of the reaction given below.

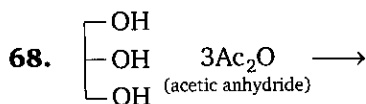


Product (A) and (B) respectively in the above reaction are :



Product (A) of above reaction is :

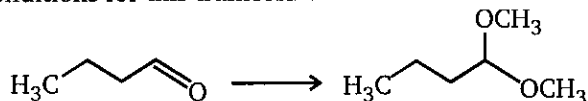




In above reaction molecular formula of glycerol increases by :

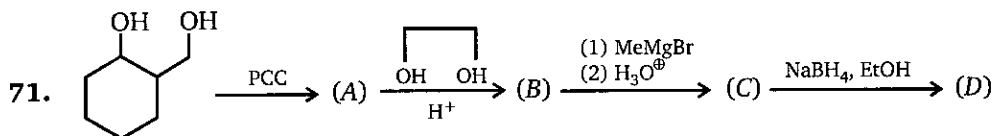
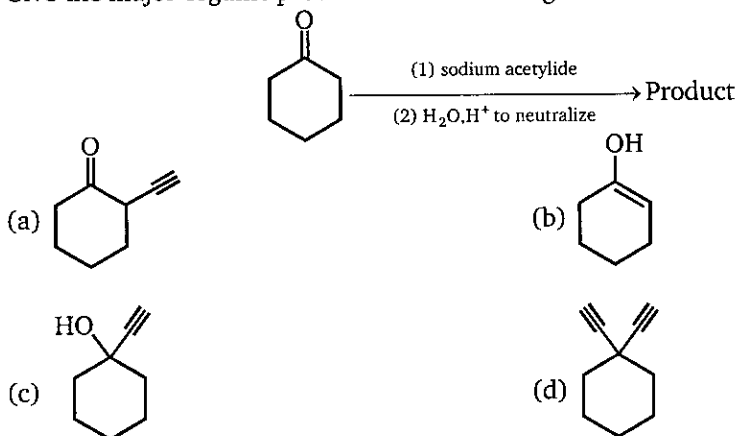
- (a)  $\text{C}_4\text{H}_4\text{O}_2$       (b)  $\text{C}_6\text{H}_6\text{O}_6$       (c)  $\text{C}_6\text{H}_6\text{O}_2$       (d)  $\text{C}_6\text{H}_6\text{O}_3$

69. Give the best conditions for this transformation:



- (a)  $\text{CH}_3\text{OH}, \text{H}^+$  (cat.), heat      (b)  $\text{H}_2\text{O}, \text{H}^+$  (cat.), heat  
(c) Mg, ether,  $\text{CH}_3\text{OH}$       (d)  $\text{SOCl}_2, \text{CH}_3\text{OH}$

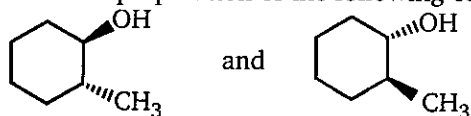
70. Give the major organic product of the following reaction.



Product (D) in above reaction is :

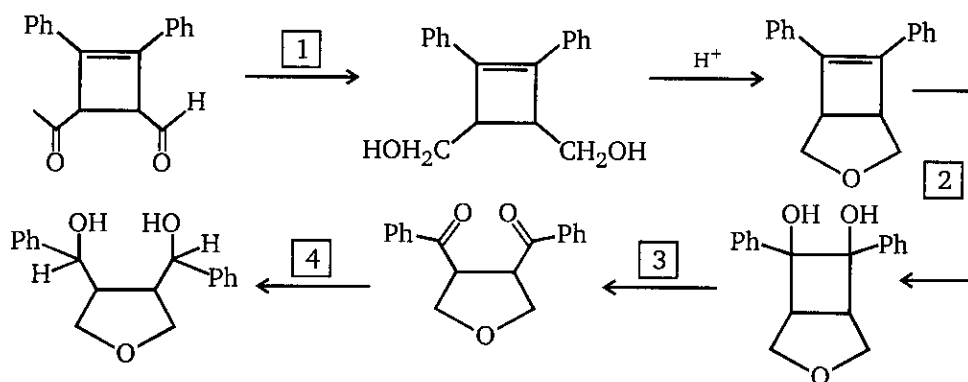


72. Select the best method for the preparation of the following compounds :



(MCPBA = Metachloro per benzoic acid )

- (a) reaction of cyclohexanone with  $\text{CH}_3\text{Li}$   
 (b) reaction of 1-methylcyclohexene with  $\text{Hg}(\text{OAc})_2$  followed by  $\text{NaBH}_4$   
 (c) reaction of cyclohexene with  $\text{BH}_3$ ;  $\text{NaOH}/\text{H}_2\text{O}_2$ , following by  $\text{CH}_3\text{Br}$   
 (d) reaction of cyclohexene with MCPBA, followed by  $\text{CH}_3\text{MgBr}$
73. Identify the reagents (1-4), required for the transformations shown and arrange them in correct order.



(1) LAH ( $\text{LiAlH}_4$ )

(2)  $\text{OsO}_4$

(3)  $\text{NaIO}_4$

(4)  $\text{NaBH}_4$

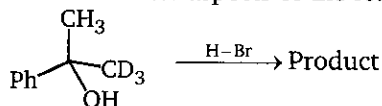
(a) 1  $\rightarrow$  3  $\rightarrow$  4  $\rightarrow$  2

(b) 2  $\rightarrow$  3  $\rightarrow$  1  $\rightarrow$  4

(c) 2  $\rightarrow$  1  $\rightarrow$  3  $\rightarrow$  4

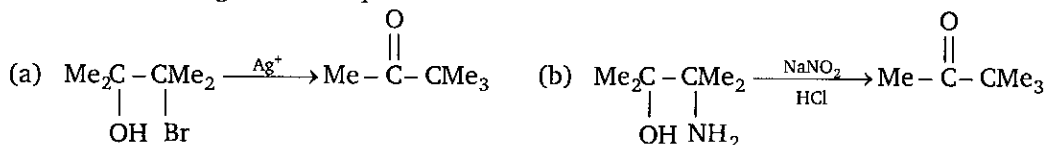
(d) 1  $\rightarrow$  2  $\rightarrow$  3  $\rightarrow$  4

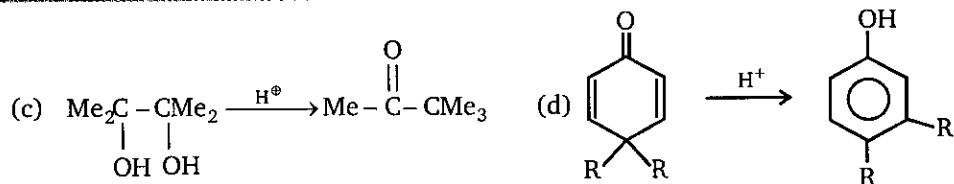
74. Which describes the best stereochemical aspects of the following reaction ?



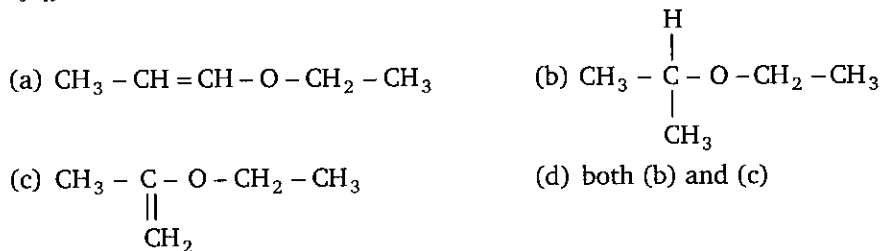
- (a) Inversion of configuration occurs at the carbon undergoing substitution.  
 (b) Retention of configuration occurs at the carbon undergoing substitution.  
 (c) Racemization (loss of configuration) occurs at the carbon undergoing substitution.  
 (d) The carbon undergoing substitution is not stereogenic

75. Which of following is an example of Pinacol-Diazotization ?

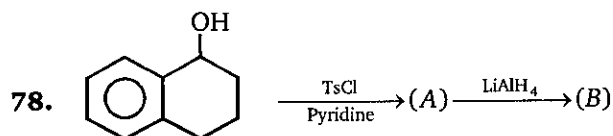
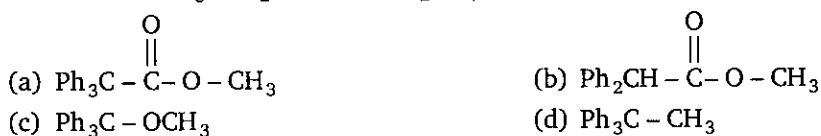




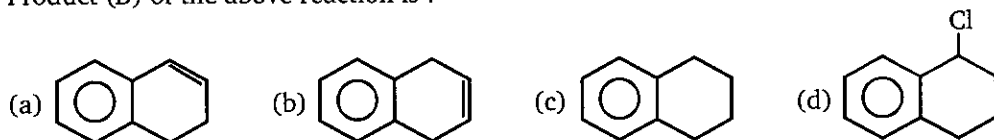
76. (A)  $\xrightarrow[\text{C}_5\text{H}_{10}\text{O}]{\text{H}_2\text{O}^{\oplus}} \text{B} + \text{C}$ ; (B) and (C) both give +ve iodoform test. Compound (A) is :



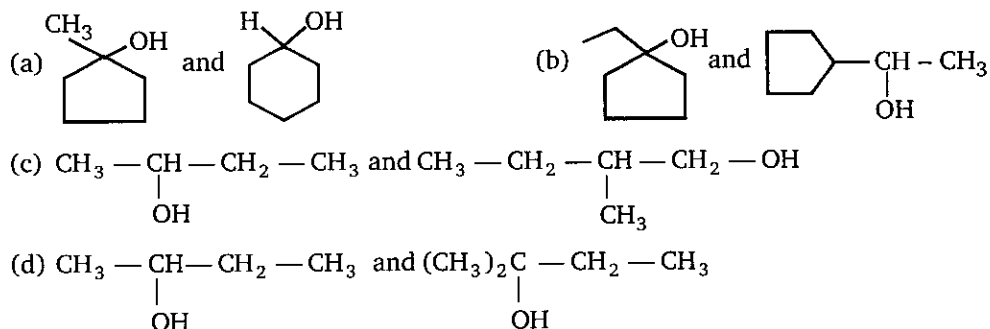
77. A solution of  $\text{Ph}_3\text{CCO}_2\text{H}$  in conc.  $\text{H}_2\text{SO}_4$  gives (X) when poured into methanol X is :



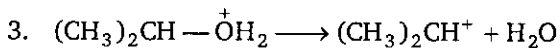
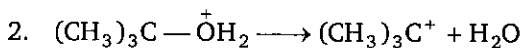
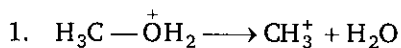
Product (B) of the above reaction is :



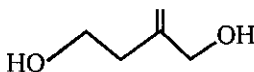
79. In the given pair of alcohol, in which pair second alcohol is more reactive than first towards hydrogen bromide?

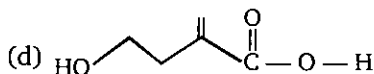
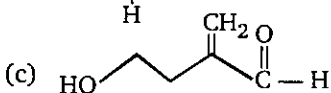
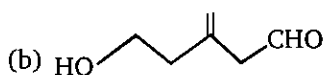
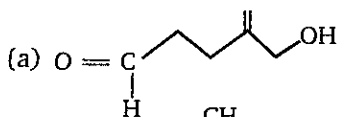


80. Rank the transition states that occur during the following reaction steps in order of increasing stability (least  $\rightarrow$  most stable)

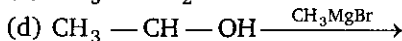
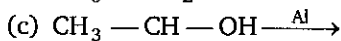
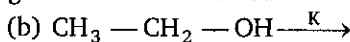
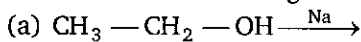


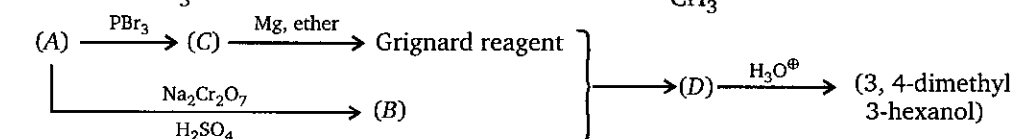
- (a)  $1 < 2 < 3$       (b)  $2 < 3 < 1$       (c)  $1 < 3 < 2$       (d)  $2 < 1 < 3$

81.   $\xrightarrow{\text{MnO}_2}$  (A), Product (A) is :

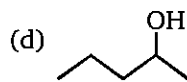
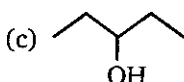
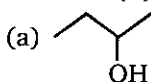


82. In which of the following reactions hydrogen gas will not be evolved ?

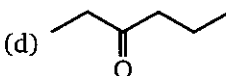
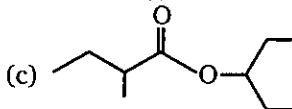
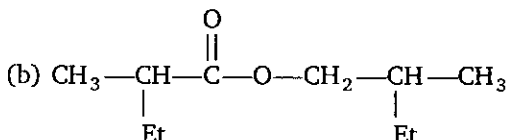
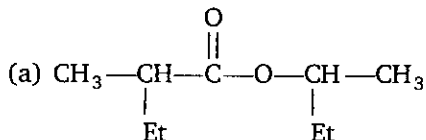


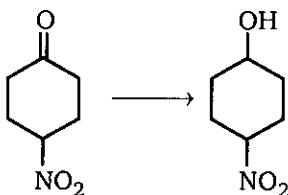
83. 

When Grignard reagent reacts with (B) product (D) will be obtained.  
Reactant (A) of the above reaction is :



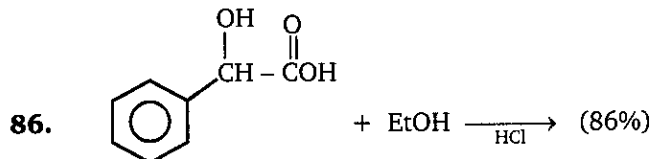
84. (A)  $\xrightarrow{\text{LiAlH}_4} 2(\text{B})$  ; structure of (A) is :  
(Chiral alcohol only)



85. 

Above conversion can be achieved by :

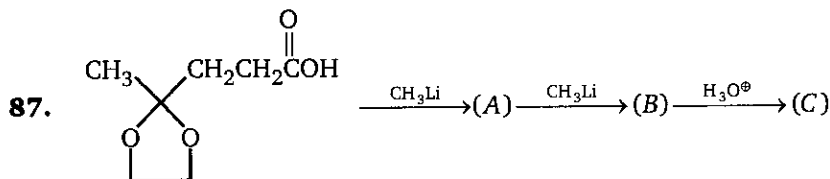
- (a)  $\text{LiAlH}_4$                       (b)  $\text{NaBH}_4$                       (c)  $\text{H}_2/\text{Ni}$                       (d)  $\text{CrO}_3$



(Mandelic acid)

Identify product of above Fischer esterification reaction :

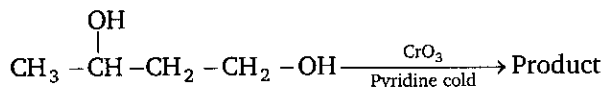
- (a)  $\text{Ph}-\overset{\text{O}-\text{Et}}{\underset{\text{O}}{\text{C}}}-\text{CH}-\text{CO}_2\text{H}$                       (b)  $\text{Ph}-\overset{\text{O}}{\text{C}}-\text{CH}-\text{CO}_2\text{H}$
- (c)  $\text{Ph}-\overset{\text{O}}{\text{C}}-\text{CH}(\text{OH})-\text{CO}_2\text{Et}$                       (d)  $\text{Ph}-\overset{\text{O}}{\text{C}}-\text{CH}(\text{OH})-\text{CO}_2\text{Et}$



Product (C) of the above reaction is :

- (a)  $\text{CH}_3-\overset{\text{O}}{\text{C}}-\text{CH}_2-\text{CH}_2-\overset{\text{OH}}{\underset{\text{CH}_3}{\text{C}}}-\text{CH}_3$                       (b)  $\text{CH}_3-\overset{\text{OH}}{\underset{\text{CH}_3}{\text{C}}}-\text{CH}_2-\text{CH}_2-\overset{\text{OH}}{\underset{\text{CH}_3}{\text{C}}}-\text{CH}_3$
- (c)  $\text{CH}_3-\overset{\text{O}}{\text{C}}-\text{CH}_2-\text{CH}_2-\overset{\text{O}}{\text{C}}-\text{CH}_3$                       (d)  $\text{CH}_3-\overset{\text{O}}{\text{C}}-\text{CH}_2-\overset{\text{O}}{\text{C}}-\text{CH}_3$

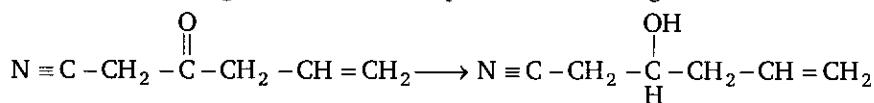
88. What is the major product of the following reaction ?



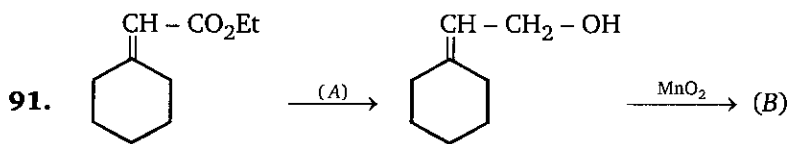
- (a)  $\text{CH}_3-\overset{\text{OH}}{\text{CH}}-\text{CH}_2-\overset{\text{O}}{\text{C}}-\text{H}$                       (b)  $\text{CH}_3-\overset{\text{O}}{\text{C}}-\text{CH}_2-\overset{\text{O}}{\text{C}}-\text{H}$
- (c)  $\text{CH}_3-\overset{\text{O}}{\text{C}}-\text{CH}_2-\overset{\text{O}}{\text{C}}-\text{OH}$                       (d)  $\text{CH}_3-\overset{\text{OH}}{\text{CH}}-\text{CH}_2-\overset{\text{O}}{\text{C}}-\text{OH}$



89. The major reason that phenol is a better Bronsted acid than cyclohexanol is that :
- it is a better proton donor.
  - the cyclohexyl group is an electron donating group by induction, which destabilizes the anion formed in the reaction by resonance.
  - phenol is able to stabilize the anion formed in the reaction.
  - the phenyl group is an electron withdrawing group by induction, which stabilizes the anion formed in the reaction.
90. Which of these reagents would accomplish the following reduction ?

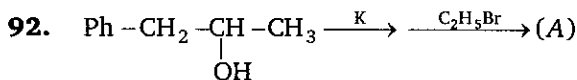


- $\text{NaBH}_4$
- $\text{LiAlH}_4$
- 1 mole  $\text{H}_2$ , poisoned catalyst, low pressure
- $\text{H}_3\text{O}^+$



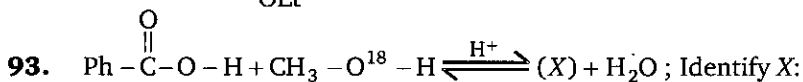
Identify A and B :

- $A = \text{NaBH}_4, B = \text{Cyclohexane ring with } -\text{CH}-\text{CO}_2\text{H}$
- $A = \text{NaBH}_4, B = \text{Cyclohexane ring with } -\text{CH}-\text{CHO}$
- $A = \text{LiAlH}_4, B = \text{Cyclohexane ring with } -\text{CH}-\text{CHO}$
- $A = \text{LiAlH}_4, B = \text{Cyclohexane ring with } -\text{CH}-\text{CO}_2\text{H}$

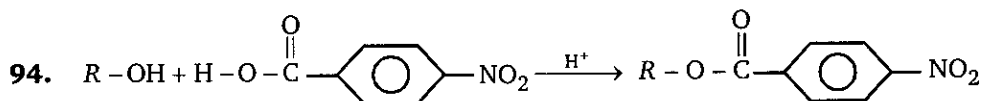
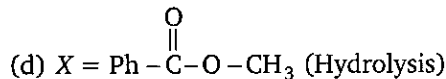
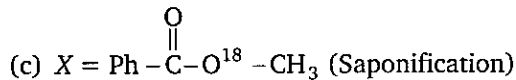
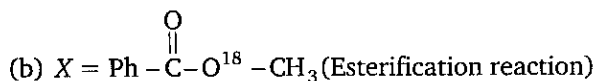


Product (A) in above reaction is:

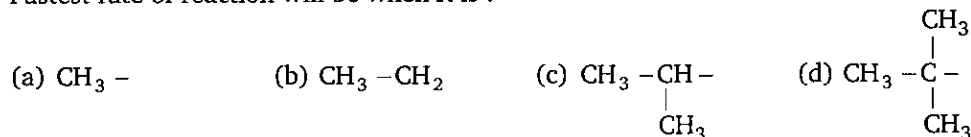
- $\text{Ph}-\text{CH}_2-\underset{\text{OEt}}{\text{CH}}-\text{CH}_3$ , (inversion)
- $\text{Ph}-\text{CH}_2-\underset{\text{OEt}}{\text{CH}}-\text{CH}_3$ , (retention)
- $\text{Ph}-\text{CH}_2-\underset{\text{OEt}}{\text{CH}}-\text{CH}_3$ , (racemic)
- $\text{Ph}-\text{CH}=\text{CH}-\text{CH}_3$



- $X = \text{Ph}-\overset{\text{O}}{\parallel}{\text{C}}-\text{O}^{18}-\text{CH}_3$  (Trans esterification)

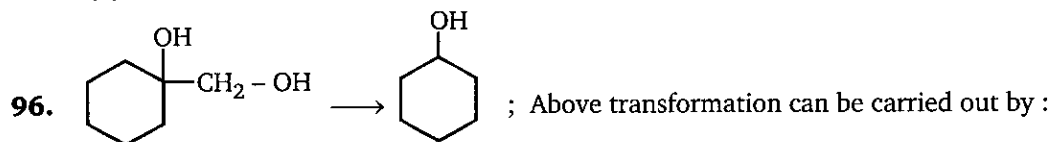


Fastest rate of reaction will be when R is :

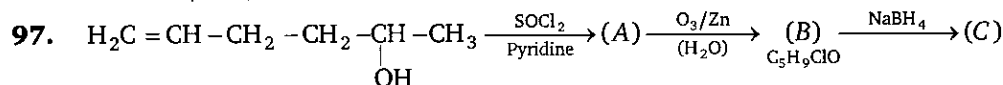


95. Select the correct statement.

- (a) Solvolysis of  $(\text{CH}_3)_2\text{C} = \text{CH} - \text{CH}_2 - \text{Cl}$  in ethanol is over 6000 times greater than alkyl chloride ( $25^\circ\text{C}$ )  
 (b)  $\text{CH}_3 - \text{CH} = \text{CH} - \text{CH}_2 - \text{OH}$  when reacts with HBr give a mixture of 1-bromo-2-butene and 3-bromo 1-butene  
 (c) When solution of 3-buten-2-ol in aqueous sulphuric acid is allowed to stand for one week, it was found to contain both 3-buten-2-ol and 2-buten-1-ol  
 (d) All of these



- (a)  $\text{H}^+/\Delta$ ,  $\text{Zn}(\text{Hg})$ ,  $\text{HCl}$                       (b)  $\text{HIO}_4$ ,  $\text{LiAlH}_4$   
 (c)  $\text{HIO}_4$ ,  $\text{H}^+/\Delta$                       (d)  $\text{H}^+/\Delta$ ,  $\text{HIO}_4$



Compound (C) is :

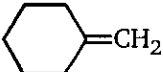
- (a)  $\text{CH}_3 - \overset{\text{OH}}{\text{CH}} - \text{CH}_2 - \underset{\text{Cl}}{\text{CH}} - \text{CH}_3$   
 (b)  $\text{HOCH}_2 - \text{CH}_2 - \text{CH}_2 - \text{CH}_2 - \text{CH}_2 - \text{CH}_2 - \text{Cl}$   
 (c)  $\text{HO} - \text{CH}_2 - \text{CH}_2 - \text{CH}_2 - \overset{\text{Cl}}{\text{CH}} - \text{CH}_3$   
 (d)  $\text{HO} - \text{CH}_2 - \text{CH}_2 - \underset{\text{Cl}}{\text{CH}} - \text{CH}_2 - \text{CH}_3$

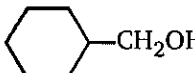
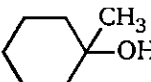
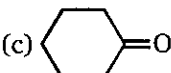
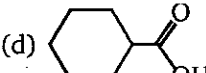
98. Iodoform can be obtained on warming NaOH and iodine with :

- (a)  $\text{CH}_3\text{CH}_2\text{CH}(\text{OH})\text{CH}_3$  (b)  $(\text{CH}_3)_2\text{CH}\overset{\text{O}}{\parallel}\text{C}\text{C}_2\text{H}_5$   
 (c)  $\text{CH}_3 - \overset{\text{O}}{\parallel}\text{C} - \text{OCH}_3$  (d)  $(\text{CH}_3)_2\text{CHCH}_2\text{OH}$

99. Which of these is a reducing agent ?

- (a)  $\text{CrO}_3/\text{H}^+$  (b)  $\text{KMnO}_4$   
 (c)  $\text{LiAlH}_4$  (d)  $\text{O}_3$

100.   $\xrightarrow[\text{(ii) H}_2\text{O}_2/\text{OH}^-]{\text{(i) (BH}_3)_2}$  (P); Product (P) in the reaction is:

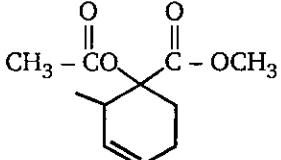
- (a)  (b)  (c)  (d) 

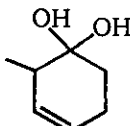
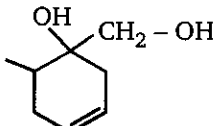
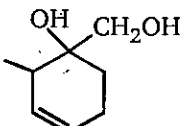
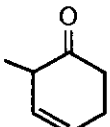
101.  $\text{CH}_3 - \overset{\text{CH}_3}{\underset{\text{OH}}{\text{C}}} - \text{CH}_3 \xrightarrow[\text{cool}]{\text{Na}_2\text{Cr}_2\text{O}_7}$  (P); Product (P) in the reaction is:

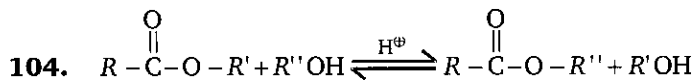
- (a)  $\text{CH}_3 - \overset{\text{CH}_3}{\text{C}} = \text{CH}_2$  (b)  $\text{CH}_3 - \overset{\text{CH}_3}{\text{CH}} - \text{CH}_3$   
 (c)  $\text{CH}_3 - \overset{\text{CH}_3}{\underset{\text{CH}_3}{\text{C}}} - \text{O} - \overset{\text{CH}_3}{\underset{\text{CH}_3}{\text{C}}} - \text{CH}_3$  (d) No reaction

102. 1, 2, 3 - butanetriol undergoes oxidative cleavage of  $\text{HIO}_4$ . During this process

- (a) 1 equivalent of  $\text{HIO}_4$  consumed &  $\text{HCO}_2\text{H}$  &  $\text{H}_3\text{C} - \overset{\text{O}}{\parallel}\text{C} - \text{CO}_2\text{H}$  are formed  
 (b) 2 equivalents of  $\text{HIO}_4$  consumed &  $\text{HCO}_2\text{H}$ ,  $\text{HCH} = \text{O}$  &  $\text{CH}_3 - \text{CH} = \text{O}$  are formed  
 (c) 3 equivalents of  $\text{HIO}_4$  consumed &  $\text{HCO}_2\text{H}$  (2 eq.) & 1 eq. of  $\text{CH}_3\text{CO}_2\text{H}$  are formed  
 (d) 2 equivalents of  $\text{HIO}_4$  consumed & 2 eq. of  $\text{HCO}_2\text{H}$  & 1 eq. of  $\text{CH}_3\text{CH} = \text{O}$  is formed

103.   $\xrightarrow[\text{(ii) H}_2\text{O}]{\text{(i) LiAlH}_4}$  (A); Product (A) of the reaction is : (96%)

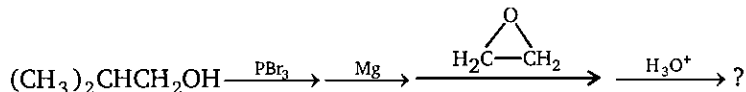
- (a)  (b)  (c)  (d) 



Above reaction is/an example of :

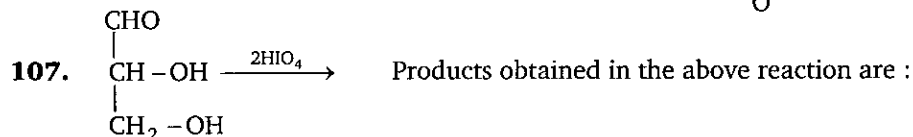
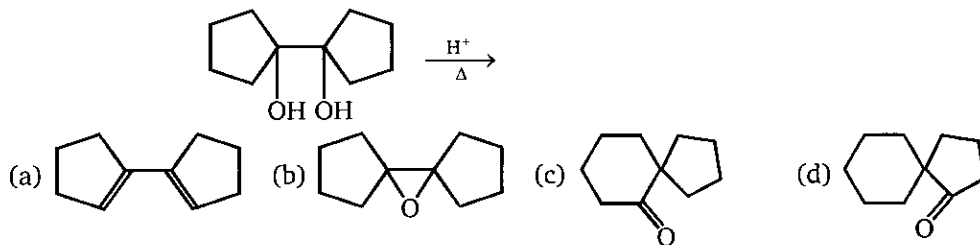
- (a) esterification (b) saponification  
(c) *trans*-esterification (d) hydrolysis

105. What is the major organic product of the following sequence of reactions ?

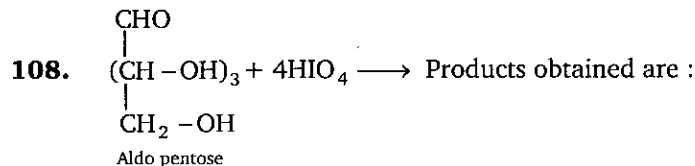


- (a)  $(\text{CH}_3)_2\text{CHCH}(\text{OH})\text{CH}_2\text{CH}_3$  (b)  $(\text{CH}_3)_2\text{CHCH}_2\text{CH}_2\text{OH}$   
(c)  $(\text{CH}_3)_2\text{CHCH}_2\text{CH}(\text{OH})\text{CH}_3$  (d)  $(\text{CH}_3)_2\text{CHCH}_2\text{CH}_2\text{CH}_2\text{OH}$

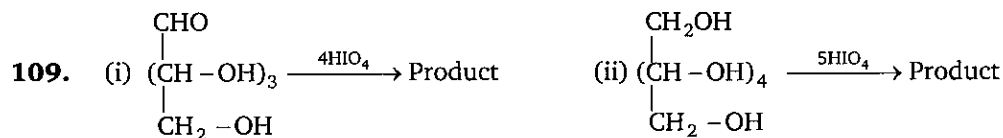
106. The structure of the product formed in the reaction given below is :



- (a) HCHO, HCO<sub>2</sub>H (b) HCHO, 2HCO<sub>2</sub>H  
(c) CO<sub>2</sub>, 2HCO<sub>2</sub>H (d) CO<sub>2</sub>, HCHO, HCO<sub>2</sub>H

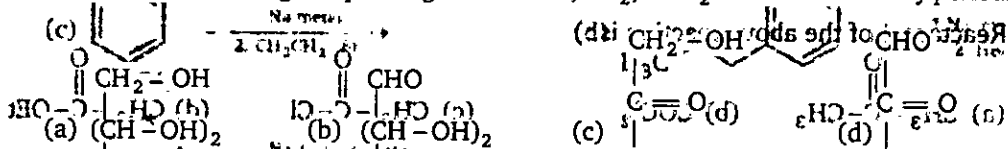


- (a) 4HCO<sub>2</sub>H, HCHO (b) 4CH<sub>2</sub>O, HCO<sub>2</sub>H  
(c) CO<sub>2</sub>, 4HCHO (d) CO<sub>2</sub>, 3HCO<sub>2</sub>H, HCHO

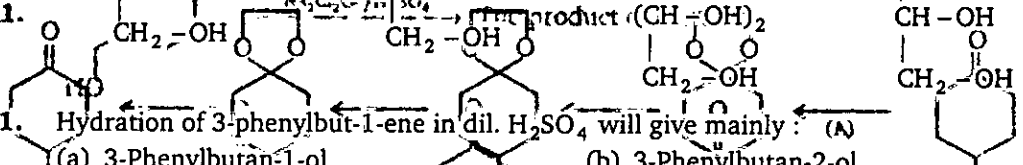


Ratio of moles of formic acid obtained in reaction (i) and reaction (ii) is : (A) 3/4 (B) 4/5 (C) 1/2 (D) 5/4


110. Which of the following compound gives 2HCHO, CO<sub>2</sub>, HCO<sub>2</sub>H when oxidised by periodic acid?



111. Hydration of 3-phenylbut-1-ene in dil. H<sub>2</sub>SO<sub>4</sub> will give mainly : (A) 3-Phenylbutan-1-ol (B) 3-Phenylbutan-2-ol (C) 2-Phenylbutan-2-ol (D) 2-Phenylbutan-1-ol



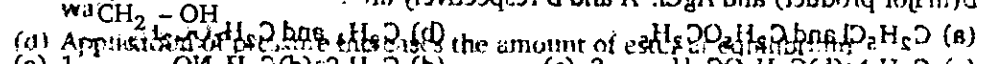
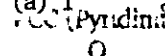
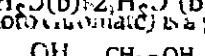
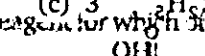
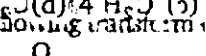
112. Decarboxylation of sodium salicylate with soda lime forms : (a) Salicylic acid (b) Phenol (c) Benzene (d) None of these

122.  with soda lime forms : (a) Salicylic acid (b) Phenol (c) Benzene (d) None of these

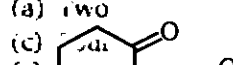
113. What is the maximum value of  $\alpha$  in the Libermann reaction? (a) 1 (b) 2 (c) 3 (d) 4

118. Ethanol when treated with PCl<sub>5</sub> and HCl gives A and B respectively. A will give the formation of a product and B will give the formation of a product. The amount of ester formed from 1 mole of A and B respectively are : (a) 1 and 2 (b) 2 and 3 (c) 3 and 4 (d) 4 and 5

123. Pyridine is a good reagent for which of the following reactions? (a) 1 (b) 2 (c) 3 (d) 4

114.  Product C is : (a)  (b)  (c)  (d) 

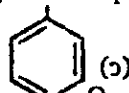
124. How many primary alcohols (including stereoisomers) are possible with formula C<sub>4</sub>H<sub>10</sub>O? (a) two (b) three (c) four (d) five

125.  can be prepared by the reaction of : (a) CH<sub>3</sub>I and CH<sub>3</sub>CH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>OH (b) CH<sub>3</sub>Br and AlCl<sub>3</sub> (c) CH<sub>3</sub>Br and ZnCl<sub>2</sub> (d) CH<sub>3</sub>OH and ZnCl<sub>2</sub>

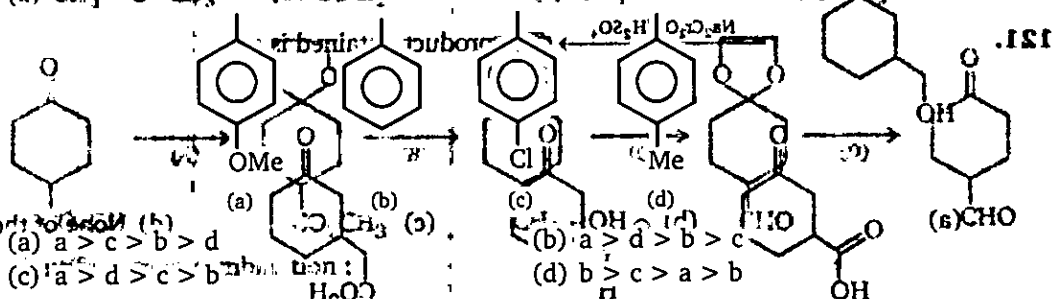
126. 0.092 g of a compound with the molecular formula  $C_3H_8O_3$  on reaction with an excess of  $CH_3MgI$  gives 67.00 mL of methane at STP. The number of active hydrogen atoms present in a molecule of the compound is :

(a) one  
(b) two  
(c) three  
(d) four

(a) one  
(b) two  
(c) three  
(d) four



127. Migratory aptitude of the following in decreasing order is :



116.

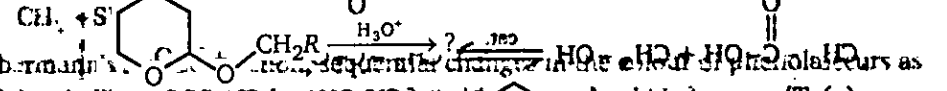


(a)  $a > c > b > d$   
(b)  $a > d > c > b$   
(c)  $a > d > c > b$   
(d)  $b > c > a > b$

128. The major product formed in the reaction is :

(a) (A) (b) (B) (c) (C) (d) (D)

117. In the following reaction, the major product is :



118. The following reaction is an example of :

(a) Electrophilic aromatic substitution  
(b) Nucleophilic aromatic substitution  
(c) Electrophilic nucleophilic aromatic substitution  
(d) Nucleophilic electrophilic aromatic substitution

129. Reaction of R-2-butanol with *p*-toluenesulphonyl chloride in pyridine then LiBr gives :

(a) R-2-butyl bromide (b) S-2-butyl tosylate  
(c) R-2-butyl tosylate (d) S-2-butyl bromide

130. Optically active 2-octanol rapidly loses its optical activity when exposed to :

(a) dilute acid (b) dilute base (c) light (d) humidity

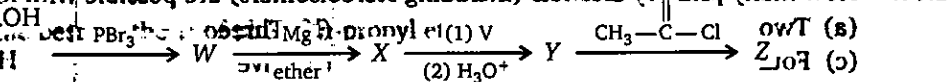
131. If (±) 2-methyl butanoic acid were esterified by reaction with (±) 2-butanol, how many optically active compounds would be present in the final equilibrium reaction mixture ?

(a) 2 (b) 3 (c) 4 (d) 6

124. How many primary alcohols (including stereoisomers) are possible with formula  $C_5H_{12}O$  ?

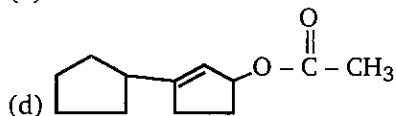
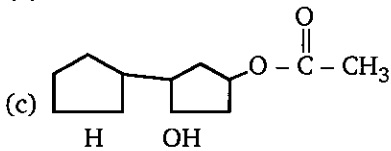
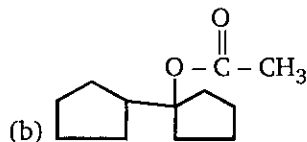
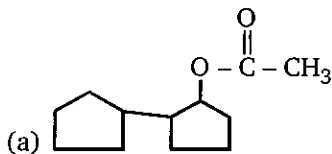
(a) Two (b) Four (c) Six (d) Eight

120.

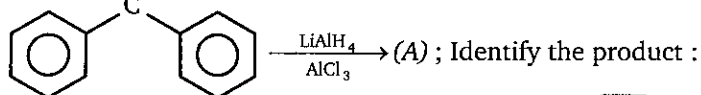


125. 1-phenylethanol can be prepared by the reaction of benzaldehyde with :

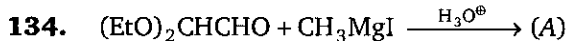
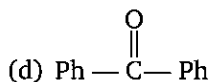
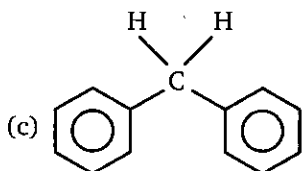
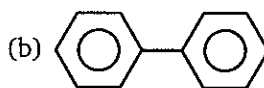
(a)  $CH_3I$  and  $Mg$  (b)  $CH_3Br$  and  $AlCl_3$   
(c)  $CH_3Br$  and  $AlCl_3$  (d)  $CH_3I$  and  $AlCl_3$



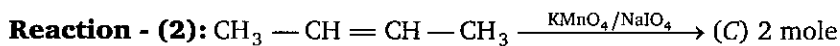
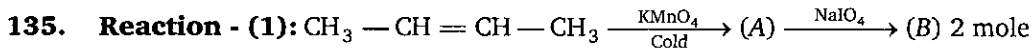
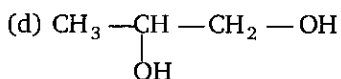
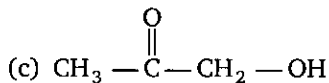
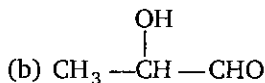
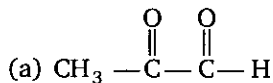
133.



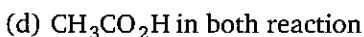
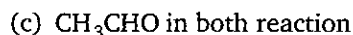
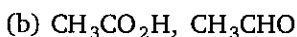
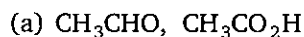
(a) No reaction

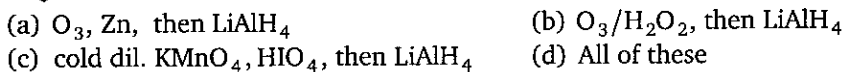
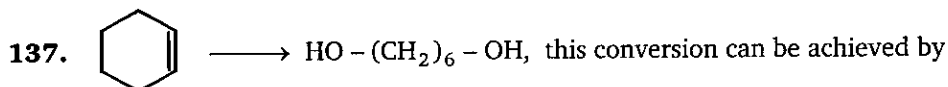
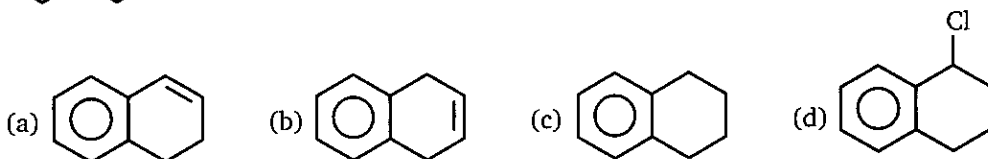
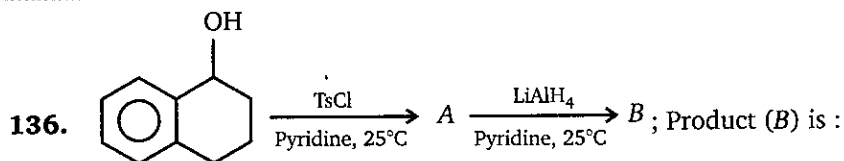


Product obtained in the above reaction is :

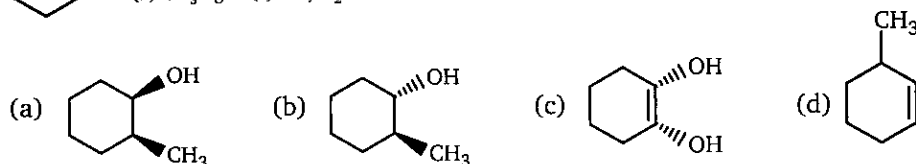
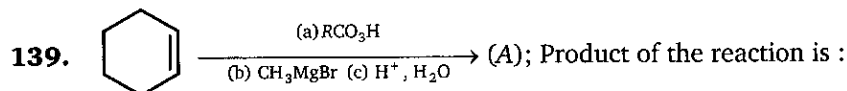
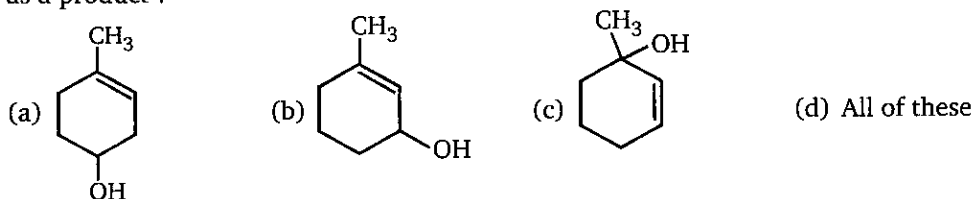


Product (B) and (C) respectively are :

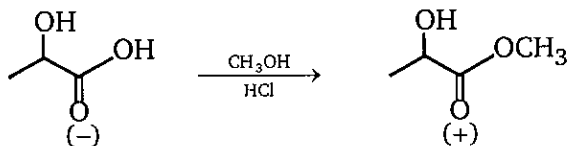




138. Which of the following alcohol on treatment with HCl give 3-chloro-3-methyl cyclohexene as a product ?



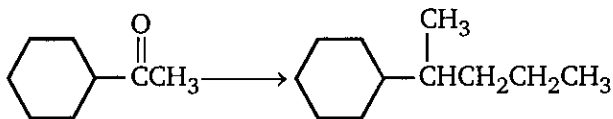
140. Esterification (shown below) is a reaction converting a carboxylic acid to its ester. It involves only the carbonyl carbon. Esterification of (-)-lactic acid with methanol yields (+)-methyl lactate. Assuming that there are no side reactions, what is true about this reaction ?



- (a) An S<sub>N</sub>2 process has occurred, inverting the absolute configuration of the chiral center  
 (b) An S<sub>N</sub>1 reaction at the chiral center has inverted the optical rotation  
 (c) A diastereomer has been produced; diastereomers have different physical properties including optical rotation  
 (d) Optical rotation is not directly related to absolute configuration, so the change in sign of rotation is merely a coincidence

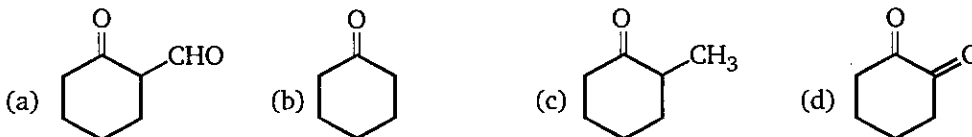


141. Which of the following sets of reagents, used in the order shown, would successfully accomplish the conversion shown ?

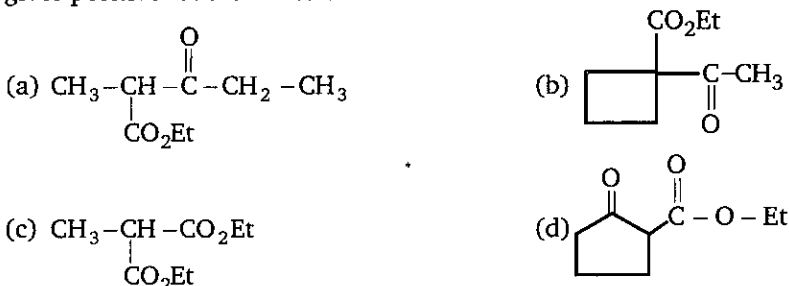


- (a)  $\text{CH}_3\text{CH}_2\text{CH}_2\text{MgBr}$ ;  $\text{H}_3\text{O}^+$ ; PCC,  $\text{CH}_2\text{Cl}_2$   
 (b)  $\text{CH}_3\text{CH}_2\text{CH}_2\text{MgBr}$ ;  $\text{H}_3\text{O}^+$ ;  $\text{H}_2\text{SO}_4$ , heat PCC,  $\text{CH}_2\text{Cl}_2$   
 (c)  $(\text{C}_6\text{H}_5)_3\text{P}^+\text{C}^-\text{HCH}_2\text{CH}_3$ ,  $\text{B}_2\text{H}_6$ ;  $\text{CH}_3\text{CO}_2\text{H}$   
 (d)  $(\text{C}_6\text{H}_5)_3\text{P}^+\text{C}^-\text{HCH}_2\text{CH}_3$ ;  $\text{H}_2\text{O}$

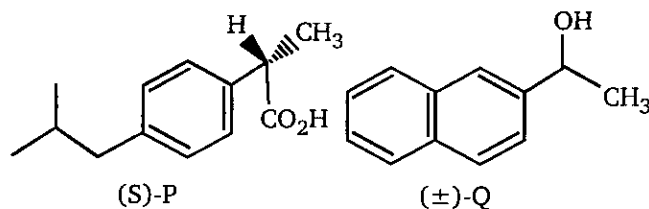
142. Product ; Product of the reaction is :



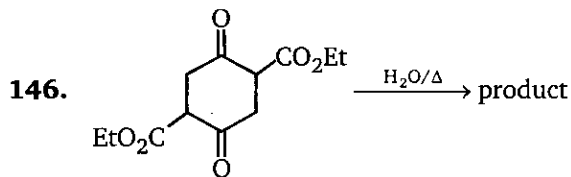
143. Which of the following compound on hydrolysis followed by heating gives a product, which gives positive iodoform test?



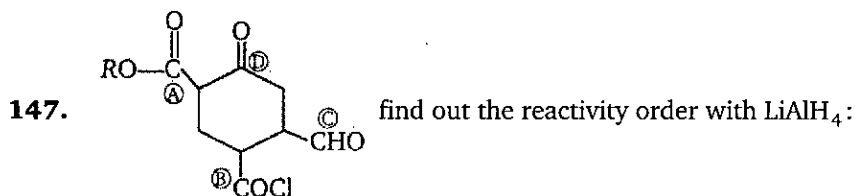
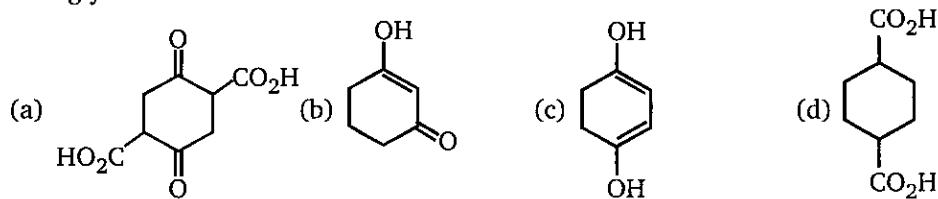
144. Treatment of a  $2^\circ$  OH with  $\text{CrO}_3/\text{H}_2\text{SO}_4$  yields an/a :  
 (a) aldehyde (b) carboxylic acid (c) ester (d) ketone
145. Esterification of the acid **P** with the alcohols **Q** will give :



- (a) only one enantiomer (b) a mixture of diastereomers  
 (c) a mixture of enantiomers (d) only one diastereomer



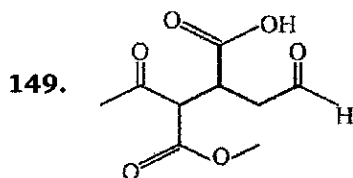
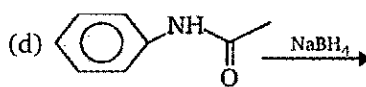
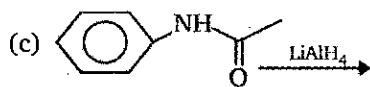
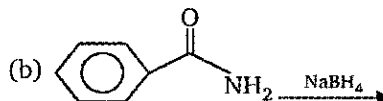
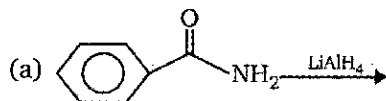
Identify major product of the reaction, when the given compound is hydrolysed and heated strongly:



- (a)  $A > B > C > D$   
 (c)  $D > C > B > A$

- (b)  $B > C > D > A$   
 (d)  $B > D > C > A$

148. Find out the reaction in which obtained product give positive isocyanide test:



In the above given compound how many functional group reduced by LAH (Lithium aluminium hydride) and SBH (sodium borohydride) respectively?

(a) 4, 4

(b) 4, 3

(c) 3, 4

(d) 4, 2

## ANSWERS — LEVEL 1

1.	(c)	2.	(a)	3.	(b)	4.	(c)	5.	(b)	6.	(b)	7.	(b)	8.	(a)
9.	(b)	10.	(b)	11.	(b)	12.	(b)	13.	(a)	14.	(a)	15.	(a)	16.	(a)
17.	(d)	18.	(a)	19.	(b)	20.	(a)	21.	(a)	22.	(a)	23.	(d)	24.	(a)
25.	(b)	26.	(b)	27.	(b)	28.	(b)	29.	(c)	30.	(c)	31.	(b)	32.	(b)
33.	(a)	34.	(b)	35.	(b)	36.	(c)	37.	(c)	38.	(c)	39.	(d)	40.	(c)
41.	(b)	42.	(b)	43.	(d)	44.	(d)	45.	(b)	46.	(a)	47.	(b)	48.	(b)
49.	(a)	50.	(b)	51.	(a)	52.	(c)	53.	(c)	54.	(c)	55.	(b)	56.	(a)
57.	(d)	58.	(c)	59.	A-d	59.	B-b	59.	C-a	60.	(c)	61.	(c)	62.	A-b
62.	B-b	63.	(b)	64.	(c)	65.	(b)	66.	(a)	67.	(a)	68.	(d)	69.	(a)
70.	(c)	71.	(b)	72.	(d)	73.	(d)	74.	(c)	75.	(b)	76.	(d)	77.	(c)
78.	(c)	79.	(d)	80.	(c)	81.	(c)	82.	(d)	83.	(a)	84.	(b)	85.	(b)
86.	(c)	87.	(c)	88.	(b)	89.	(d)	90.	(a)	91.	(c)	92.	(b)	93.	(b)
94.	(a)	95.	(d)	96.	(b)	97.	(c)	98.	(a)	99.	(c)	100.	(a)	101.	(d)
102.	(b)	103.	(c)	104.	(c)	105.	(d)	106.	(c)	107.	(b)	108.	(a)	109.	(c)
110.	(d)	111.	(c)	112.	(b)	113.	(b)	114.	(b)	115.	(b)	116.	(d)	117.	(b)
118.	(a)	119.	(b)	120.	(a)	121.	(a)	122.	(b)	123.	(b)	124.	(d)	125.	(a)
126.	(c)	127.	(b)	128.	(c)	129.	(d)	130.	(a)	131.	(c)	132.	(b)	133.	(c)
134.	(b)	135.	(a)	136.	(c)	137.	(d)	138.	(d)	139.	(b)	140.	(d)	141.	(c)
142.	(b)	143.	(b)	144.	(d)	145.	(b)	146.	(c)	147.	(b)	148.	(a)	149.	(b)



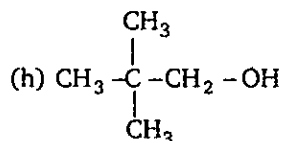
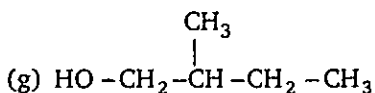
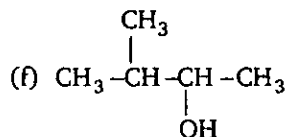
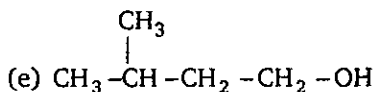
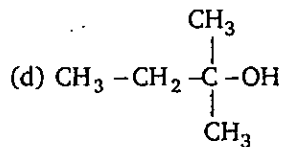
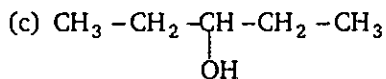
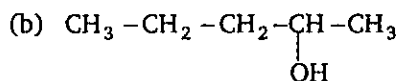
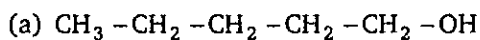
1. Consider the pairs of ethers, numbered I through V, shown below. To the right of each pair is a description of reaction conditions to be applied to each. One compound of the pair will react more rapidly than the other.

Which ether of the two will be more rapidly cleaved?

Write your answer in box.

	(A)	Ether Pairs	(B)	Cleavage Conditions
I.		$\text{O}-\text{CH}(\text{CH}_3)_2$ &		Treated with HBr in $\text{CH}_3\text{CN}$ , $40^\circ\text{C}$
II.		$\text{O}-\text{C}(\text{CH}_3)_3$ &		Treated with $\text{H}_2\text{SO}_4$ in $\text{CH}_3\text{CN}$ , $40^\circ\text{C}$
III.		&		Treated with $\text{H}_2\text{SO}_4$ in $\text{CH}_3\text{CN}$ , $40^\circ\text{C}$
IV.		&		Treated with 5% aqueous $\text{H}_2\text{SO}_4$ , $25^\circ\text{C}$
V.		&		Treated with 5% aqueous $\text{H}_2\text{SO}_4$ , $25^\circ\text{C}$

## 2. Comprehension

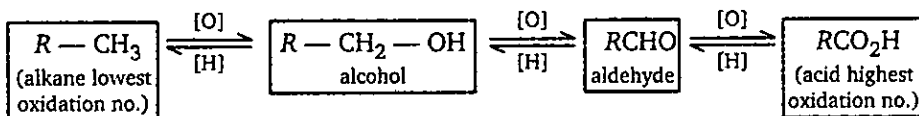


Above compounds (a) to (h) are isomers of  $\text{C}_5\text{H}_{12}\text{O}$ .

Based on the above isomer answer the following (A to F).

- A. Which isomer is most reactive towards dehydration by conc.  $\text{H}_2\text{SO}_4$ ?
- B. Which isomer will undergo rearrangement when treated with conc.  $\text{H}_2\text{SO}_4$ ?
- C. Which isomers on dehydration with conc.  $\text{H}_2\text{SO}_4$  give alkene which is capable to show geometrical isomerism?
- D. Which isomer is least acidic?
- E. Which isomers on dehydration give most stable alkene?
- F. Which isomer on dehydration with conc.  $\text{H}_3\text{PO}_4$  undergo maximum rearrangement?

## 3. Comprehension



[O] = Oxidation      [H] = Reduction

Consider the above sequence and answer A to F.

- A.** Conversion  $(CH_3-CH_3 \longrightarrow CH_3-CH_2-OH)$  alkane  $\longrightarrow$  alcohol is achieved by:  
 (a)  $Br_2/h\nu$ , alc. KOH                      (b)  $Br_2/h\nu$ , aq. KOH  
 (c)  $Br_2/CCl_4$ ,  $LiAlH_4$                       (d)  $Br_2/CCl_4$ ,  $NaBH_4$
- B.** Conversion  $R-CH_2-OH \longrightarrow R-CHO$  can be done by:  
 (a) PCC/ $CH_2Cl_2$                               (b) Cu,  $300^\circ C$   
 (c)  $CrO_3$     (d) All of these
- C.** Conversion  $R-CHO \longrightarrow R-CO_2H$  can be done by:  
 (a)  $KMnO_4$                                       (b)  $H_2CrO_4$   
 (c)  $K_2Cr_2O_7$                                       (d) All of these
- D.** Conversion  $R-CO_2H \longrightarrow R-CHO$  can be done by:  
 (a)  $LiAlH_4$                                       (b)  $NaBH_4$   
 (c) DIBAL-H                                      (d) All of these
- E.** Conversion  $R-CHO \longrightarrow R-CH_2-OH$  can be done by:  
 (a)  $LiAlH_4$                                       (b)  $NaBH_4$   
 (c)  $H_2/Ni$                                         (d) All of these
- F.** Reduction  $R-CH_2-OH \longrightarrow R-CH_3$  can be done by:  
 (a)  $LiAlH_4$                                       (b)  $NaBH_4-AlCl_3$   
 (c)  $H_2-Ni$                                         (d) Red P + HI
- 4. Which of the following is true for 3-methylbutanal ?**

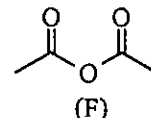
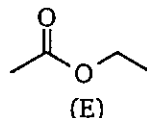
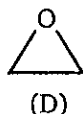
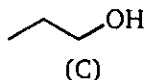
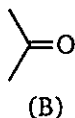
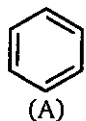
a.	This compound may be classified as an aldehyde.	
b.	This compound may be classified as a ketone	
c.	An aldol reaction takes place on treatment with NaOH solution.	
d.	There is no reaction with $LiAlH_4$ in ether solution.	
e.	An excess of $CH_3MgBr$ in ether reacts to give 4-methyl-2-pentanol.	
f.	Wolff-Kishner reduction gives butane.	
g.	This compound is an isomer of 3-pentanone.	

5. This problem is an introduction to the planning of multistep syntheses.

For use, you have six reactant compounds (A through F); and eight reagents (1 through 8), shown below.

Following these lists, five multistep syntheses are outlined. For each of these, certain reactants or reagents must be identified by writing an appropriate letter or number in designated answer boxes. Write a single letter or number, indicating your choice of the best reactant or reagent, in each answer box.

### Reactant Compounds :



### Reagents :

(1) Jones' reagent [ $\text{Na}_2\text{Cr}_2\text{O}_7$  in  $\text{H}_3\text{O}^+$ ]

(2) PCC [ $\text{CrO}_3$  in pyridine + HCl]

(3) Sodium hydride NaH

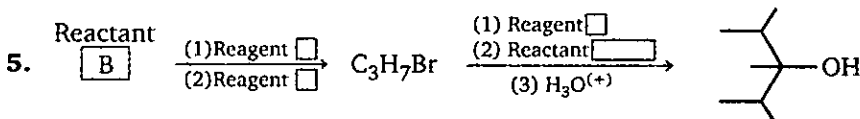
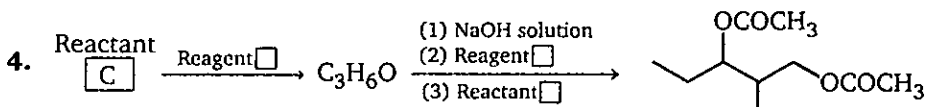
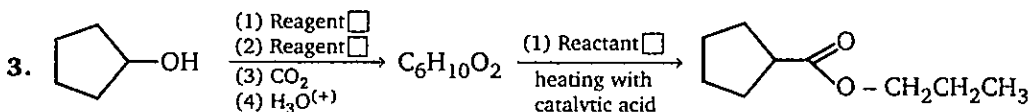
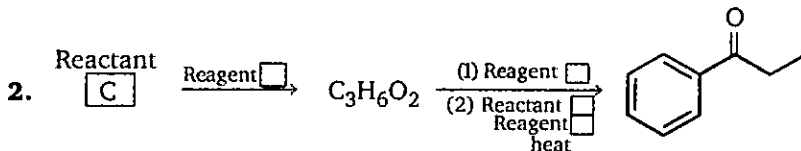
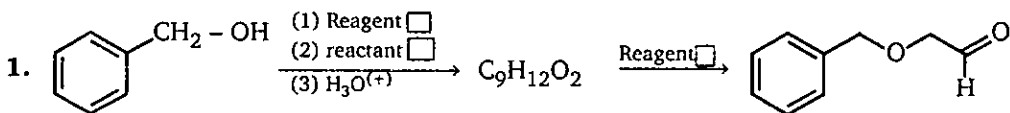
(4) Sodium borohydride  $\text{NaBH}_4$

(5) Thionyl chloride  $\text{SOCl}_2$

(6) Phosphorus tribromide  $\text{PBr}_3$

(7) Aluminium trichloride  $\text{AlCl}_3$

(8) Magnesium turnings in ether



6. Which of the following is true for 3-methyl-2-butanone?

a.	It may be prepared by $\text{CrO}_3$ oxidation of 2-methyl-2-butanol.	
b.	Its reaction with $\text{NaBH}_4$ gives a secondary alcohol.	
c.	It may be prepared by acidic $\text{Hg}^{2+}$ catalyzed hydration of 3-methyl-1-butyne.	
d.	It forms a silver mirror on treatment with $[\text{Ag}(\text{NH}_3)_2]^+$ .	
e.	This compound is an isomer of 4-penten-1-ol.	

7. Which of these methods would serve to prepare 1-phenyl-2-propanol?

a.	Addition of benzyl Grignard reagent to acetaldehyde (ethanal).	
b.	Addition of phenyl lithium to propylene oxide (methyloxirane).	
c.	Addition of phenyl Grignard reagent to acetone (2-propanone).	
d.	Acid-catalyzed hydration (addition of water to) of 2-phenyl-1-propene.	
e.	Addition of methyl Grignard reagent to acetophenone (methyl phenyl ketone).	
f.	Addition of methyl Grignard reagent to phenylacetaldehyde.	

8. Match the Column (I) and (II).

Column (I)		Column (II)	
	Reaction		Name of Reaction
(a)		(p)	Pinacol-Pinacolone rearrangement

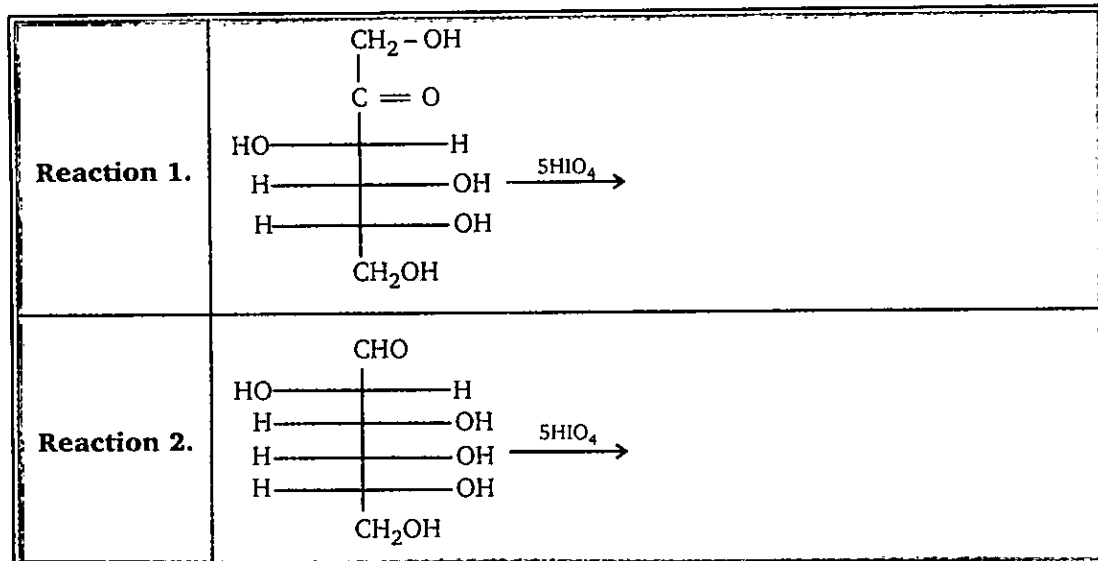


(b)	<p style="text-align: center;"> <math>\xrightarrow[2\text{HCl}]{\text{NaNO}_2}</math> </p>	(q)	Semi-Pinacol reaction
(c)	<p style="text-align: center;"> <math>\xrightarrow[\Delta]{\text{H}^+}</math> </p>	(r)	Pinacolic-Diazotization
(d)	<p style="text-align: center;"> <math>\xrightarrow[(2) \text{Et}_3\text{N}, \Delta]{(1) \text{TsCl}}</math> </p>	(s)	Pinacol fashion reaction

## 9. Match the Column (I) and (II).

Column (I)		Column (II)	
	Reactant		Products
(a)	<p style="text-align: center;"> <math>\xrightarrow[\text{H}_2\text{SO}_4 \text{ Conc.}]{\text{CH}_3\text{OH}}</math> </p>	(p)	
(b)	<p style="text-align: center;"> <math>\xrightarrow[(2) \text{CH}_3\text{I}]{(1) \text{NaH}}</math> </p>	(q)	
(c)	<p style="text-align: center;"> <math>\xrightarrow[(3) \text{CH}_3\text{I}]{(1) \text{HBr}, (2) \text{Mg}}</math> </p>	(r)	
(d)	<p style="text-align: center;"> <math>\xrightarrow[(2) \text{CH}_3\text{I}]{(1) \text{Na}}</math> </p>	(s)	

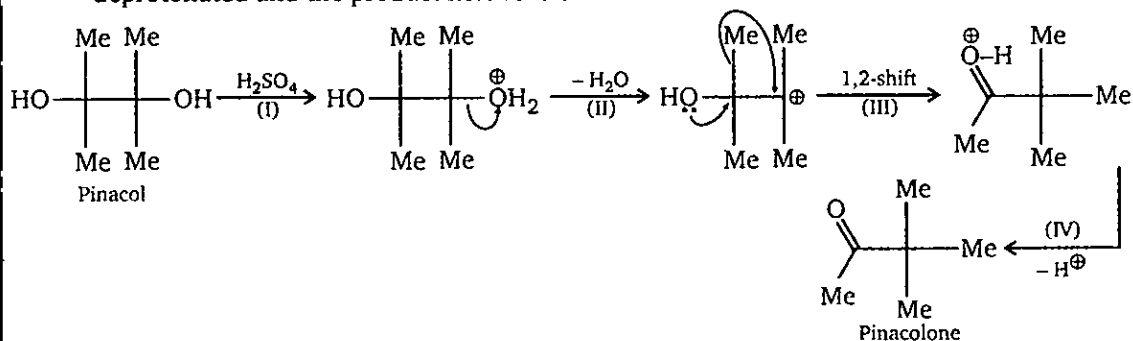
10.



Ratio of moles of formaldehyde obtained in the reaction (1) and reaction (2) ?

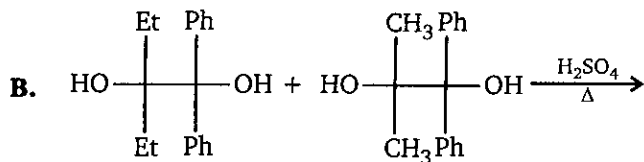
### 11. Comprehension

Di-tert-glycols rearrange in the presence of acid to give  $\alpha$ -tertiary ketones. The trivial name of the simplest glycol of this type is pinacol, and this type of reaction therefore is named pinacol rearrangement (in this specific case, the reaction is called a pinacol-pinacolone rearrangement). The rearrangement involves 4 steps. one of the hydroxyl groups is protonated in the first step. A molecule of water is eliminated in the second step and a tertiary carbocation is formed. The carbocation rearranges in the third step into a more stable carboxonium ion via a [1, 2] rearrangement. In the last step, the carboxonium ion is deprotonated and the product ketone is obtained.



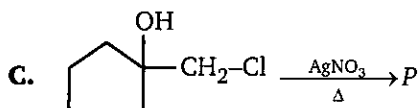
A. What is R.D.S. of pinacol-pinacolone rearrangement ?

- (a) I step  
 (b) II step  
 (c) III step  
 (d) IV step

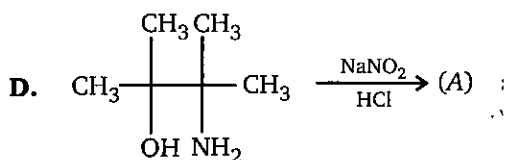
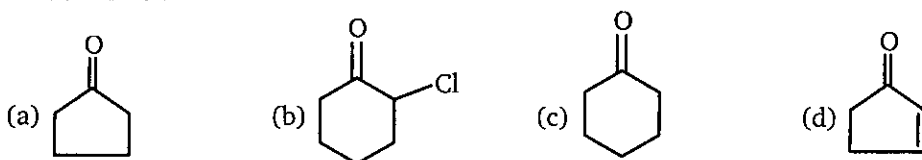


How many products obtained in above reaction ?

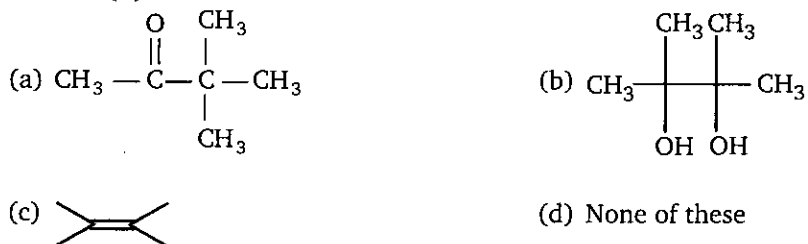
- (a) 1 (b) 2  
(c) 3 (d) 4



Product 'P' is :

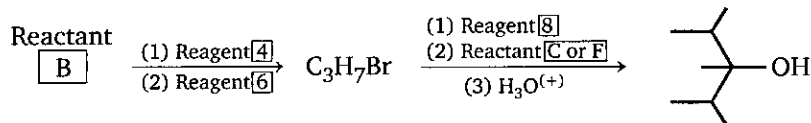
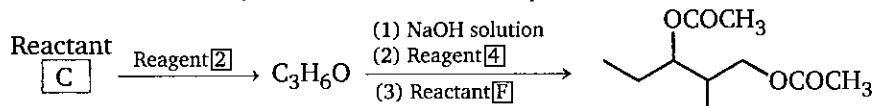
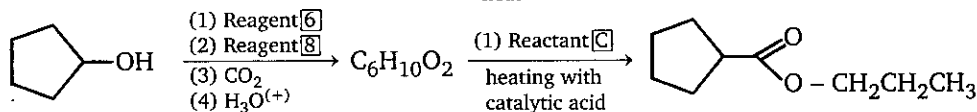
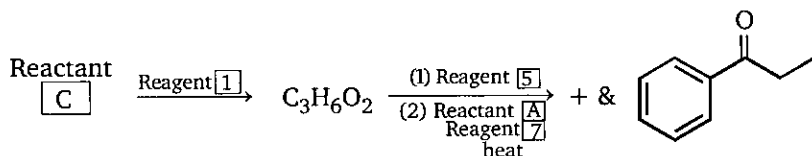
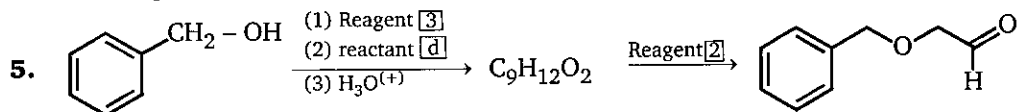


Product (A) is :



## ANSWERS — LEVEL 2

- I - B; II - A; III - A; IV - B; V - B
- A - d; B - a, c, e, f, g, h; C - a, b, c; D - d; E - d, e, f, g, h; F - e
- A - b; B - d, C - d, D - c, E - d; F - d
- a, c, e, g



- b, c, e
- a, b, f
- a - p, b - r, c - s, d - q
- a - s, b - r, c - q, d - p
- Ratio of reaction I and II = 2
- A - b; B - b; C - c; D - a

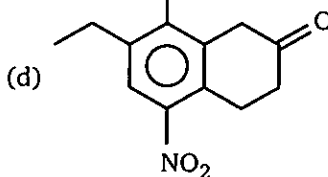
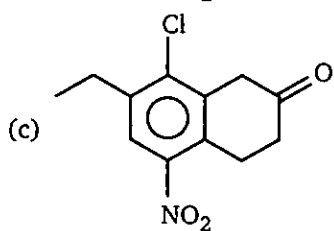
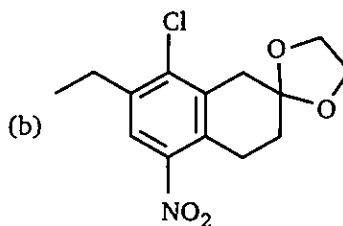
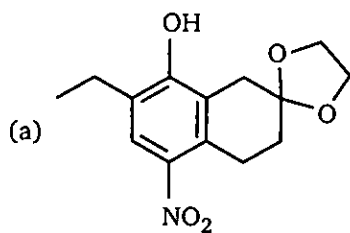
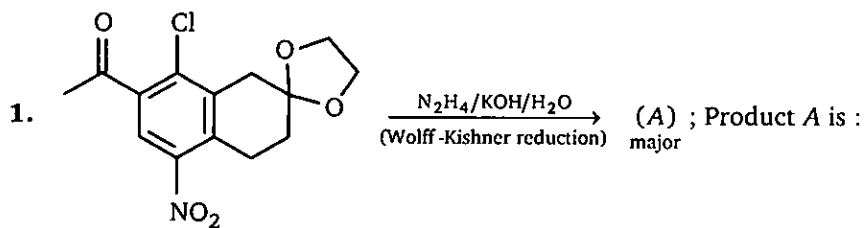


# 7

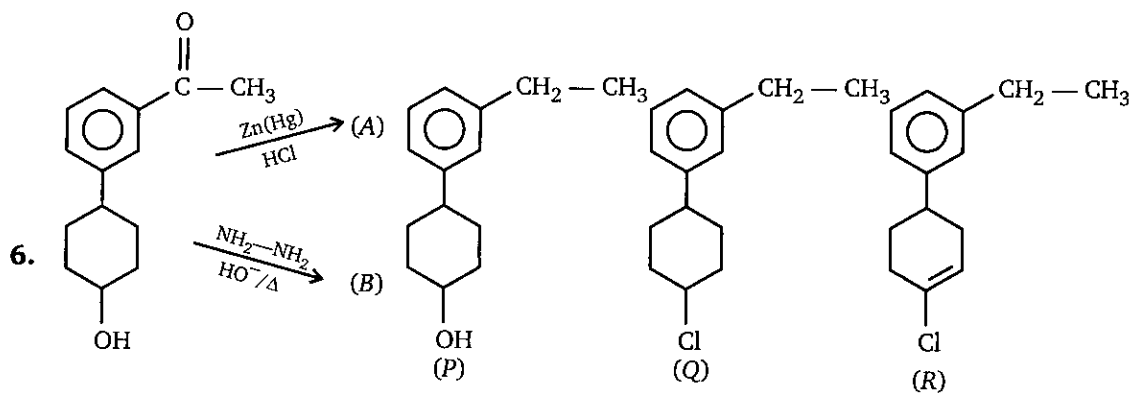
## ALDEHYDES AND KETONES



### LEVEL-1

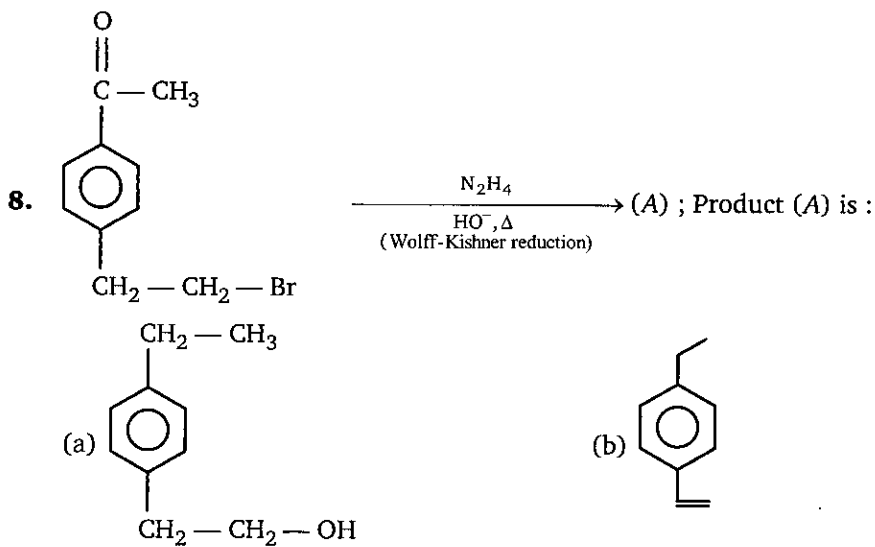
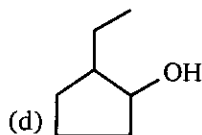
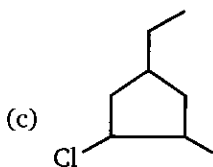
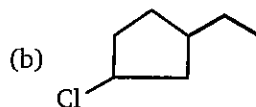
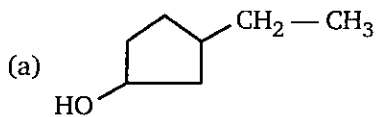
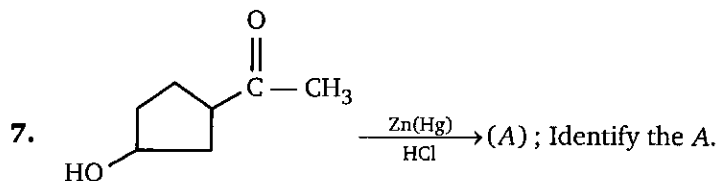


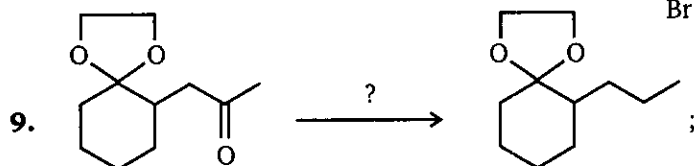
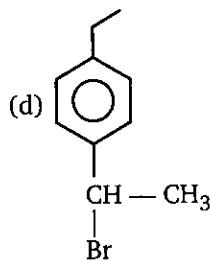
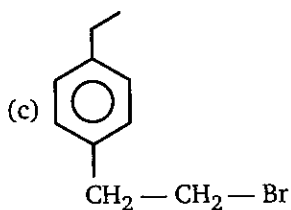




Identify product (A) & (B) from the given product P, Q, R:

- (a)  $A = P, B = Q$       (b)  $A = Q, B = R$       (c)  $A = Q, B = P$       (d)  $A = R, B = P$

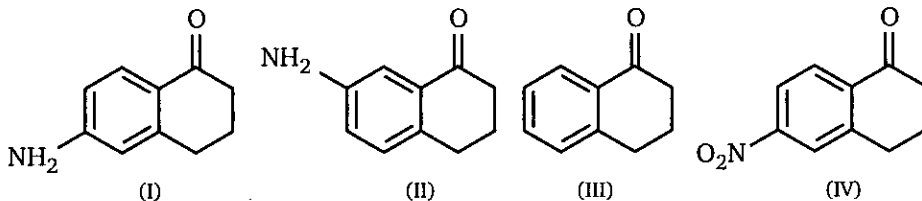




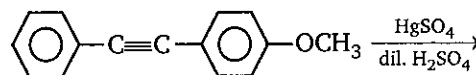
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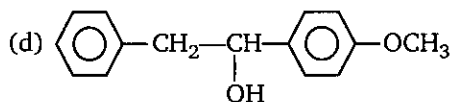
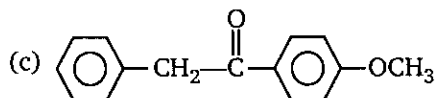
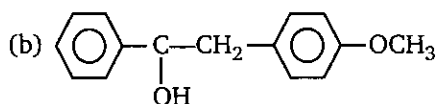
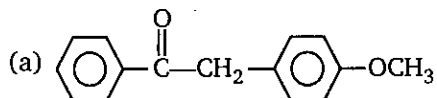
- (a) Clemmensen reduction                      (b) Wolff-Kishner reduction  
(c)  $\text{LiAlH}_4$                                       (d)  $\text{NaBH}_4$

10. Increasing order of equilibrium constants for the formation of a hydrate:

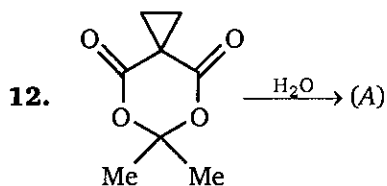


- (a)  $\text{IV} < \text{III} < \text{II} < \text{I}$                       (b)  $\text{IV} < \text{III} < \text{I} < \text{II}$   
(c)  $\text{I} < \text{II} < \text{III} < \text{IV}$                       (d)  $\text{II} < \text{III} < \text{I} < \text{IV}$

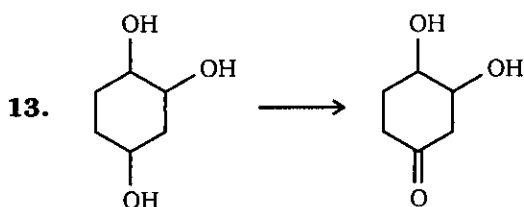
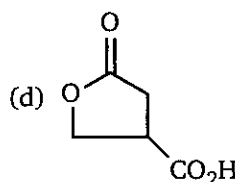
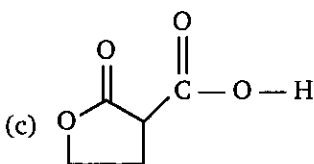
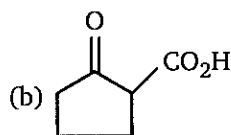
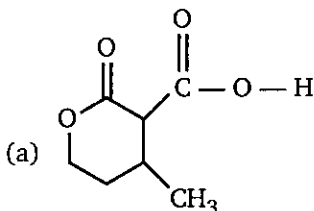
11.  (A) Product (A) is:



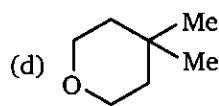
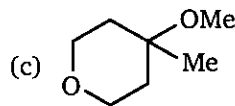
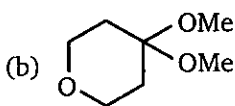
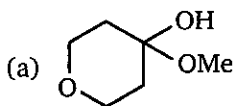
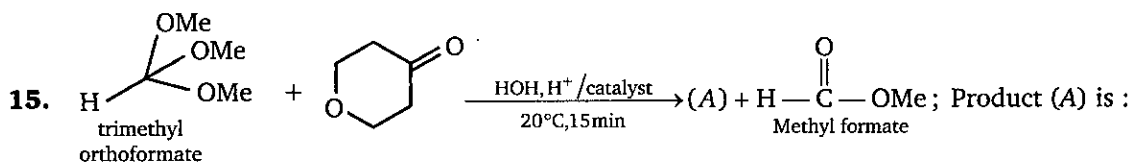
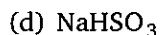
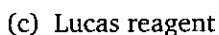
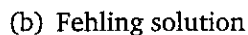
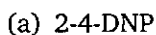
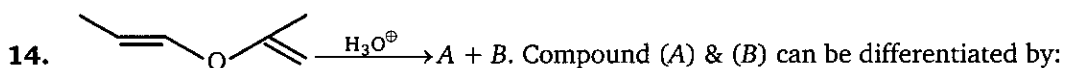
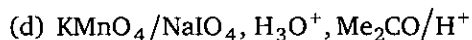
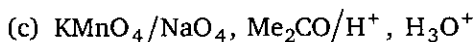
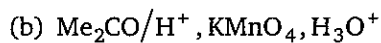
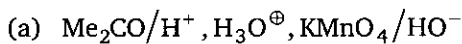


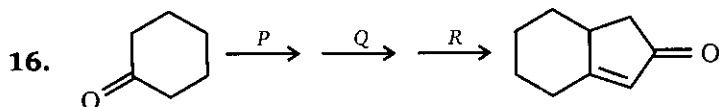


Predict the product of hydrolysis of the above molecule.



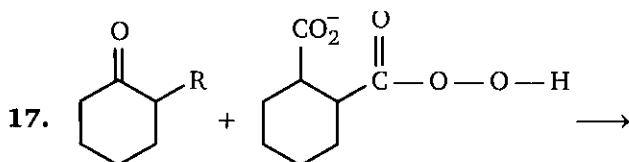
, This conversion can be achieved by :



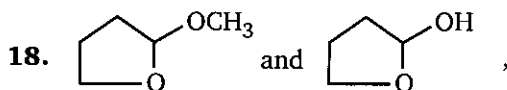
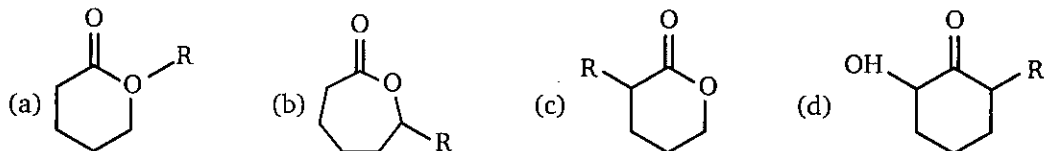


Reagents to carry out above conversion, P, Q, R respectively are :

- (a)  $\text{H}_2\text{C}=\text{CH}-\text{CH}_2-\text{Br}$ ,  $(\text{HO}^\ominus)$ ,  $[\text{HO}^\ominus, \Delta]$ , Wacker-process  
 (b)  $\text{H}_2\text{C}=\text{CH}-\text{CH}_2-\text{Br}$ ,  $(\text{HO}^\ominus)$ , Wacker-process,  $\text{HO}^\ominus, \Delta$   
 (c) Wacker process,  $\text{H}_2\text{C}=\text{CH}-\text{CH}_2-\text{Br}$ ,  $(\text{HO}^\ominus)$ ,  $\text{HO}^\ominus (\Delta)$   
 (d) Wacker process,  $\text{HO}^\ominus (\Delta)$ ,  $\text{H}_2\text{C}=\text{CH}-\text{CH}_2-\text{Br}$ ,  $(\text{HO}^\ominus)$

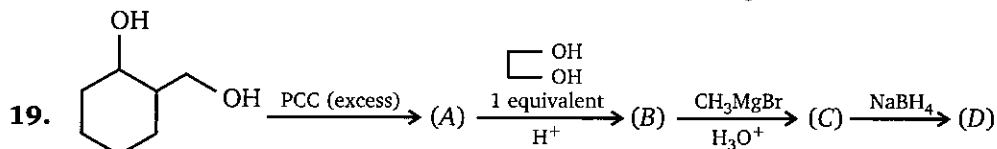


Above reaction is a Baeyer Villiger rearrangement of an asymmetric ketone with magnesium mono peroxy phthalate hexahydrate (in the drawing,  $\text{Mg}^{+2}$  is omitted for clarity) Identify major product.

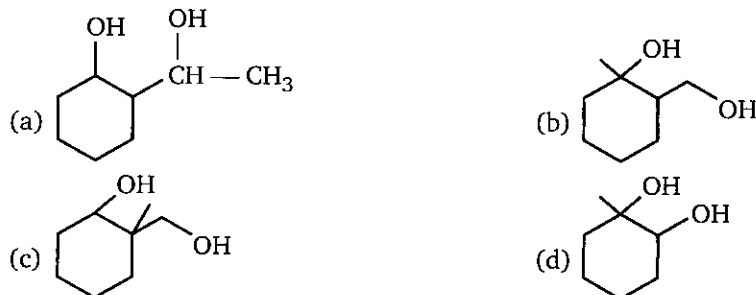


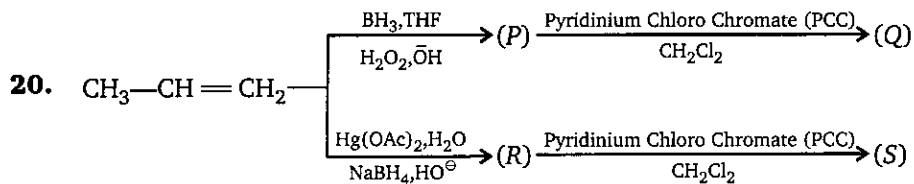
Above compounds can be differentiated by following reagent:

- (a) 2-4 DNP (Brady reagent) (b) Tollen's reagent  
 (c) Lucas reagent (d)  $\text{NaHSO}_3$



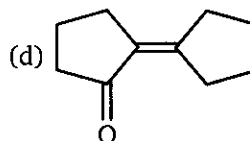
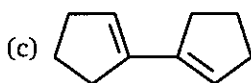
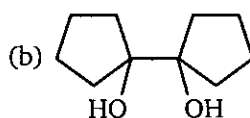
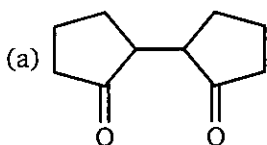
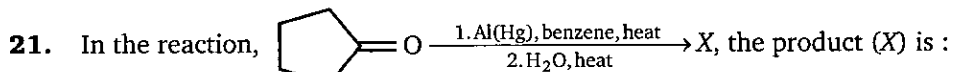
Product (D) will be :



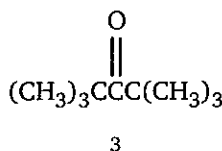
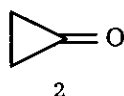
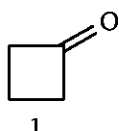


Relationship between products (Q) and (S) is:

- (a) Positional isomer (b) Chain isomer  
(c) Stereoisomer (d) Functional isomer



22. Rank the following in order of increasing value of the equilibrium constant for hydration,  $K_{\text{hyd}}$ . (smallest value first).

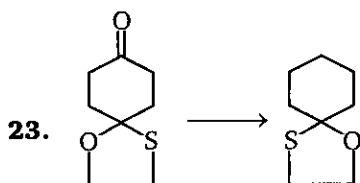


(a)  $1 < 2 < 3$

(b)  $3 < 1 < 2$

(c)  $2 < 1 < 3$

(d)  $2 < 3 < 1$



Above conversion can be achieved by:

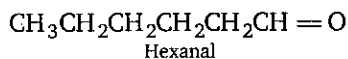
(a)  $\text{Zn}(\text{Hg}), \text{HCl}$

(b)  $\text{NH}_2-\text{NH}_2/\text{KOH}/\Delta$

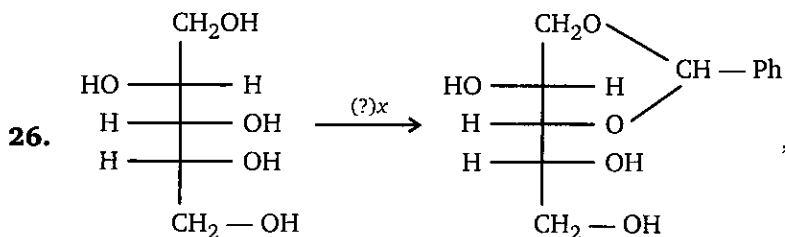
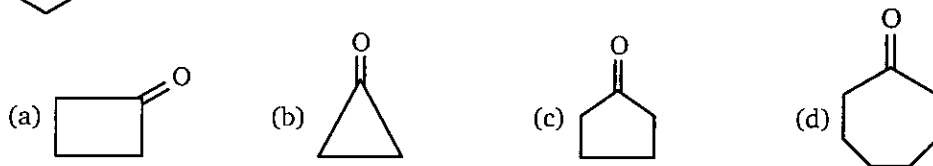
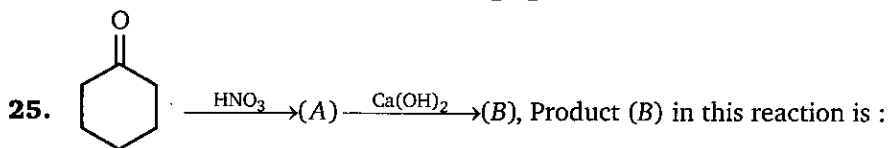
(c)  $\text{LiAlH}_4$

(d)  $\text{H}_2/\text{Ni}$

24. Which sequence represents the best synthesis of hexanal ?

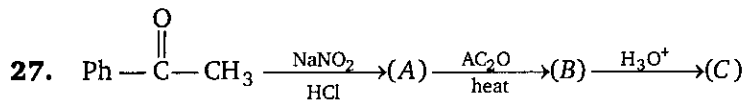


- (a) 1.  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{Br} + \text{NaC}\equiv\text{CH}$   
2.  $\text{H}_2\text{O}$ ,  $\text{H}_2\text{SO}_4$ ,  $\text{HgSO}_4$
- (b) 1.  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}=\text{CH}_2 + \text{CH}_3\overset{\text{O}}{\parallel}\text{COOH}$   
2.  $\text{CH}_3\text{MgBr}$ , diethyl ether  
3.  $\text{H}_3\text{O}^+$   
4. PCC,  $\text{CH}_2\text{Cl}_2$
- (c) 1.  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\overset{\text{O}}{\parallel}\text{CCH}_3$   
2.  $\text{CH}_3\overset{\text{O}}{\parallel}\text{COOH}$   
3.  $\text{LiAlH}_4$   
4.  $\text{H}_2\text{O}$   
5. PCC,  $\text{CH}_2\text{Cl}_2$
- (d) 1.  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{MgBr} + \text{H}_2\text{C}=\overset{\text{O}}{\text{C}}\text{CH}_3$   
2.  $\text{H}_3\text{O}^+$   
3. PCC,  $\text{CH}_2\text{Cl}_2$

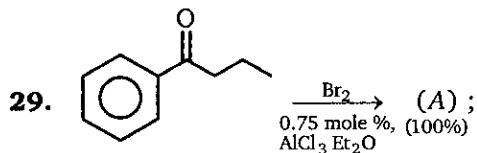
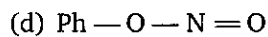
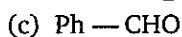
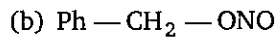
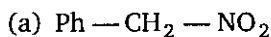
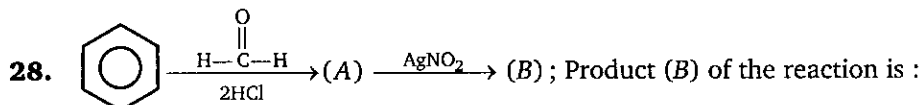
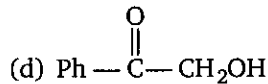
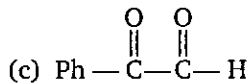
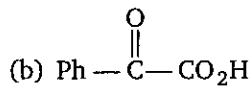
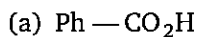


Compound (x) in the above reaction is :

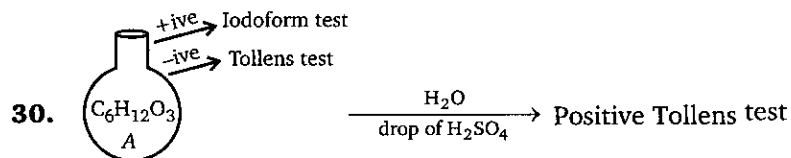
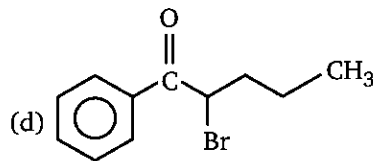
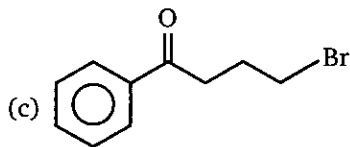
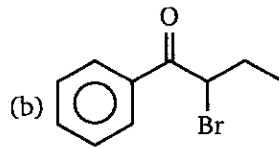
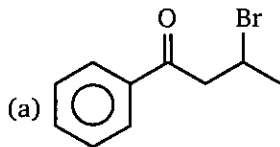
- (a)  $\text{Ph}-\overset{\text{O}}{\parallel}\text{C}-\text{CH}_3$  (b)  $\text{Ph}-\overset{\text{O}}{\parallel}\text{C}-\text{H}$
- (c)  $\text{Ph}-\text{CH}_2-\overset{\text{O}}{\parallel}\text{C}-\text{H}$  (d)  $\text{Ph}-\text{CH}_2-\overset{\text{O}}{\parallel}\text{C}-\text{CH}_3$



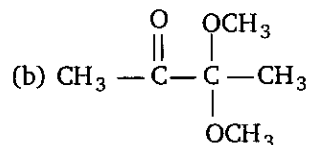
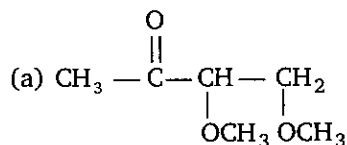
Product (C) of the above reaction is :

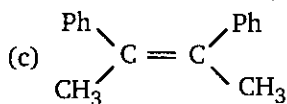
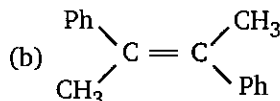
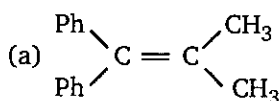
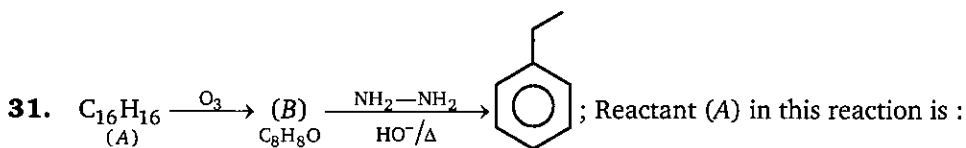
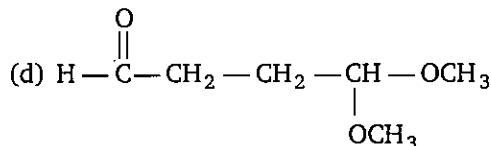
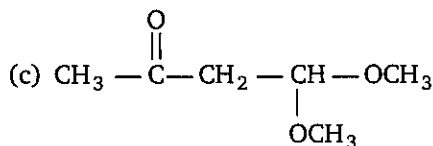


Product (A) of the above reaction is (bromination occur not in the benzene ring) :

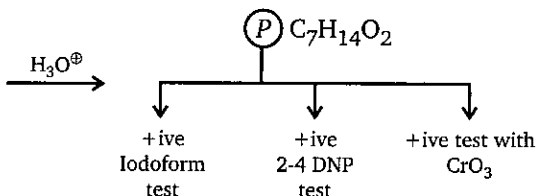
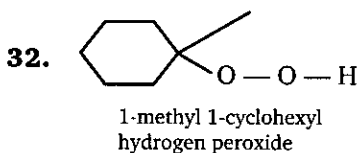


Compound (A) is :

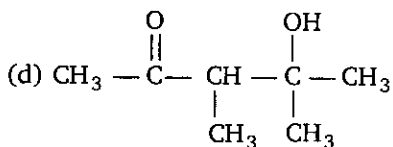
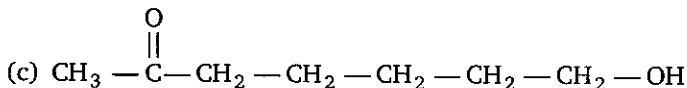
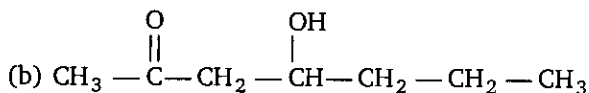
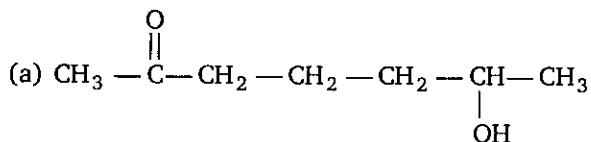




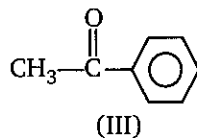
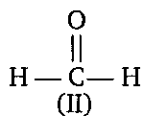
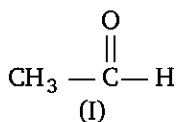
(d) both (b) and (c)



Compound (P) is :



33. Correct order of reactivity of following compounds towards Grignard reagent?

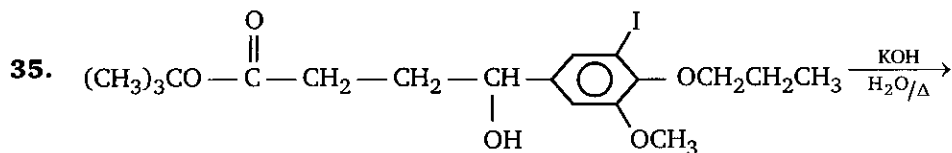
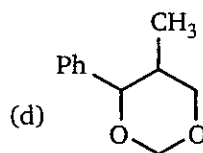
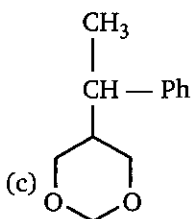
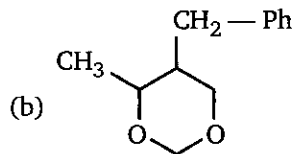
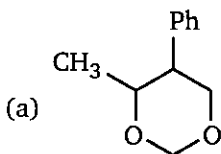
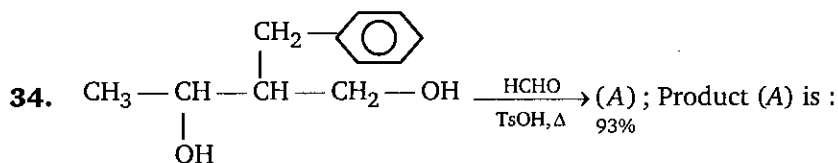


(a) I > II > III

(b) II > I > III

(c) II > III > I

(d) I > III > II



Total number of products obtained in above reaction is :

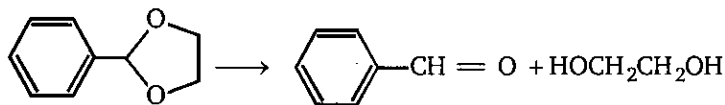
(a) 2

(b) 3

(c) 4

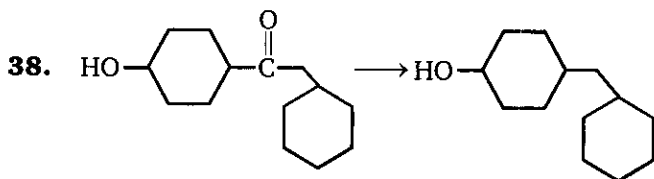
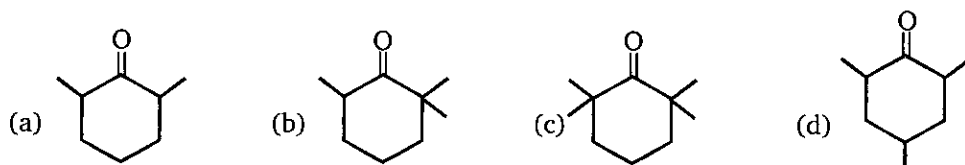
(d) 5

36. What reagent and/or reaction conditions would you choose to bring about the following conversion?



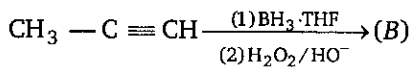
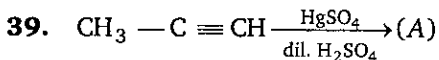
- (a) 1.  $\text{LiAlH}_4$ , 2.  $\text{H}_2\text{O}$  (b)  $\text{H}_2\text{O}$ ,  $\text{H}_2\text{SO}_4$ , heat  
(c)  $\text{H}_2\text{O}$ ,  $\text{NaOH}$ , heat (d)  $\text{PCC}$ ,  $\text{CH}_2\text{Cl}_2$

37. Product of the reaction is :



The above reduction can be best carried out by :

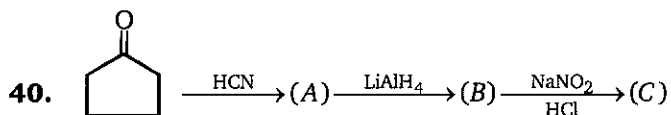
- (a) Clemmensen reduction (b) Wolff-Kishner reduction  
(c)  $\text{NaBH}_4$  (d) None of these



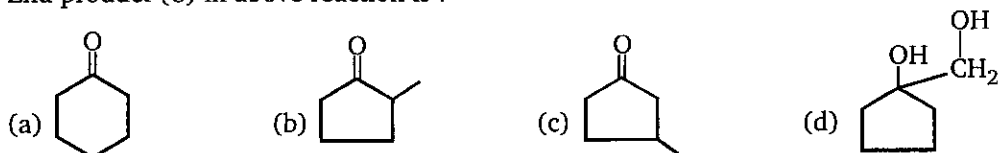
Product (A) and (B) is differentiated by:

- (a) 2-4-DNP (b)  $\text{NaOI}$  (c) Na-metal (d)  $\text{NaHSO}_3$

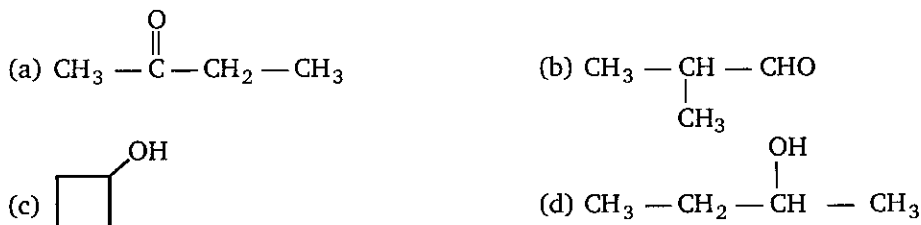




End product (C) in above reaction is :



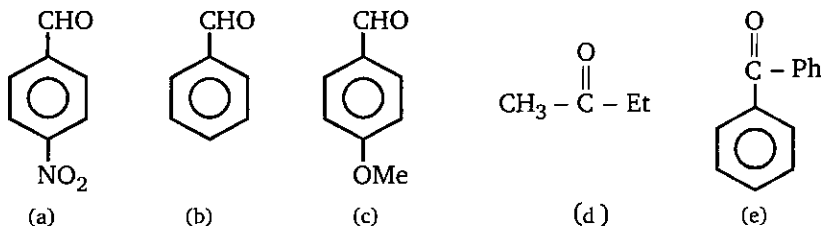
41. Compound (X)  $C_4H_8O$ , which reacts with 2, 4-DNP derivative and gives negative haloform test is :



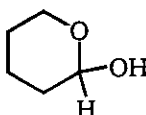
42. When a nucleophile encounters a ketone, the site of attack is :

- (a) the carbon atom of the carbonyl  
 (b) the oxygen atom of the carbonyl  
 (c) both the carbon and oxygen atoms, with equal probability  
 (d) no attack occurs as ketones do not react with nucleophiles

43. The correct order of rate of reaction toward nucleophilic addition reaction:

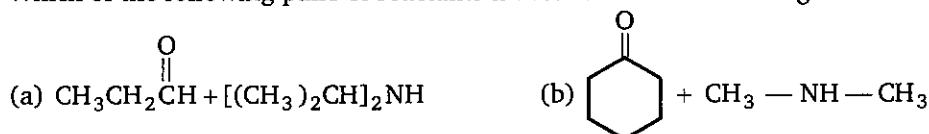


- (a)  $a > b > c > d > e$  (b)  $a > b > d > c > e$   
 (c)  $a > d > e > b > c$  (d)  $a > b > e > d > c$

44. The structure  would be best classified as a(an) :

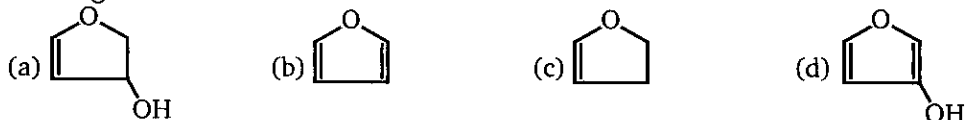
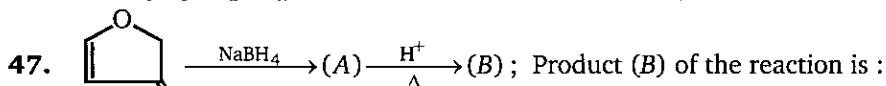
- (a) Acetal (b) Hemiacetal (c) Hydrate (d) Cyanohydrin

45. Which of the following pairs of reactants is most effective in forming an enamine ?

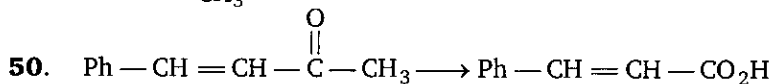
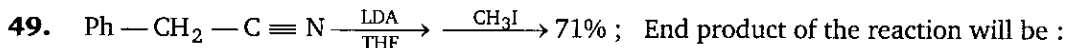
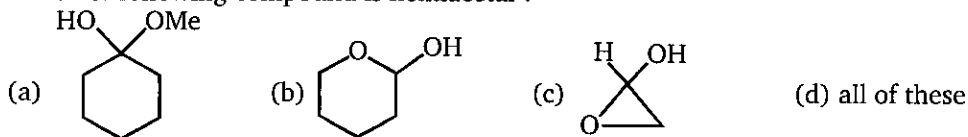




46. The reaction of  $\text{C}_6\text{H}_5\text{CH}=\text{CHCHO}$  with  $\text{LiAlH}_4$  gives :  
 (a)  $\text{C}_6\text{H}_5\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$  (b)  $\text{C}_6\text{H}_5\text{CH}=\text{CHCH}_2\text{OH}$   
 (c)  $\text{C}_6\text{H}_5\text{CH}_2\text{CH}_2\text{CHO}$  (d)  $\text{C}_6\text{H}_5\text{CH}_2\text{CHOHCH}_3$

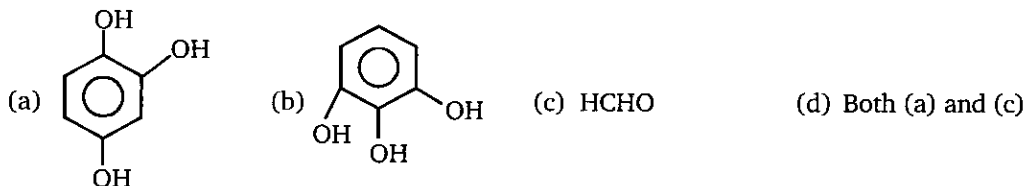
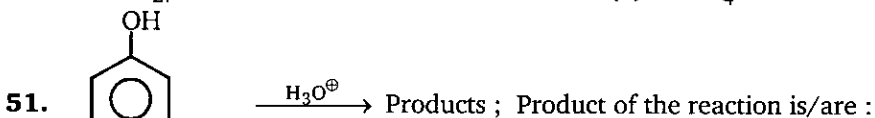


48. Which of following compound is hemiacetal ?



Above conversion can be achieved by :

- (a)  $\text{KMnO}_4, \Delta$  followed by  $\text{H}^+$  (b)  $\text{I}_2/\text{NaOH}$  followed by  $\text{H}^+$   
 (c)  $\text{H}_2/\text{Pt}$  (d)  $\text{LiAlH}_4$



52. O=C1CCCCC1  $\xrightarrow{SeO_2}$  (A); Product (A) of the reaction is:

- (a) O=C1CCCC(O)C1 (b) O=C1CCCC(=O)C1 (c) C=C1CCCCC1 (d) O=C1CCCC1

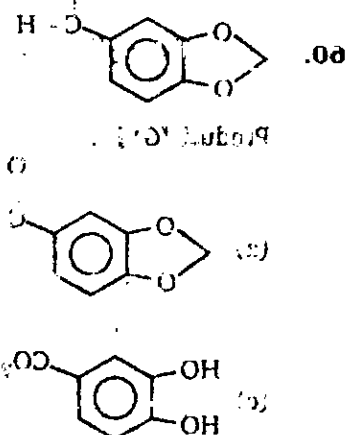
53. CC(=O)C1CCCCC1  $\xrightarrow{Br_2+NaOH}$  (A) +  $CHBr_3$  Product (C) of the reaction is:

- (a) CC(=O)C1CCCC(O)C1 (b) CC(=O)C1CCCC(=O)C1 (c) CC(=O)C1CCCC(Br)C1 (d) CC(=O)C1CCCC(Br)C1

54. CCCC1(C)OC(C)OC1  $\xrightarrow{H_3O^+}$  (A) + 2 Glycol

Product (A) of the reaction will be :

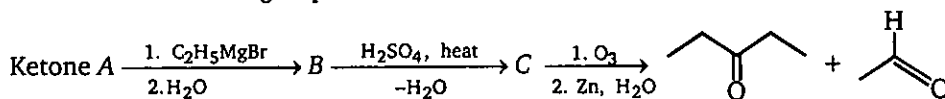
- (a) CC(=O)CC(=O)CC (b) CC(=O)CC(=O)CC (c) CC(=O)CC(=O)CC (d) CC(=O)CC(=O)CC



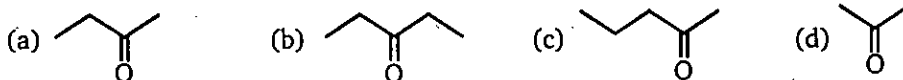
56. An aromatic compound A of the molecular formula  $C_8H_{10}O$  on reaction with iodine and dilute NaOH gives a yellow precipitate. The structure of the compound is expected to be:

- (a) CC(=O)c1ccccc1 (b) CC(O)Cc1ccccc1 (c) CC(O)c1ccccc1 (d) CC(=O)c1ccc(O)c1

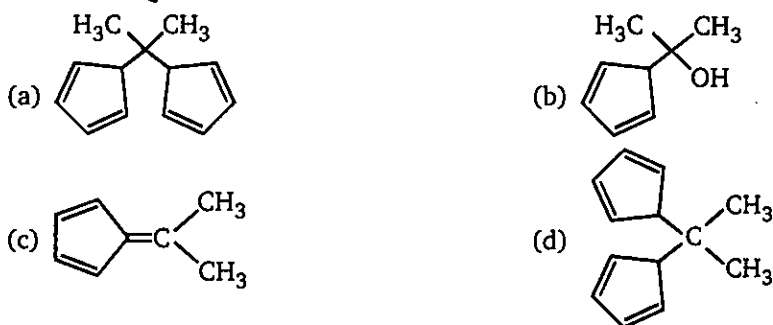
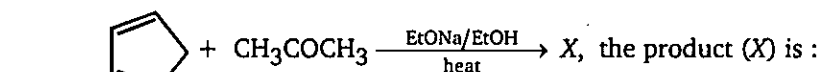
69. Consider the following sequence of reactions.



The ketone (A) is :



70. In the reaction,



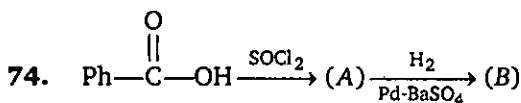
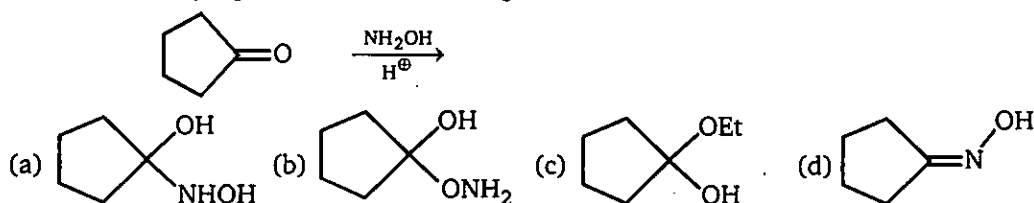
71. The conversion of acetophenone into benzoic acid can be achieved by its reaction with :

- (a) sodium hydroxide followed by acidification  
 (b) iodine and sodium hydroxide, followed by acidification  
 (c) hydroxylamine followed by reaction with  $\text{H}_2\text{SO}_4$   
 (d) *m*-chloroperoxobenzoic acid

72. In which of the following compounds the methylenic hydrogens are the most acidic ?

- (a)  $\text{CH}_3\text{COCH}_2\text{CH}_3$  (b)  $\text{CH}_3\text{CH}_2\text{COOC}_2\text{H}_5$   
 (c)  $\text{CH}_3\text{CH}_2\text{CH}(\text{COOC}_2\text{H}_5)_2$  (d)  $\text{CH}_3\text{COCH}_2\text{CN}$

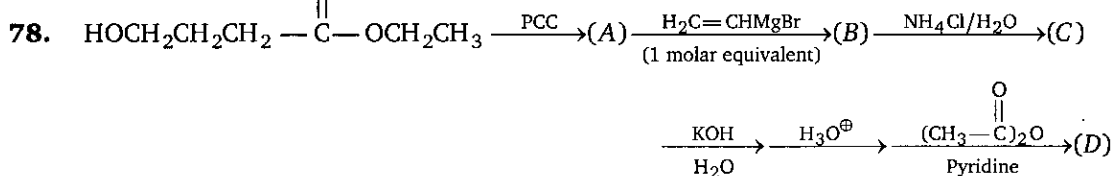
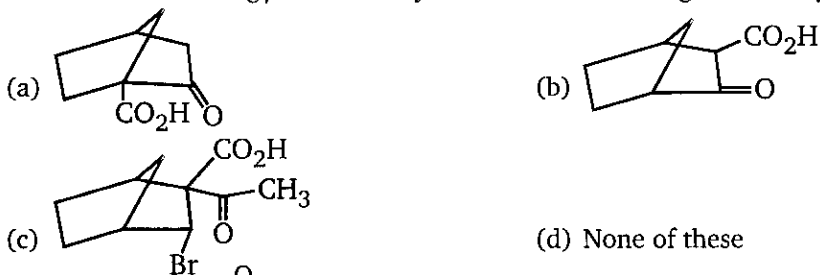
73. Which is the major product of the following reaction ?



Product (B) is :

- (a)  $\text{Ph}-\overset{\text{O}}{\parallel}{\text{C}}-\text{H}$  (b)  $\text{Ph}-\text{CH}_2-\text{OH}$   
 (c)  $\text{Ph}-\text{CH}_2-\text{Cl}$  (d)  $\text{Ph}-\text{CH}=\text{CH}_2$

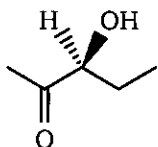
75. The presence of unsaturation in organic compounds can be tested with :  
 (a) Schiff's reagent (b) Tollens' reagent (c) Fehling's reagent (d) Baeyer's reagent  
 76. Which of the following gives iodoform test ?  
 (a)  $\text{CH}_3\text{CH}_2\text{OH}$  (b)  $\text{C}_2\text{H}_5\text{CHO}$  (c)  $(\text{CH}_2\text{OH})_2$  (d) None of these  
 77. Which of the following  $\beta$ -keto carboxylic acid does not undergo decarboxylation on heating ?



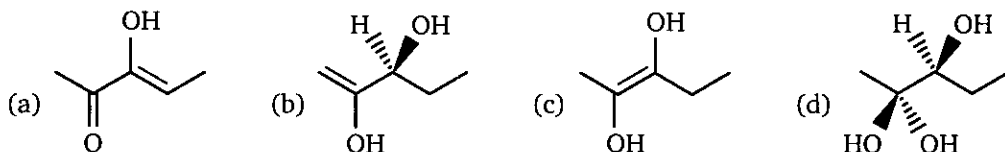
Product (D) is :

- (a)  $\text{H}_2\text{C}=\text{CH}-\overset{\text{O}-\overset{\text{O}}{\parallel}{\text{C}}-\text{CH}_3}{\text{CH}}-\text{CH}_2-\text{CH}_2-\overset{\text{O}}{\parallel}{\text{C}}-\text{OH}$
- (b)  $\text{H}_2\text{C}=\text{CH}-\text{CH}_2-\overset{\text{OH}}{\underset{\text{OH}}{\text{C}}}-\text{CO}_2\text{H}$
- (c)  $\text{H}_2\text{C}=\text{CH}-\overset{\text{OH}}{\underset{\text{OH}}{\text{C}}}-\text{CH}_2-\text{CH}_2-\overset{\text{O}}{\parallel}{\text{C}}-\text{O}-\overset{\text{O}}{\parallel}{\text{C}}-\text{CH}_3$
- (d)  $\text{H}_2\text{C}=\text{CH}-\text{CH}_2-\overset{\text{OH}}{\underset{\text{OH}}{\text{CH}}}-\text{CH}_2-\overset{\text{O}}{\parallel}{\text{C}}-\text{O}-\text{H}$

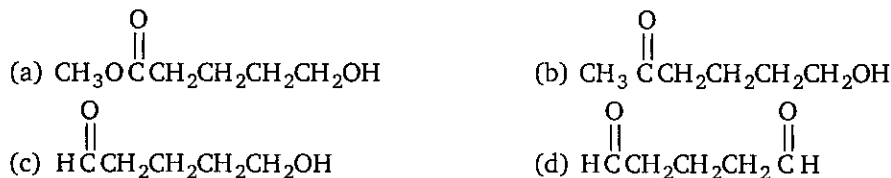
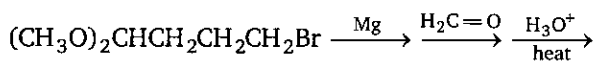
79. The compound shown in the below undergoes racemization on reaction with aqueous acid.



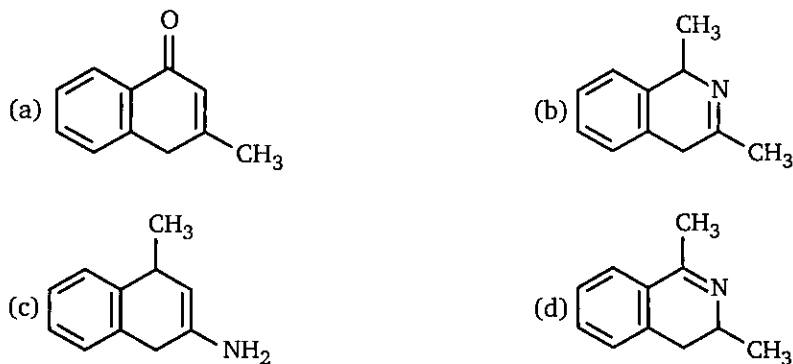
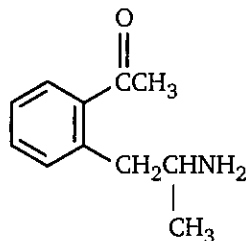
Which of the following structures best represents the intermediate responsible for this process?



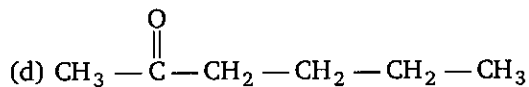
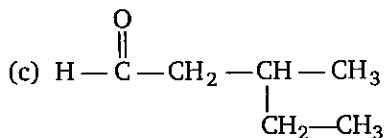
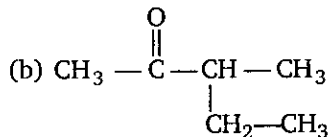
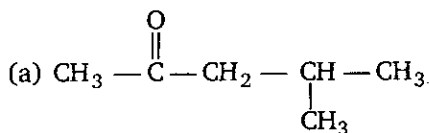
80. The final product of the following sequence of reaction is :



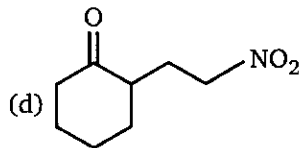
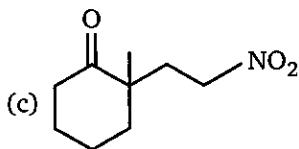
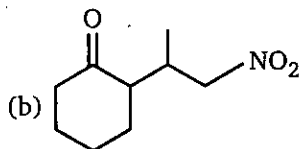
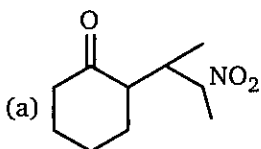
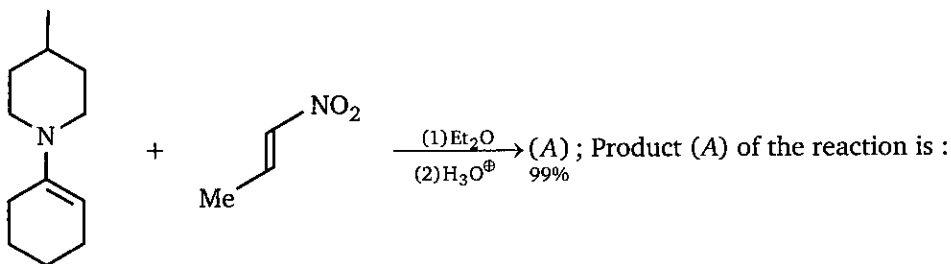
81. The amino ketone shown below undergoes a spontaneous cyclization on standing. What is the major product of this intramolecular reaction ?



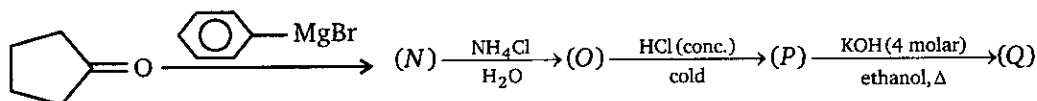
82. Compound (A)  $C_6H_{12}O$  is optically active. Compound (A) give negative Tollens test and positive test with 2-4-di-nitro phenyl hydrazine. Identify A.



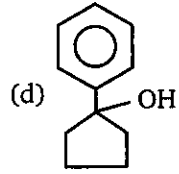
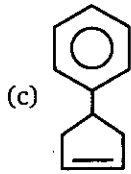
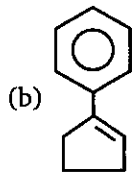
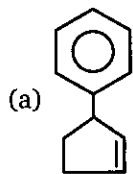
83.



84.

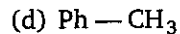
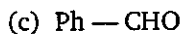
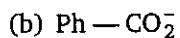
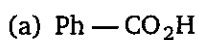


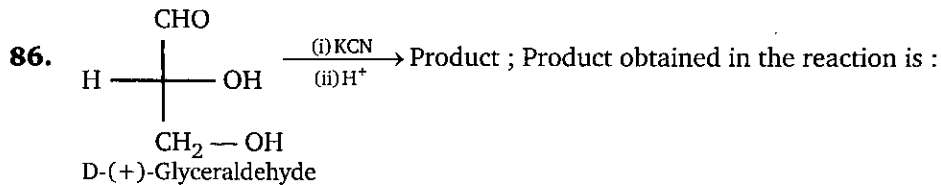
Product (Q) will be :



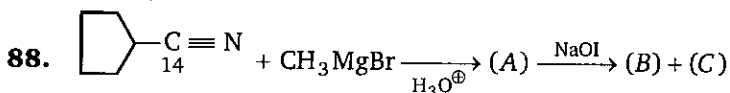
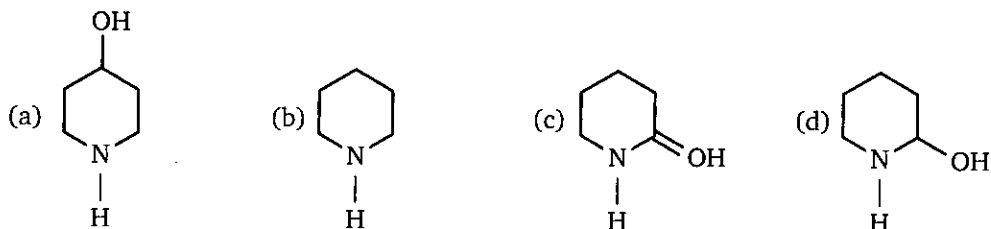
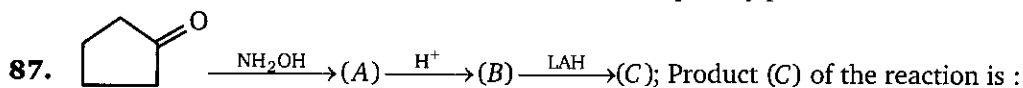
85.  $Ph - CH_3 \xrightarrow{CrO_2Cl_2} (A) \xrightarrow{conc. KOH} Ph - CH_2OH + (B)$

Product (B) of above the reaction is :

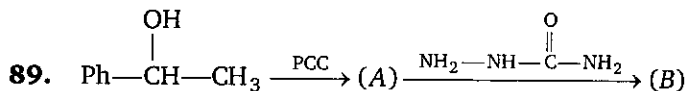
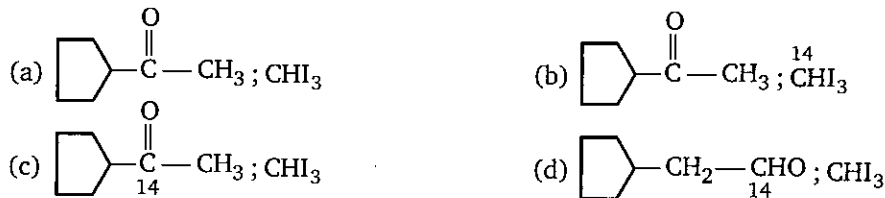




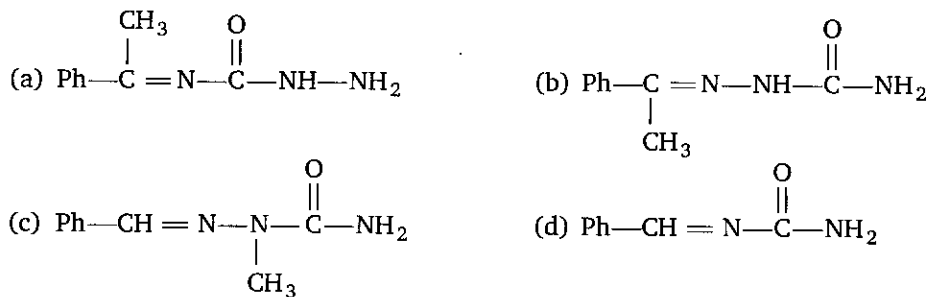
- (a) Diastereomer (b) Racemic  
 (c) Meso (d) Optically pure enantiomer



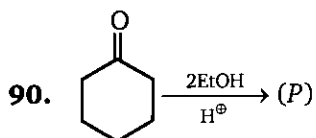
Product (A) and (C) is :



Product (B) is :

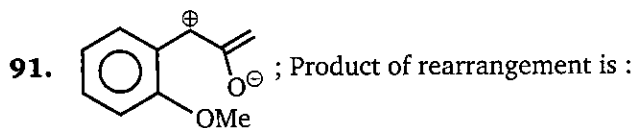




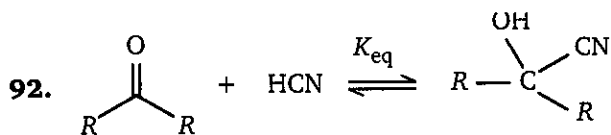
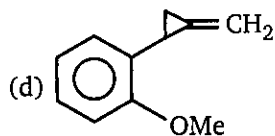
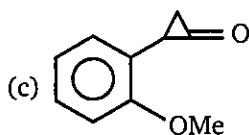
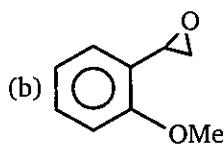
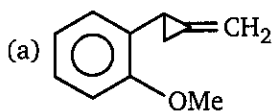


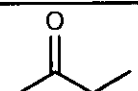
Product (P) is :

- (a) Hemiacetal      (b) Acetal      (c) Alcohol      (d) Alkane



(Oxyallyl cation)

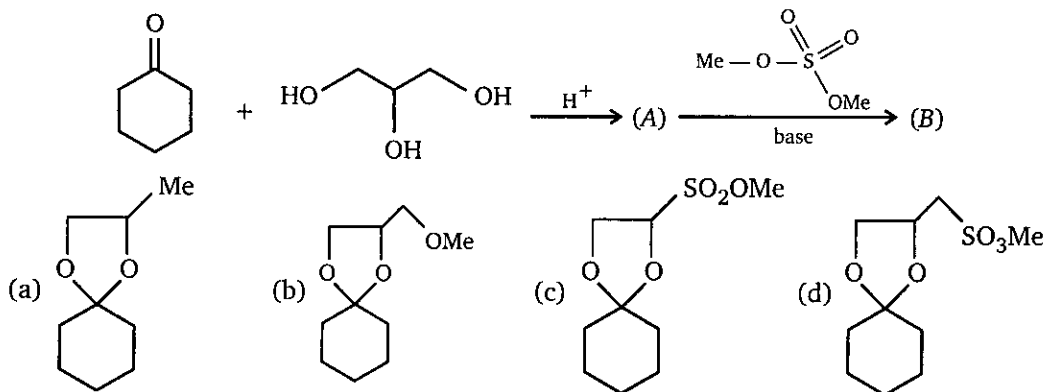


Reactant	$K_{\text{eq}}$
PhCHO	a
	b
Ph-C(=O)-CH <sub>3</sub>	c
CH <sub>3</sub> -C(=O)-H	d

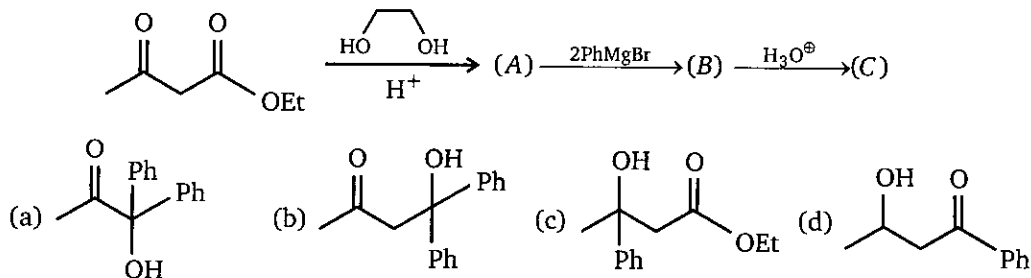
The correct order of decreasing value of  $K_{\text{eq}}$  is :

- (a)  $a > b > c > d$       (b)  $d > a > b > c$   
 (c)  $d > b > a > c$       (d)  $d > a > c > d$

93. Product (B) of the given reaction is :

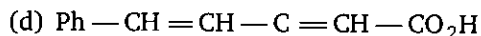
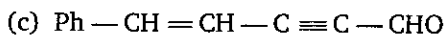
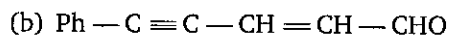
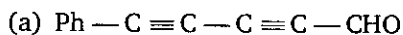


94. End product (C) of the reaction is :

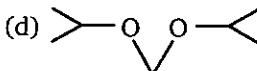
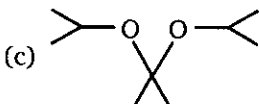
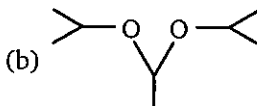
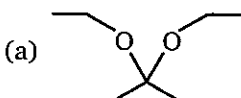


95. (A)  $\xrightarrow{\text{O}_3}$  does not undergo self aldol condensation  
 $\xrightarrow{\text{O}_3}$  Ph-CHO + 2b  $\xrightarrow{\text{Ag}^+}$  oxalic acid

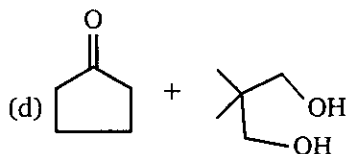
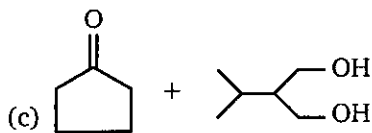
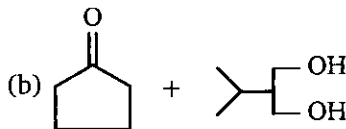
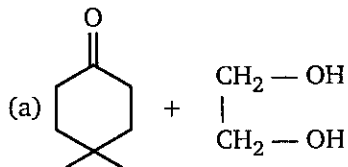
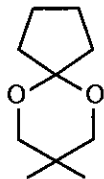
Compound (A) will be :

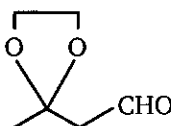


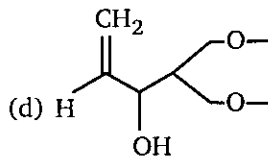
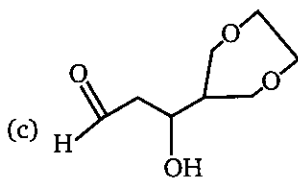
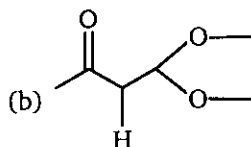
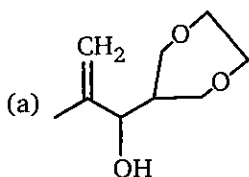
96. Product ; Product of the reaction is :




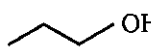
97. Which pair of reactants compounds may be used to make given acetal ?



98.   $\xrightarrow{\text{H}^{\oplus}}$  (B); (A) & (B) are isomers; Isomer (B) is :



99.   $\xrightarrow{\text{PCC}}$  (A)

  $\xrightarrow{\text{PCC}}$  (B)

(A) and (B) is differentiated by :

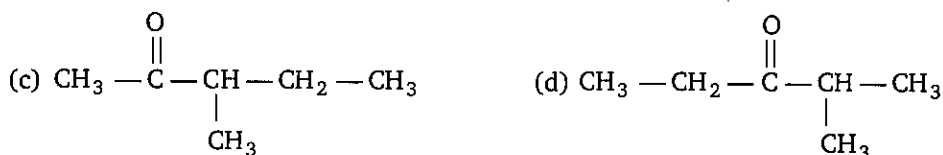
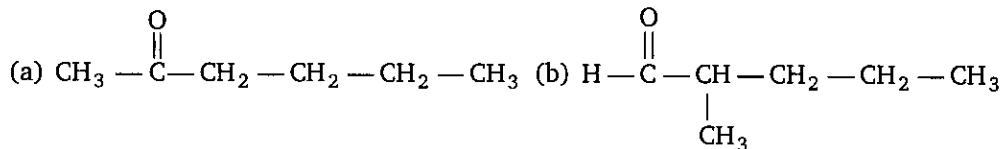
(a) NaH

(b) 2-4 DNA

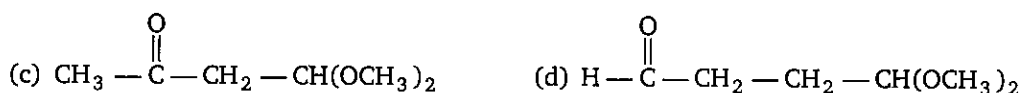
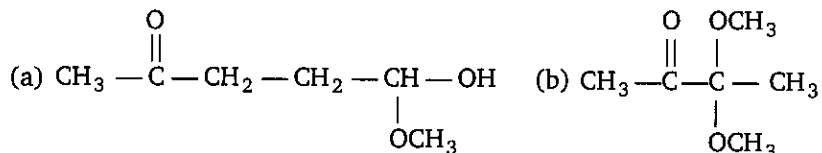
(c) Tollen's reagent

(d) NaHSO<sub>3</sub>

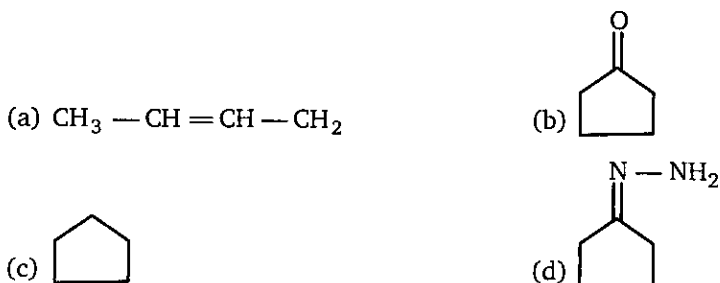
100. Which of the following pairs cannot be differentiated by Tollens' reagent ?  
 (a) Benzaldehyde and benzyl alcohol      (b) Hexanal and 2-hexanone  
 (c) 2-Hexanol and 2-hexanone      (d) Pentanal and diethyl ether
101. An optically active compound  $C_6H_{12}O$  gives positive test with 2, 4-dinitrophenyl hydrazine, but negative with Tollens' reagent, what is the structure of the compound ?



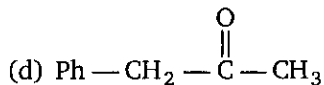
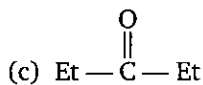
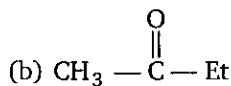
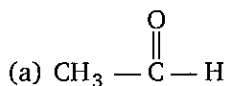
102. Compound (A)  $C_6H_{12}O_3$ , when treated with  $I_2$  in aqueous sodium hydroxide gives yellow precipitate. When A is treated with Tollens reagent no reaction occur. When A is hydrolysed and then treated with Tollens reagent, a silver mirror is formed in test tube. Compound (A) will be :

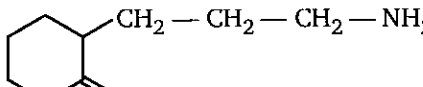


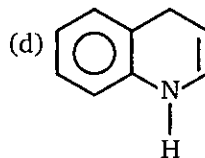
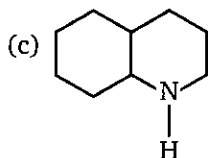
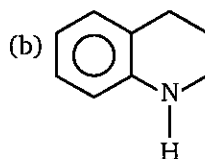
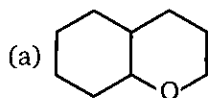
103.  $\begin{array}{c} CH_2 - CH_2 - CO_2H \\ | \\ CH_2 - CH_2 - CO_2H \end{array} \xrightarrow[BaCO_3]{\Delta} A \xrightarrow{NH_2-NH_2} B \xrightarrow[KOH]{heat} (C)$ , Product (C) obtained is :

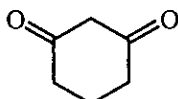


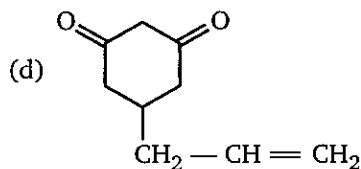
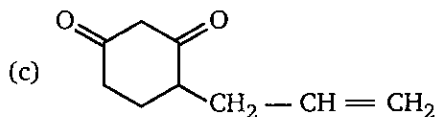
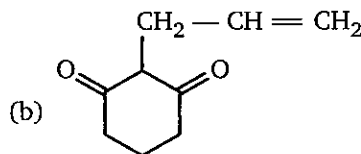
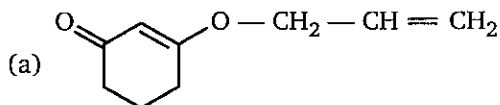
104. Which of following does not react with  $\text{NaHSO}_3$  (sodium bisulphite)?

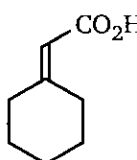


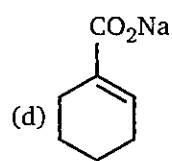
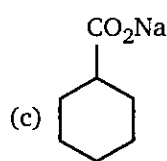
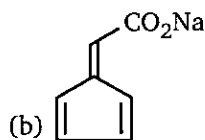
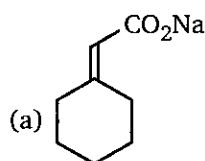
105.   $\xrightarrow[\text{Raney Ni}]{\text{H}_2}$  (A); Product (A) is :

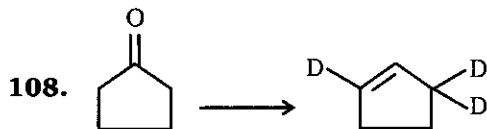


106.  +  $\text{CH}_2 = \text{CH} - \text{CH}_2 - \text{Br} \xrightarrow[\text{(75\%)}]{\text{KOH}}$  (A); Product (A) is :



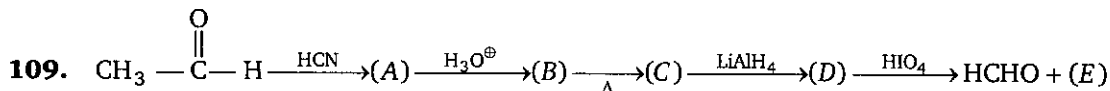
107.   $\xrightarrow[\text{(2)HCl/H}_2\text{O}]{\text{(1)Me-Li(excess)}} (A) \xrightarrow[\text{NaOH}]{\text{I}_2}$  (B) +  $\text{CHI}_3$ ; Product (B) in this reaction is :





Arrange the following reagent in the correct order in which above transformation is carried out :

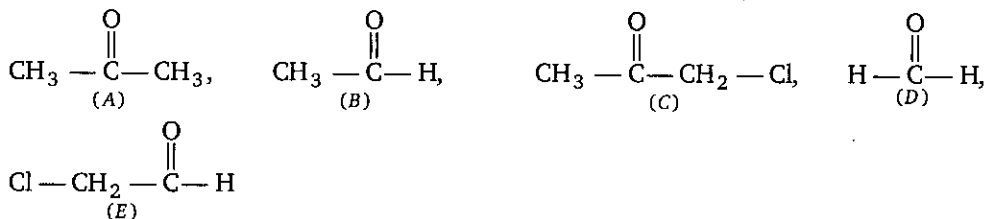
- (a)  $\text{KOD}/\text{D}_2\text{O}, \text{H}^+/\Delta, \text{LiAlH}_4$  (b)  $\text{H}^+/\Delta, \text{KOD}/\text{D}_2\text{O}, \text{LiAlH}_4$   
 (c)  $\text{KOD}/\text{D}_2\text{O}, \text{LiAlH}_4, \text{H}^+/\Delta$  (d)  $\text{LiAlH}_4, \text{H}^+/\Delta, \text{KOD}/\text{D}_2\text{O}$



Compound (C) can show geometrical isomerism. Product (E) of the reaction will be :

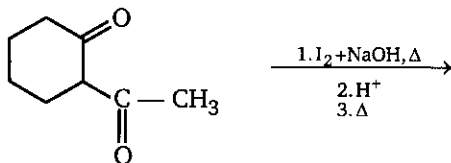
- (a)  $\text{CH}_3 - \overset{\text{O}}{\parallel}{\text{C}} - \text{CH}_3$  (b)  $\text{CH}_3 - \text{CH}_2 - \overset{\text{O}}{\parallel}{\text{C}} - \text{H}$   
 (c)  $\text{CH}_3 - \text{CHO}$  (d)  $\text{HCHO}$

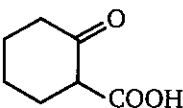
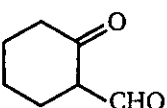
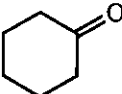
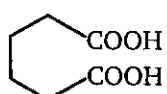
110. Arrange in their increasing order of equilibrium constants for hydration ?

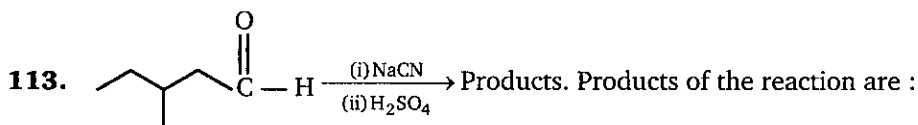
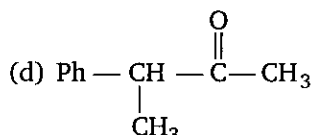
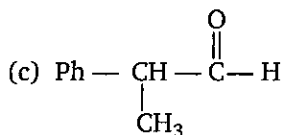
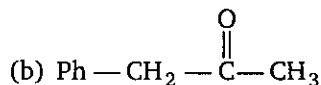
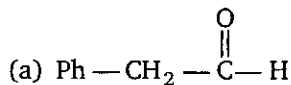
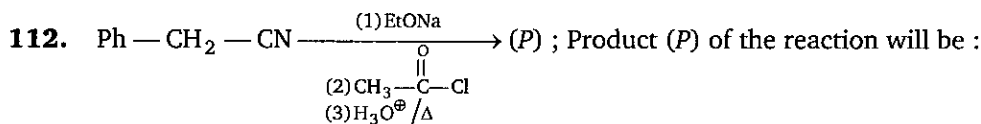


- (a)  $A < B < C < D < E$  (b)  $A < C < B < E < D$   
 (c)  $A < C < E < B < D$  (d)  $C < A < B < E < D$

111. End products of the following sequence of reactions are :



- (a) yellow ppt. of  $\text{CHI}_3$ ,  (b) yellow ppt. of  $\text{CHI}_3$ ,   
 (c) yellow ppt. of  $\text{CHI}_3$ ,  (d) yellow ppt. of  $\text{CHI}_3$ , 

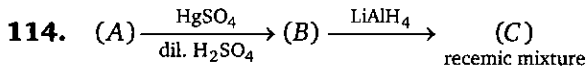


(a) Racemic mixture

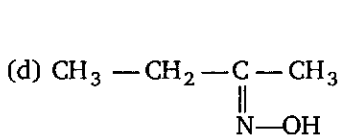
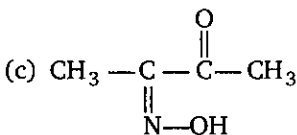
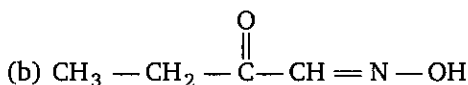
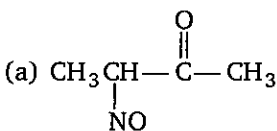
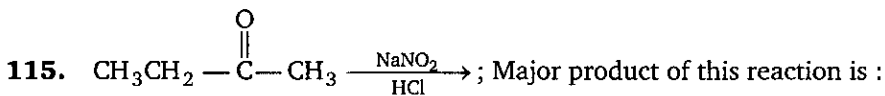
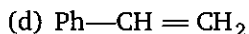
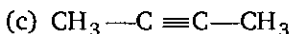
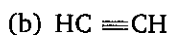
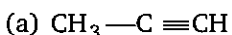
(b) Diastereomers

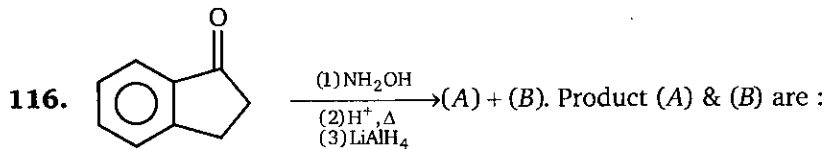
(c) Meso

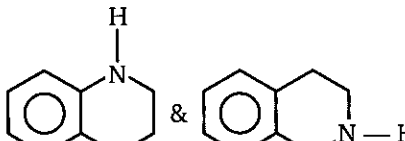
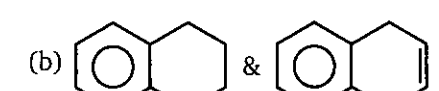
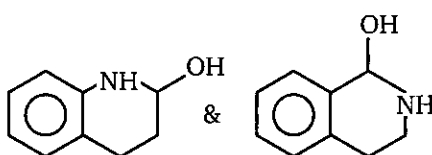
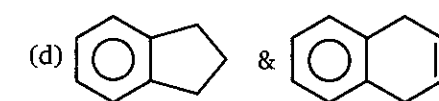
(d) Mixture of meso compound and optically active compound

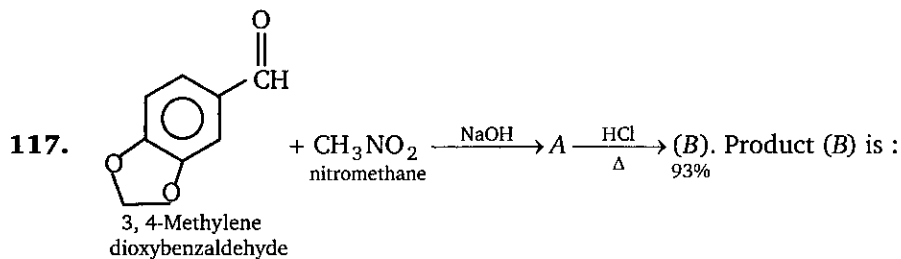


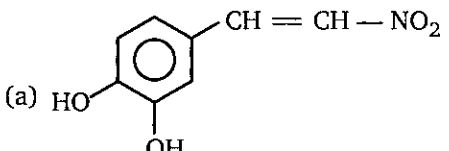
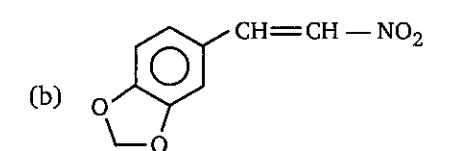
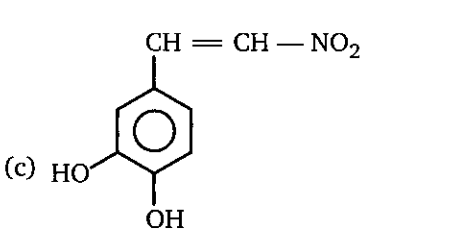
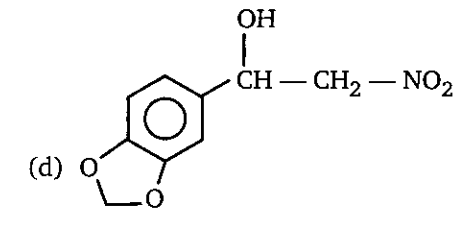
∴ reactant (A) is :

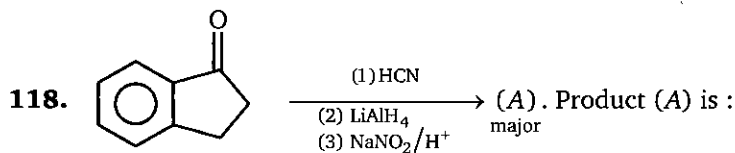


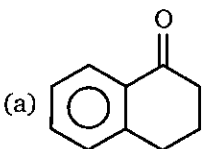
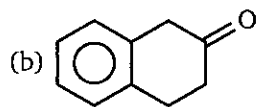
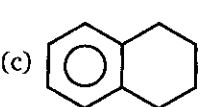
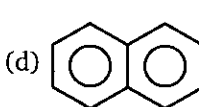


- (a)  & (b) 
- (c)  & (d) 

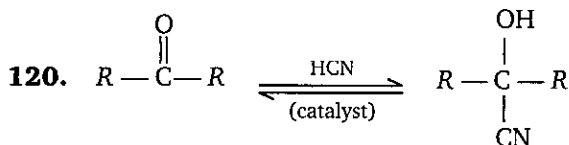
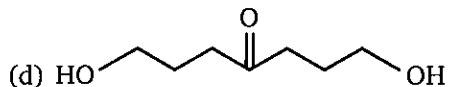
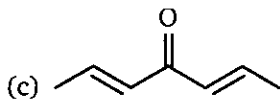
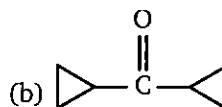
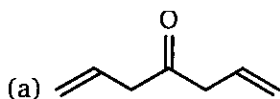
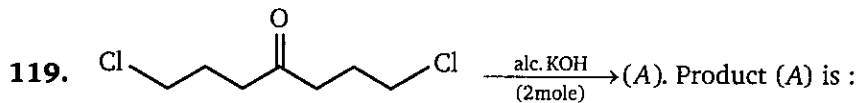


- (a)  (b) 
- (c)  (d) 

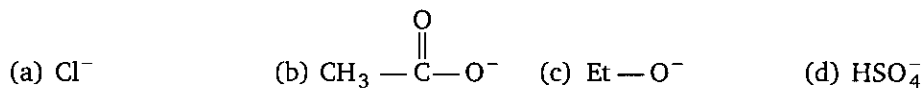


- (a)  (b)  (c)  (d) 

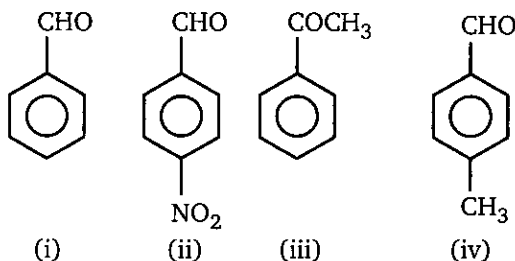




Which of following can be used as a catalyst in the above reaction?

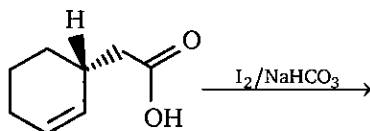


121. Arrange the following carbonyl compounds in decreasing order of their reactivity in nucleophilic addition reaction.

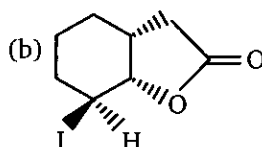
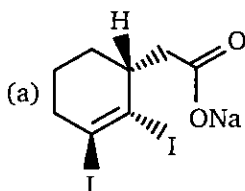


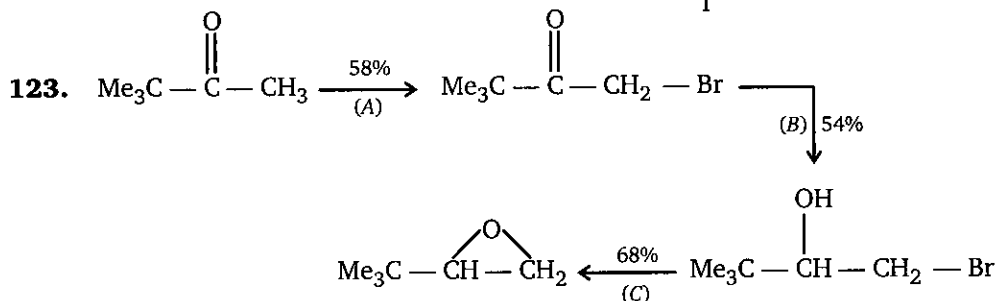
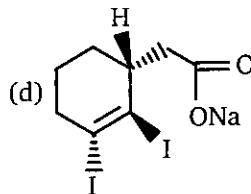
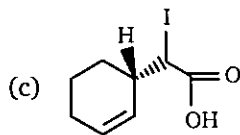
- (a) ii > iii > i > iv      (b) ii > i > iv > iii  
(c) iii > ii > i > iv      (d) iii > i > iv > ii

122. The following reaction were carried out.



The final product formed in the above reaction sequence is :



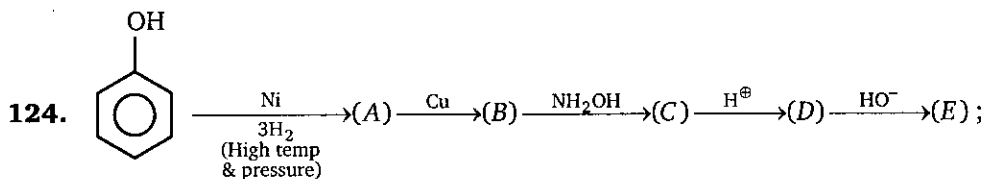


A. Yield of each step as actually carried out in the laboratory is given above. What is overall yield of reaction?

- (a) 42% (b) 31%  
(c) 21% (d) 60%

B. What is the appropriate reagent to carry out above synthesis, i. e., A, B, C respectively are :

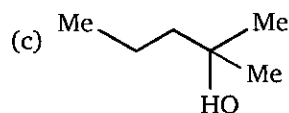
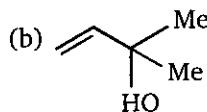
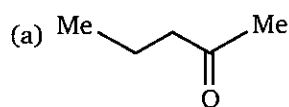
- (a)  $\text{Br}_2/\text{H}^+$ ,  $\text{LiAlH}_4$ ,  $\text{H}^\oplus$  (b)  $\text{Br}_2/\text{H}^+$ ,  $\text{NaBH}_4$ ,  $\text{HO}^-$   
(c)  $\text{NBS}$ ,  $\text{AlCl}_3$ ,  $\text{HO}^-$  (d)  $\text{Br}_2/\text{HO}^-$ ,  $\text{BF}_3$ ,  $\text{HO}^-$



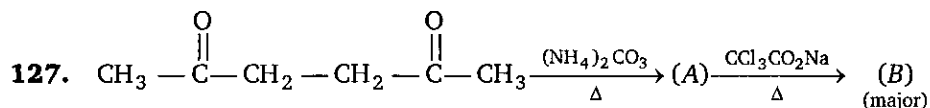
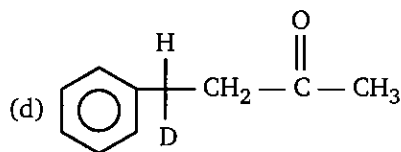
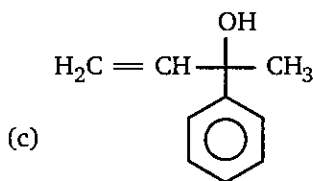
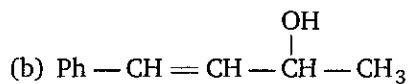
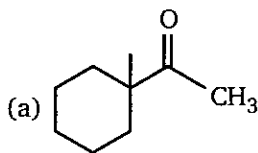
Product (E) is :

- (a) Nylon 66 (b) Nylon 6 (c) Styrene (d) Polystyrene

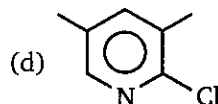
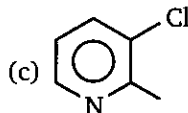
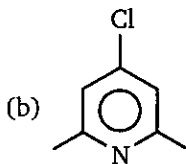
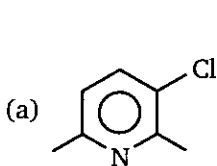
125. Methyl vinyl ketone on reaction with  $\text{LiCuMe}_2$  gives a major product, whose structure is :



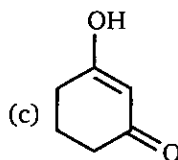
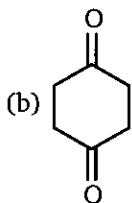
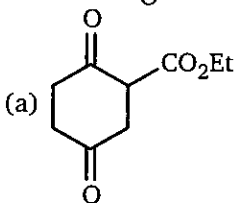
126. Which of following is in capable to show iodoform test ?



Product (B) of above reaction is :



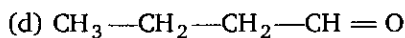
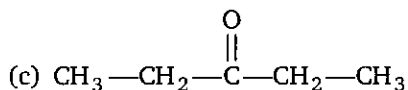
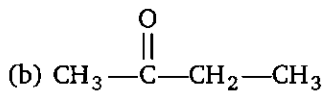
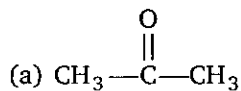
128.  $\xrightarrow[\Delta]{\text{H}_3\text{O}^+} \text{A}$  ; Product obtained is :

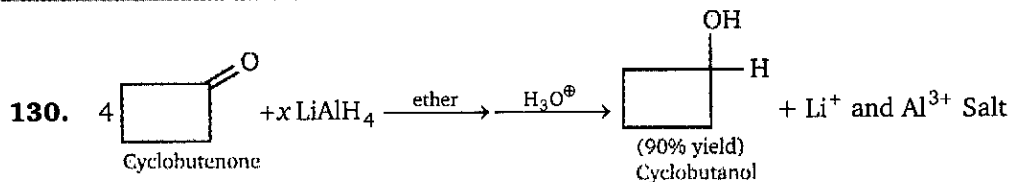


(d) None of these

129. (A)  $\xrightarrow{\text{LiAlH}_4} (\text{B}) \xrightarrow[\Delta]{\text{H}^\oplus} \text{Diastereomers}$   
Symmetrical  
Ketone

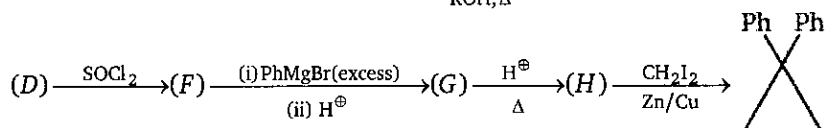
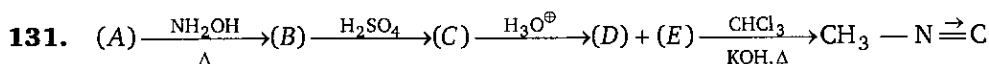
Reactant (A) is :





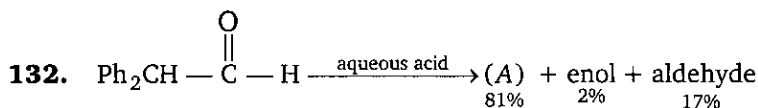
Value of  $x$  in above reaction is :

- (a) 1 (b) 2 (c) 3 (d) 4



Molecular weight of compound (A) is :

- (a) 58 (b) 120  
(c) 60 (d) 182

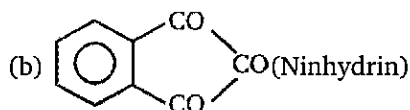


Product (A) of above reaction will be :

- (a)  $\text{Ph} - \overset{\text{O}}{\parallel}{\text{C}} = \text{CH} - \text{O}$   
|  
Ph
- (b)  $\text{Ph}_2\text{CH} - \overset{\text{OH}}{\text{CH}_2}$
- (c)  $\text{Ph}_2\text{CH} - \overset{\text{OH}}{\text{CH}} - \text{OH}$
- (d)  $\text{Ph}_2\text{CH} - \overset{\text{O}}{\parallel}{\text{C}} - \text{CH}_3$

133. Which of the following will form stable hydrate ?

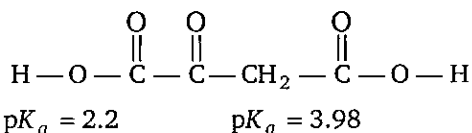
- (a)  $\text{CCl}_3\text{CHO}$  (Chloral)



- (c)  $(\text{CF}_3)_2\text{CO}$

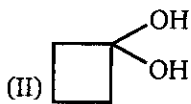
- (d) All of these

134. The pH at which maximum hydrate is present in an solution of oxaloacetic acid:



- (a) pH = 0 (b) pH = 12  
(c) pH = 4 (d) pH = 6

135. Arrange their stabilities of given gem-diols in decreasing order.



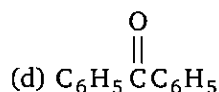
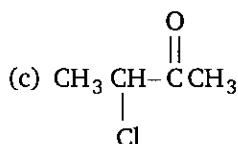
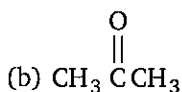
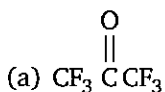
(a) I > II > III

(b) III > II > I

(c) I > III > II

(d) III > I > II

136. Maximum hydration takes place of :



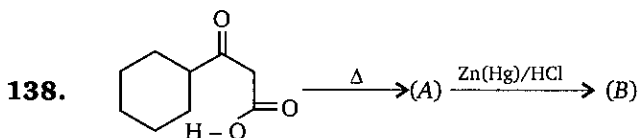
137. The conversion,  $\text{PhCN} \rightarrow \text{PhCOCH}_3$ , can be achieved most conveniently by reaction with:

(a)  $\text{CH}_3\text{MgBr}$  followed by hydrolysis

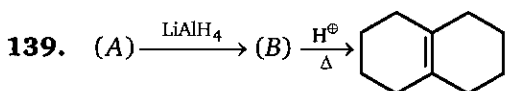
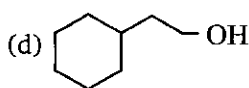
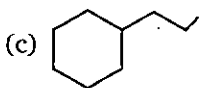
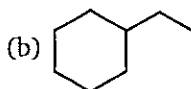
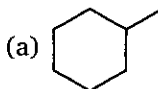
(b)  $\text{I}_2 - \text{NaOH}$ ,  $\text{CH}_3\text{I}$

(c) dil.  $\text{H}_2\text{SO}_4$  followed by reaction with  $\text{CH}_2\text{N}_2$

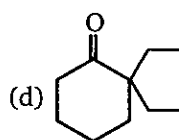
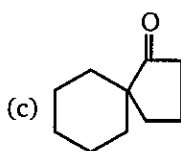
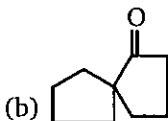
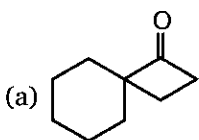
(d) LAH followed by reaction with  $\text{CH}_3\text{I}$

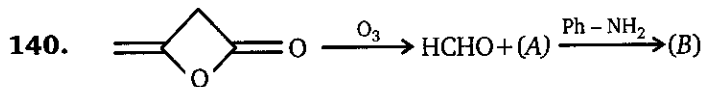


In the above reaction, product (B) is:

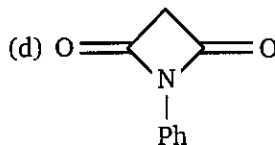
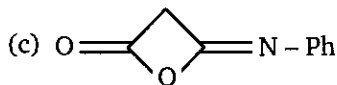
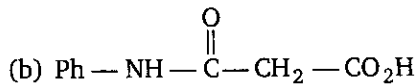
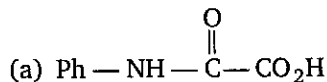


Structure of A is :

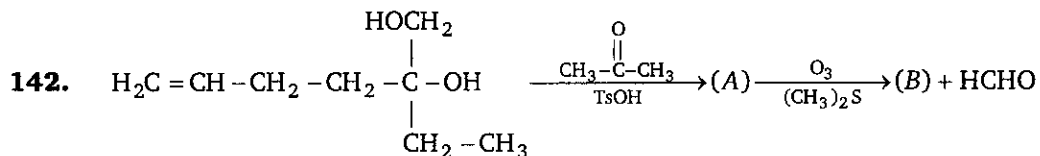
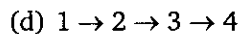
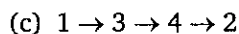
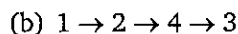
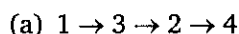
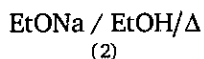




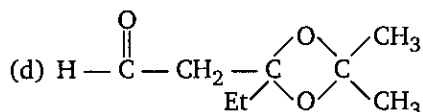
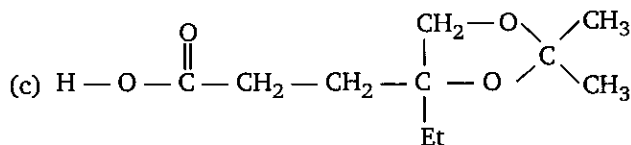
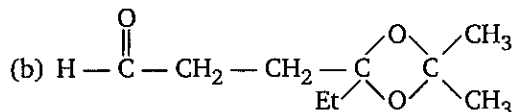
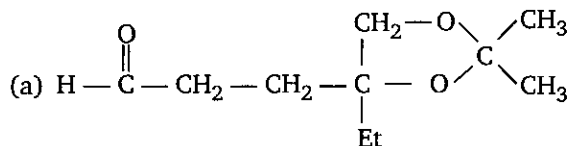
Product (B) is :

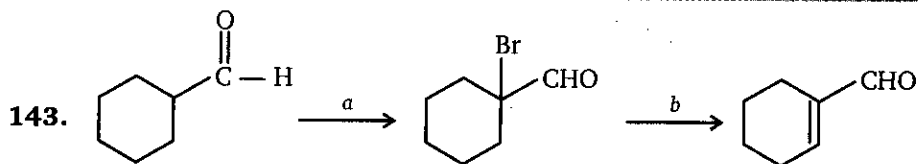


To carry out above conversion, arrange the following reagents in correct order.



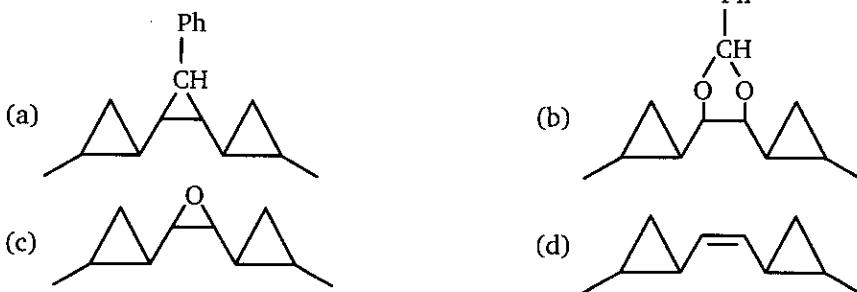
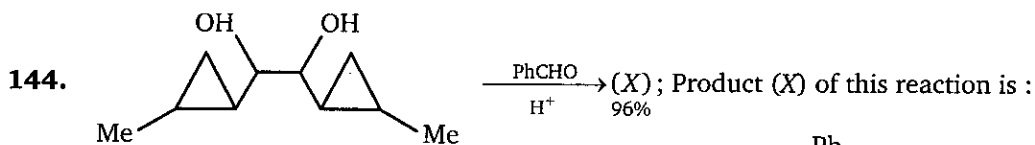
Product (B) is:



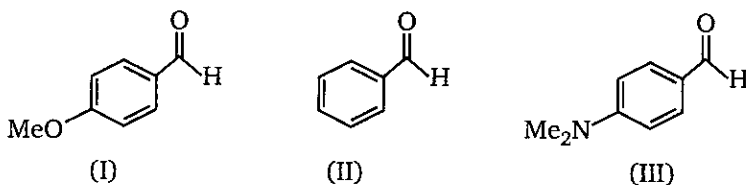


Identify appropriate reagents for the above reaction:

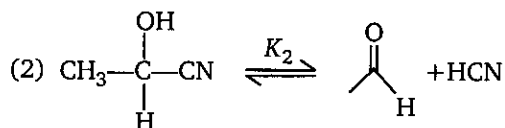
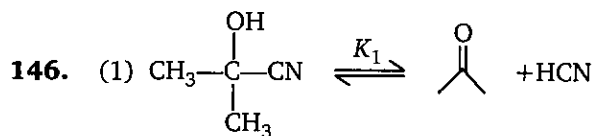
- (a)  $a = \text{Br}_2/\text{CCl}_4$ ,  $b = \text{aq. KOH}$   
 (b)  $a = \text{Br}_2/\text{H}^+$ ,  $b = \text{aq. KOH}$   
 (c)  $a = \text{Br}_2/\text{H}^+$ ,  $b = \text{alc. KOH}$   
 (d)  $a = \text{Br}_2/\text{HO}^-$ ,  $b = \text{aq. KOH}$



145. The  $K_{\text{eq}}$  values in HCN addition to following aldehydes are in the order :



- (a)  $\text{I} > \text{II} > \text{III}$       (b)  $\text{II} > \text{III} > \text{I}$       (c)  $\text{III} > \text{I} > \text{II}$       (d)  $\text{II} > \text{I} > \text{III}$



relation between  $K_1$  and  $K_2$  is :

- (a)  $K_1 = K_2$       (b)  $K_1 > K_2$       (c)  $K_2 > K_1$       (d)  $K_1 = K_2 = 1$

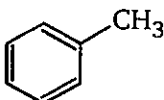
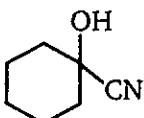
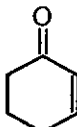
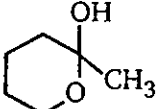
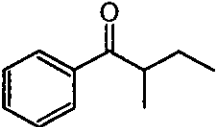
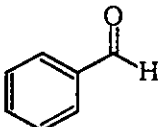
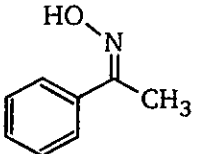






1. Select the best choice for example (A to L) from the examples (a to n) given below. Write your choice in the box given.

<b>A.</b>	An acetal derivative of a ketone.	
<b>B.</b>	A chiral ketone.	
<b>C.</b>	An aldehyde that gives a aldol condensation with itself.	
<b>D.</b>	An oxime derivative	
<b>E.</b>	A reagent that reduces aldehydes to 1°- alcohols.	
<b>F.</b>	An $\alpha$ , $\beta$ -unsaturated ketone.	
<b>G.</b>	A reagent that oxidizes aldehydes to carboxylic acids.	
<b>H.</b>	A reagent that reduces ketones to alkanes.	
<b>I.</b>	An enamine derivative of a ketone.	
<b>J.</b>	An intermediate in imine formation.	
<b>K.</b>	A cyclic hemiacetal.	
<b>L.</b>	A cyanohydrin derivative.	

(a)		(b)		(c)	
(d)	$\begin{array}{c} \text{OH} \\   \\ \text{R}-\text{C}-\text{NHR}' \\   \\ \text{H} \end{array}$	(e)		(f)	$\text{Zn(Hg)H}_3\text{O}^{(+)}$
(g)		(h)	$\text{NaBH}_4$ aq. alcohol	(i)	
(j)	$\text{Ag(NH}_3)_2^{(+)}\text{OH}^{(-)}$	(k)		(l)	$\begin{array}{c} \text{OCH}_3 \\   \\ \text{CH}_3-\text{C}-\text{OCH}_3 \\   \\ \text{CH}_3 \end{array}$

(m)		(n)	$\text{CH}_3-\text{CH}_2-\text{C} \begin{matrix} \text{=O} \\ \text{H} \end{matrix}$
-----	--	-----	--

2. The following questions refer to the compounds (A to G) shown below :

i.	Which compounds are reduced by sodium borohydride ?	ii.	Which compounds are hydrolyzed by hot aqueous acid ?	iii.	Which compound are oxidized by $\text{CrO}_3/\text{pyridine}$ ?
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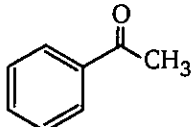
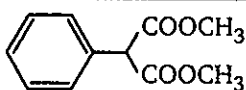
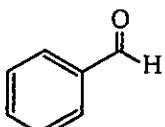
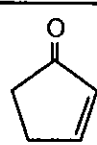
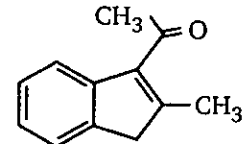
A	E	A	E	A	E
B	F	B	F	B	F
C	G	C	G	C	G
D	H	D	H	D	H

A.		B.		C.		D.	
E.		F.		G.		H.	

3. Match the column:

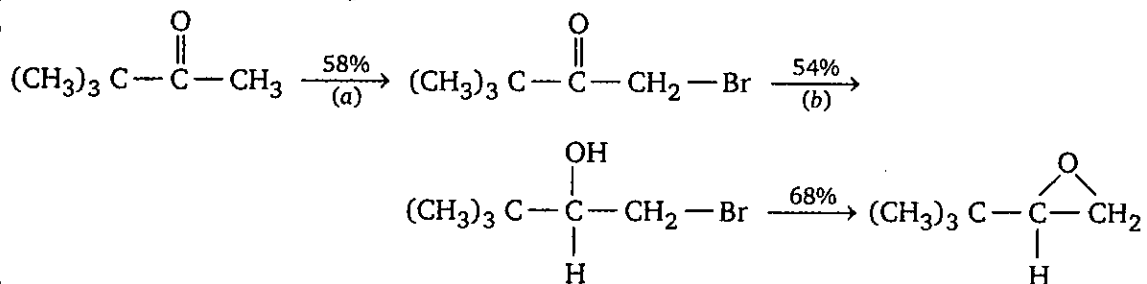
Column (I)		Column (II)	
(a)		(p)	racemic mixture
(b)		(q)	Diastereomers
(c)	$\text{Ph}-\text{CH}_2-\text{Cl} \xrightarrow{\text{KCN}}$	(r)	Nu-addition reaction
(d)		(s)	Nu-Substitutions reaction

## 4. Complete the following table.

	REACTANT	REAGENT(S)/ CONDITIONS	MAJOR ORGANIC PRODUCTS
a.		H <sub>2</sub> /Pd - C in ethanol (solvent)	A
b.		H <sup>+</sup> /H <sub>2</sub> O/Δ	B
c.		(CH <sub>3</sub> ) <sub>2</sub> C <sup>-</sup> —P <sup>+</sup> (C <sub>6</sub> H <sub>5</sub> ) <sub>3</sub>	C
d.		1. Li <sup>+</sup> [(CH <sub>3</sub> ) <sub>2</sub> Cu] <sup>-</sup> in dry ether 2. H <sup>+</sup> /H <sub>2</sub> O	D
e.	E	OH <sup>-</sup> /ethanol/Δ	

## 5. Comprehension

Consider the following reactions and answer A and B.



A. Suggest a reagent appropriate step (a) the synthesis.

(a) HO<sup>-</sup>/Br<sub>2</sub> (1 mole)

(b) H<sup>+</sup>/Br<sub>2</sub> (1 mole)

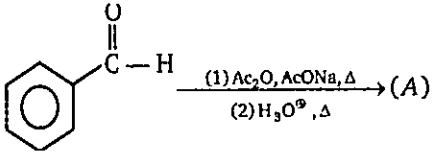
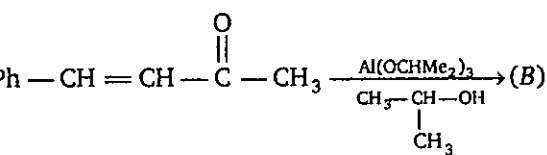
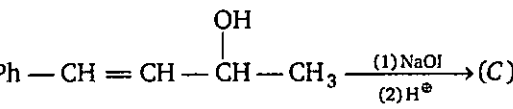
(c) both (a) and (b)

(d) None of these

B. Yield of each step as actually carried out in laboratory is given above each arrow. What is overall yield of the reaction ?

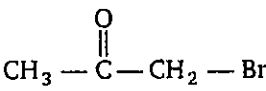
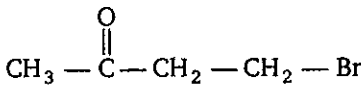
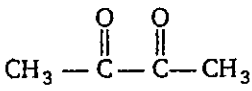
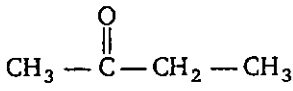
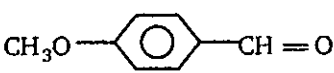
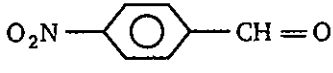
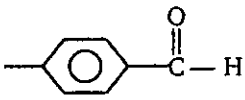
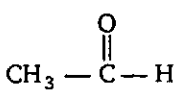
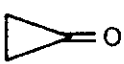
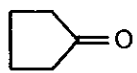
- (a) 60%                      (b) 21%                      (c) 40%                      (d) 68%

6.

<b>Reaction 1.</b>	
<b>Reaction 2.</b>	
<b>Reaction 3.</b>	

**Degree of unsaturation present in compound (A + B + C) is ?**

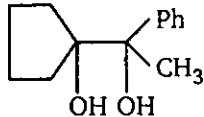
7. Within each set, which compound should be more reactive toward carbonyl addition reaction ?

	A	B
<b>Set (1)</b>		
<b>Set (2)</b>		
<b>Set (3)</b>		
<b>Set (4)</b>		
<b>Set (5)</b>		

Set (6)		
Set (7)		
Set (8)		
Set (9)		
Set (10)	$\text{CH}_3 - \text{C}(=\text{O}) - \text{CH}_2 - \text{CH}_3$	

## 8. Match the Column (I) and Column (II). (Matrix)

Column (I)		Column (II)	
(A)		(p)	Formation of six member ring takes place
(B)		(q)	Final product is Ketone

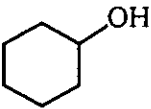
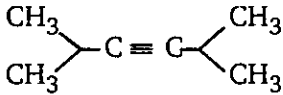
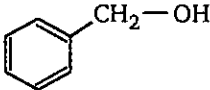

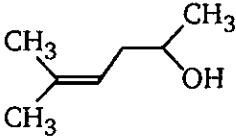
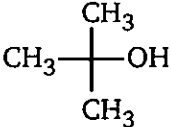
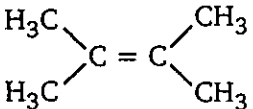
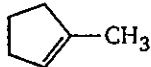

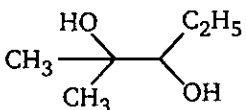
(C)	$\text{CH}_3 - \overset{\text{O}}{\parallel}{\text{C}} - \text{CH}_2 - \text{CH}_2 - \text{CH}_2 - \overset{\text{O}}{\parallel}{\text{C}} - \text{H} \xrightarrow[\Delta]{\text{HO}^-} (\text{A})$	(r)	Final product formed will give positive Tollens test
(D)	 $\xrightarrow[\Delta]{\text{H}^+} (\text{A})$	(s)	Final product formed will react with 2,4-DNP. (2,4-di-nitrophenyl hydrazine)

9. Consider reactions A through F. Those carbon atoms undergoing change, as part of a functional group, are marked as C<sup>12</sup>, C<sup>14</sup> or starred. In the cases shown, each carbon atom has either been reduced or oxidized. Your job is to identify the change in oxidation state that has occurred for each of the marked carbon.

Reaction		C <sup>12</sup>	C <sup>14</sup>
A.	$\text{CH}_3\underset{12}{\text{CH}}=\underset{14}{\text{CH}_2} \xrightarrow{\text{Br}_2} \text{CH}_3\text{CHBrCH}_2\text{Br}$	Reduced	Reduced
		Oxidized	Oxidized
B.	$\text{CH}_3\underset{12}{\text{CH}}=\underset{14}{\text{CH}_2} \xrightarrow[\text{(ii) H}_2\text{O}_2, \text{NaOH}]{\text{(i) B}_2\text{H}_6} \text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$	Reduced	Reduced
		Oxidized	Oxidized
C.	$\text{CH}_3\text{CH}_2\overset{\star}{\text{C}}\text{H}=\text{O} \xrightarrow{\text{NaBH}_4} \text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$	Reduced	
		Oxidized	
D.	$\text{CH}_3\text{CH}_2\overset{\star}{\text{C}}\text{H}=\text{O} \xrightarrow[\text{H}_2\text{O, pH} > 8]{\text{Ag}^{+}} \text{CH}_3\text{CH}_2\text{CO}_2\text{H}$	Reduced	
		Oxidized	
E.	$\text{CH}_3\overset{12}{\text{C}}\text{O}\overset{14}{\text{C}}\text{H}_2\text{CO}_2\text{H} \xrightarrow{\text{Heat}} \begin{matrix} \text{CH}_3\text{COCH}_3 \\ + \\ \text{O}=\text{C}=\text{O} \end{matrix}$	Reduced	Reduced
		Oxidized	Oxidized
F.	$\text{H}_2\overset{12}{\text{C}}=\overset{14}{\text{C}}(\text{OH})\text{C}_2\text{H}_5 \xrightarrow{\text{tautomerization}} \text{H}_3\text{CCOC}_2\text{H}_5$	Reduced	Reduced
		Oxidized	Oxidized

10. Consider the possible formation of an aldehyde or ketone product when each of the ten compounds in the column on the left is treated with each of the reagents shown in the top row. Check the designated answer box if you believe an aldehyde or ketone will be formed.

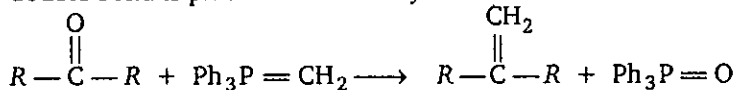
Assume that the reagents may be present in excess. For each checked reaction, try to draw the structure of the major product (s).

Starting	PCC $C_5H_5NHCrO_3Cl$	Jone's Reagent $CrO_3$ in aq. acid	$Pb(OAc)_4$ [or $HIO_4$ ]	(i) $O_3$ , (ii) Zn dust	$H_3O^+$	(i) $BH_3$ in THF (ii) $H_2O_2 + NaOH$
						
						
						
						
						
						
						
						
						
						

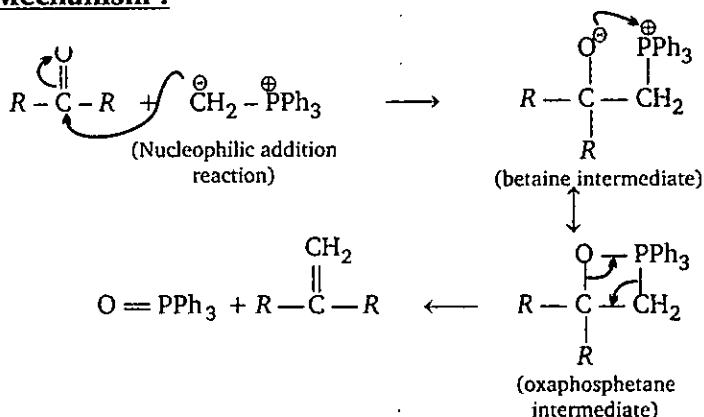
## 11. Comprehension

Wittig reaction :

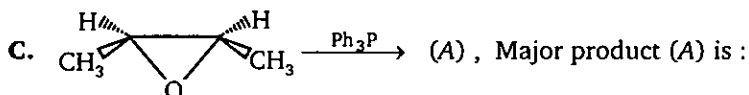
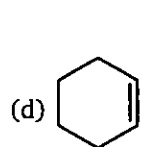
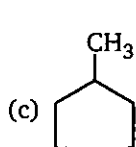
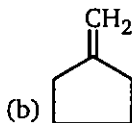
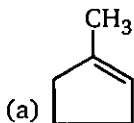
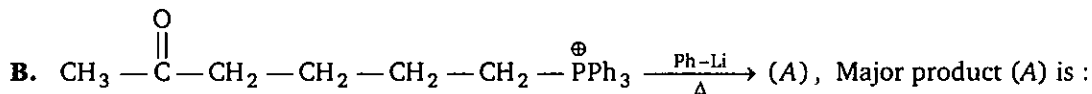
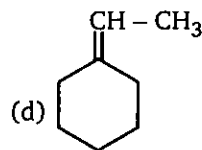
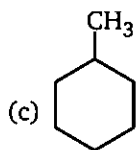
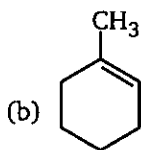
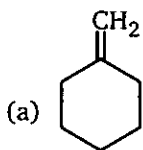
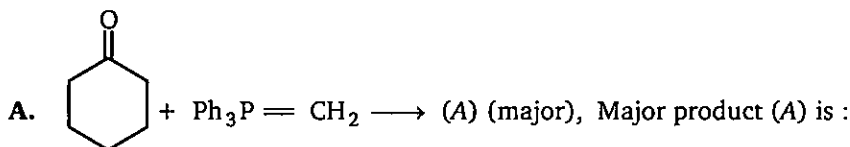
The reaction of a phosphorus ylide with an aldehyde (or) ketone introduces a carbon-carbon double bond in place of the carbonyl bond.



**Mechanism :**



Driving force of the reaction is high bond energy of ( $\text{P}=\text{O}$ ) . ( $\Delta H = -ve$ )



(a) *cis*-2-butene

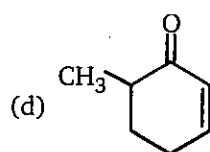
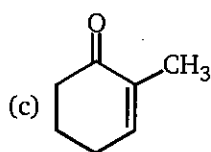
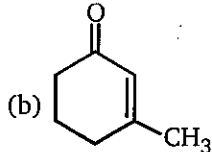
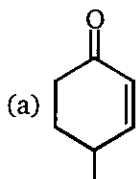
(b) *trans*-2-butene

(c) *iso*-butene

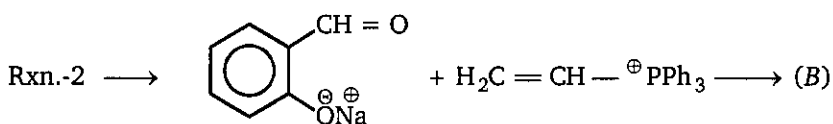
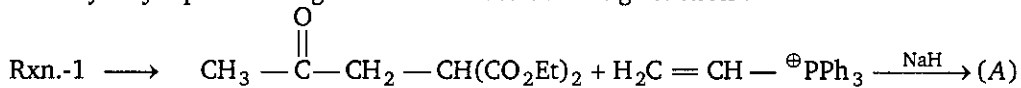
(d) 1-butene



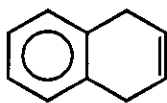
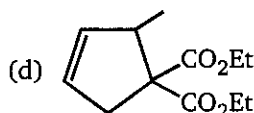
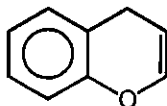
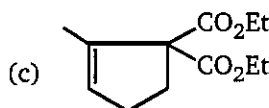
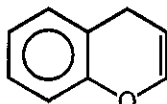
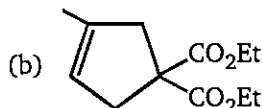
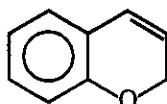
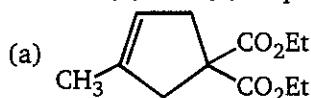
D.  $\text{CH}_3 - \overset{\text{O}}{\parallel}{\text{C}} - (\text{CH}_2)_3 - \overset{\text{O}}{\parallel}{\text{C}} - \text{CH}_2 - \overset{\text{O}}{\parallel}{\text{P}}(\text{OEt})_2 \xrightarrow{\text{NaH}} (\text{A})$  (cyclic). Product (A) is :



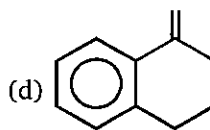
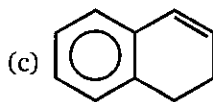
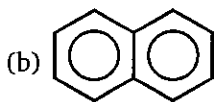
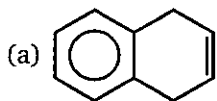
E. Identify major product in given intramolecular Wittig reaction :



Product (A) and (B) respectively are :



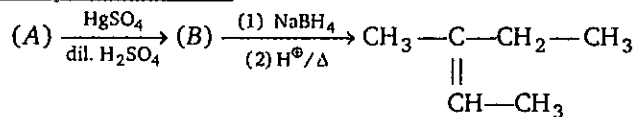
F.  $\xrightarrow[\text{(3) CHO}]{\text{(1) Ph}_3\text{P(2 mole), (2) 2Ph-Li}}$  (A) ; product (A) is :



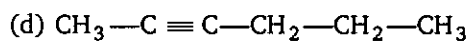
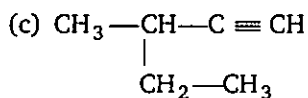
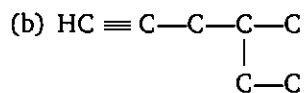
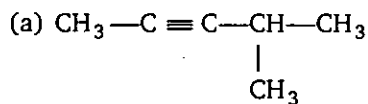
## 12. Match the column :

Column (I)		Column (II)	
Conversion		Reagent	
(a)		(p)	$\text{NH}_2/\text{NH}_2/\text{HO}^\ominus, \Delta$ (Wolff-Kishner reduction)
(b)		(q)	$\text{Zn(Hg), HCl}$ (Clemmensen reduction)
(c)		(r)	$\text{LiAlH}_4$
(d)		(s)	None

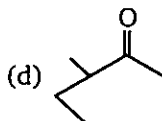
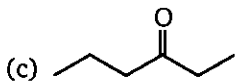
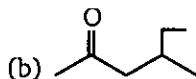
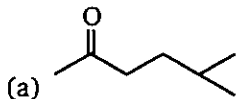
## 13. Comprehension



A. Reactant (A) is :



B. Product (B) is :



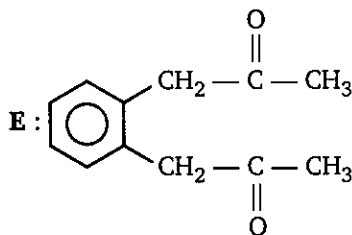
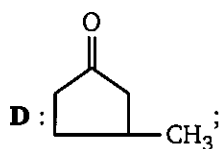
## ANSWERS — LEVEL 2

1. A - l; B - g; C - n; D - k; E - h; F - c; G - j; H - f; I - m; J - d; K - e; L - b

2. i - A, B, C, E, F; ii - D, G, H; iii - B, E, F

3. a - p, r; b - r; c - s; d - p, r

4. A :  $\text{Ph} - \overset{\text{OH}}{\text{CH}} - \text{CH}_3$ ;    B :  $\text{Ph} - \text{CH}_2 - \text{COOH}$ ;    C :  $\text{Ph} - \text{CH} = \text{C} \begin{matrix} \text{CH}_3 \\ \text{CH}_3 \end{matrix}$ ;



5. A - c; B - b

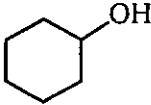
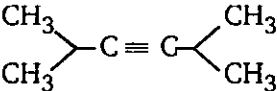
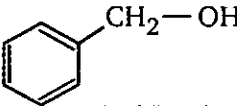

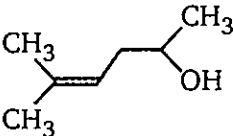
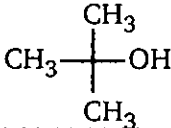
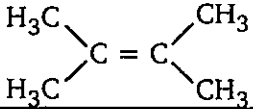
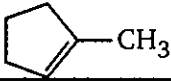

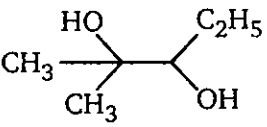
6.  $A + B + C = 17$

7. set 1 - A; set 2 - A; set 3 - B; set 4 - B; set 5 - A; set 6 - B; set 7 - B;  
set 8 - B; set 9 - A; set 10 - B

8. A - p, q, s; B - p; C - p, q, s; D - p, q, s

9. A : both are oxidized; B :  $\text{C}^{12}$  is reduced,  $\text{C}^{14}$  is oxidized; C : reduced; D : oxidized  
E :  $\text{C}^{12}$  is reduced,  $\text{C}^{14}$  is oxidized; F :  $\text{C}^{12}$  is reduced,  $\text{C}^{14}$  is oxidized

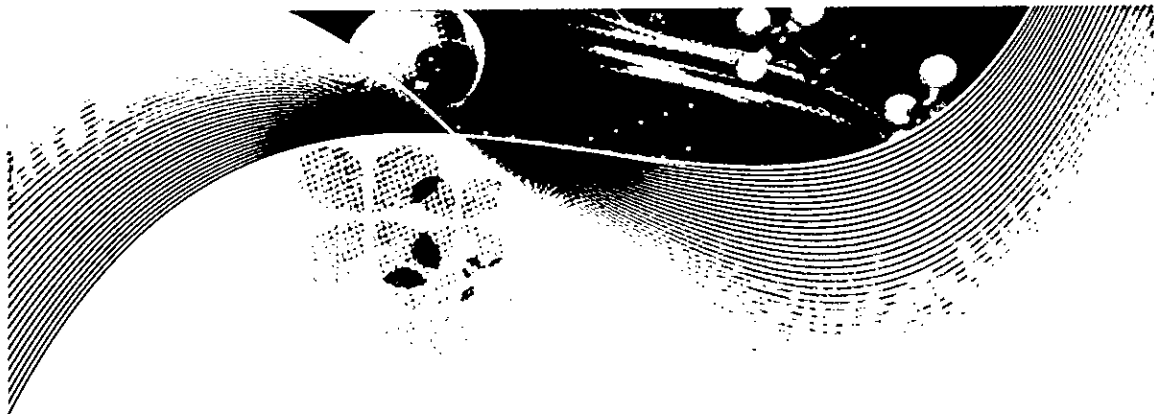
10.

Compound	PCC $C_5H_5NHCrO_3Cl$	Jone's Reagent $CrO_3$ in aq. acid	$Pb(OAc)_4$ [or $HIO_4$ ]	(i) $O_3$ , (ii) Zn dust	$H_3O^+$	(i) $BH_3$ in THF (ii) $H_2O_2 + NaOH$
	✓	✓	✗	✗	✗	✗
	✗	✗	✗	✓	✓	✓
	✓	✓	✗	✓	✗	✗
	✗	✗	✗	✓	✗	✗
	✓	✓	✗	✓	✓	✓
	✗	✗	✗	✗	✗	✗
	✗	✗	✗	✓	✓	✓
	✗	✗	✗	✓	✓	✓
	✓	✓	✗	✗	✗	✗
	✓	✓	✓	✗	✗	✗

11. A - a; B - a; C - b; D - b; E - a; F - b

12. a - q; b - s; c - r; d - p

13. A. (c) B. (d)



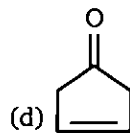
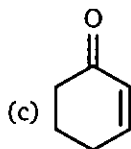
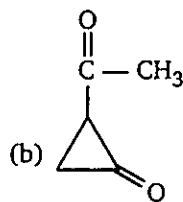
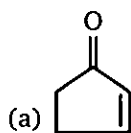
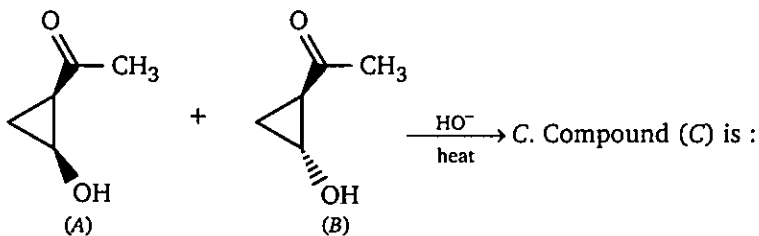
# 8

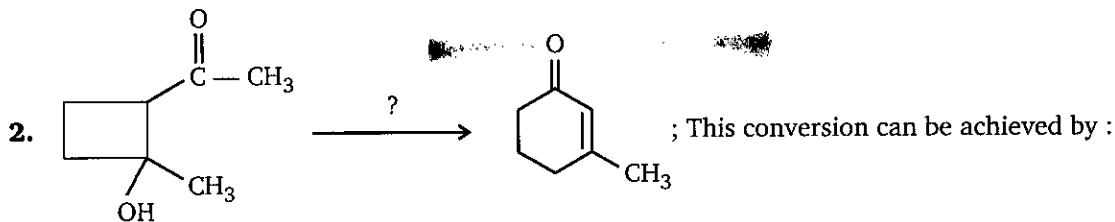
# ALDOL AND CANNIZARO REACTION



# LEVEL - 1

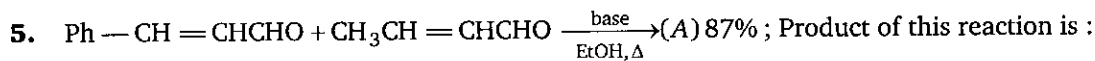
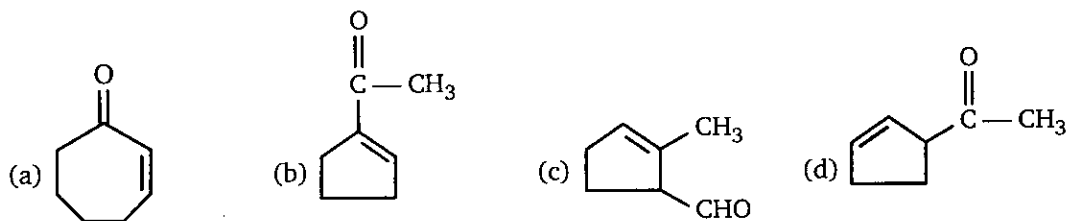
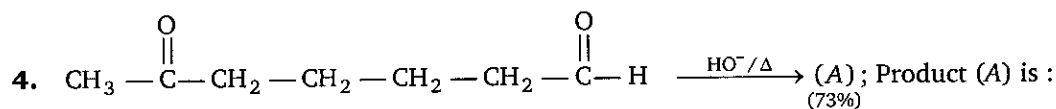
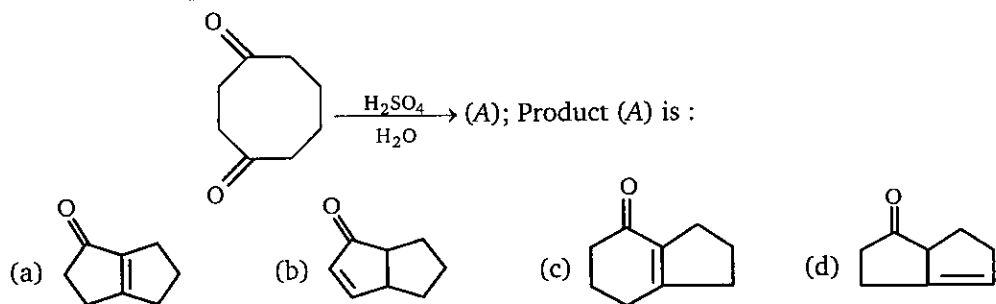
1. Compound A and B, both were treated with NaOH, producing a single compound C.



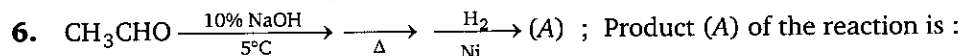


- (a) Dehydration, Hydrolysis
- (b) Retro aldol and further condensation
- (c) Perkin condensation & Clemmensen reduction
- (d) Clemmensen and Perkin condensation

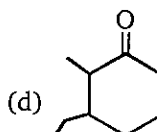
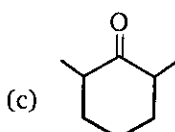
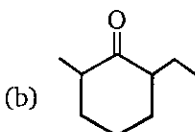
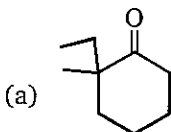
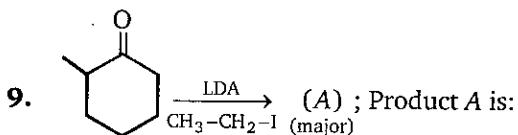
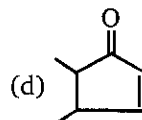
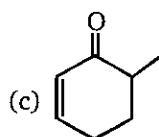
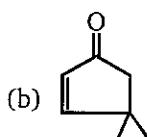
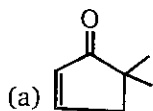
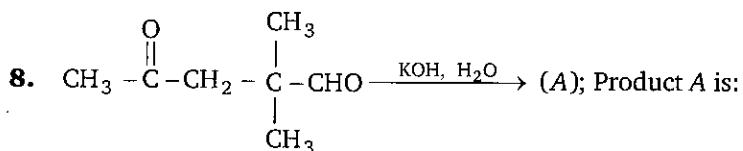
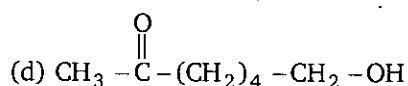
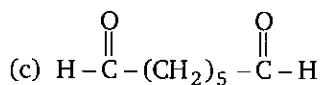
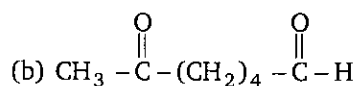
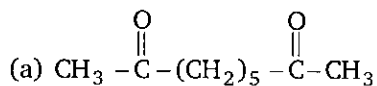
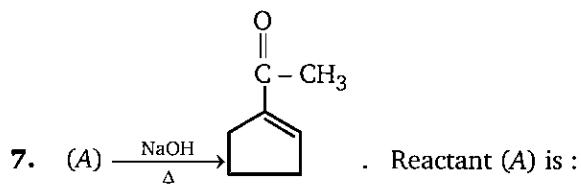
3. This is an example of an intramolecular aldol reaction :



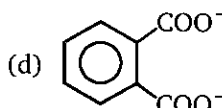
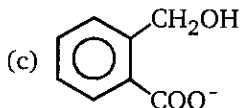
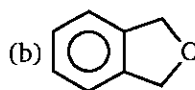
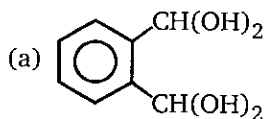
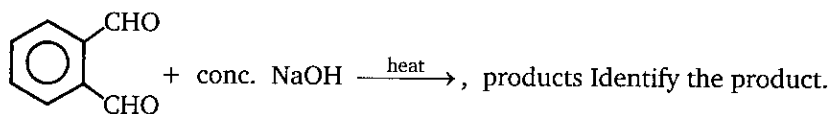
- (a)  $\text{Ph} - (\text{CH} = \text{CH})_2 - \text{CHO}$
- (b)  $\text{Ph} - (\text{CH} = \text{CH})_3\text{CHO}$
- (c)  $\text{Ph} - (\text{CH} = \text{CH})_4\text{CHO}$
- (d)  $\text{Ph} - \text{CH} = \text{CH} - \text{CH} = \text{CH} - \text{CH}_3$



- (a) propanol
- (b) ethanol
- (c) butanol
- (d) pentanol

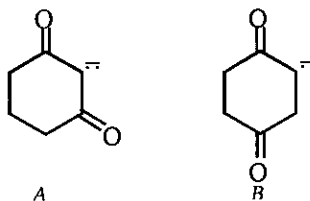


10. The reaction ,





11. Compare enolate A with enolate B.

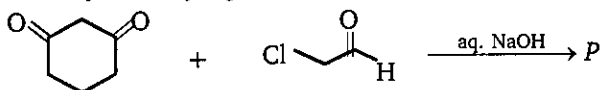


Which of the following statements is true ?

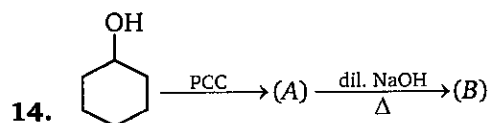
- (a) A is more stable than B (b) A and B have the same stability  
 (c) B is more stable than A (d) No comparison of stability can be made
12. Benzalacetone is the product of mixed aldol condensation between benzaldehyde ( $C_6H_5CH=O$ ) and acetone [ $(CH_3)_2C=O$ ]. What is its structure ?

- (a)  $C_6H_5CH=CHC(=O)CH_3$  (b)  $C_6H_5CH=C(CH_3)_2$   
 (c)  $C_6H_5C(=O)CH=CHCH_3$  (d)  $C_6H_5CH_2C(=O)CH=CH_2$

13. Identify the major product P in the following reaction:

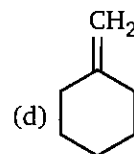
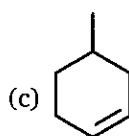
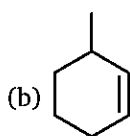
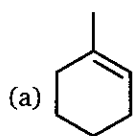
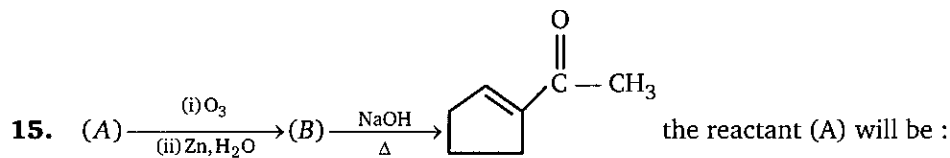


- (a)
- (b)
- (c)
- (d)

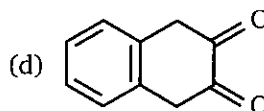
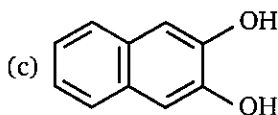
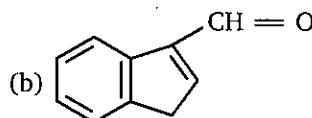
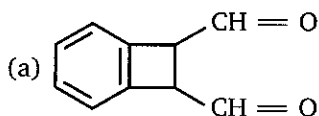


Product (B) is:

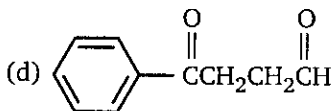
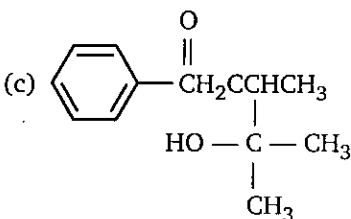
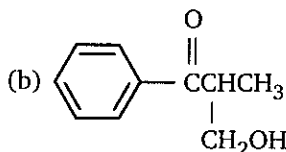
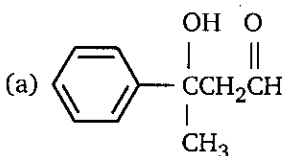
- (a)
- (b)
- (c)
- (d)



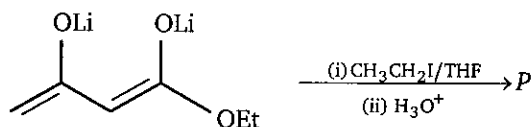
16. Identify the principal product of the following reaction?

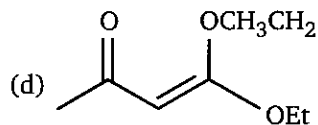
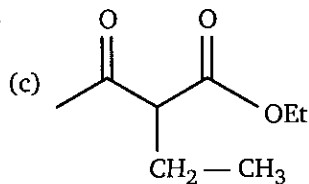
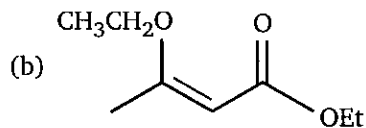
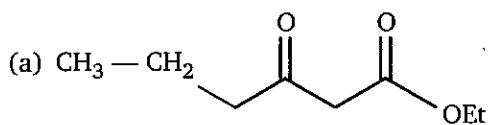


17. Which one of the following compounds is the best choice for being prepared by an efficient mixed aldol addition reaction?

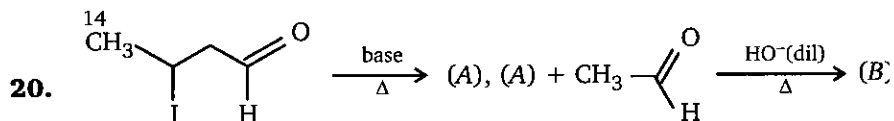
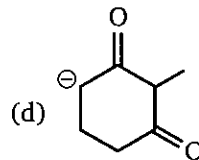
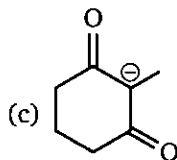
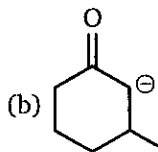
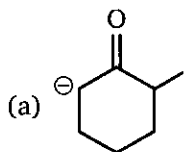
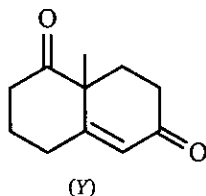


18. Identify the major product P in the following reaction:

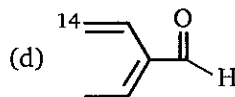
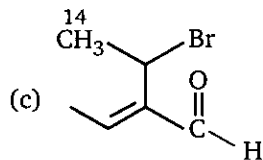
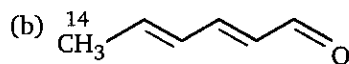
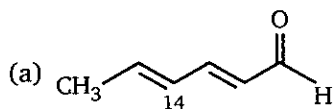




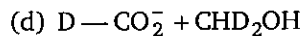
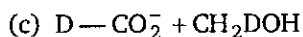
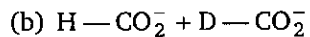
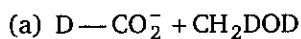
19. The enolate ion that reacts with 3-buten-2-one to form (Y) is :



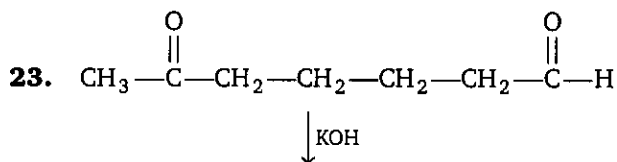
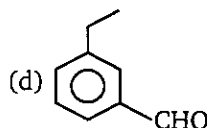
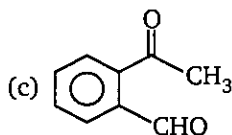
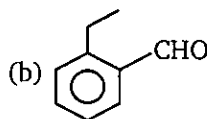
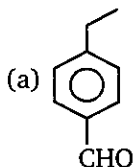
Product (B) in the above reaction is :



21.  $\text{H} - \overset{\text{O}}{\parallel}{\text{C}} - \text{D} \xrightarrow[(50\%)]{\text{HO}^-}$ ; Product of this Cannizaro reaction is :



22. An organic compound with the molecular formula  $C_9H_{10}O$  forms a 2,4-DNP derivative, reduces Tollen's reagent and undergoes Cannizaro reaction, on vigorous oxidation it gives 1,2-benzenedicarboxylic acid. Structure of organic compound is:

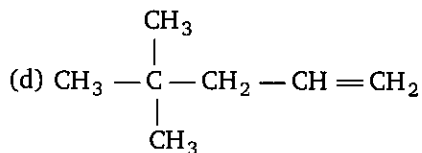
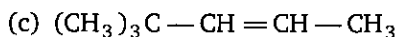
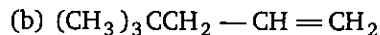
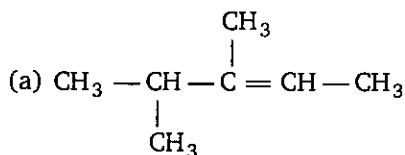


Number of intramolecular aldol condensation product is :

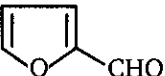
- (a) 1.                      (b) 2                      (c) 3                      (d) 4
24.  $(A) \xrightarrow[\text{Zn/AcOH}]{\text{O}_3} (B) + (C)$   
 $C_7H_{14}$

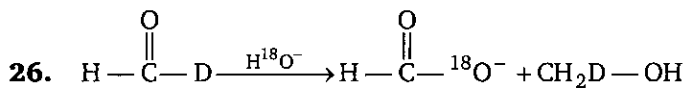
Compound (A) exist in geometrical isomers and (B) gives Cannizaro reaction.

(A) will be :



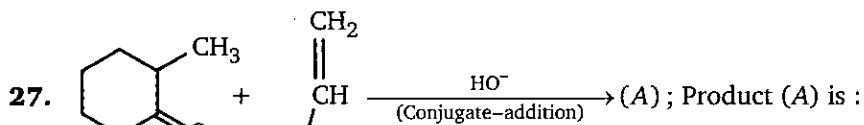
25. Which of the following compounds will not undergo Cannizzaro reaction, when treated with 50% aqueous alkali?

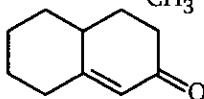
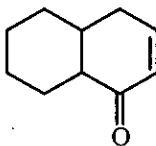
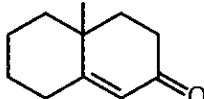
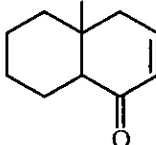
- (a)  $\text{Ph}-\overset{\text{O}}{\parallel}{\text{C}}-\text{H}$       (b)       (c)  $\text{Me}_2\text{CHCHO}$       (d)  $\text{Ph}-\text{CH}_2-\text{CHO}$

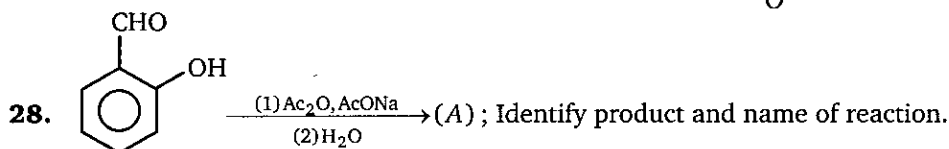


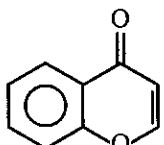
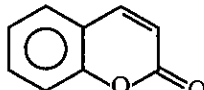
Above reaction is known as :

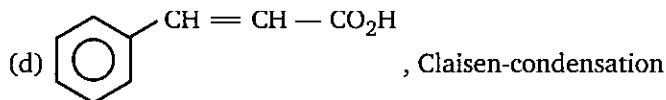
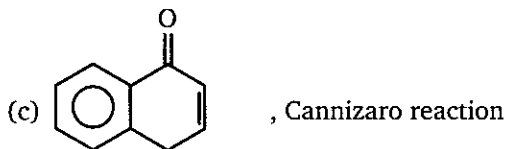
- (a) Cannizzaro reaction, Disproportionation reaction  
 (b) Tischenko reaction, Disproportionation reaction  
 (c) Cross Cannizzaro reaction, Redox reaction  
 (d) Tischenko reaction, Redox reaction



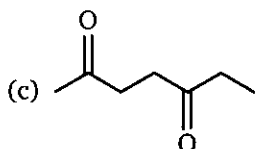
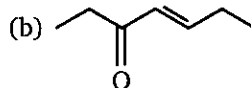
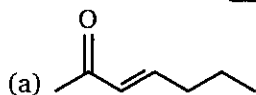
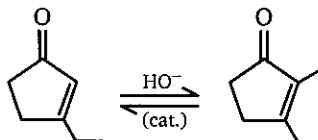
- (a)       (b)   
 (c)       (d) 



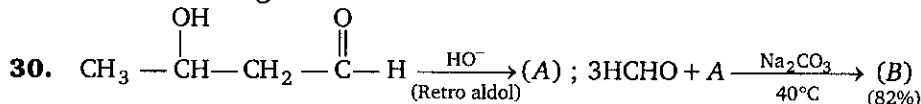
- (a)  , Aldol condensation  
 (b)  , Perkin reaction



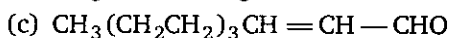
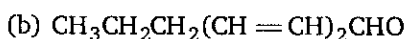
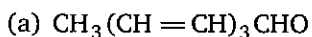
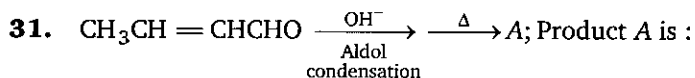
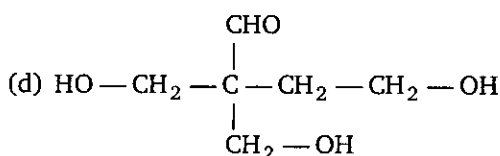
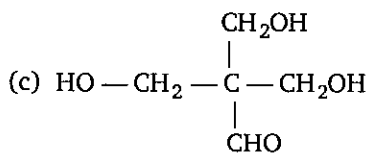
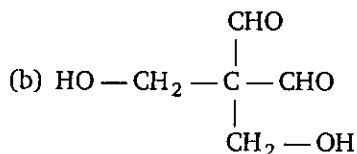
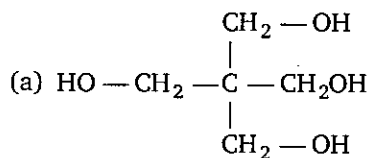
29. Choose the most reasonable reaction intermediate for the following reaction.



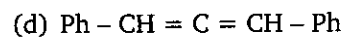
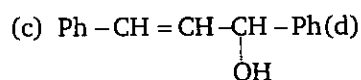
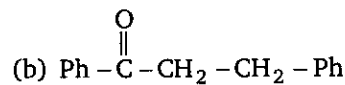
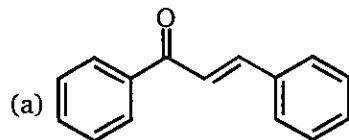
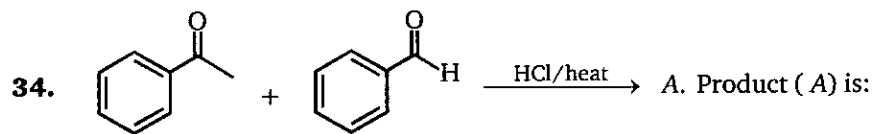
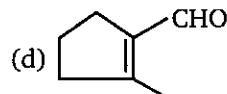
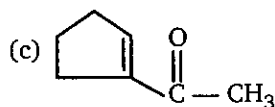
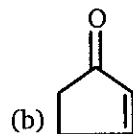
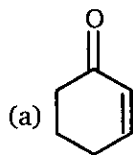
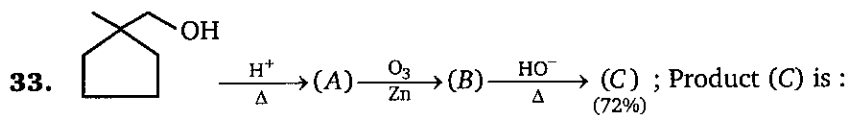
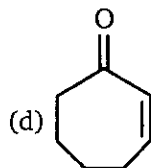
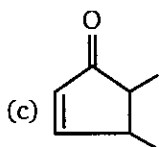
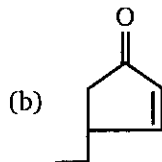
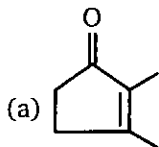
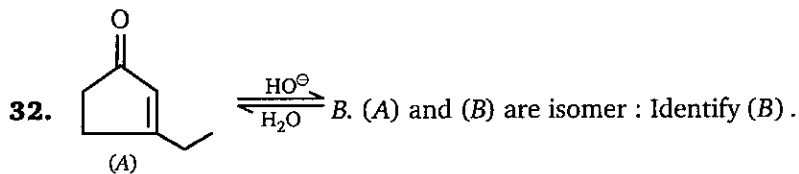
(d) None of these



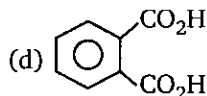
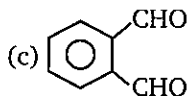
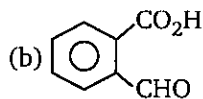
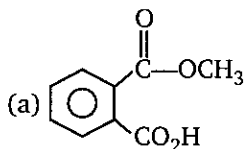
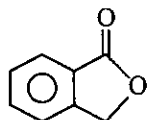
Product (B) of the above reaction is :



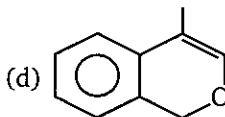
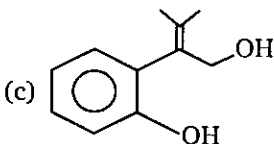
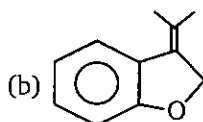
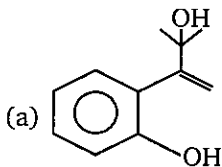
(d) none is correct



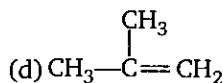
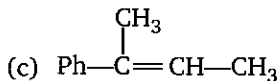
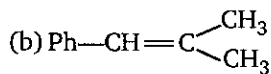
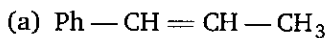
35. Which of the following reactant on reaction with conc. NaOH followed by acidification gives the following lactone as the product ?



36.  $\xrightarrow{\text{NaOH}}$  Product; Product is:

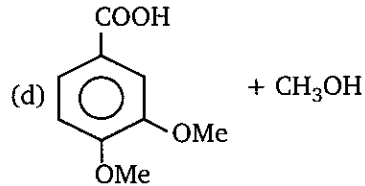
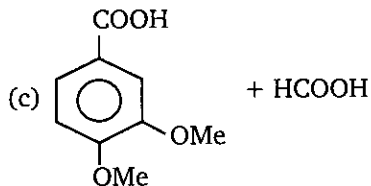
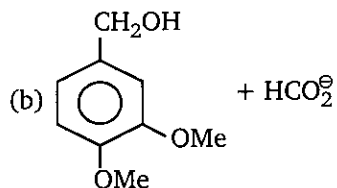
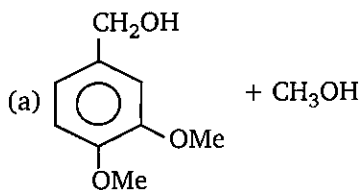
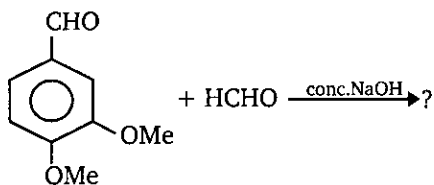


37. (P)  $\xrightarrow[\Delta]{\text{KOH}}$
- (Q)  $\xrightarrow[\Delta]{\text{KOH}}$  Ph-CH<sub>2</sub>-OH + Ph-CO<sub>2</sub><sup>⊖</sup>
- (R)  $\xrightarrow{\text{O}_3}$  P + Q, Structure of (R) is :





38. The following reaction gives:



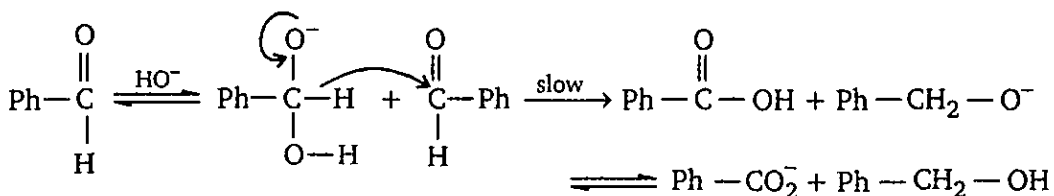
## ANSWERS — LEVEL 1

1.	(a)	2.	(b)	3.	(a)	4.	(b)	5.	(b)	6.	(c)	7.	(b)	8.	(b)
9.	(b)	10.	(c)	11.	(a)	12.	(a)	13.	(a)	14.	(b)	15.	(a)	16.	(b)
17.	(b)	18.	(a)	19.	(c)	20.	(a)	21.	(c)	22.	(b)	23.	(c)	24.	(c)
25.	(d)	26.	(a)	27.	(c)	28.	(b)	29.	(c)	30.	(c)	31.	(a)	32.	(a)
33.	(c)	34.	(a)	35.	(c)	36.	(b)	37.	(b)	38.	(b)				

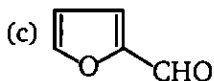
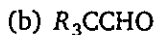
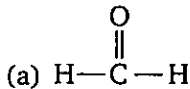


### 1. Comprehension

Mechanism of Cannizzaro's reaction of benzaldehyde is



A. Which of the following reactants can undergo Cannizzaro's reaction?



(d) All of these

B. Order of the above reaction is:

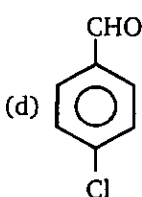
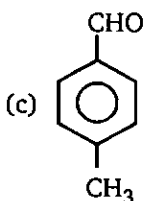
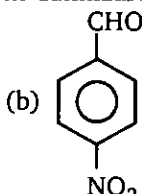
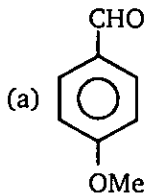
(a) 1

(b) 2

(c) 3

(d) 4

C. Which of the following is best hydride donor in Cannizzaro's reaction?



D. Cannizzaro's reaction is:

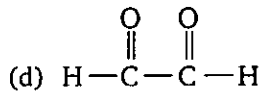
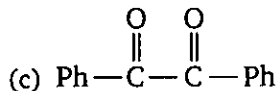
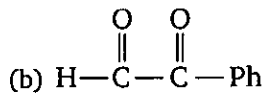
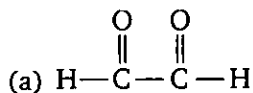
(a) Reduction

(b) Disproportionation reaction

(c) Oxidation

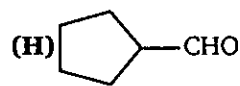
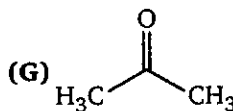
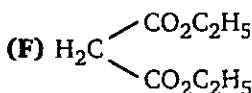
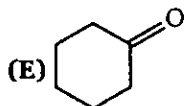
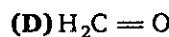
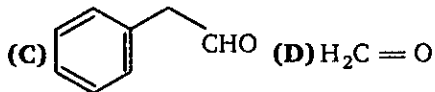
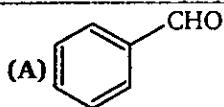
(d) Ion - exchange reaction

E. Which of the following cannot undergo intramolecular Cannizzaro's reaction?



2. Aldol condensation proceeds by carbon-carbon bond formation between an enolate donor and a carbonyl acceptor. For each of the following aldol products (a through e) select a donor and an acceptor compound from the list at the bottom of the page (compounds A through H). Write the letter corresponding to your selection in the appropriate answer box.

	Aldol Product	Donor	Acceptor
a.			
b.			
c.			
d.	$(\text{CH}_3)_2\text{C}(\text{OH})\text{CH}_2\text{COCH}_3$		
e.			



## 3. Comprehension

During an experimental workup procedure, a chemist treated a starting material with NaOH in the solvent acetone  $[(\text{CH}_3)_2\text{C}=\text{O}]$ ; however, the starting material was recovered unreacted. Instead, the chemist isolated a small amount of Product A (shown below).

## Product A

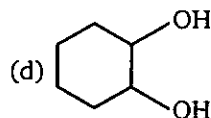
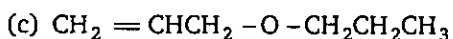
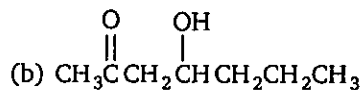
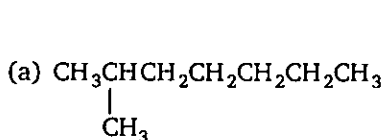
The chemist determined that Product A resulted from the aldol self-condensation of acetone. Product A was identified based on the following observations.

## Observations about Product A

1. Elemental analysis of Product A indicated that it consisted only of carbon, hydrogen, and oxygen.
2. Product A had a molecular weight of 116 g/mol.
3. Product A was a methyl ketone because it gave a positive iodoform test.
4. When product A was treated with  $\text{Br}_2$  in  $\text{CCl}_4$ , the red bromine colour persisted, because no carbon-carbon double bonds were present to react with the bromine.

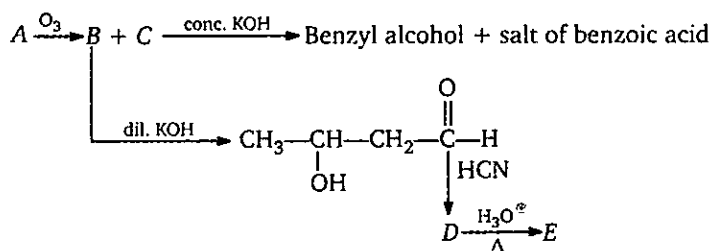
The structure of Product A was further confirmed when treatment with hot sulfuric acid resulted in the corresponding dehydration product, Product B.

- A.** What is the molecular weight of a compound that undergoes an aldol self-condensation reaction to result in a  $\beta$ -hydroxy ketone with a molecular weight of 144 ?
- (a) 70 g/mol (b) 72 g/mol  
(c) 74 g/mol (d) 76 g/mol
- B.** The aldol self-condensation of acetone is an equilibrium that favours acetone over its condensation product. Which of the following experimental modifications is most likely to shift the position of equilibrium toward Product A ?
- (a) Using only a catalytic amount of NaOH  
(b) Using only a catalytic amount of acetone  
(c) Removing Product A as it is formed  
(d) Increasing the reaction temperature to the boiling point of acetone
- C.** Based only on observation 1 and 2, which of the following compounds could have been Product A ?

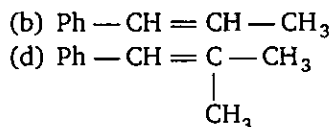
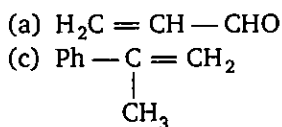


- D. When a drop of  $\text{Br}_2$  in  $\text{CCl}_4$  is added to Product B, the resulting solution will be :
- colourless, because Product B does not contain a carbon-carbon double bond
  - colourless, because Product B contains a carbon-carbon double bond
  - red, because Product B does not contain a carbon-carbon double bond
  - red, because Product B contains a carbon-carbon double bond
- E. Which of the following compounds from the passage will give a positive iodoform test ?
- Product A only
  - Product A and Product B
  - Product A and acetone only
  - Product A, Product B, and acetone

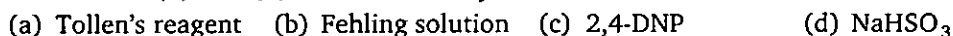
## 4. Comprehension



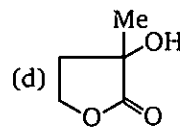
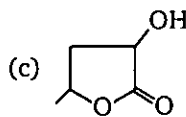
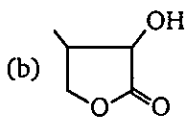
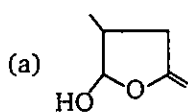
A. Structure of A is :



B. Structure of (B) and (C) differentiated by :



C. Structure of E is :



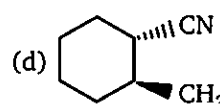
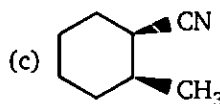
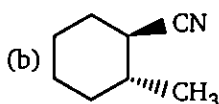
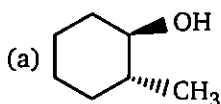
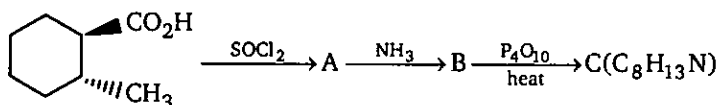
## ANSWERS — LEVEL 2

- A - d; B - c; C - a; D - b; E - c
- a - Donor = C, Acceptor = C; b - Donor = E, Acceptor = D;  
c - Donor = B, Acceptor = A; d - Donor = G, Acceptor = G; e - Donor = F, Acceptor = B
- A - b; B - c; C - d; D - b; E - d
- A - b, B - b, C - c

# 9 CARBOXYLIC ACID AND THEIR DERIVATIVES

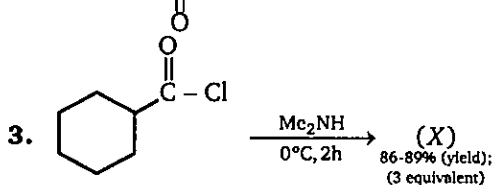
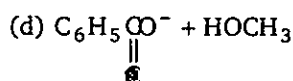
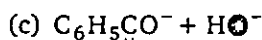
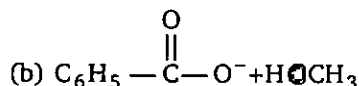
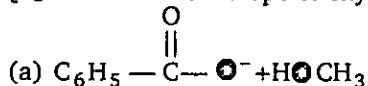
## LEVEL - 1

1. Identify C in the following sequence of reactions :

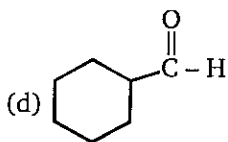
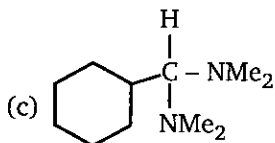
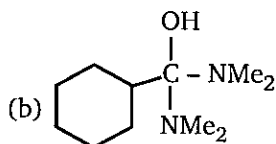
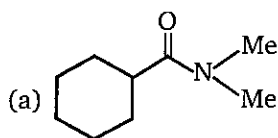


2. Saponification (basic hydrolysis) of  $\text{C}_6\text{H}_5\text{C}(\text{O})\text{CH}_3$  will yield :

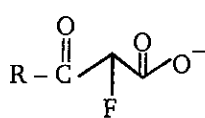
[  $\text{O}^*$  = mass - 18 isotope of oxygen ]



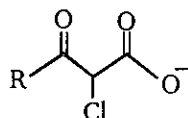
Product (X) of the reaction is :



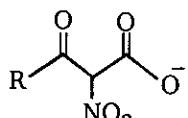
4. Which of the following is the correct order of decarboxylation of  $\beta$ -keto carboxylate anion ?



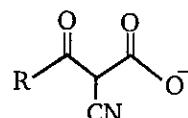
(a)



(b)



(c)



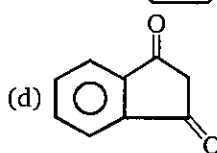
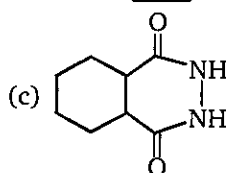
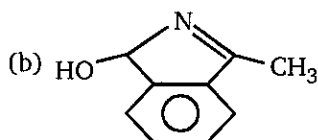
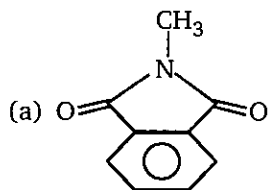
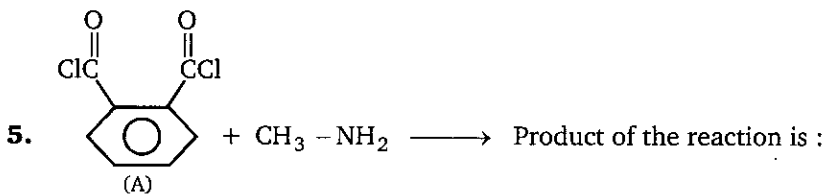
(d)

(a)  $a > b > c > d$

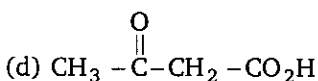
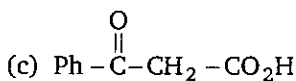
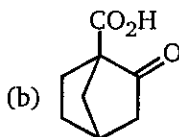
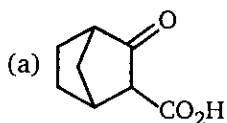
(b)  $c > d > a > b$

(c)  $c > d > b > a$

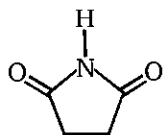
(d)  $d > c > a > b$



6. Which  $\beta$ -keto acid shown will not undergo decarboxylation ?



7. Choose the response that matches the correct functional group classification with the following group of structural formulas.

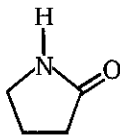


(a) Anhydride

(b) Lactam

(c) Imide

(d) Imide

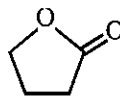


Lactam

Imide

Lactone

Lactam

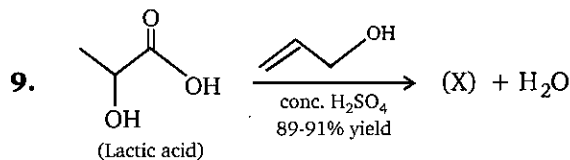
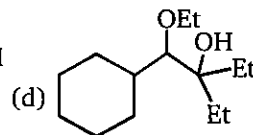
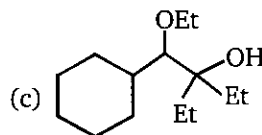
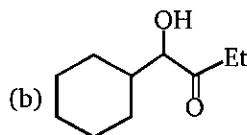
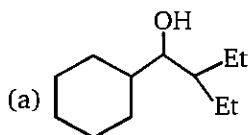
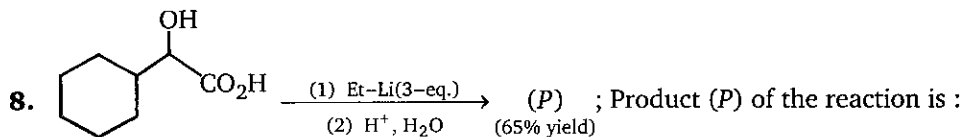


Lactone

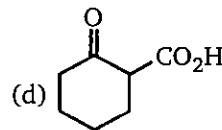
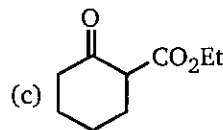
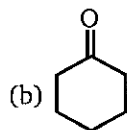
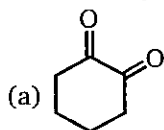
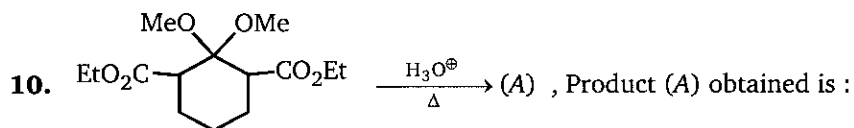
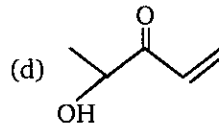
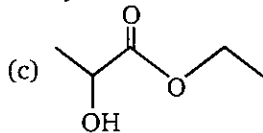
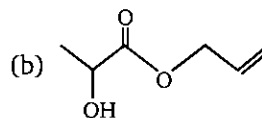
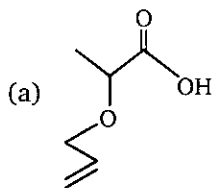
Lactone

Anhydride

Lactone

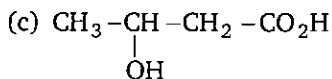
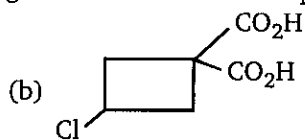
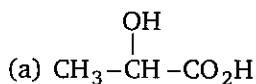


Product (X) of the reaction is :

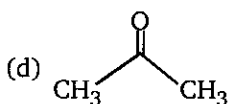
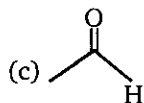
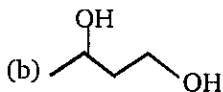
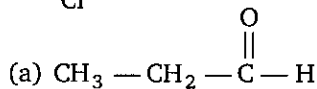
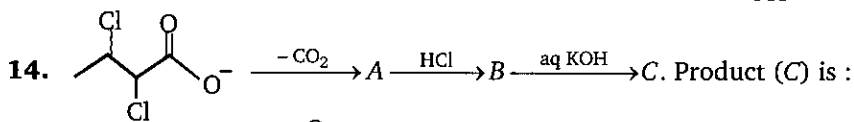
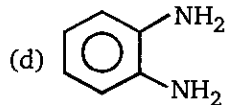
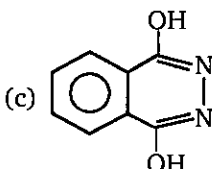
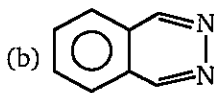
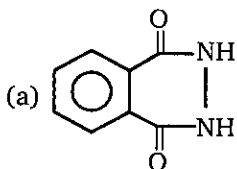
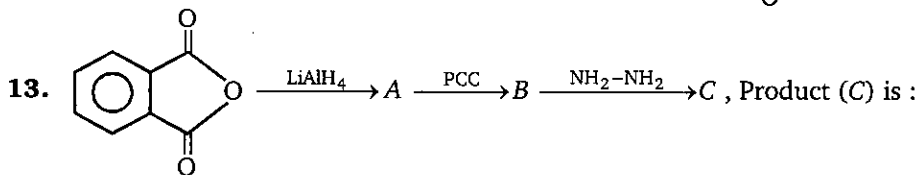
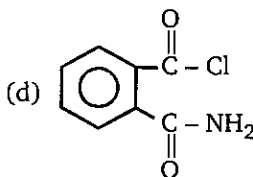
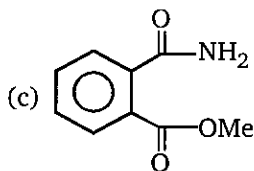
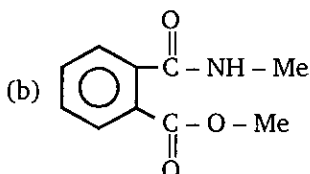
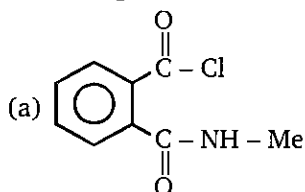
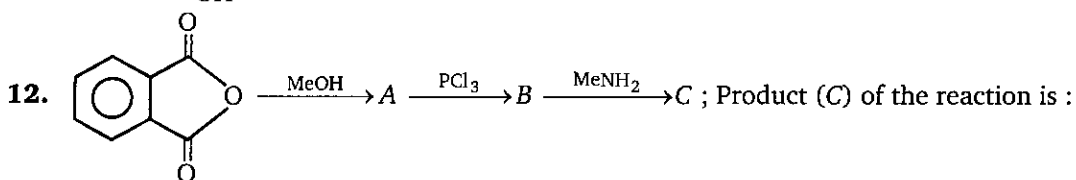


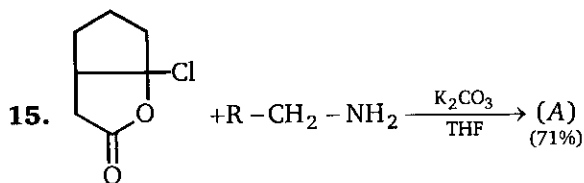


11. Which of the following acid on heating gives geometrical isomers as a product ?

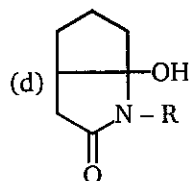
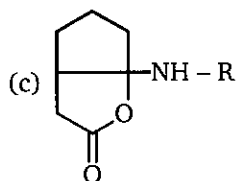
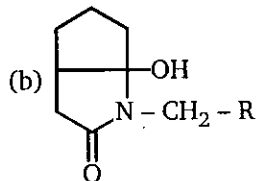
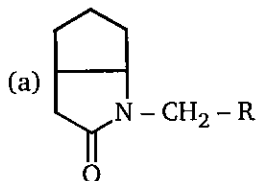


(d) All of these

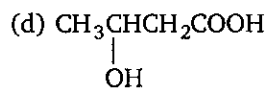
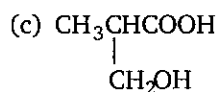
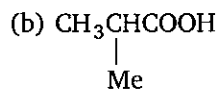
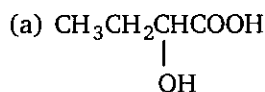




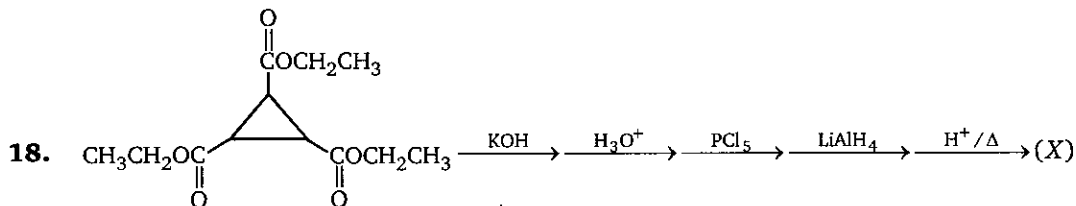
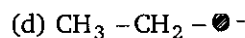
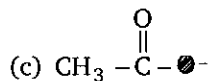
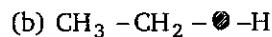
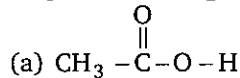
In above reaction identify major product (A) of the reaction:



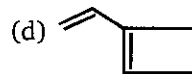
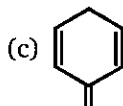
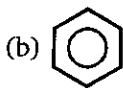
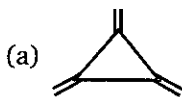
16. An optically active compound 'X' has molecular formula C<sub>4</sub>H<sub>8</sub>O<sub>3</sub>. It evolves CO<sub>2</sub> with NaHCO<sub>3</sub>. 'X' reacts with LiAlH<sub>4</sub> to give an achiral compound. 'X' is :



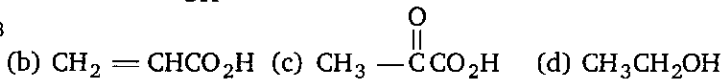
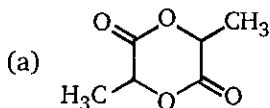
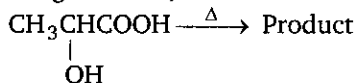
17.  $\text{CH}_3 - \overset{\text{O}}{\parallel} \text{C} - \text{O} - \text{CH}_2 - \text{CH}_3 + \text{H} - \ominus \longrightarrow (\ominus = \text{O}^{18})$  One of the product of the reaction is :



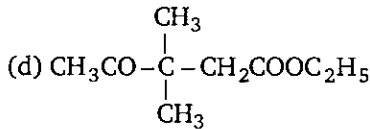
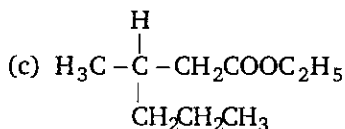
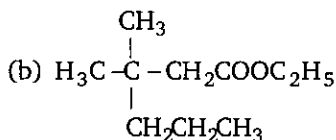
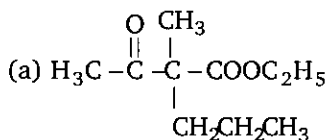
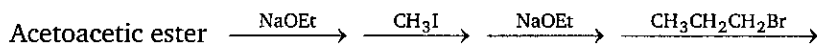
Product (X) is :



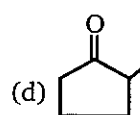
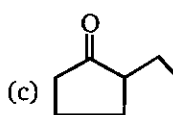
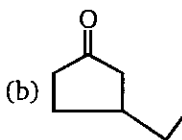
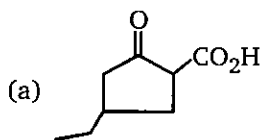
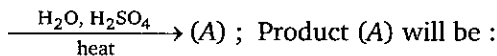
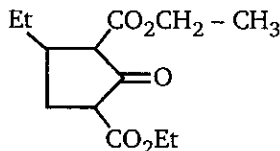
19. Identify final product in the following reaction;



20. Select the final product from this sequence of reactions.

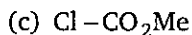
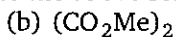
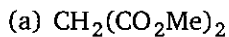


21.

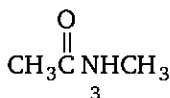
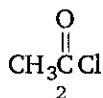
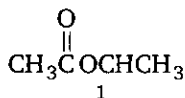


22.  $\text{CH}_2(\text{CO}_2\text{Me})_2 + ? \xrightarrow[\text{(ii) AcOH}]{\text{(i) Na}} \text{CH}(\text{CO}_2\text{Me})_3$

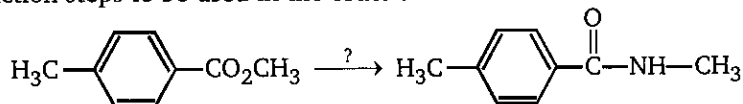
Which of the following reactants will complete the above reaction ?



23. Arrange the following in order of increasing reactivity (least  $\longrightarrow$  most) towards nucleophile



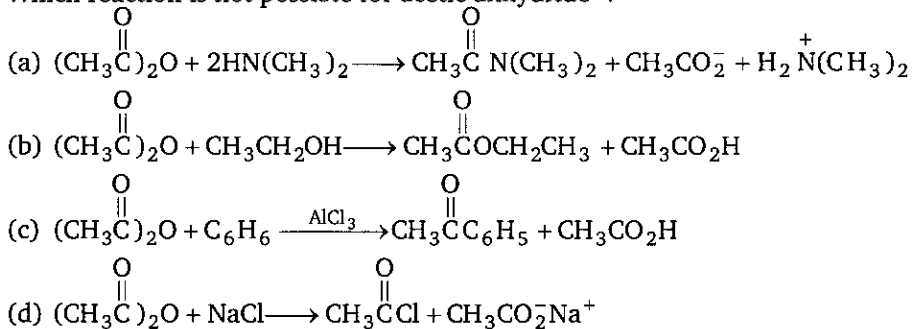
24. Choose the best sequence of reactions for transformation given. Semicolons indicate separate reaction steps to be used in the order shown.



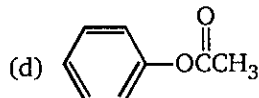
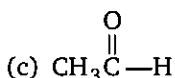
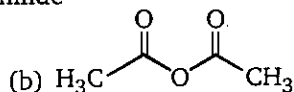
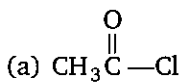
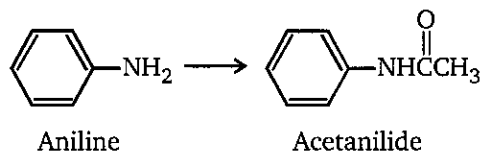
- (a)  $\text{H}_3\text{O}^+$ ;  $\text{SOCl}_2$ ;  $\text{CH}_3\text{NH}_2$   
 (b)  $\text{HO}^-/\text{H}_2\text{O}$ ;  $\text{PBr}_3$ ;  $\text{Mg}$ ;  $\text{CO}_2$ ;  $\text{H}_3\text{O}^-$ ;  $\text{SOCl}_2$ ;  $\text{CH}_3\text{NH}_2$   
 (c)  $\text{LiAlH}_4$ ;  $\text{H}_2\text{O}$ ;  $\text{HBr}$ ;  $\text{Mg}$ ;  $\text{CO}_2$ ;  $\text{H}_3\text{O}^+$ ;  $\text{SOCl}_2$ ;  $\text{CH}_3\text{NH}_2$   
 (d) None of these would yield the desired product
25. A key step in the hydrolysis of acetamide in aqueous acid proceeds by nucleophilic addition of :



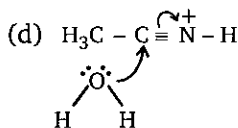
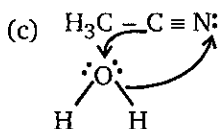
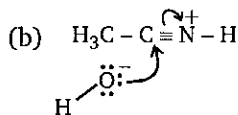
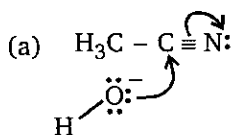
26. Which reaction is not possible for acetic anhydride ?



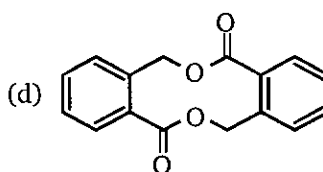
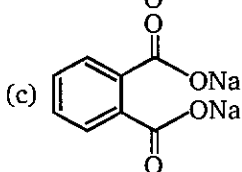
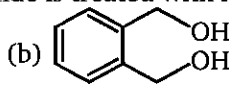
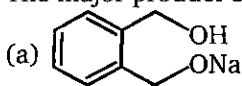
27. All but one of the following compounds react with aniline to give acetanilide. Which one does not?



28. Which of the following best describes the nucleophilic addition step in the acid-catalyzed hydrolysis of acetonitrile ( $\text{CH}_3\text{CN}$ ) ?



29. The major product expected, when Phthalamide is treated with NaOH, is :



30. Which of following acid remains unaffected on heating ?

- (a) malonic acid  
(c) Fumaric acid

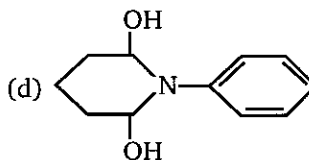
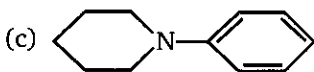
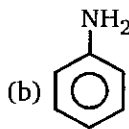
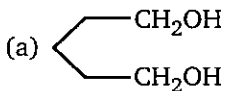
- (b) maleic acid  
(d) Succinic acid

31.  $\text{Br}-\text{CH}_2(\text{CH}_2)_n-\text{Br} + \text{CH}_2(\text{CO}_2\text{Et})_2 \xrightarrow[\text{EtOH}]{\text{NaOEt}}$  cyclic product

At which value of  $n$  the formation of six membered ring takes place ?

- (a)  $n = 2$                       (b)  $n = 3$                       (c)  $n = 5$                       (d)  $n = 6$

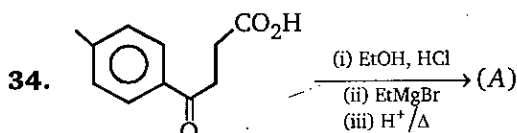
32. Product of the reaction is :



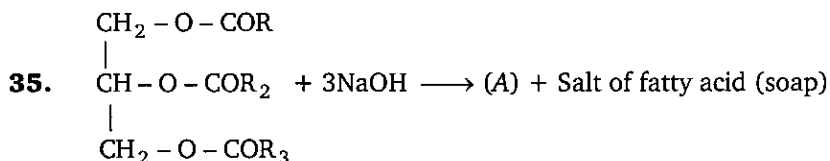
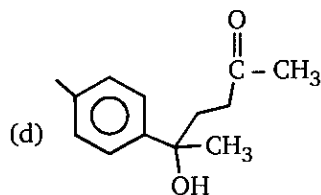
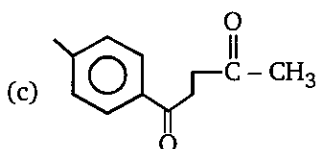
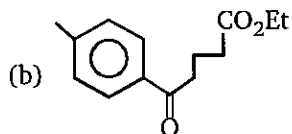
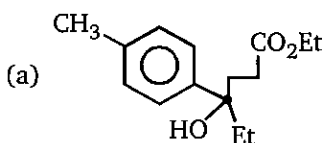
33. Product of the reaction is :

- (a) *cis*-anhydride  
(c) both (a) & (b)

- (b) *trans*-anhydride  
(d) mono-basic acid

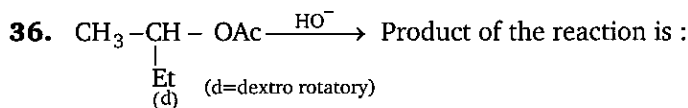


Product (A) of the reaction is :

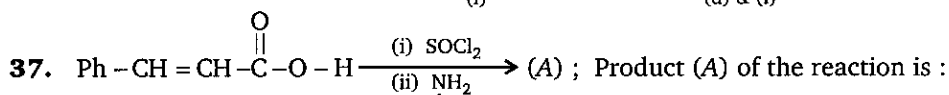


Product (A) of the reaction is :

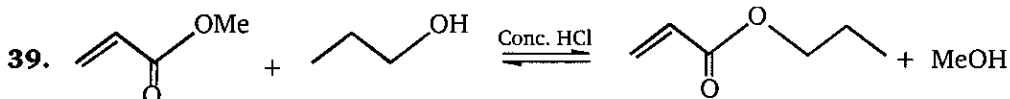
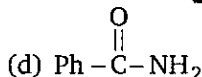
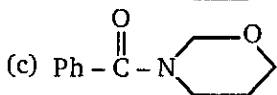
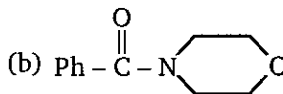
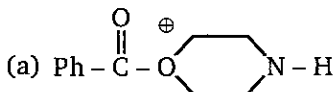
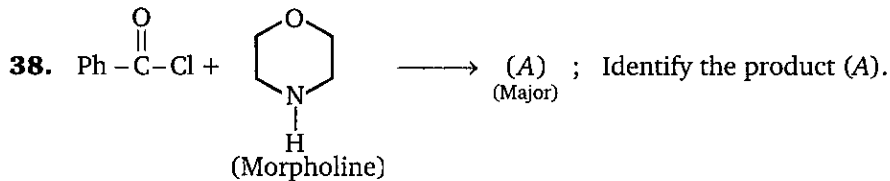
- (a) Ethylene glycol  
(c) Glyceroltrinitrate (explosive)
- (b) Glycerol  
(d) Cumene hydrogen peroxide



- (a) 
$$\begin{array}{c} \text{CH}_3 - \text{CH} - \text{OH} \\ | \\ \text{Et} \\ \text{(d)} \end{array}$$
 (b) 
$$\begin{array}{c} \text{CH}_3 - \text{CH} - \text{OH} \\ | \\ \text{Et} \\ \text{(l)} \end{array}$$
 (c) 
$$\begin{array}{c} \text{CH}_3 - \text{CH} - \text{OH} \\ | \\ \text{Et} \\ \text{(d) \& (l)} \end{array}$$
 (d) 
$$\begin{array}{c} \text{CH}_3 - \text{C} = \text{CH}_2 \\ | \\ \text{CH}_3 \end{array}$$



- (a) 
$$\text{Ph} - \text{CH} = \text{CH} - \overset{\text{O}}{\parallel} \text{C} - \text{CH}_2 - \text{NH} - \text{Cyclopropyl}$$
 (b) 
$$\text{Ph} - \text{CH} = \text{CH} - \overset{\text{O}}{\parallel} \text{C} - \text{NH} - \text{Cyclopropyl}$$
- (c) 
$$\text{Ph} - \text{CH} = \text{CH} - \overset{\text{O}}{\parallel} \text{C} - \text{H}$$
 (d) 
$$\text{Ph} - \text{CH} = \text{CH} - \text{NH} - \text{Cyclopropyl}$$



Above reaction is an example of :

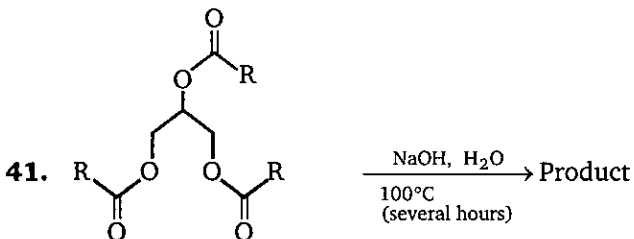
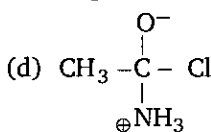
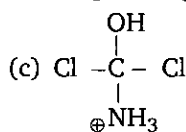
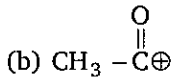
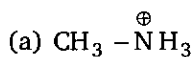
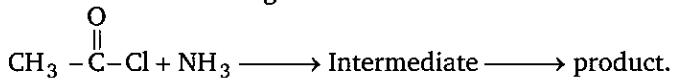
(a) Esterification

(b) Saponification

(c) Hydrolysis

(d) Trans Esterification

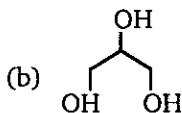
40. Which of the following is an intermediate formed in the reaction shown below ?



(Principal component of coconut oil.)

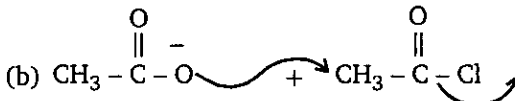
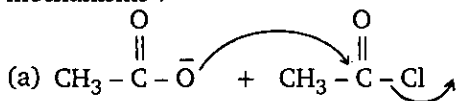
Product is obtained in the above reaction is :

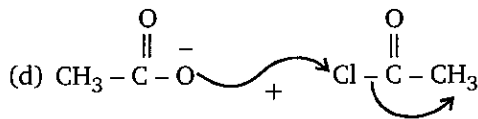
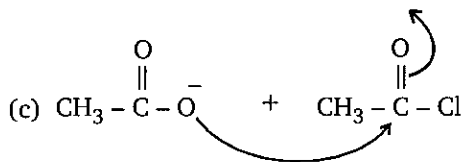
(a)  $\text{R}-\text{CO}_2\text{Na}$



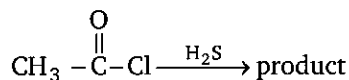
(c) Both (a) and (b) (d) None of these

42. The reaction of sodium acetate with acetyl chloride proceeds through which of the following mechanisms ?



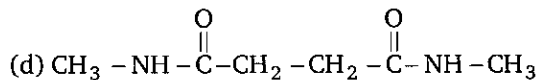
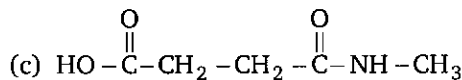
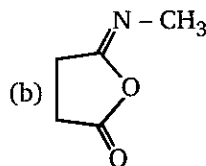
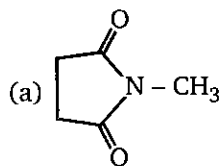
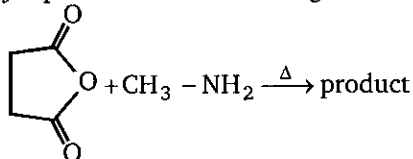


43. Which is the major product of the following reaction ?

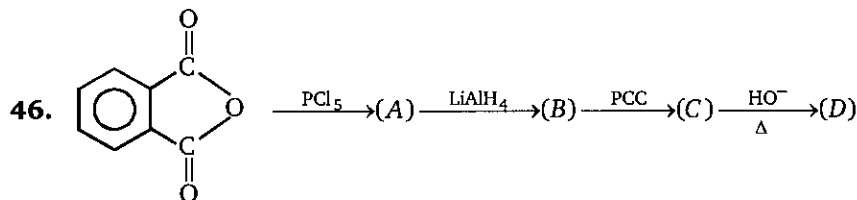
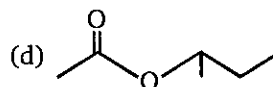
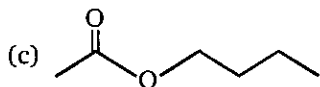
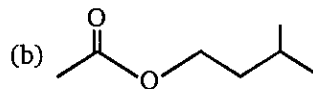
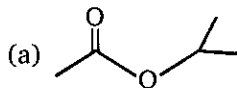


- (a)  $\text{CH}_3-\overset{\text{OH}}{\underset{\text{SH}}{\text{C}}}-\text{Cl}$       (b)  $\text{CH}_3-\overset{\text{O}}{\parallel}{\text{C}}-\text{SH}$       (c)  $\text{CH}_3-\overset{\text{S}}{\parallel}{\text{C}}-\text{Cl}$       (d)  $\text{CH}_3-\overset{\text{O}}{\parallel}{\text{C}}-\text{S}-\overset{\text{O}}{\parallel}{\text{C}}-\text{CH}_3$

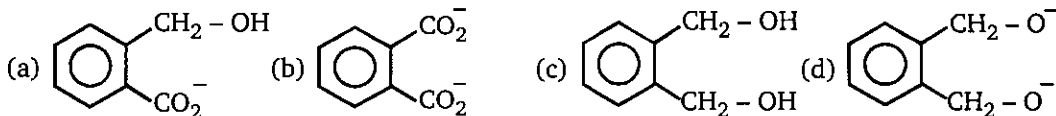
44. Which is the major product of the following reaction ?



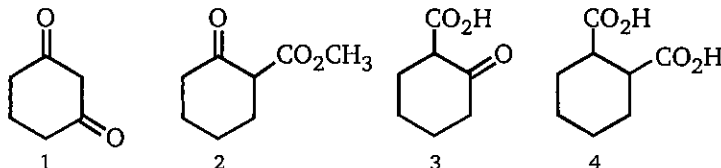
45. Ethanoic acid + 3-methyl-1-butanol  $\xrightleftharpoons[\text{traces H}_2\text{SO}_4]{}$  (A); Compound (A) is :





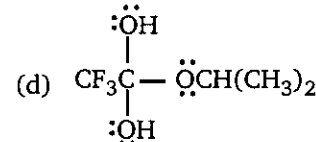
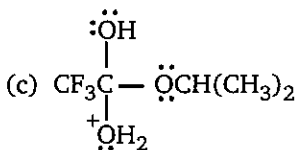
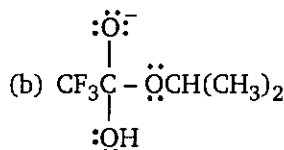
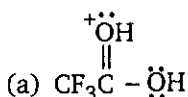
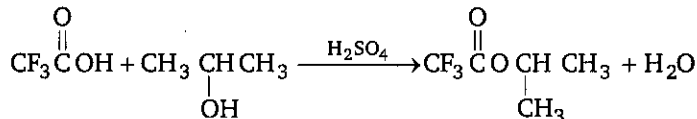


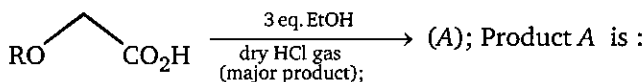
47. Which of the following compounds will undergo decarboxylation on heating ?

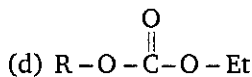
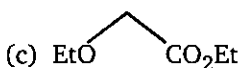
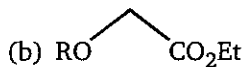
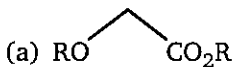


(a) 2 and 3 (b) 3 and 4 (c) 3 only (d) 1 and 4

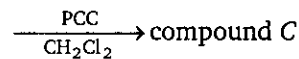
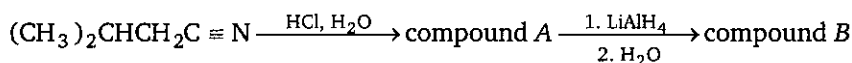
48. Which one of the following is not an intermediate in the generally accepted mechanism for the reaction shown below ?

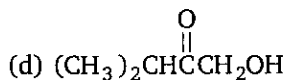
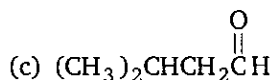
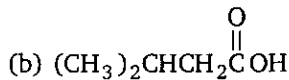
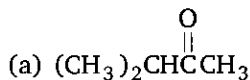


49.  (A); Product A is :

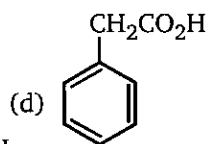
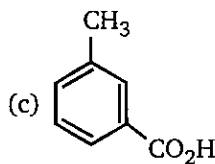
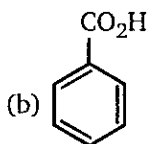
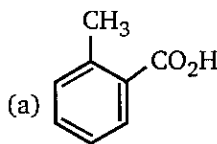
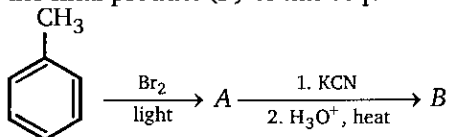


50. Identify the compound C in the following sequence :

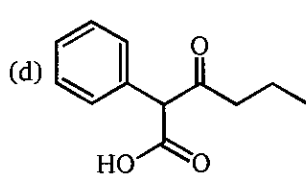
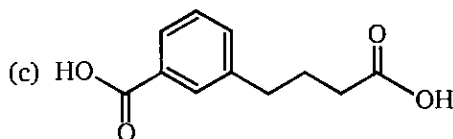
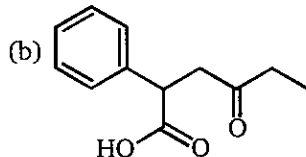
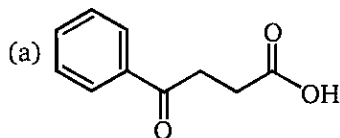




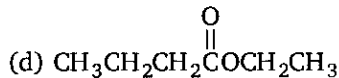
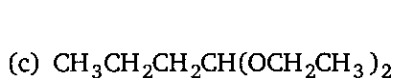
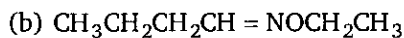
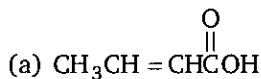
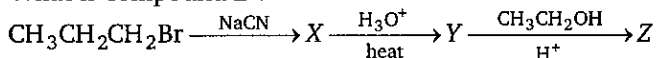
51. What is the final product (B) of this sequence ?

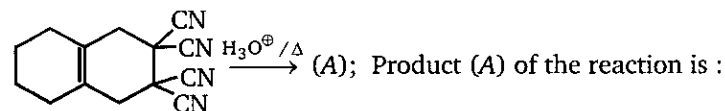


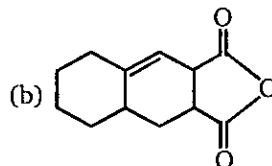
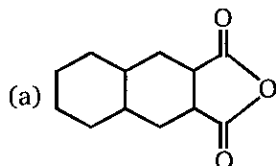
52. Which of the following undergoes decarboxylation most readily on being heated ?

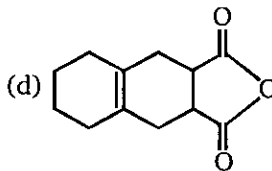
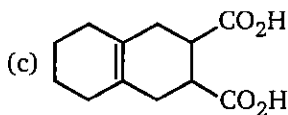


53. What is compound Z ?

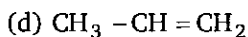
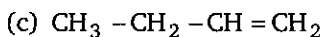
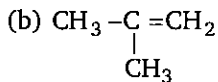


54.  (A); Product (A) of the reaction is :

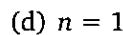
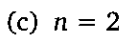
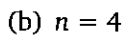
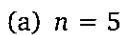




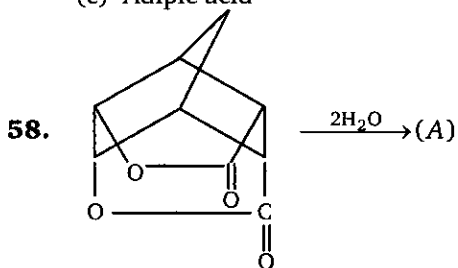
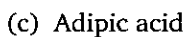
55.  $\text{CH}_3 - \text{CH} = \text{CH} - \text{CH}_2 - \text{CO}_2\text{H} \xrightarrow{\Delta} (X)$  (major); Product (X) is :



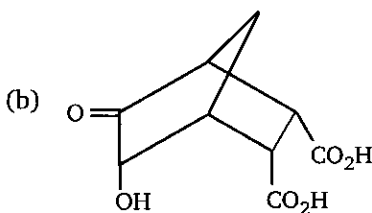
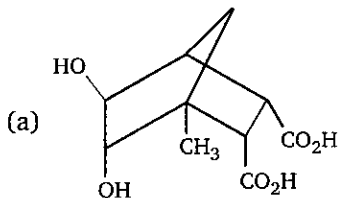
56.  $\text{H} - \text{O} - \overset{\text{O}}{\parallel}{\text{C}} - (\text{CH}_2)_n - \overset{\text{O}}{\parallel}{\text{C}} - \text{O} - \text{H} \xrightarrow{\Delta}$  product, At what value of (n) given compound will not evolve  $\text{CO}_2$  gas ?

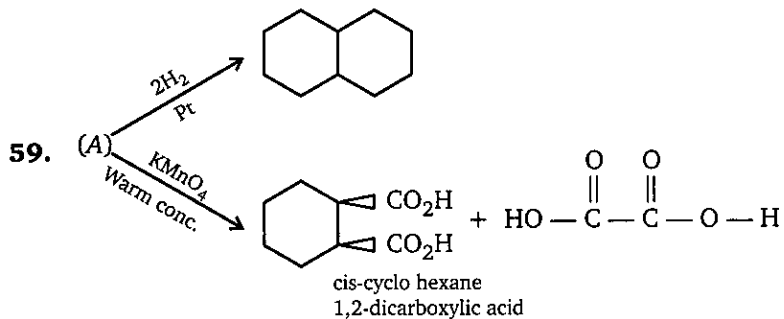
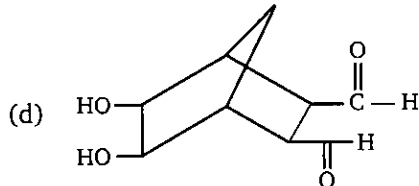
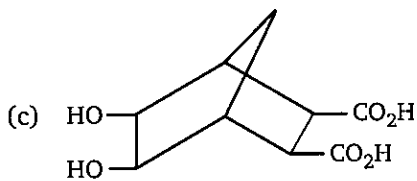


57.  $\text{CO}_2\text{H} - (\text{CH}_2)_n - \text{CO}_2\text{H}$ ; If ( $n = 4$ ) then di-carboxylic acid would be known as :

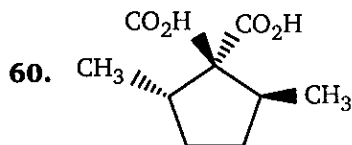
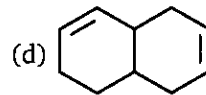
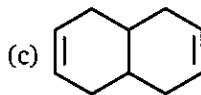
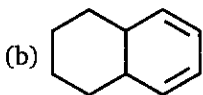
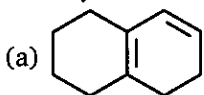


Product (A) of the above reaction is :





Identify (A).



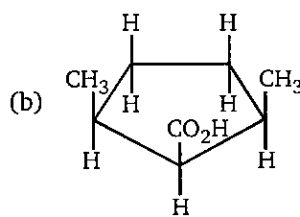
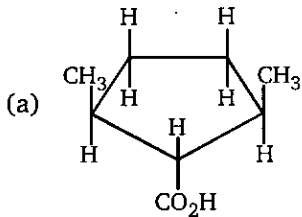
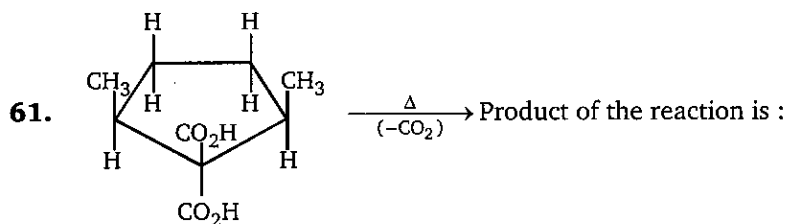
How many product will be formed when above compound undergo de-carboxylation?

(a) 0

(b) 1

(c) 2

(d) 3



(c) Both (a) and (b)

(d) none of these



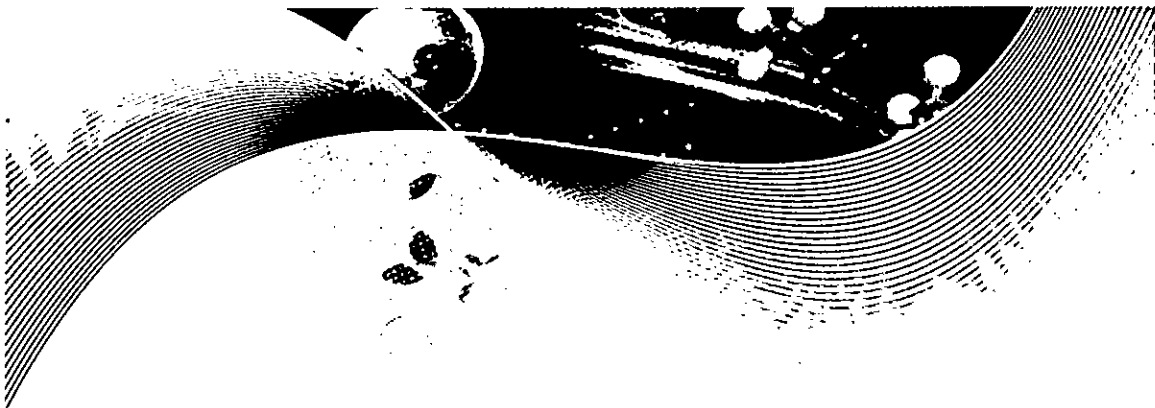
# LEVEL-2

## 1. Match the Column (I) and (II). (Matrix)

Column (I)		Column (II)	
Reaction		Products formed	
(a)	$\xrightarrow{\Delta}$	(p)	Diastereomers
(b)	$\xrightarrow{\Delta}$	(q)	Racemic mixture
(c)	$\xrightarrow{\Delta}$	(r)	Meso compound
(d)	$\xrightarrow{\Delta}$	(s)	CO <sub>2</sub> gas will evolve

### ANSWERS — LEVEL 2

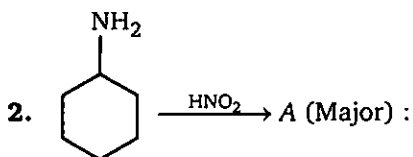
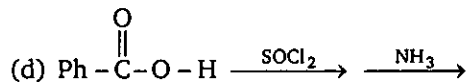
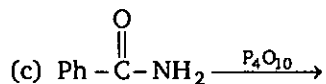
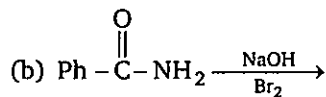
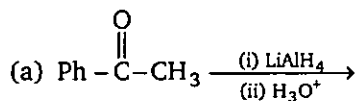
1. a - p, s; b - q, s; c - p, s; d - r



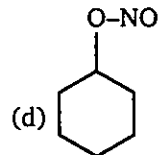
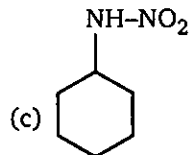
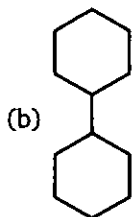
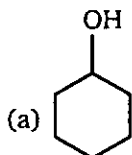
# 10 AMINES

## LEVEL - 1

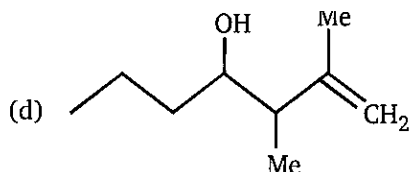
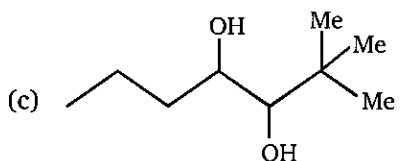
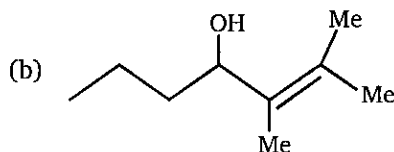
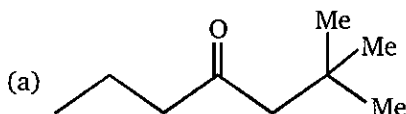
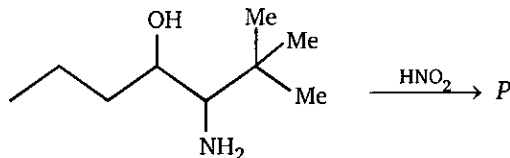
1. In which of the following reaction cyanide will be obtained as a major product ?



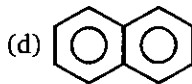
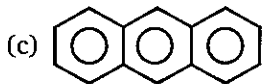
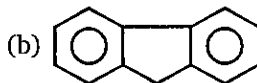
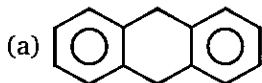
Product (A) is :



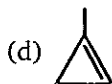
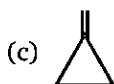
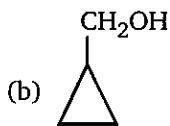
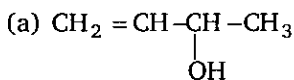
3. Which of the following alkene cannot be prepared by de-amination of  $n\text{-Bu-NH}_2$  with  $\text{NaNO}_2/\text{HCl}$ ? (n-Butyl)
- (a) 1-butene      (b) *cis*-2-butene      (c) *trans*-2-butene      (d) Iso-butene
4. Predict the major product  $P$  in the following reaction.



5. Product of this reaction is :

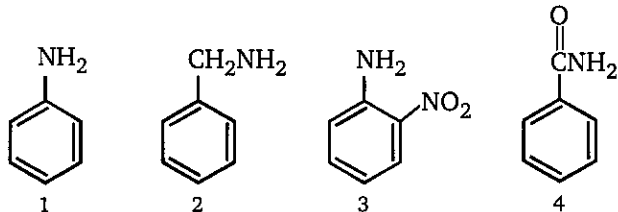


6. +  $\text{CH}_2 = \text{CH}-\text{CH}_2-\text{CH}_2-\text{OH}$
- A will be :

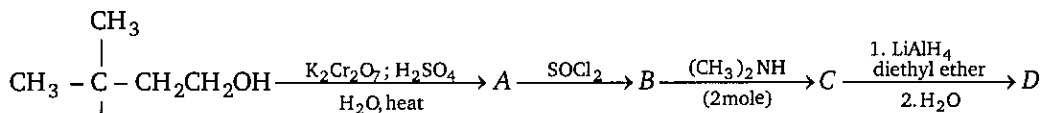




7. Which of the following isomers of  $C_8H_9NO$  is the weakest base ?  
 (a) *o*-Aminoacetophenone (b) *p*-Aminoacetophenone  
 (c) *m*-Aminoacetophenone (d) Acetanilide
8. Rank the following compounds in order of increasing basic strength. (weakest  $\rightarrow$  strongest) :

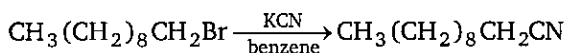


- (a)  $4 < 2 < 1 < 3$  (b)  $4 < 3 < 1 < 2$   
 (c)  $4 < 1 < 3 < 2$  (d)  $2 < 1 < 3 < 4$
9. Which of the following arylamines will not form a diazonium salt on reaction with sodium nitrite in hydrochloric acid ?  
 (a) *m*-Ethylaniline (b) *p*-Aminoacetophenone  
 (c) 4-Chloro-2-nitroaniline (d) *N*-Ethyl-2-methylaniline
10. Identify product *D* in the following reaction sequence :



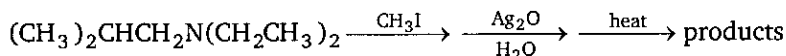
- (a)  $\text{CH}_3\underset{\begin{array}{c} | \\ \text{CH}_3 \\ | \\ \text{CH}_3 \end{array}}{\text{C}}\text{CH}_2\text{C} \equiv \text{N}$  (b)  $\text{CH}_3\underset{\begin{array}{c} | \\ \text{CH}_3 \end{array}}{\text{C}}\text{CH}_2\text{CH}_2\text{N}(\text{CH}_3)_2$   
 (c)  $\text{CH}_3\underset{\begin{array}{c} | \\ \text{CH}_3 \end{array}}{\text{C}}\text{CH}_2\underset{\begin{array}{c} | \\ \text{N}(\text{CH}_3)_2 \end{array}}{\text{CHN}}(\text{CH}_3)_2$  (d)  $\text{CH}_3\underset{\begin{array}{c} | \\ \text{CH}_3 \end{array}}{\text{C}}\text{CH}_2\underset{\begin{array}{c} | \\ \text{OH} \end{array}}{\text{CHN}}(\text{CH}_3)_2$

11. Which one of the following is best catalyst for the reaction shown below ?



- (a) (b)   
 (c) (d)

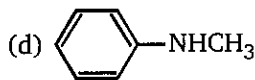
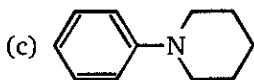
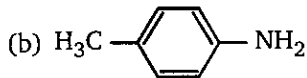
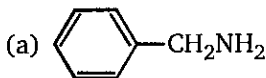
12. The major products obtained from the following sequence of reactions are :



- (a)  $(\text{CH}_3)_2\text{CHCH}_2\text{NH}_2 + \text{H}_2\text{C} = \text{CH}_2$       (b)  $(\text{CH}_3)_2\text{NCH}_2\text{CH}_3 + \text{H}_2\text{C} = \text{C}(\text{CH}_3)_2$

- (c)  $(\text{CH}_3)_2\text{CHCH}_2\overset{\text{CH}_3}{\underset{|}{\text{N}}}\text{CH}_2\text{CH}_3 + \text{H}_2\text{C} = \text{CH}_2$       (d)  $(\text{CH}_3)_3\overset{+}{\text{N}}\text{CH}_2\text{CH}_3\text{I}^- + \text{H}_2\text{C} = \text{CH}_2$

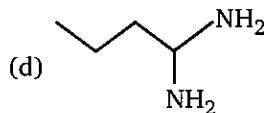
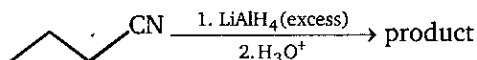
13. Which amine yields *N*-nitroso amine after treatment with nitrous acid ( $\text{NaNO}_2, \text{HCl}$ ) ?



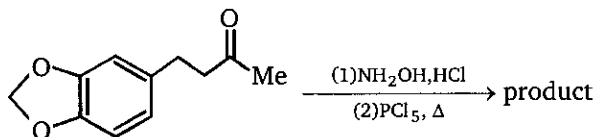
14.  $\xrightarrow{\text{HNO}_2} (A)$ ; Product (A) is :

- (a) cyclopentane carboxyaldehyde      (b) cyclohexane-1, 2-diol  
(c) 2-aminocyclohexene      (d) cyclohex-2-enol

15. Choose the appropriate product for this reaction.



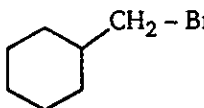
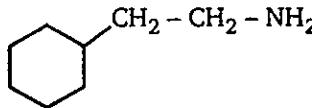
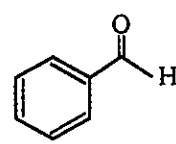
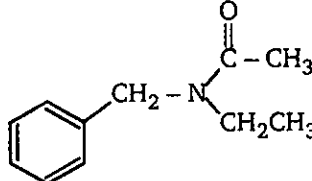
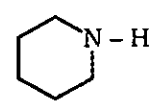
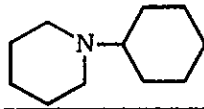
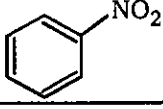
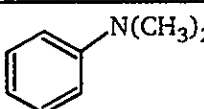
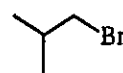
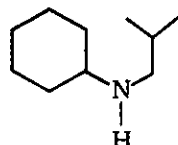
16. Which of the following product will be obtained in the given (consider minor product also) Beckmann-type rearrangement ?






# LEVEL - 2

1. Five amine syntheses are outlined below. In each reaction box enter a single letter designating the best reagent and conditions selected from the list at the bottom of the page.

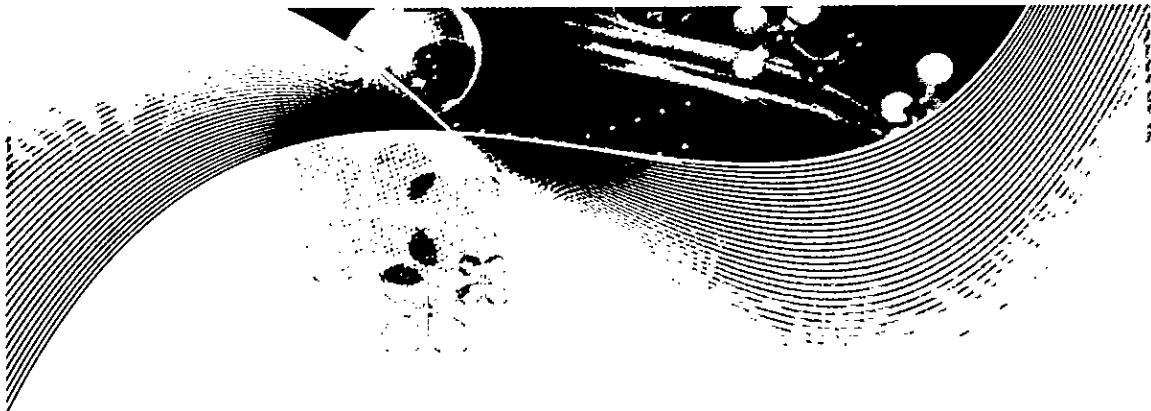
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<b>B.</b>		First Step <input style="width: 40px; height: 20px;" type="text"/> Second Step <input style="width: 40px; height: 20px;" type="text"/> Third Step <input style="width: 40px; height: 20px;" type="text"/>	
<b>C.</b>		First Step <input style="width: 40px; height: 20px;" type="text"/> Second Step <input style="width: 40px; height: 20px;" type="text"/>	
<b>D.</b>		First Step <input style="width: 40px; height: 20px;" type="text"/> Second Step <input style="width: 40px; height: 20px;" type="text"/>	
<b>E.</b>		First Step <input style="width: 40px; height: 20px;" type="text"/> Second Step <input style="width: 40px; height: 20px;" type="text"/> Third Step <input style="width: 40px; height: 20px;" type="text"/> Fourth Step <input style="width: 40px; height: 20px;" type="text"/>	

<b>(a)</b>	(i) $\text{LiAlH}_4$ in ether      (ii) $\text{H}_2\text{O}$ & base	
<b>(b)</b>	$\text{C}_2\text{H}_5\text{NH}_2$ (cat. $\text{H}^{(+)}$ )	
<b>(c)</b>	$\text{NaCN}$ in alcohol	
<b>(d)</b>	$\text{H}_2$ & Ni catalyst or $\text{H}_2$ & Pd catalyst	
<b>(e)</b>	$\text{NaN}_3$ in alcohol	
<b>(f)</b>	$(\text{CH}_3\text{CO})_2\text{O}$ & pyridine	
<b>(g)</b>	$\text{C}_2\text{H}_5\text{Br}$	

(h)	 , $\text{H}^{\oplus}$	
(i)	$2\text{CH}_3\text{I}$ & pyridine	
(j)	KOH in $\text{H}_2\text{O}$	

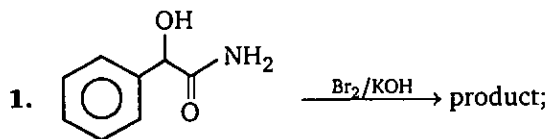
## ANSWERS — LEVEL 2

1. A - c, a or c, d; B - b, d, f; C - h, d; D - d, i or a, i; E - e, a, h, a



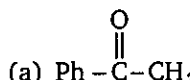
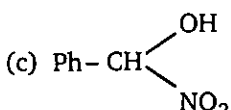
# 11 CARBENE AND NITRENE

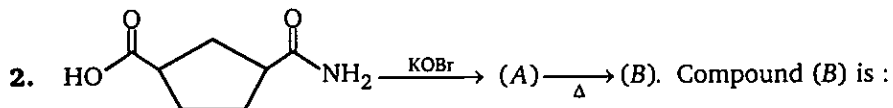
## LEVEL - 1

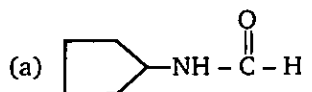
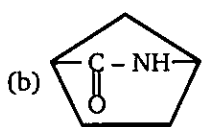
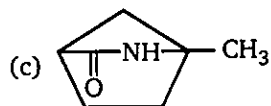
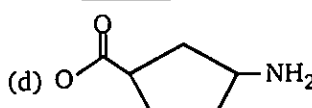


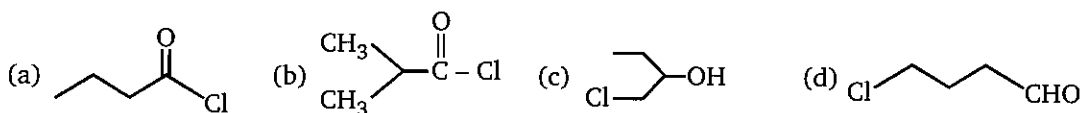
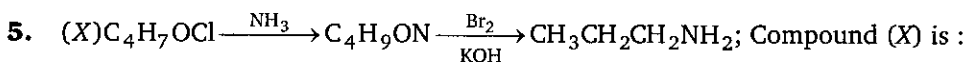
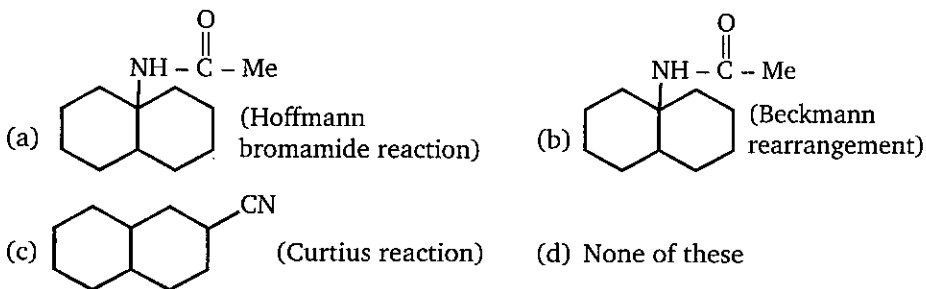
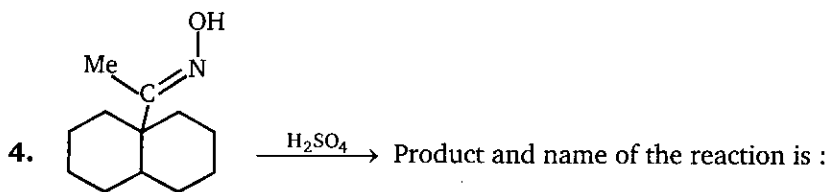
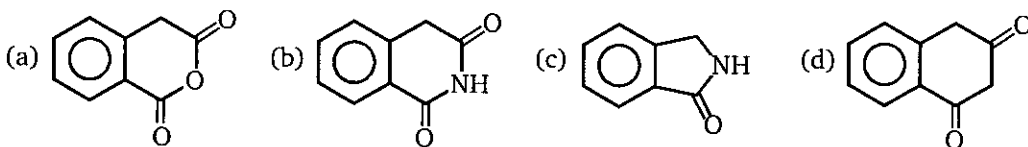
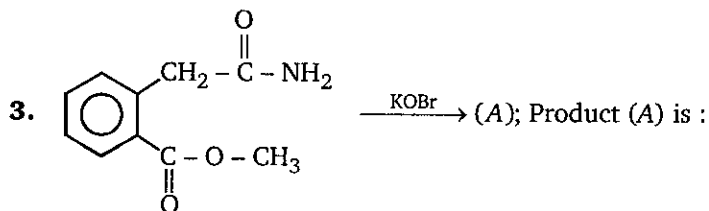
( $\alpha$ -hydroxy amide)

Product of this Hoffmann bromamide reaction is :

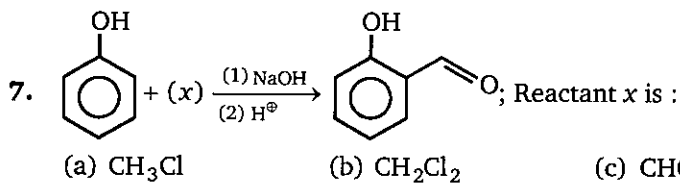
- (a)  (b) Ph - CHO (c)  (d) Ph - CH<sub>2</sub> - NH<sub>2</sub>

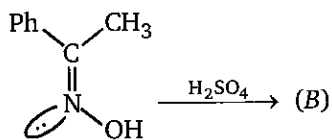
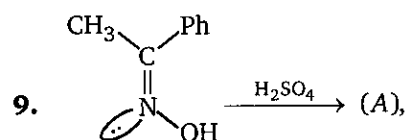
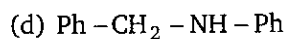
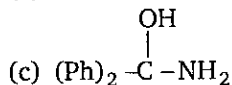
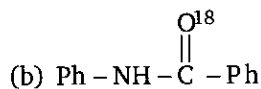
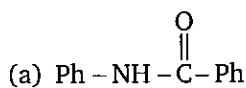
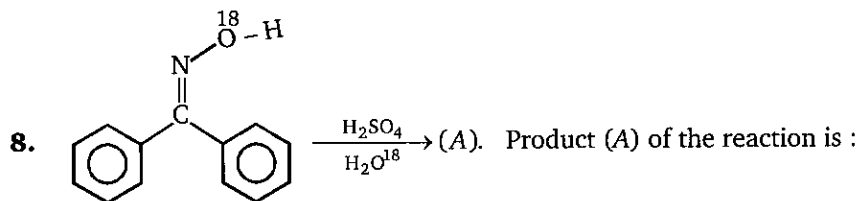


- (a)  (b) 
- (c)  (d) 

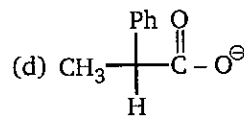
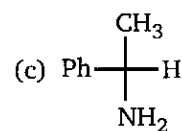
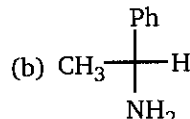
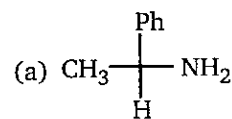
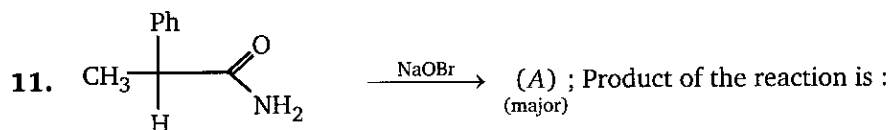
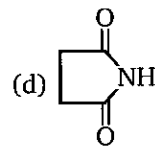
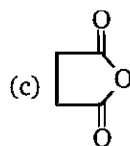
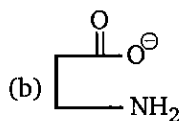
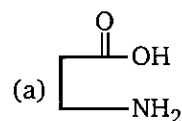
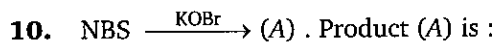
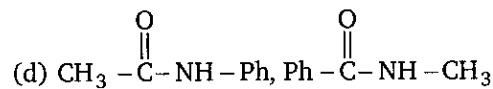
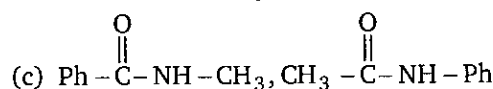
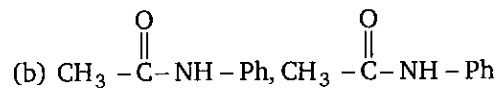
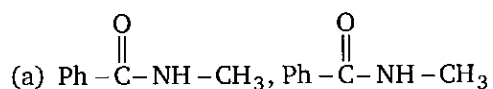


6. Which of the following will not give Hoffmann bromamide reaction ?

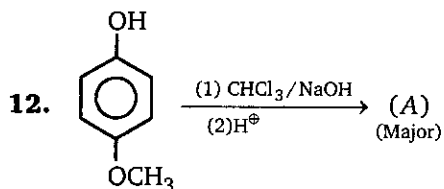




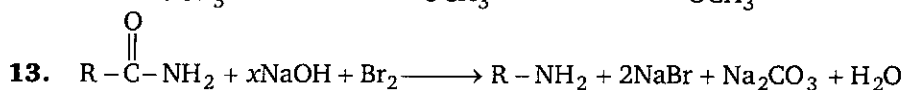
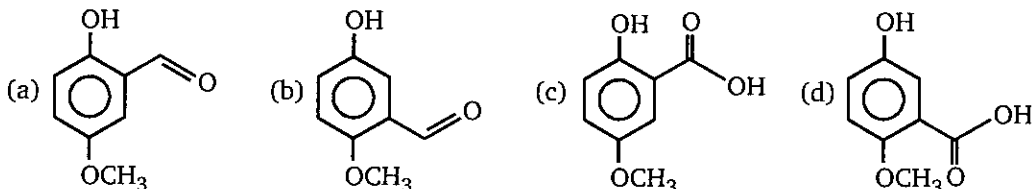
Product (A) & (B) respectively in the above reaction are :





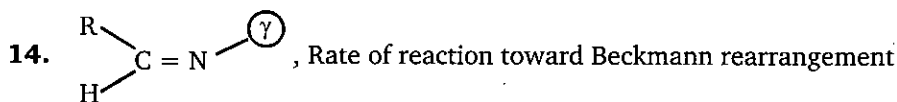


Product (A) is :



Number of moles of NaOH used in above Hoffmann bromamide reaction is :

- (a) 3 (b) 4 (c) 5 (d) 6



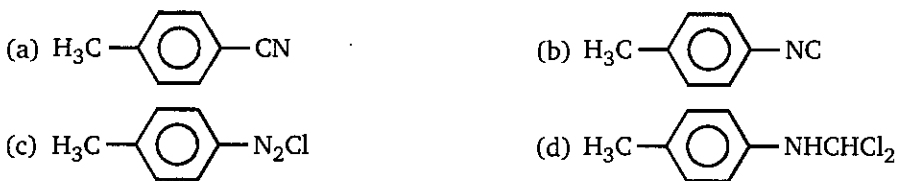
when  $\gamma = CH_3CO_2^-$  (i),  $Cl-CH_2-CO_2^-$  (ii),  $Ph-SO_3^-$  (iii)

- (a) (i) > (ii) > (iii) (b) (ii) > (i) > (iii)  
 (c) (iii) > (ii) > (i) (d) (iii) > (i) > (ii)

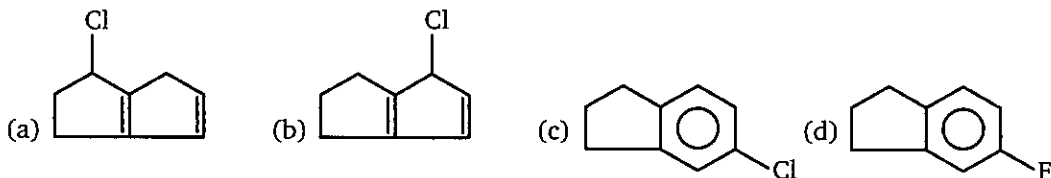
15. When primary amine reacts with chloroform in ethanolic KOH, then product is :

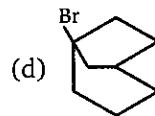
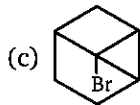
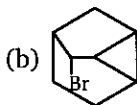
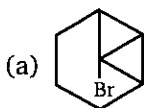
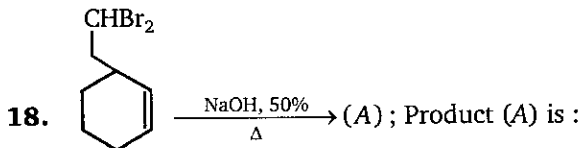
- (a) an isocyanide (b) an aldehyde  
 (c) a cyanide (d) an alcohol

16. The reaction of chloroform with alcoholic KOH and *p*-toluidine forms :

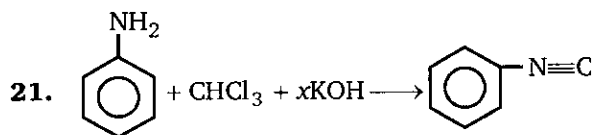
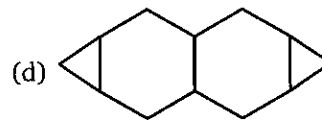
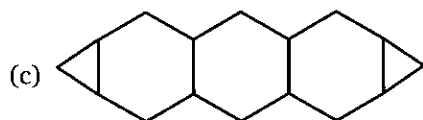
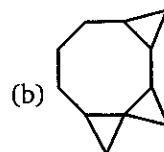
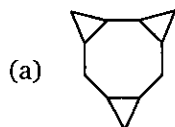
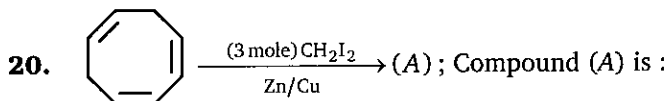
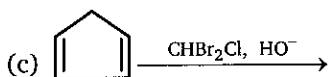
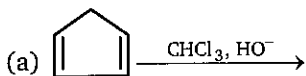


17. What is the product (Q) of the following reaction ?





19. Which of the following reaction, does not give chloro benzene as a product ?



$x$  = moles of KOH consumed is :

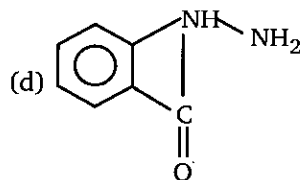
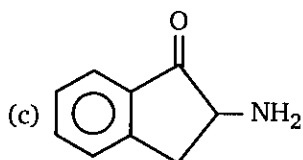
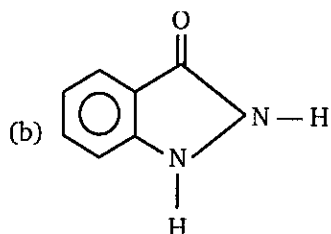
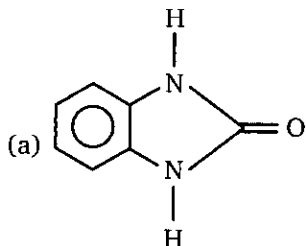
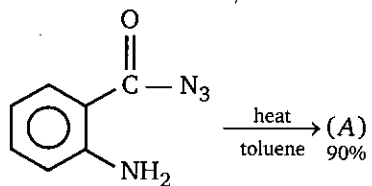
(a) 1

(b) 2

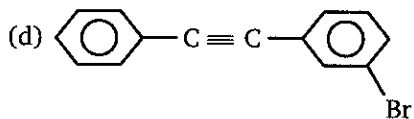
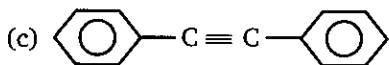
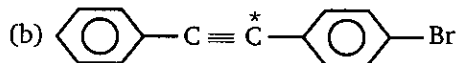
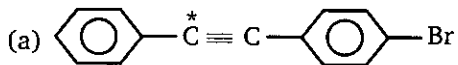
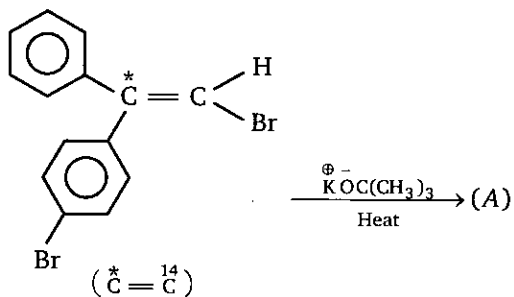
(c) 3

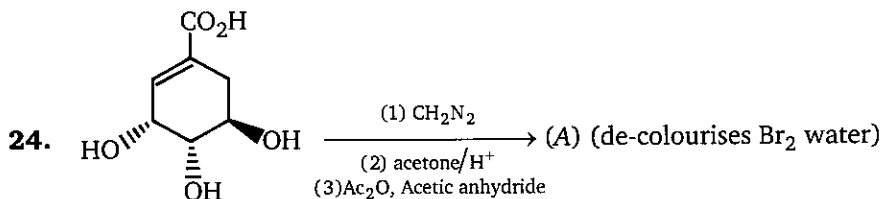
(d) 4

22. Heating the acyl azide in dry toluene under reflux for 3-hours give a 90% yield for a heterocyclic product. Identify the product (A).

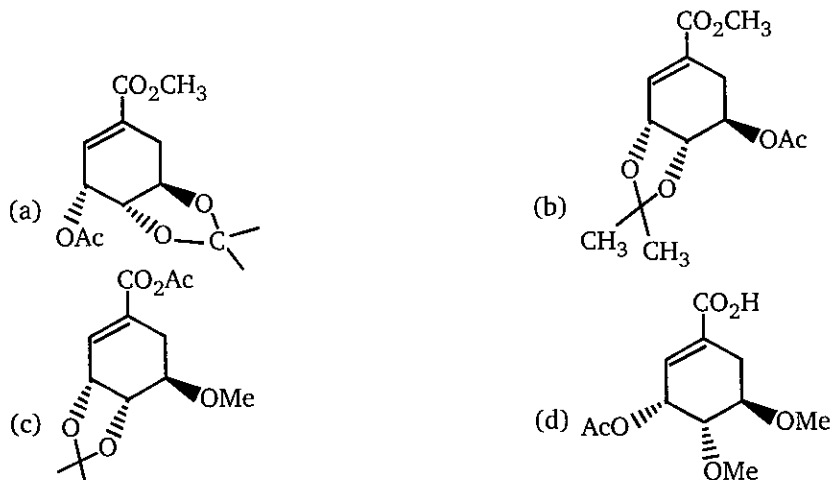


23.

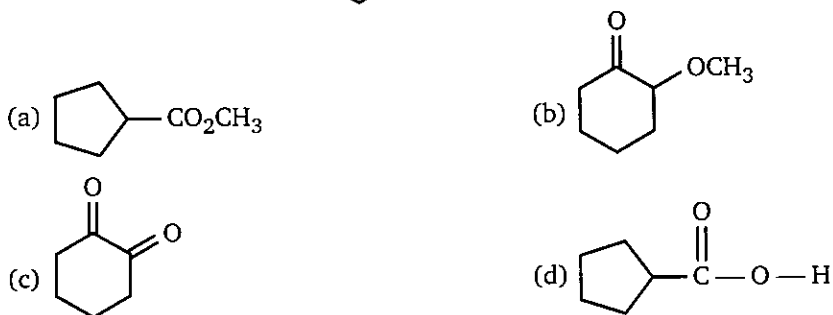
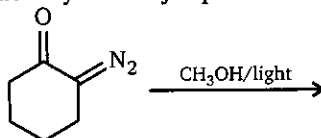




Product (A) of the above reaction is :

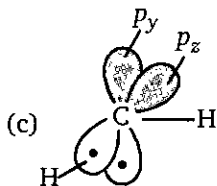


25. A rather interesting example of the Wolff rearrangement with 2-diazocyclohexanone in methanol is given below. Identify the major product :



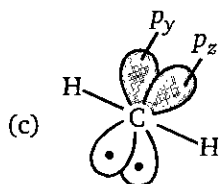
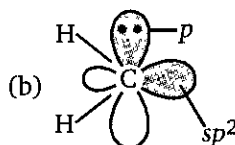
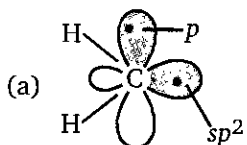
26. The orbital picture of a singlet carbene ( $:\text{CH}_2$ ) can be drawn as :



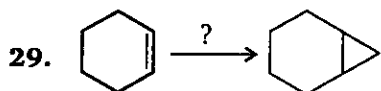
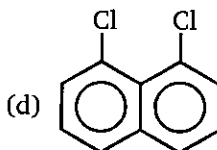
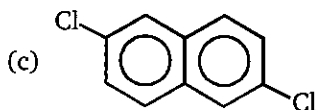
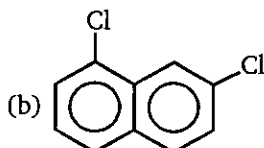
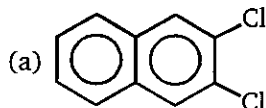
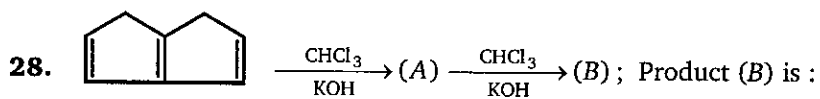


(d) none of these

27. The orbital picture of a triplet carbene can be drawn as :



(d) none of these



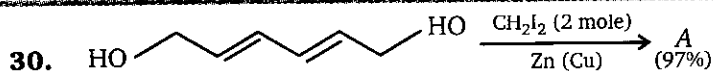
Select the suitable reagent for above conversion.

(a)  $\text{CH}_2\text{N}_2 / \Delta$

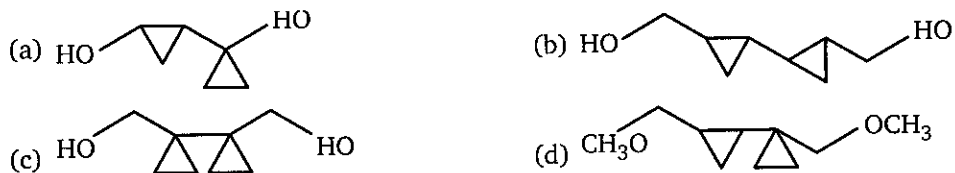
(b)  $\text{CBr}_4 / \text{RLi}$

(c)  $\text{H}_2\text{C} = \text{CH}_2$

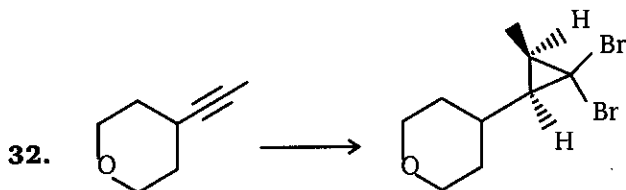
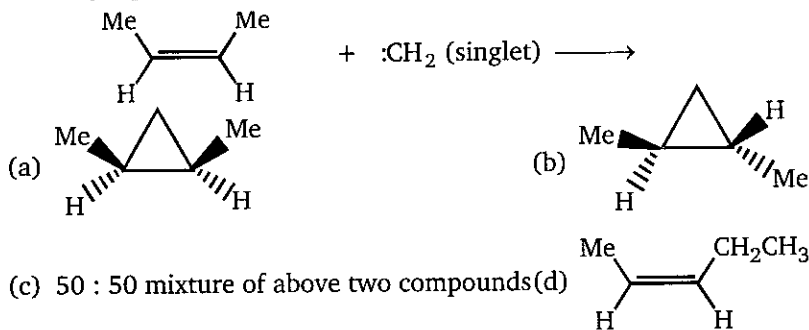
(d) *t*-BuOK



Product (A) will be :

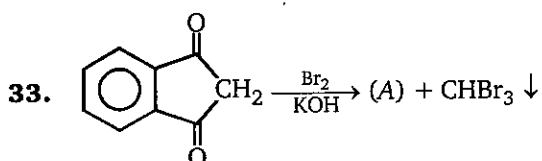


31. The major product formed in the following reaction is

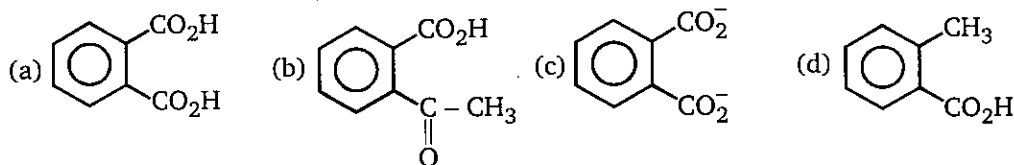


To carry out above conversion reagent used in decreasing order.

- (a)  $\text{Na/liq. NH}_3, \text{CHBr}_3/\text{NaOH}(\Delta)$  (b)  $\text{H}_2/\text{Pd} - \text{CaCO}_3, \text{CHBr}_3/\text{NaOH}(\Delta)$   
 (c)  $\text{Na/liq. NH}_3, \text{CHCl}_3/\text{NaOH}$  (d)  $\text{H}_2/\text{Pd} - \text{CaCO}_3, \text{CHCl}_3/\text{NaOH}$



Product (A) of the reaction is :

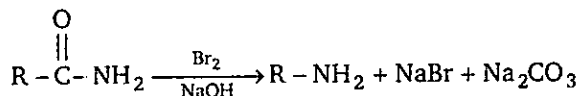




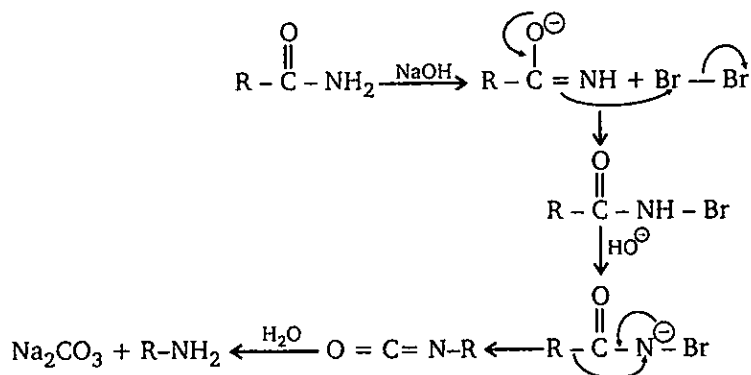
## LEVEL-2

## 1. Comprehension

Hoffmann bromamide reaction involves conversion of a carboxylic acid amide into an amine with a loss of a carbon atom on treatment with aqueous sodium hypobromite. Thus Hoffmann result in shortening of a carbon chain.

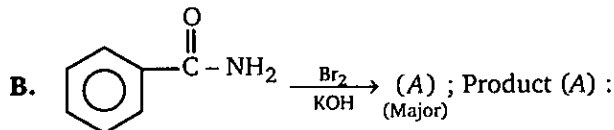


Mechanism of the reaction is :



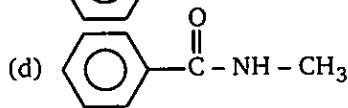
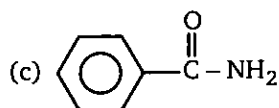
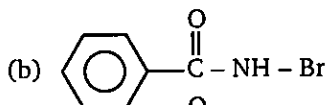
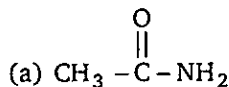
A. Number of moles of NaOH consumed in above reaction.

- (a) 1                      (b) 2                      (c) 3                      (d) 4

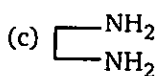
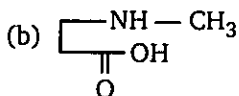
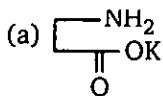
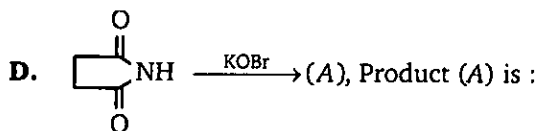


- (a) Ph-NH<sub>2</sub>              (b) Ph-CH<sub>2</sub>-NH<sub>2</sub>      (c) Ph-NH-CH<sub>3</sub>      (d) Ph-N  $\begin{array}{l} \text{CH}_3 \\ \text{CH}_3 \end{array}$

C. Which of the following will not give Hoffmann bromamide reaction.



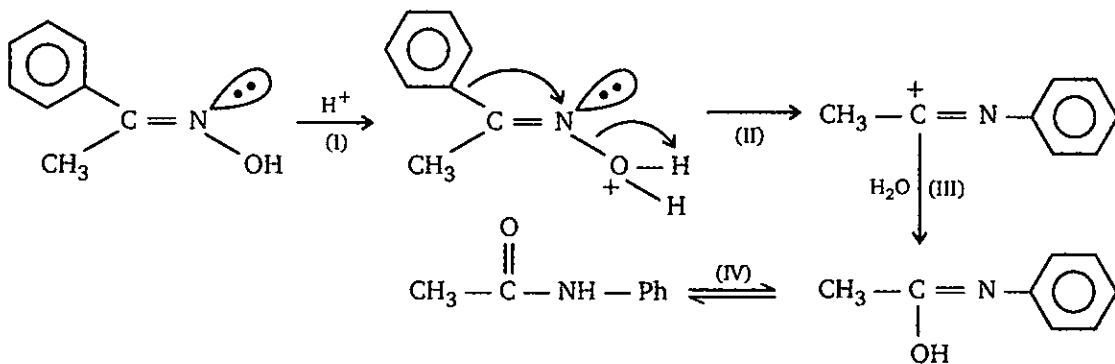




(d) None of these

2. Comprehension

Given is mechanism of Beckmann rearrangement.



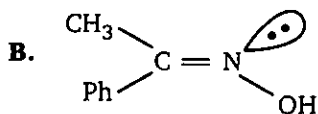
A. Rate determining step in Beckmann rearrangement :

(a) I

(b) II

(c) III

(d) IV



On treatment  $\text{H}_2\text{SO}_4$  followed by hydrolysis in acidic medium above compound gives.

(a)  $\text{CH}_3 - \text{CO}_2\text{H}$ ,  $\text{Ph} - \text{NH}_2$

(b)  $\text{CH}_3 - \text{NH}_2$ ,  $\text{Ph} - \text{CO}_2\text{H}$

(c)  $\text{Ph} - \text{CH}_2 - \text{NH}_2 + \text{Ph} - \text{CO}_2\text{H}$

(d)  $\text{Ph} - \text{CO}_2\text{H} + \text{CH}_3 - \text{CO}_2\text{H}$

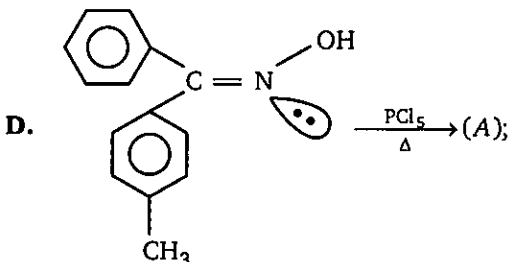
C. Which of the following reagent cannot used in Beckmann rearrangement ?

(a)  $\text{TsOH}$

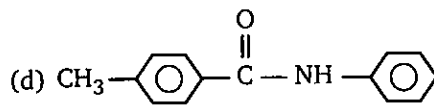
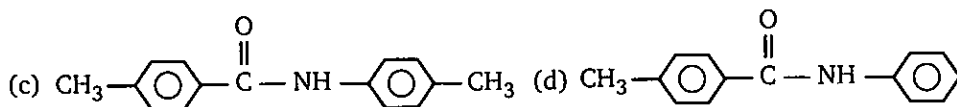
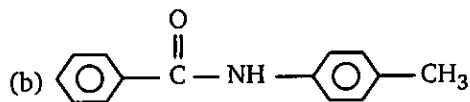
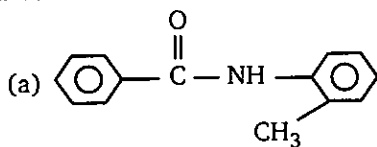
(b)  $\text{R} - \text{SO}_2\text{Cl}$

(c)  $\text{BF}_3$

(d)  $\text{Ph} - \text{Li}$



Product (A) of the above reaction is :



### 3. Match the column I and II.

Column (I)		Column (II)	
(a)		(p)	D.B.E. = even for product (Double bond equivalent)
(b)		(q)	D.B.E. = odd for product
(c)		(r)	Ring expansion takes place
(d)		(s)	Carbene will be formed

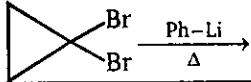
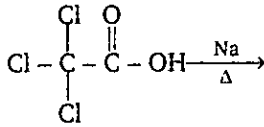
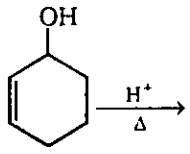
4. Match the column I and II.

Column (I)		Column (II)	
(a)		(p)	Reimer Tiemann reaction
(b)		(q)	Reimer Tiemann expansion (or) Abnormal RNT reaction
(c)		(r)	Simman-smith reaction.
(d)		(s)	Increase in carbon takes place

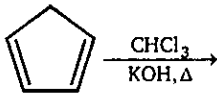
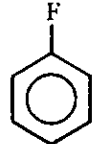

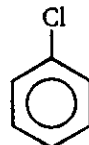
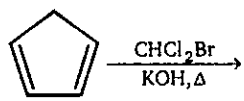
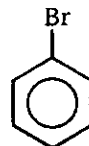
5. Match the column I and II.

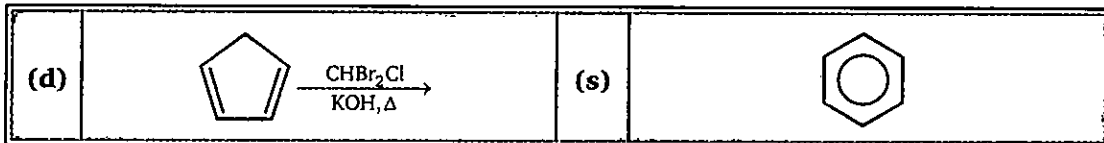
Column (I)		Column (II)	
(a)		(p)	Aromatic compound will formed
(b)		(q)	Migration take place from carbon to electron deficient nitrogen
(c)		(r)	Carbene will formed in this reaction
(d)		(s)	N2 will evolve.

6. Match the column I and II:

Column (I)		Column (II)	
Reaction		Intermediate	
(a)	$\text{CHCl}_3 + \text{KOH} \xrightarrow{\Delta}$	(p)	Carbocation
(b)		(q)	Carbanion
(c)		(r)	Free radical
(d)		(s)	Carbene

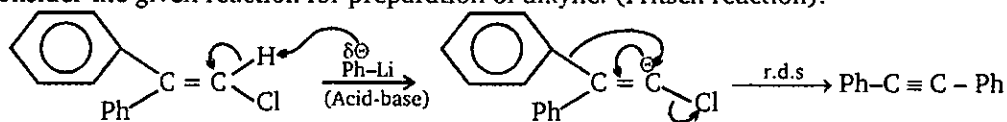
7. Matrix :

Column (I)		Column (II)	
Reaction		Product	
(a)		(p)	
(b)		(q)	
(c)		(r)	

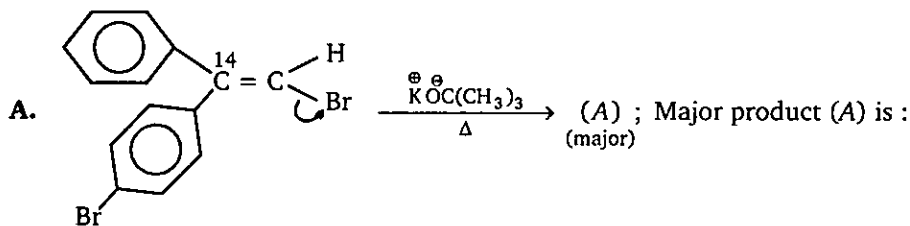


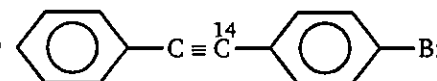
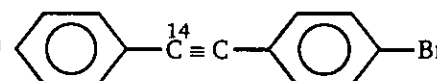
**8. Comprehension**

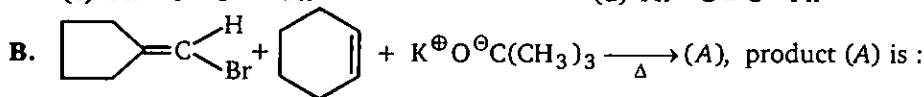
1. Consider the given reaction for preparation of alkyne. (Fritsch reaction).

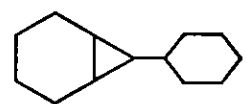
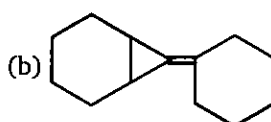
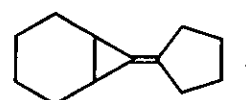



Anti group will migrate because of less steric hindrance.



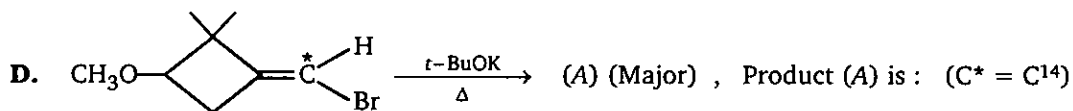
- (a)  (b)   
 (c)  $\text{Ph} - \text{C} \equiv \text{C}^{14} - \text{Ph}$  (d)  $\text{Ph} - \text{C} \equiv \text{C} - \text{Ph}$

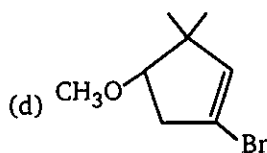
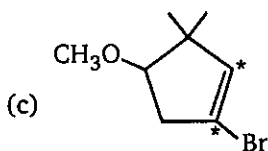
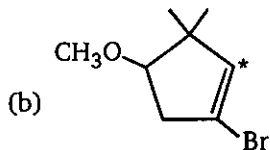
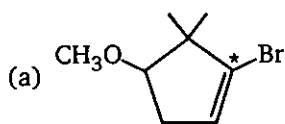


- (a)  (b)   
 (c)  (d) 

C. Rate of reaction when the halide ion:

- (a)  $\text{I}^\ominus > \text{Cl}^\ominus > \text{Br}^\ominus > \text{F}^\ominus$  (b)  $\text{I}^\ominus > \text{Br}^\ominus > \text{Cl}^\ominus > \text{F}^\ominus$   
 (c)  $\text{F}^\ominus > \text{Cl}^\ominus > \text{Br}^\ominus > \text{I}^\ominus$  (d)  $\text{F}^\ominus > \text{Br}^\ominus > \text{Cl}^\ominus > \text{I}^\ominus$



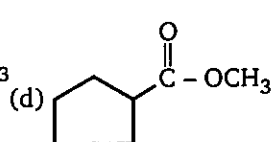
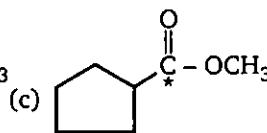
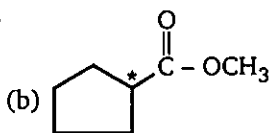
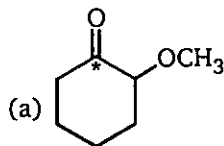
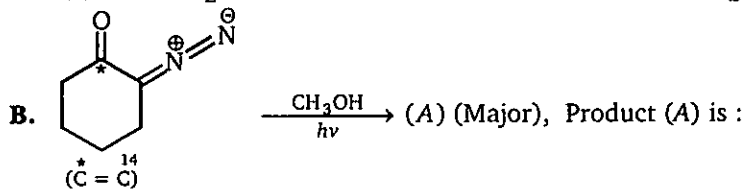
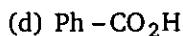
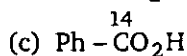
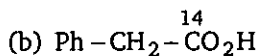
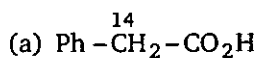
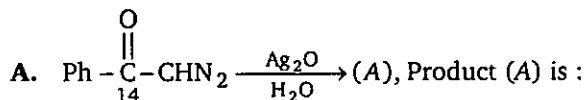
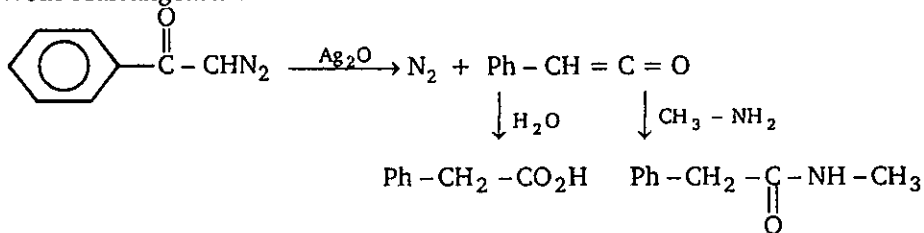


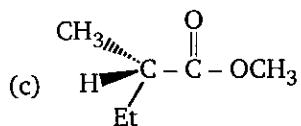
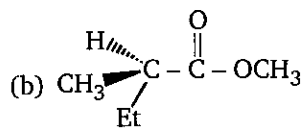
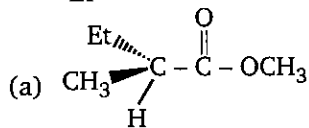
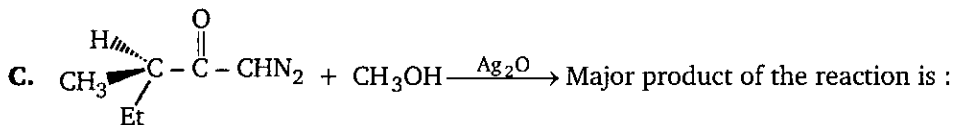
### 9. Comprehension

Wolff rearrangement

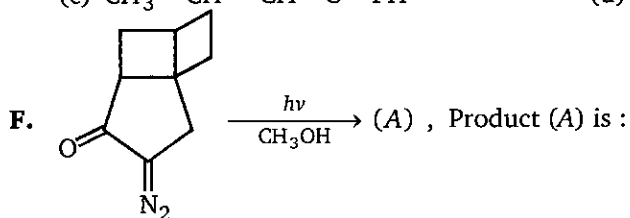
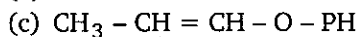
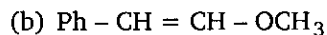
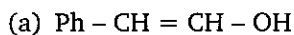
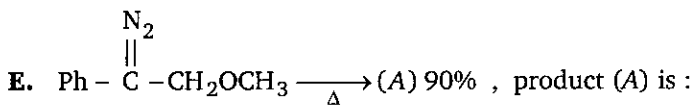
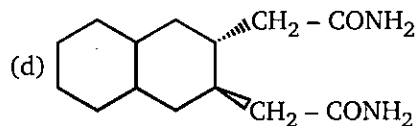
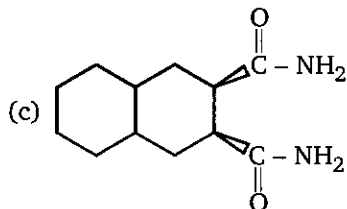
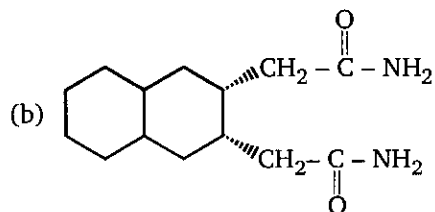
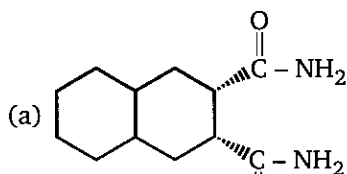
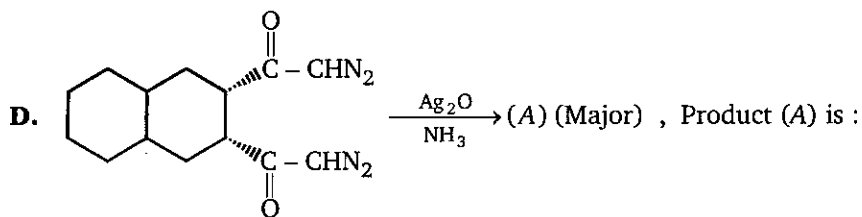
When  $\alpha$ -Diazoketones are photo-irradiated or heated at high temperature or reacted with silver oxide or silver salts at room temperature, they lose nitrogen and rearrange to form ketene.

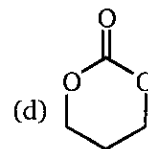
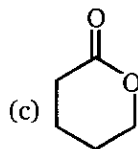
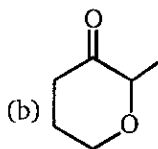
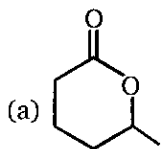
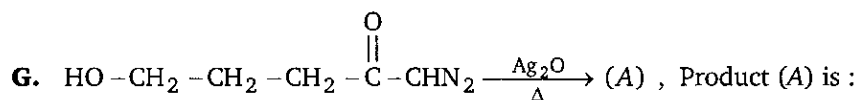
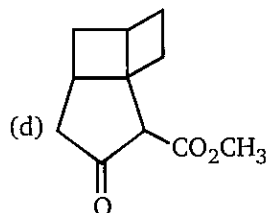
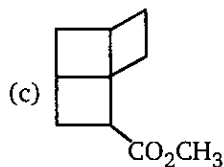
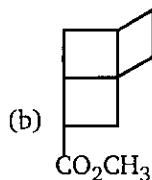
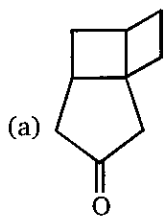
The ketene reacts rapidly with water, alcohol and amines. Therefore, the reactions called Wolff-rearrangement.





(d) None of these





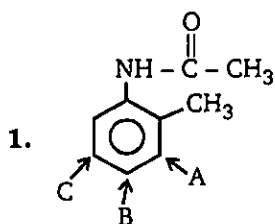
## ANSWERS — LEVEL 2

1. A - d ; B - a ; C - d ; D - a,
2. A - b ; B - b ; C - d ; D - b
3. a - p, r, s ; b - q, r, s ; c - q, r, s ; d - p, r, s
4. a - q, s ; b - p, s ; c - s ; d - r, s
5. a - p, q, s ; b - r ; c - p, r ; d - q
6. a - q, s ; b - q, s ; c - q, s ; d - p
7. a - q ; b - p ; c - q ; d - q
8. A - a ; B - c ; C - b ; D - b
9. A - b ; B - c ; C - d ; D - b ; E - b ; F - b ; G - d



# 12 AROMATIC COMPOUNDS

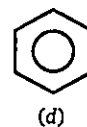
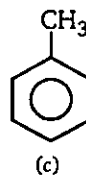
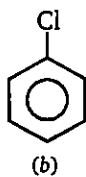
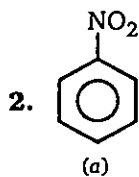
## LEVEL - 1



Identify the position where electrophilic aromatic substitution (EAS) is most favourable.

- (a) A  
(c) C

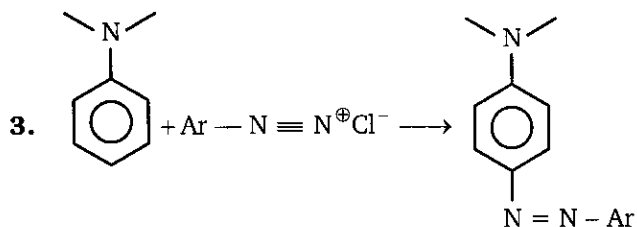
- (b) B  
(d) A and C



Correct order of rate of EAS (electrophilic aromatic substitution) is :

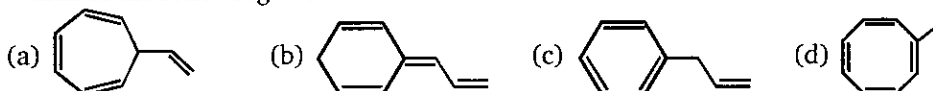
- (a)  $c > b > a > d$   
(c)  $a > b > c > d$

- (b)  $c > d > a > b$   
(d)  $c > d > b > a$

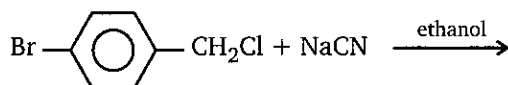


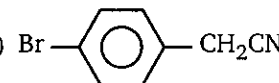
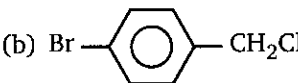
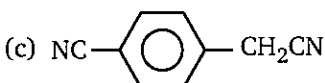
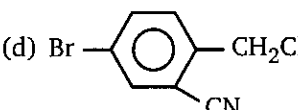
Above (C—N) coupling reaction take place at :

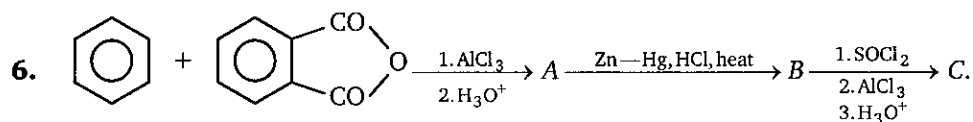
- (a) low pH (b) Intermediate pH  
(c) high pH (d) any pH
4. Which of the following has the lowest heat of combustion ?



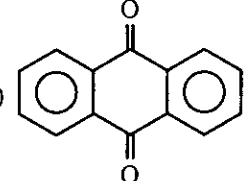
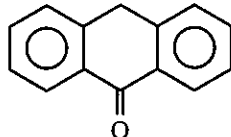
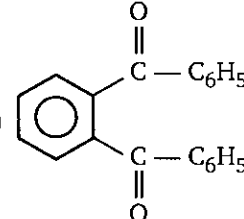
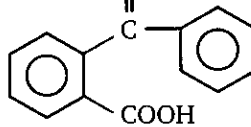
5. The product obtained from the reaction is :



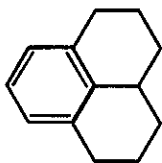
- (a)  (b)   
(c)  (d) 



The end product (C) is :

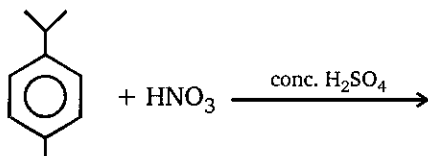
- (a)  (b)   
(c)  (d) 

7. How many benzylic hydrogens are present in the hydrocarbon shown below ?



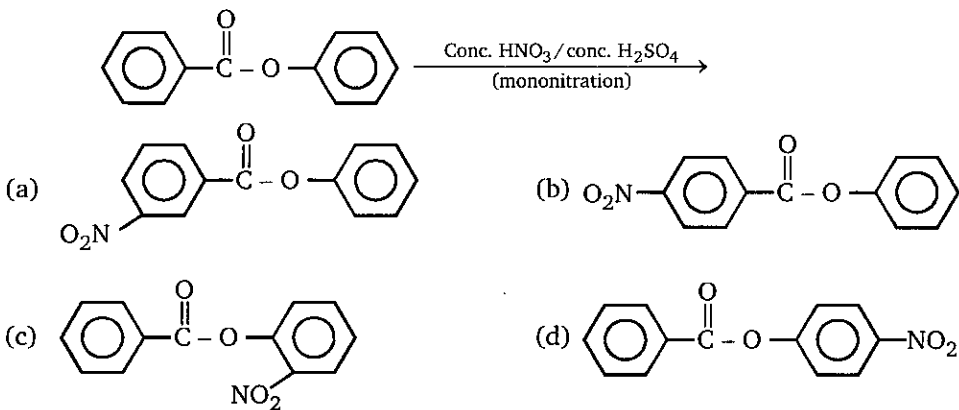
- (a) 3                      (b) 4                      (c) 5                      (d) 6                      (e) 8

8. The major product formed in the reaction is :

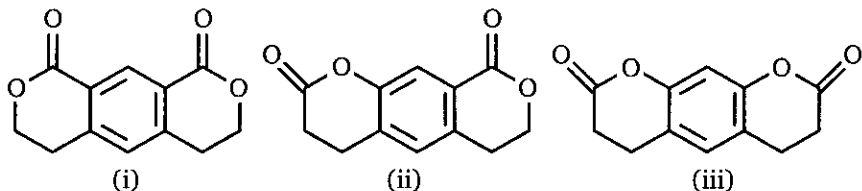


- (a)      (b)      (c)      (d)

9. The major product formed in the reaction is :

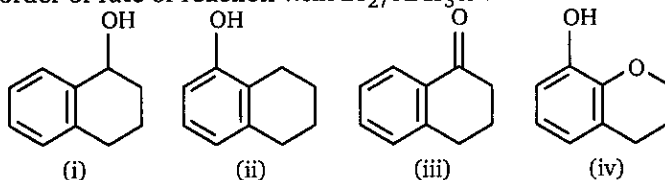


10. Increasing order of rate of reaction with  $\text{HNO}_3/\text{H}_2\text{SO}_4$  is :

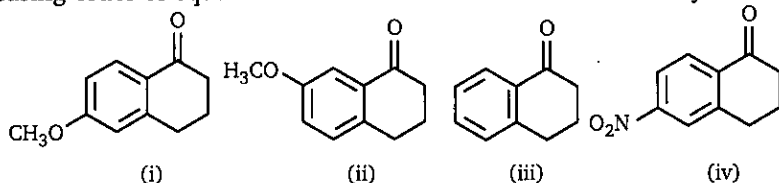


- (a) iii < ii < i      (b) ii < iii < i      (c) i < iii < ii      (d) i < ii < iii

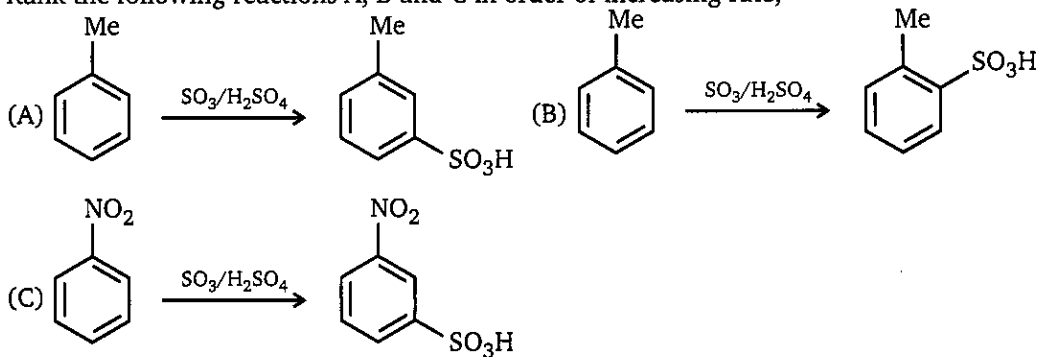
11. Increasing order of rate of reaction with  $\text{Br}_2/\text{AlCl}_3$  is :



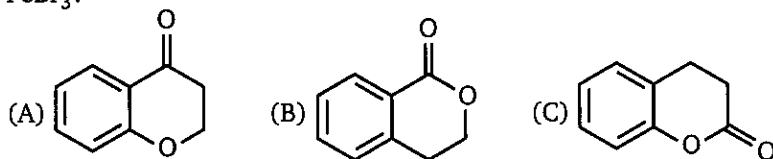
- (a)  $\text{iii} < \text{i} < \text{ii} < \text{iv}$  (b)  $\text{iv} < \text{ii} < \text{i} < \text{iii}$  (c)  $\text{ii} < \text{iv} < \text{iii} < \text{i}$  (d)  $\text{iv} < \text{ii} < \text{iii} < \text{i}$
12. Increasing order of equilibrium constant for the formation of a hydrate is :



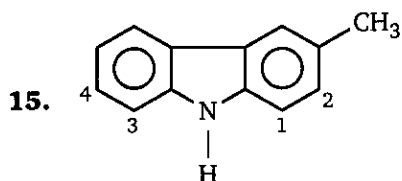
- (a)  $\text{i} < \text{ii} < \text{iii} < \text{iv}$  (b)  $\text{iv} < \text{ii} < \text{i} < \text{iii}$  (c)  $\text{ii} < \text{iv} < \text{iii} < \text{i}$  (d)  $\text{iv} < \text{ii} < \text{iii} < \text{i}$
13. Rank the following reactions A, B and C in order of increasing rate,



- (a)  $\text{B} > \text{A} > \text{C}$  (b)  $\text{B} > \text{C} > \text{A}$  (c)  $\text{A} > \text{B} > \text{C}$  (d)  $\text{A} > \text{C} > \text{B}$
14. Rank in order of increasing rate of reaction towards EAS with bromine in the presence of  $\text{FeBr}_3$ .

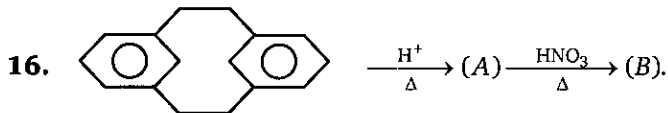


- (a)  $\text{B} < \text{A} < \text{C}$  (b)  $\text{B} < \text{C} < \text{A}$   
(c)  $\text{A} < \text{B} < \text{C}$  (d)  $\text{A} < \text{C} < \text{B}$

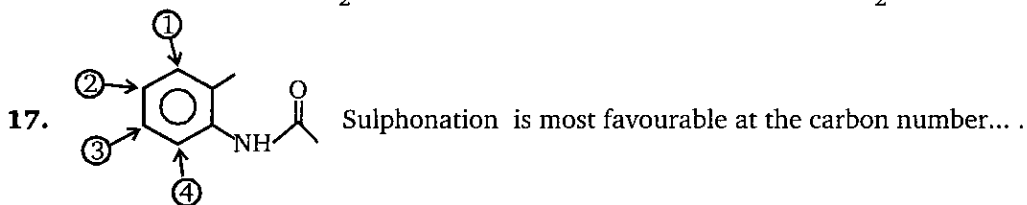
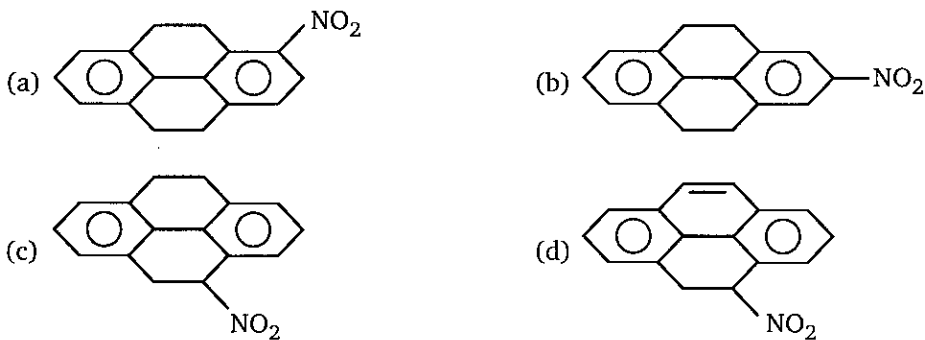


Identify the position where E.A.S. can take place.

- (a) 1 (b) 2 (c) 3 (d) 4

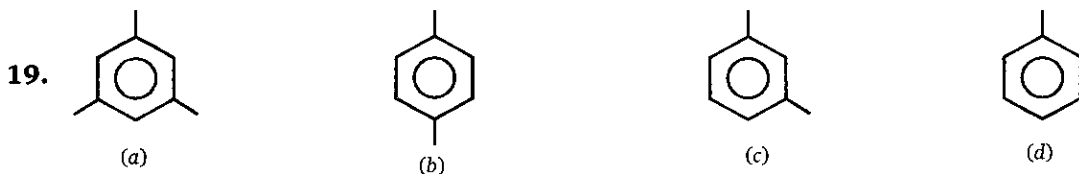
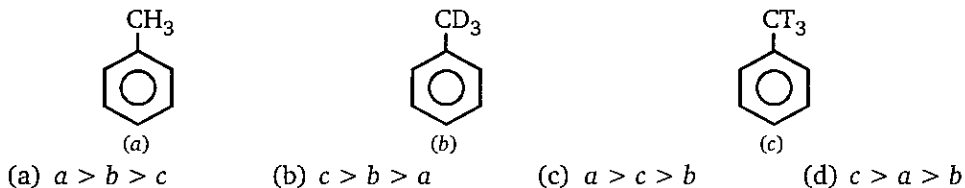


Product (B) in the above reactions is:



- (a) 1 (b) 2 (c) 3 (d) 4

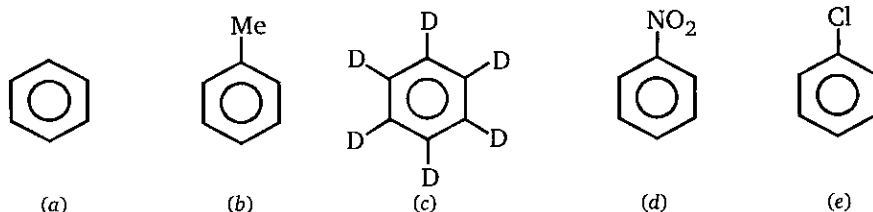
18. Arrange the following in decreasing order of reactivity towards EAS (electrophilic aromatic substitution)



Decreasing order of rate of electrophilic aromatic substitution is :

- (a)  $a > b > c > d$  (b)  $a > c > b > d$   
 (c)  $b > a > c > d$  (d)  $b > c > a > d$

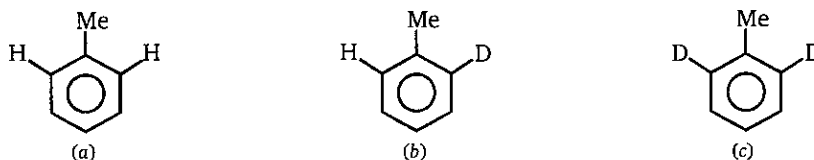
20. Arrange the following in increasing order of rate of Nitration:



(a)  $b < c < a < d < e$   
 (c)  $d < a = c < e < b$

(b)  $d < e < a = c < b$   
 (d)  $a < c < b < e < d$

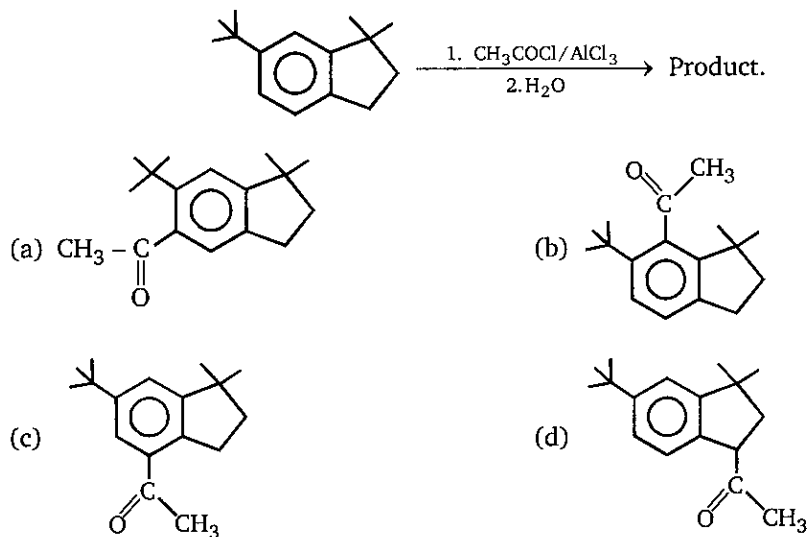
21.



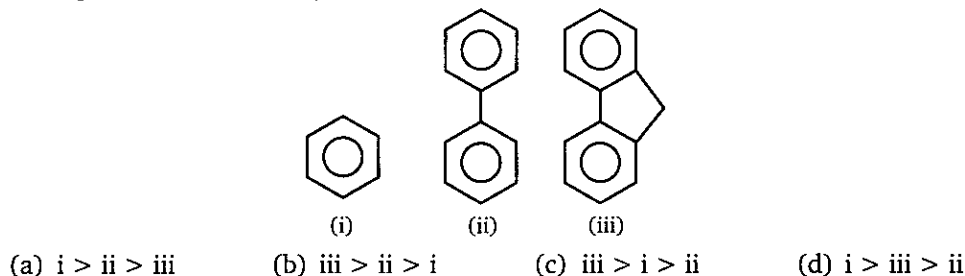
The rate of nitration will be:

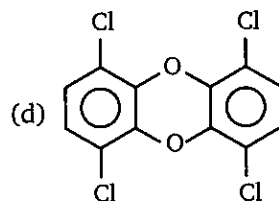
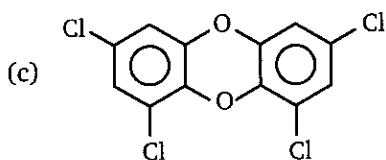
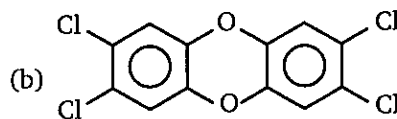
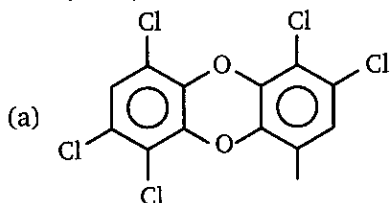
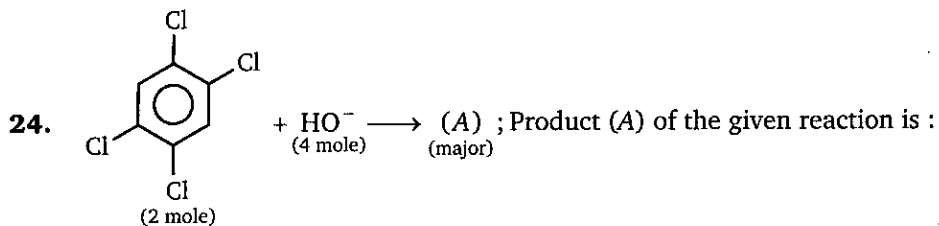
(a)  $a > b > c$  (b)  $a > c > b$  (c)  $a = b = c$  (d)  $c > a > b$

22. The major product of the reaction is

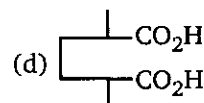
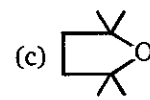
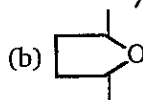
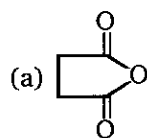
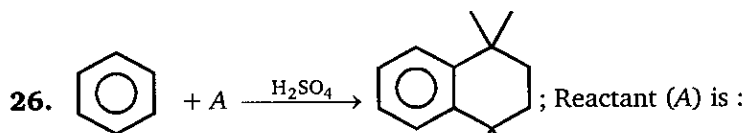
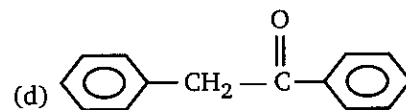
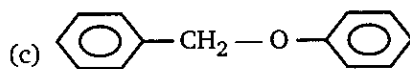
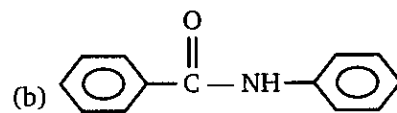
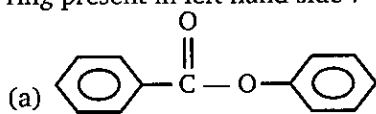


23. Arrange in their decreasing order of rate of electrophilic aromatic substitution :

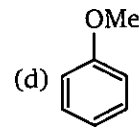
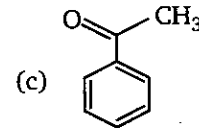
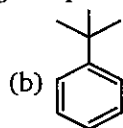
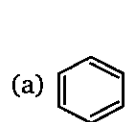


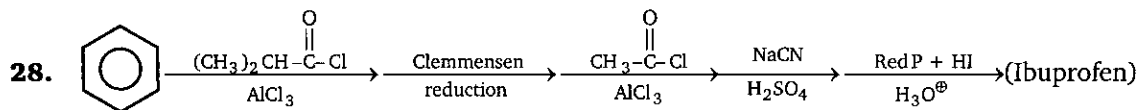


25. In which of the following compound electrophilic aromatic substitution take place in phenyl ring present in left hand side ?

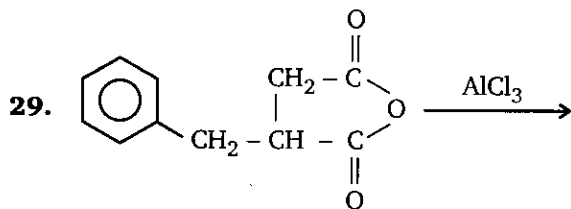
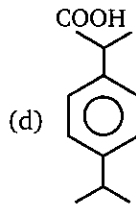
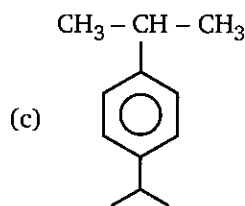
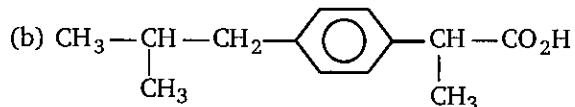
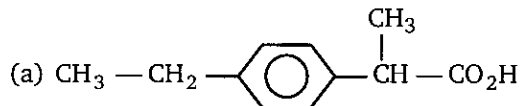


27. Which of the following compounds is the slowest to react with nitronium ion ( $\text{NO}^+$ )?

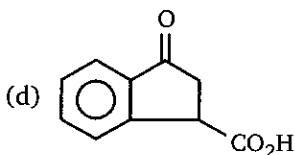
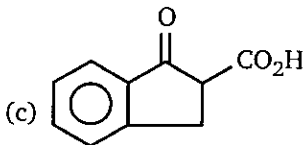
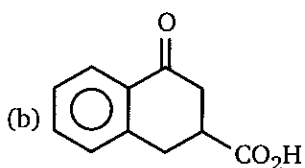
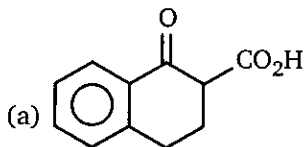




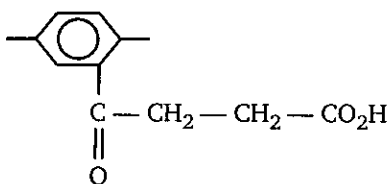
Ibuprofen is :



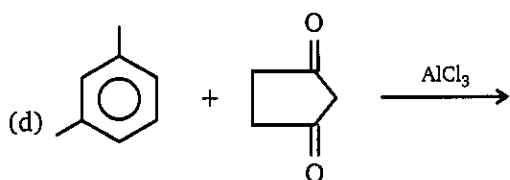
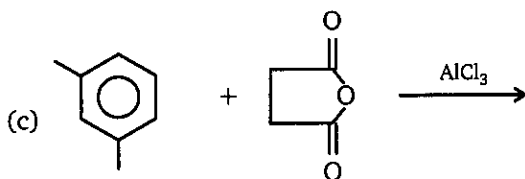
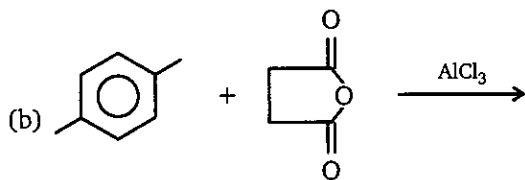
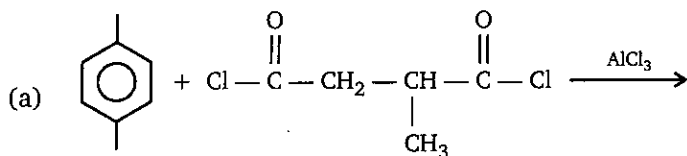
What is the major product of above Friedel-Craft reaction ?



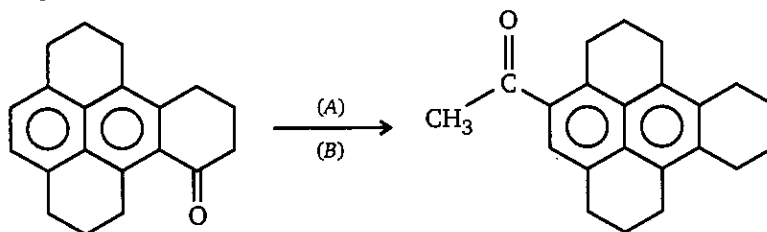
30. What combination of acid chloride or anhydride and arene would you choose to prepare given compound ?







31. In the given conversion best yield will obtained with :



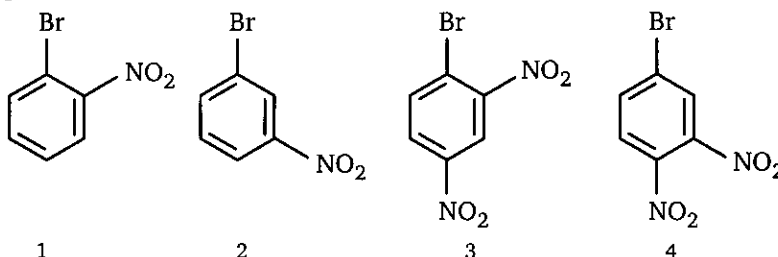
(a)  $A = \text{CH}_3 - \overset{\text{O}}{\parallel}{\text{C}} - \text{Cl}, \text{AlCl}_3, B = \text{Zn(Hg)}, \text{HCl}$

(b)  $A = \text{Zn(Hg)}, \text{HCl}, B = \text{CH}_3 - \overset{\text{O}}{\parallel}{\text{C}} - \text{Cl}, \text{AlCl}_3$

(c)  $A = \text{CH}_3 - \text{CH}_2 - \text{Cl}, \text{AlCl}_3, B = \text{Zn(Hg)}, \text{HCl}$

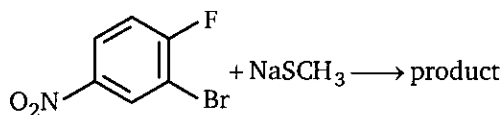
(d)  $A = \text{NH}_2 - \text{NH}_2 / \text{HO}^-, \text{D}, B = \text{CH}_3 - \text{CH}_2 - \text{Cl}, \text{AlCl}_3$

32. Rank the following in order of decreasing rate of reaction with alkoxide ion ( $\text{CH}_3\text{CH}_2\text{O}^-$ ) in a nucleophilic aromatic substitution reaction :



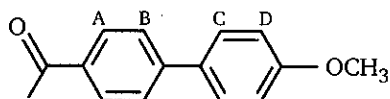
- (a)  $3 > 4 > 1 > 2$     (b)  $3 > 4 > 2 > 1$     (c)  $2 > 1 > 4 > 3$     (d)  $4 > 3 > 2 > 1$

33. Identify the principal organic product of the following reaction.



- (a)    (b)
- (c)    (d)

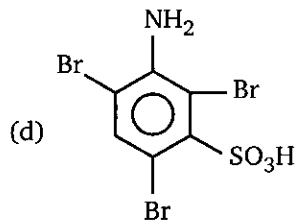
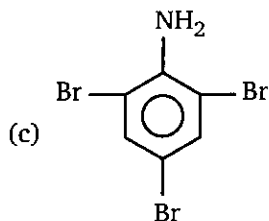
34. Which position will be attacked most rapidly by the nitronium ion ( $-\text{NO}_2^+$ ) when the compound undergoes nitration with  $\text{HNO}_3/\text{H}_2\text{SO}_4$  :



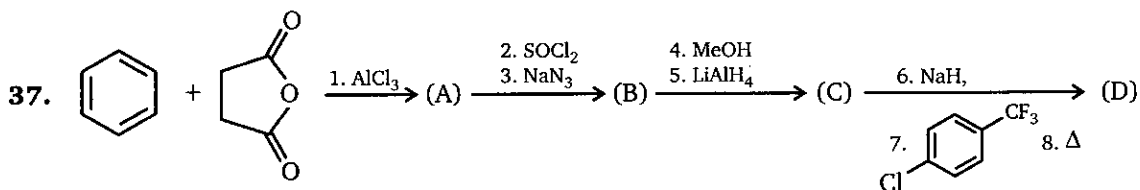
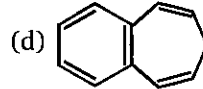
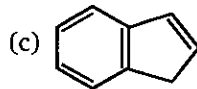
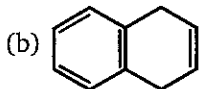
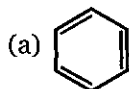
- (a) A    (b) B    (c) C    (d) D

35.  $\xrightarrow{\text{Conc. H}_2\text{SO}_4}$  (X)  $\xrightarrow[\text{excess}]{\text{Br}_2/\text{H}_2\text{O}}$  (Y): Product (Y) of this reaction is :

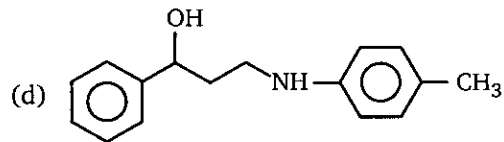
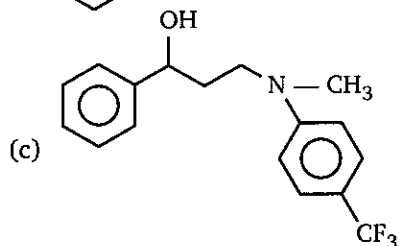
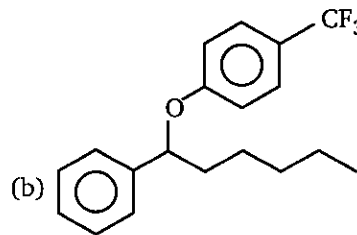
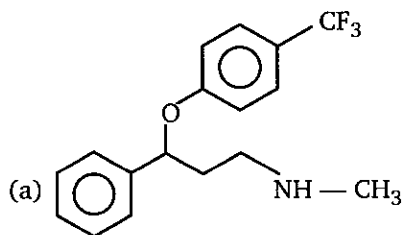
- (a)    (b)



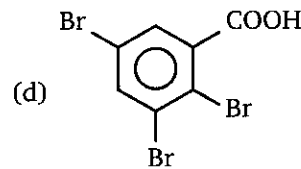
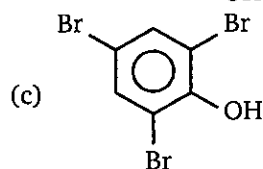
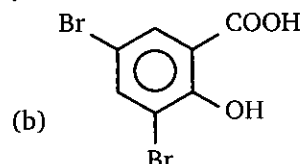
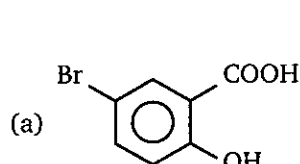
36. All the hydrocarbons shown are very weak acids. One, however, is far more acidic than the others. Which one is the strongest acid ?



Product (D) in above sequence is :



38. The action of bromine water (excess) on salicylic acid results in the formation of :

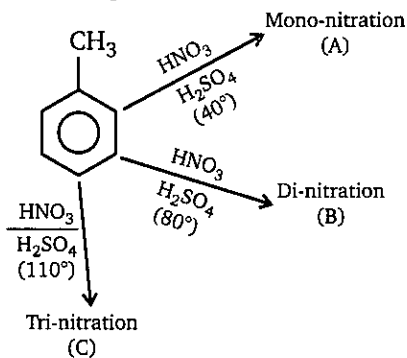


39. What is the correct order of *o/p* ratio when  $E^+$  attacks the following system ?



(a)  $A < B < C < D$     (b)  $A = B = C = D$     (c)  $D < C < B < A$     (d)  $D < B < A < C$

40. How many products are capable of being formed from toluene in each of following reaction ?



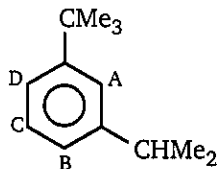
(a)  $A = 3, B = 6, C = 8$

(b)  $A = 3, B = 6, C = 6$

(c)  $A = 3, B = 6, C = 10$

(d)  $A = 3, B = 4, C = 6$

41. Nitration takes place at the which position of the given compound ?



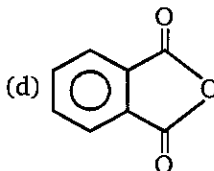
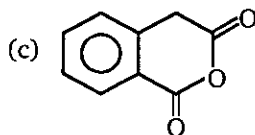
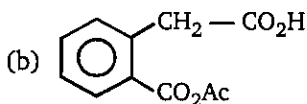
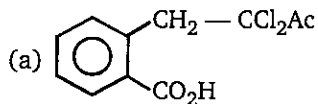
(a) A

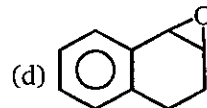
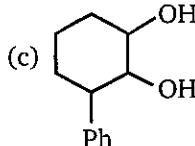
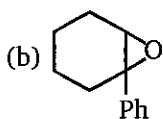
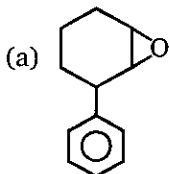
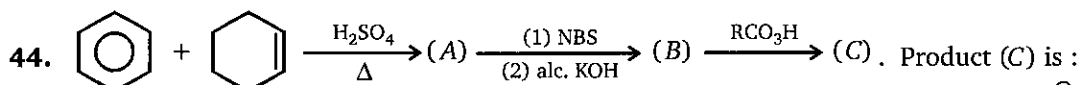
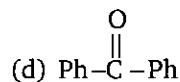
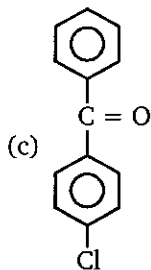
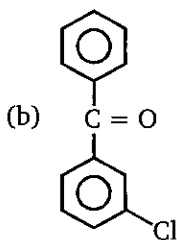
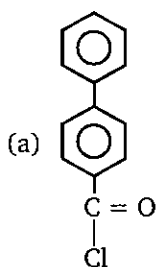
(b) B

(c) C

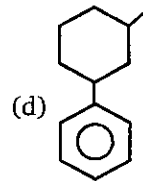
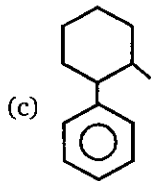
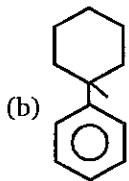
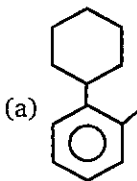
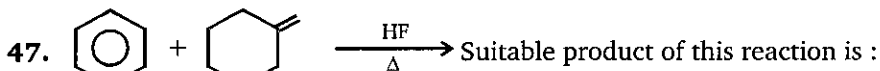
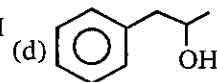
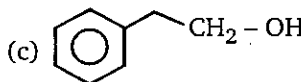
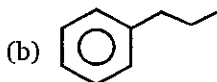
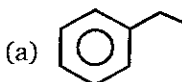
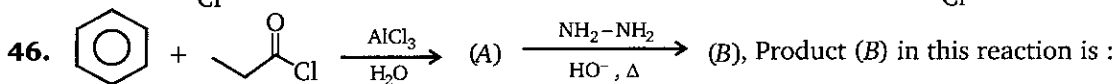
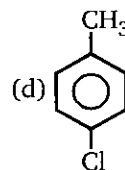
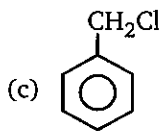
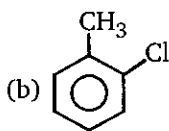
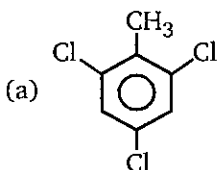
(d) D

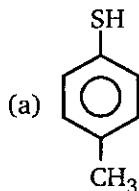
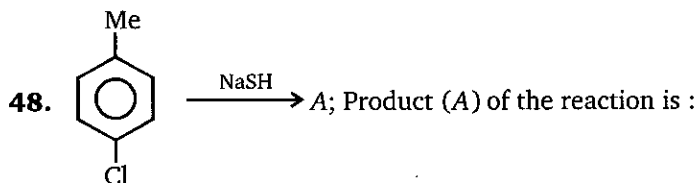
42. Identify the product.



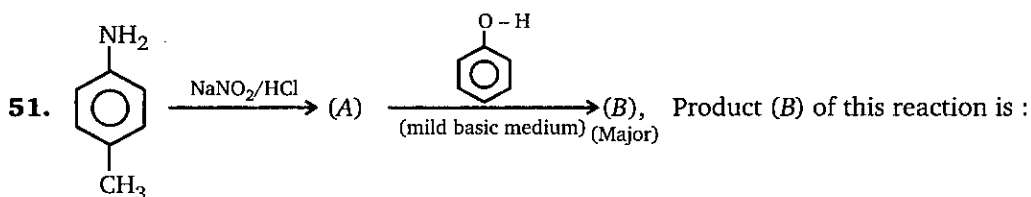
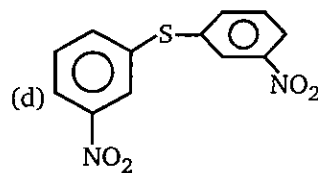
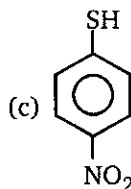
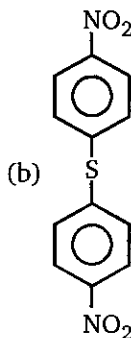
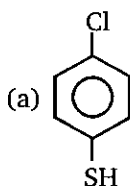
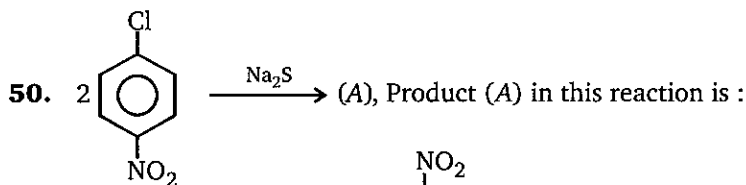
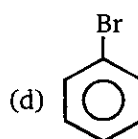
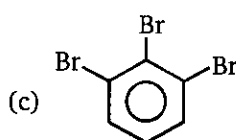
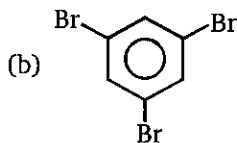
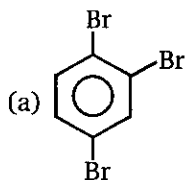
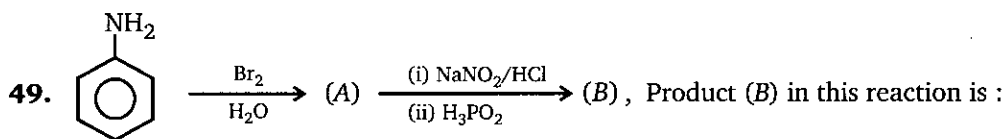
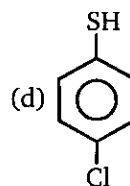
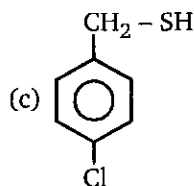


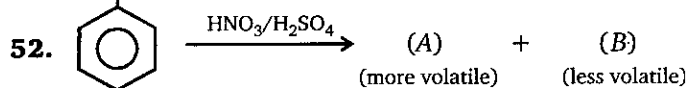
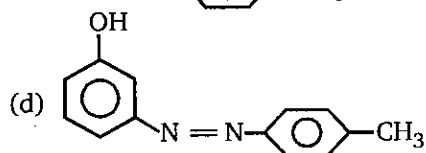
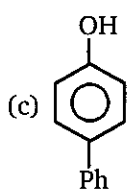
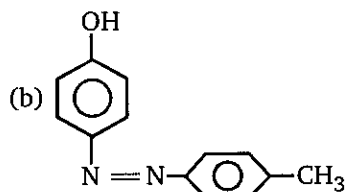
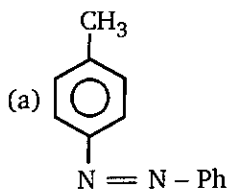
45. The reaction of toluene with chlorine in the presence of light gives :



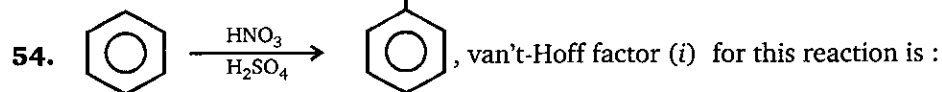
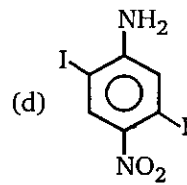
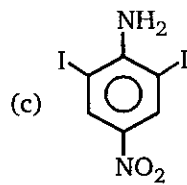
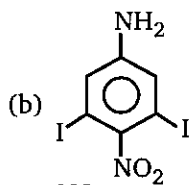
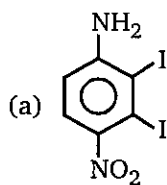
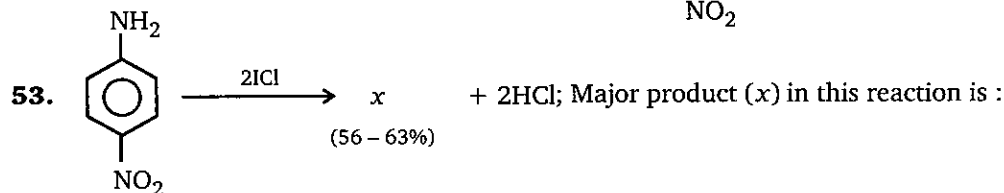
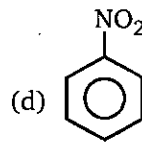
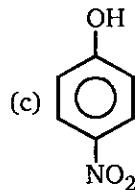
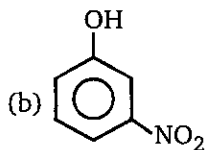
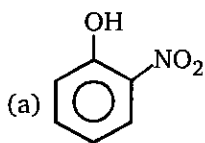


(b) no reaction





Product (A) of the above reaction is :

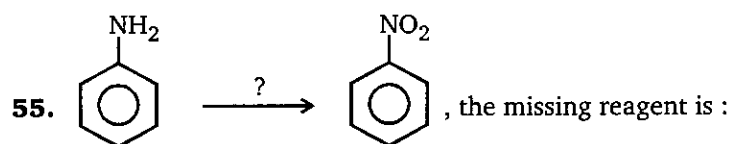


(a) 2

(b) 3

(c) 4

(d) 5

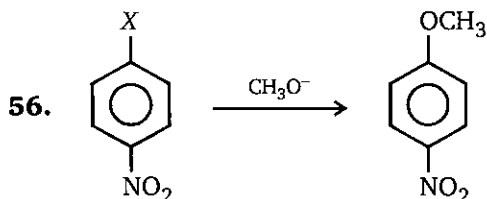


(a)  $\text{CF}_3\text{CO}_3\text{H}$

(b)  $\text{H}_2\text{SO}_4$

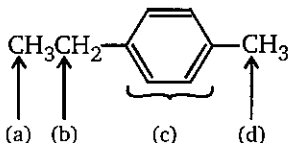
(c) LAH

(d)  $\text{NaBH}_4$



above reaction is an example of Nucleophilic aromatic substitution. Which of the following halide ( $-X$ ) is most readily replaced.

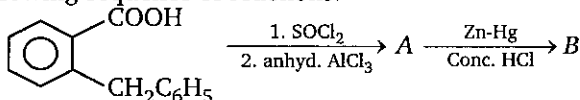
- (a)  $-F$                       (b)  $-Cl$                       (c)  $-Br$                       (d)  $-I$
57. When comparing the hydrogenation of benzene with that of a hypothetical 1, 3, 5-cyclohexatriene, benzene \_\_\_\_\_ than the cyclohexatriene.
- (a) absorbs 152 kJ/mol more heat                      (b) gives off 152 kJ/mol more heat  
(c) absorbs 152 kJ/mol less heat                      (d) gives off 152 kJ/mol less heat
58. Which of the following hydrogens is most easily abstracted on reaction with bromine free radicals,  $Br\cdot$  ?



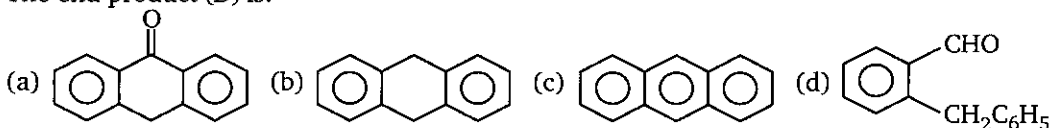
- (a) a                      (b) b                      (c) c                      (d) d
59. The electrophilic aromatic substitution proceeds through a :
- (a) free radical                      (b) sigma complex                      (c) benzyne                      (d) carbene
60. Which of the following substitution of benzene is ortho-para in electrophilic substitution and ortho-para in nucleophilic substitution ?
- (a)  $-NO_2$                       (b)  $-NO$   
(c)  $-SO_3H$                       (d)  $-SO_2Me$
61. The number of possible isomers of dichloronitrobenzene is :
- (a) 3                      (b) 4                      (c) 6                      (d) 8
62. Which of the following is not an aromatic compound ?



63. Consider the following sequence of reactions.

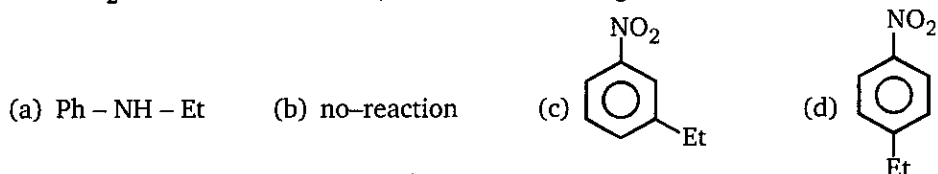


The end product (B) is:



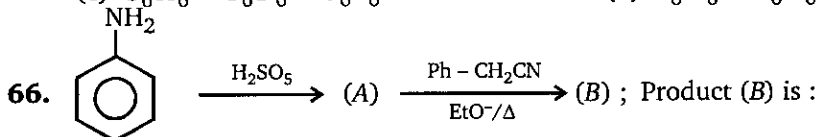


64.  $\text{Ph} - \text{NO}_2 + \text{Et} - \text{Cl} \xrightarrow{\text{AlCl}_3} (\text{A})$ , Product (A) of the given reaction is :



65. In nitration of benzene by mixed acid the rate of reaction will be :

- (a)  $\text{C}_6\text{H}_6 = \text{C}_6\text{D}_6 = \text{C}_6\text{T}_6$       (b)  $\text{C}_6\text{H}_6 > \text{C}_6\text{D}_6 > \text{C}_6\text{T}_6$   
 (c)  $\text{C}_6\text{H}_6 = \text{C}_6\text{D}_6 > \text{C}_6\text{T}_6$       (d)  $\text{C}_6\text{H}_6 < \text{C}_6\text{D}_6 < \text{C}_6\text{T}_6$



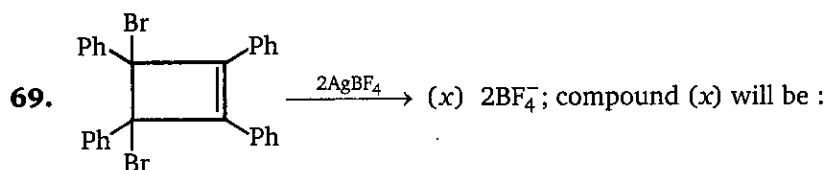
- (a)  $\text{Ph} - \text{N} = \underset{\text{Ph}}{\text{C}} - \text{CN}$       (b)  $\text{Ph} - \text{N} = \text{C} - \text{Ph}$   
 (c)  $\text{Ph} - \text{N} = \text{N} - \text{Ph}$       (d)  $\text{Ph} - \text{CH} = \text{CH} - \text{Ph}$

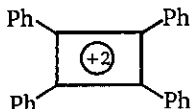
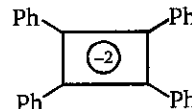
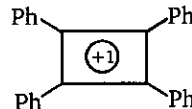
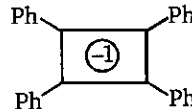
67. Which of the following ring compounds obeys Huckel's rule ?

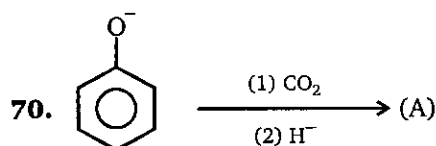
- (a)  $\text{C}_4\text{H}_4^{-1}$       (b)  $\text{C}_4\text{H}_4^{+1}$       (c)  $\text{C}_4\text{H}_4^{-2}$       (d)  $\text{C}_4\text{H}_4$

68. Nitration of which of the following reactant gives maximum % of meta product (using  $\text{HNO}_3/\text{H}_2\text{SO}_4$ ) ?

- (a) Toluene      (b) Aniline  
 (c) Benzene      (d) Isopropyl benzene



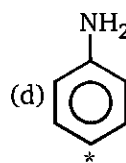
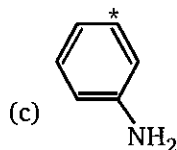
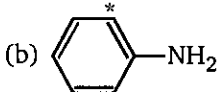
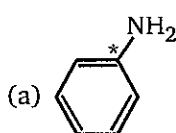
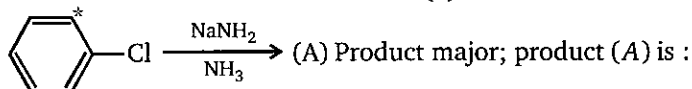
- (a)       (b)       (c)       (d) 



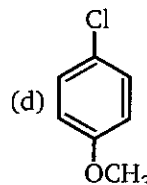
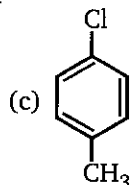
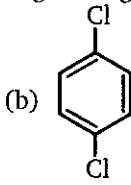
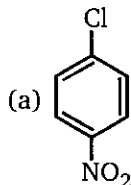
Which of the following is true statement about the reaction ?

- (a) Ortho isomer is major if  $\text{PhONa}$  is used  
 (b) Para isomer is major if  $\text{PhOK}$  is used  
 (c) Product formed is further used for preparation of drug aspirin  
 (d) All of these

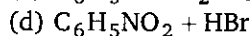
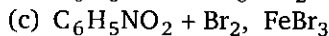
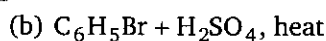
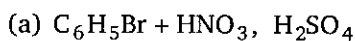
71. Two benzyne intermediates are likely to be formed equally. Reaction with amide ion can occur in two different directions with each benzyne, giving three possible products. They are formed in a 1 : 2 : 1 ratio. Asterisk (\*) refers to  $^{14}\text{C}$ .



72. Which one of the following undergoes nucleophilic aromatic substitution at the fastest rate ?



73. For the reaction ;  ; the best combination of reactants is :



74. The action of  $\text{AlCl}_3$  in Friedel Craft's reaction is:

(a) to absorb  $\text{HCl}$

(b) to release  $\text{HCl}$

(c) to produce electrophile

(d) to produce nucleophile

75. *n*-Butylbenzene on oxidation with hot alkaline  $\text{KMnO}_4$  gives :

(a) benzoic acid

(b) butanoic acid

(c) benzyl alcohol

(d) benzaldehyde

76. Which sequence of steps describes the best synthesis of 2-phenylpropene ?

(a) Benzene + 2-chloropropene,  $\text{AlCl}_3$

(b) 1. Benzaldehyde ( $\text{C}_6\text{H}_5\text{CH}=\text{O}$ ) +  $\text{CH}_3\text{CH}_2\text{MgBr}$ , diethyl ether

2.  $\text{H}_3\text{O}^+$                       3.  $\text{H}_2\text{SO}_4$ , heat

(c) 1. Bromobenzene +  $\text{Mg}$ , diethyl ether

2. Propanal ( $\text{CH}_3\text{CH}_2\text{CH}=\text{O}$ )

3.  $\text{H}_3\text{O}^+$

4.  $\text{H}_2\text{SO}_4$ , heat

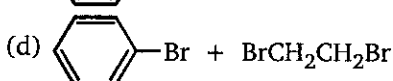
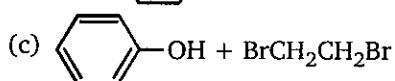
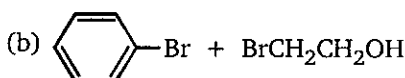
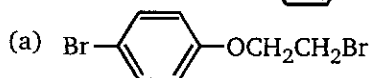
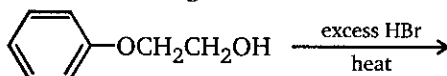
(d) 1. Bromobenzene +  $\text{Mg}$ , diethyl ether

2. Acetone [ $(\text{CH}_3)_2\text{C}=\text{O}$ ]

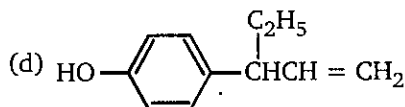
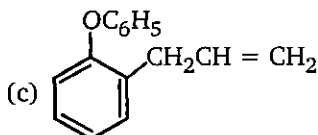
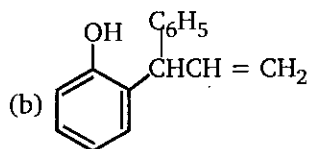
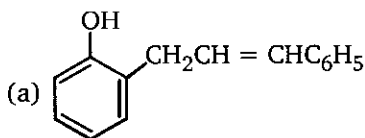
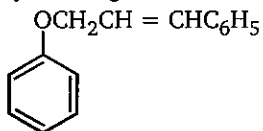
3.  $\text{H}_3\text{O}^+$

4.  $\text{H}_2\text{SO}_4$ , heat

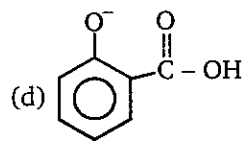
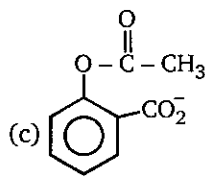
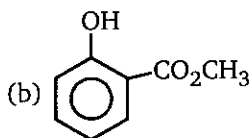
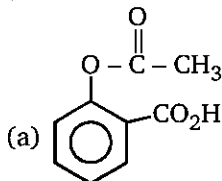
77. What are the products of the following reaction ?



78. What is the product obtained by heating the following allylic ether of phenol ?



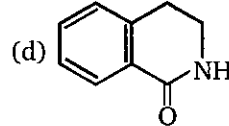
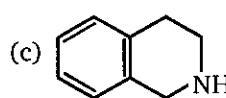
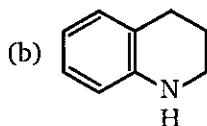
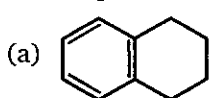
79. When you ingest aspirin, it passes through your stomach, which has an acidic pH, before traveling through the basic environment of your intestine. Provide the structure form as it exists in the intestine.



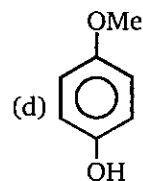
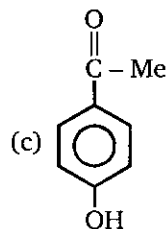
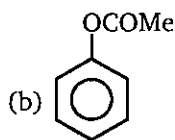
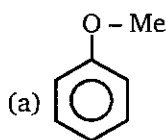
80. Which of the following sets of reagents, used in the order shown, would be enable for the preparation of *p*-chlorophenol from *p*-chloronitrobenzene ?

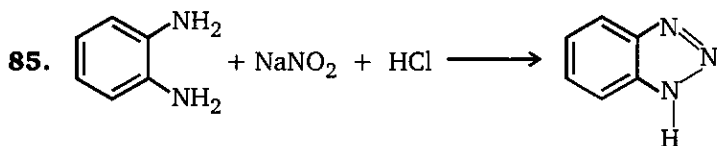
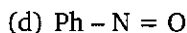
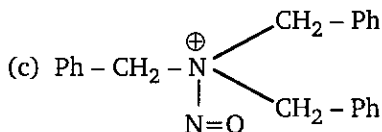
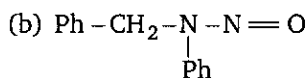
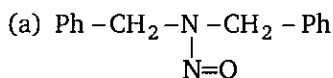
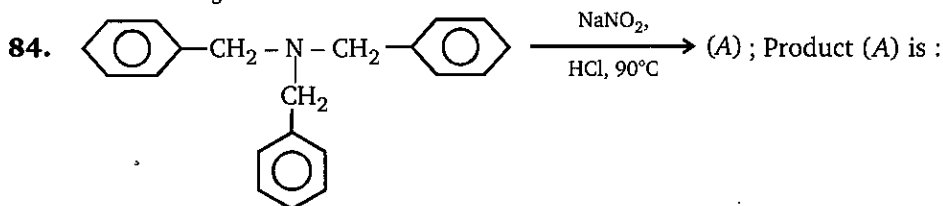
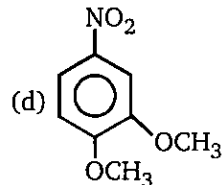
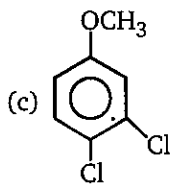
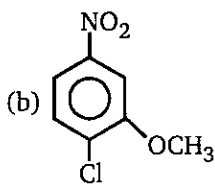
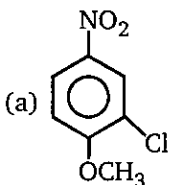
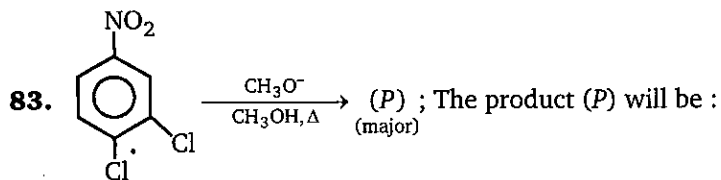
- (a) 1. Fe, HCl ; 2. NaOH ; 3. NaNO<sub>2</sub>, H<sub>2</sub>SO<sub>4</sub> ; 4. H<sub>3</sub>PO<sub>2</sub>  
 (b) 1. Fe, HCl ; 2. NaOH ; 3. NaNO<sub>2</sub>, H<sub>2</sub>SO<sub>4</sub> ; 4. H<sub>2</sub>O, heat  
 (c) 1. Fe, HCl ; 2. NaOH ; 3. NaNO<sub>2</sub>, H<sub>2</sub>SO<sub>4</sub> ; 4. ethanol  
 (d) 1. NaOH, heat ; 2. HCl

81. Which one of the following compounds undergoes bromination of its aromatic ring (electrophilic aromatic substitution) at the fastest rate ?



82. Product (Q) in this reaction is :





This reaction is example of :

(a) Intermolecular C - N coupling

(b) Intramolecular C - N coupling

(c) Intermolecular N - N coupling

(d) Intramolecular N - N coupling

86. The total number of isomeric trimethylbenzene is :

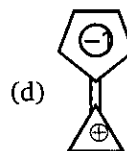
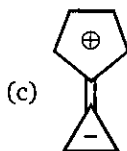
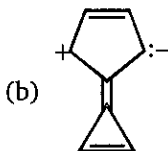
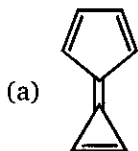
(a) 2

(b) 3

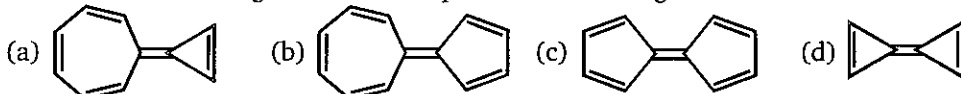
(c) 4

(d) 6

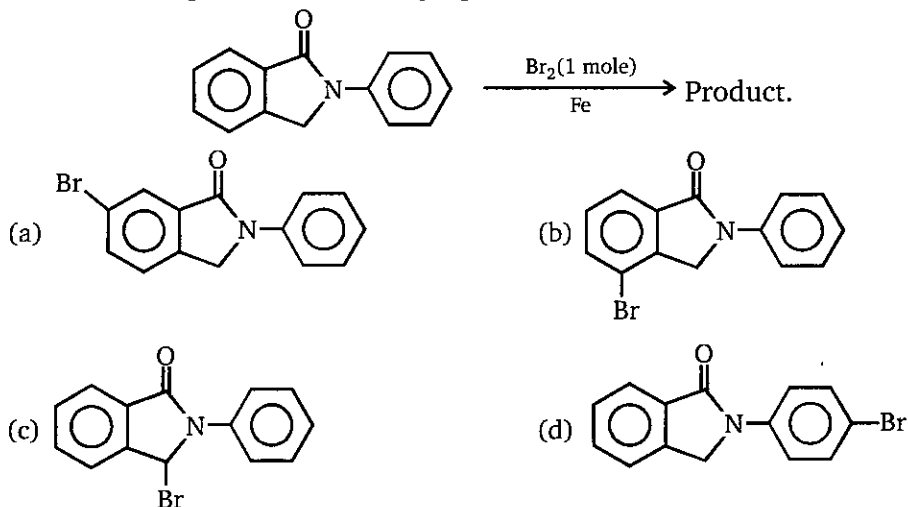
87. Caliene,  $\text{C}_7\text{H}_6$ , is expected to be a fairly polar aromatic molecule. Which of the following resonance forms contributes to the greatest extent towards the real structure (resonance hybrid) of the molecule ?



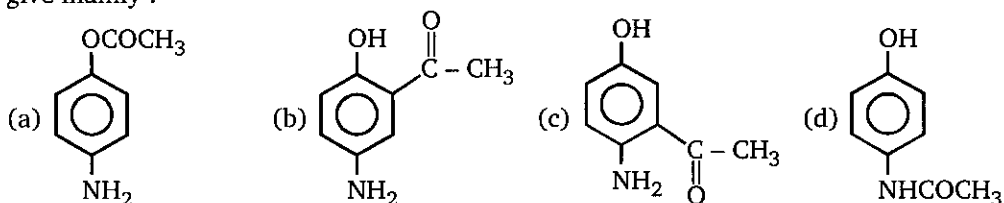
88. Which of the following molecules is expected to have the greatest resonance stabilization ?



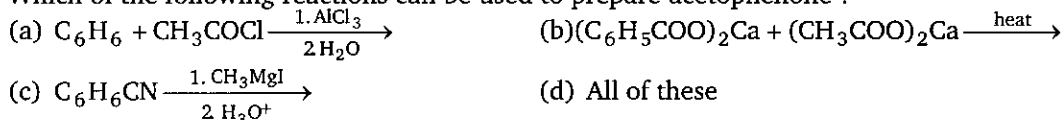
89. In the reaction given below, the major product formed is :



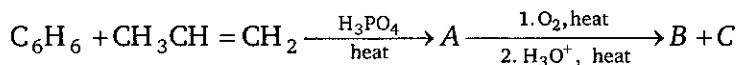
90. *p*-aminophenol reacts with one equivalent of acetyl chloride in the presence of pyridine to give mainly :



91. Which of the following reactions can be used to prepare acetophenone ?



92. Consider the following sequence of reactions.

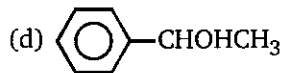
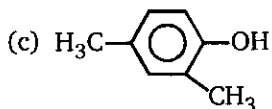


The products (B) and (C) are :

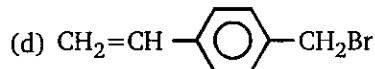
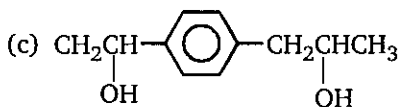
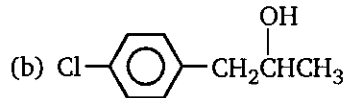
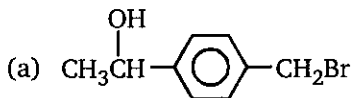
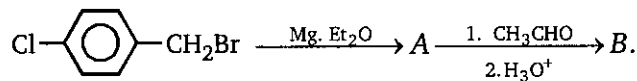
- (a) benzaldehyde and acetaldehyde (b) benzoic acid and acetic acid  
(c) phenol and propionaldehyde (d) phenol and acetone

93. An organic compound having the molecular formula  $C_8H_{10}O$  on being heated with  $I_2$  and dilute NaOH gives a yellow precipitate. The expected compound is :

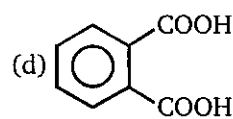
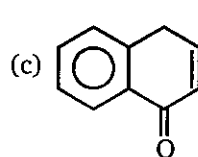
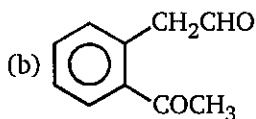
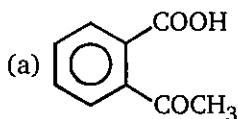
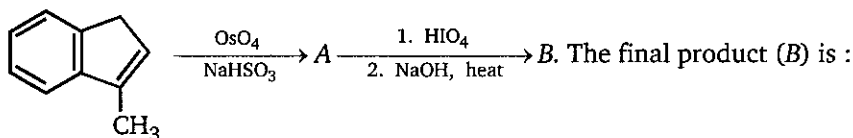




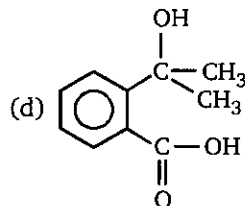
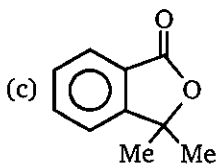
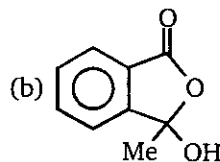
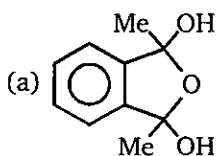
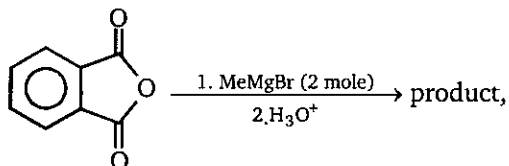
94. The product (B) of the reaction sequence is :



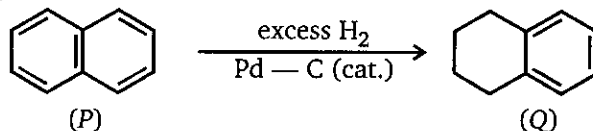
95. Consider the following sequence of reactions.



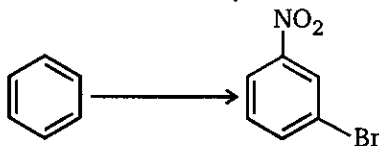
96. For the reaction, the product expected is :



97. Hydrogenation of naphthalene (*P*) with excess hydrogen gas stops cleanly at 1, 2, 3, 4-tetrahydronaphthalene (*Q*). What conclusion can be drawn from this experiment?

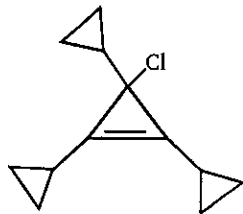


- (a) the hydrogenation of *P* is exothermic  
 (b) one aromatic ring of *P* is more reactive than the aromatic ring of *Q*  
 (c) one aromatic ring of *P* is less reactive than the other ring of *Q*  
 (d) reduction of the first C = C of *P* is faster than reduction of the second or third C = C
98. Suggest the best reaction conditions for the synthesis shown below.



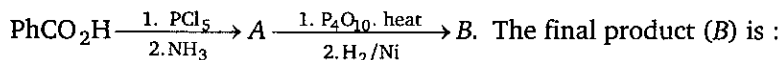
- (a) (1) HNO<sub>3</sub>, H<sub>2</sub>SO<sub>2</sub>; then (2) Br<sub>2</sub>  
 (b) (1) Br<sub>2</sub>; then (2) HNO<sub>3</sub>, H<sub>2</sub>SO<sub>2</sub>  
 (c) (1) CH<sub>3</sub>Br, AlBr<sub>3</sub>; then (2) HNO<sub>3</sub>, H<sub>2</sub>SO<sub>3</sub>  
 (d) HNO<sub>3</sub>, H<sub>2</sub>SO<sub>2</sub>, then (2) Br<sub>2</sub>, FeBr<sub>3</sub>

99.

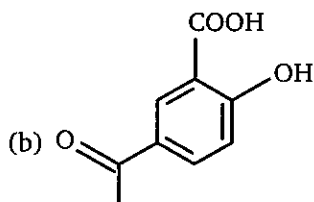
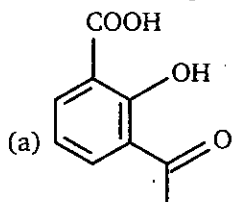


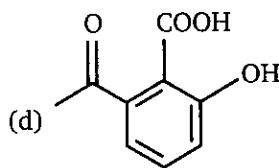
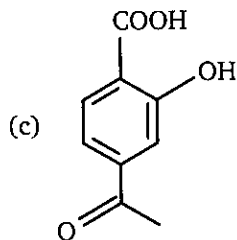
In the above compound Cl will be liberated easily in the form of :

- (a) Cl<sup>⊕</sup>                      (b) Cl<sup>-</sup>                      (c) Cl<sup>•</sup>                      (d) Cl<sup>2+</sup>
100. Consider the following sequence of reactions:

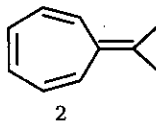
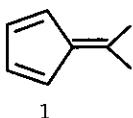


- (a) benzonitrile              (b) benzylamine              (c) aniline                      (d) benzamide
101. The major product of the acetylation of salicylic acid with Ac<sub>2</sub>O/H<sup>+</sup> followed by heating with anhydrous AlCl<sub>3</sub> is :



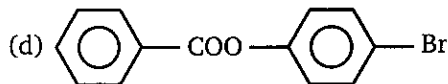
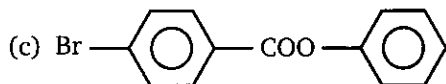
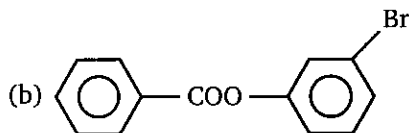
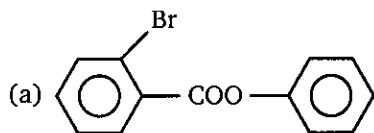


102. Which one of the following statements is **True**:

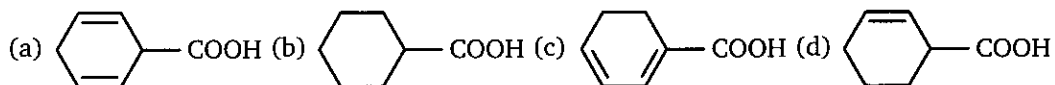


- (a) PhLi adds to both compounds with equal ease  
 (b) PhLi does not add to either of the compounds  
 (c) PhLi reacts readily with 1 but does not add to 2  
 (d) PhLi reacts readily with 2 but does not add to 1

103. The major product expected from the mono-bromination of phenyl benzoate is :



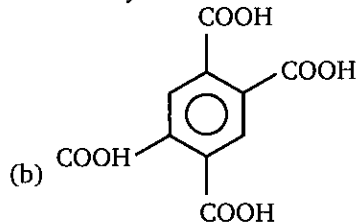
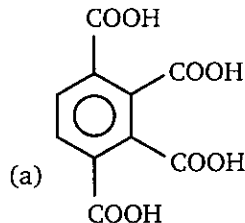
104. The Birch reduction of benzoic acid gives :



105. The decreasing order of reactivity of meta-nitrobromobenzene (I), 2,4,6-trinitrobromobenzene (II), para-nitrobromobenzene (III), and 2,4-dinitrobromobenzene (IV) towards  $\text{HO}^-$  ions is :

- (a) I > II > III > IV (b) II > IV > III > I (c) IV > II > III > I (d) II > IV > I > III

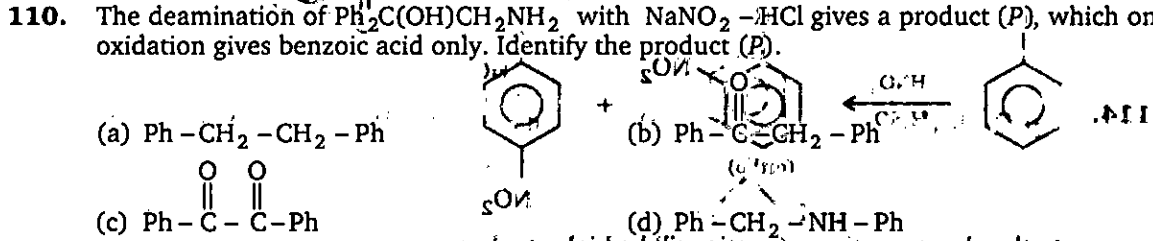
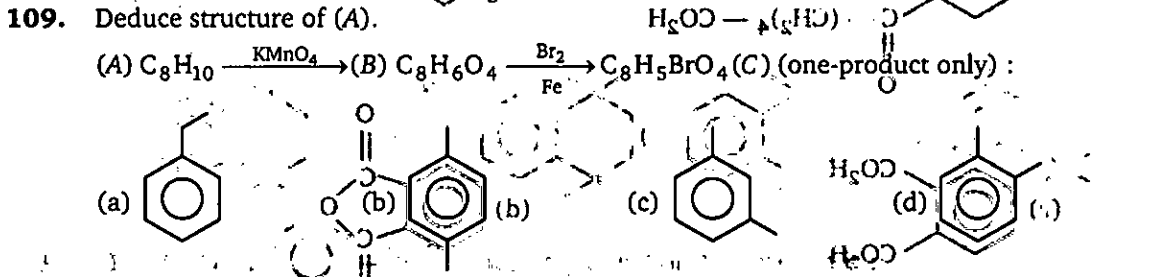
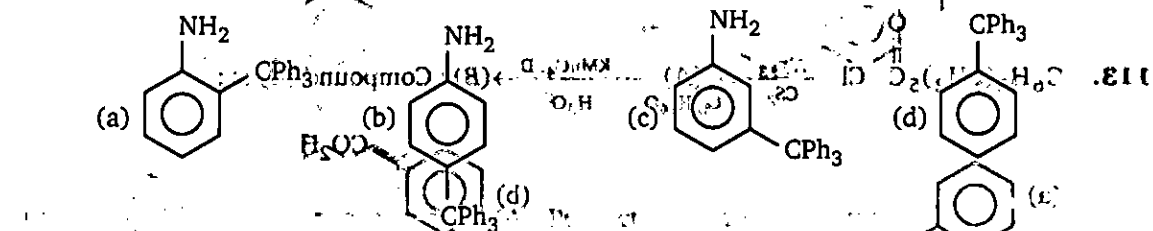
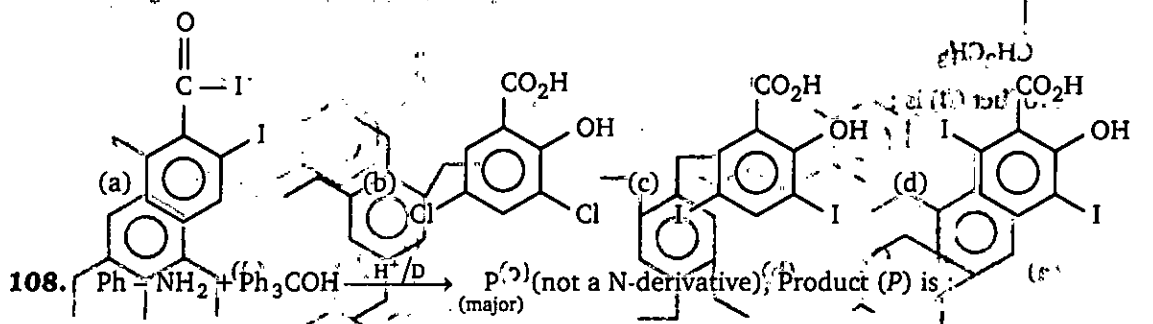
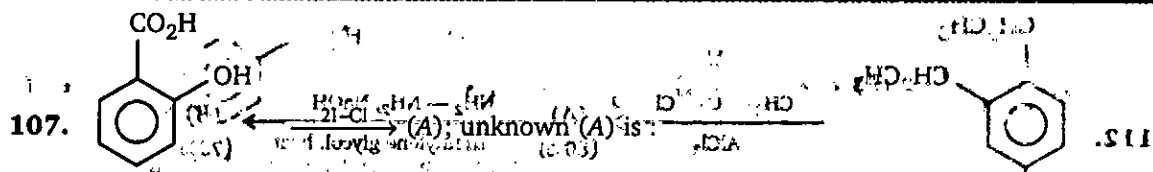
106. Which of the following tetracarboxylic acid form di-anhydride :



(c) neither (a) nor (b)

(d) both (a) and (b)





128. Ph-NH2 + 2 CH3Cl -> (A) -> (B) + (C)  
 Product of the above reaction is :  
 (a) Ph-N(CH3)2 (b) Ph-N(CH3)Cl (c) Ph-N(CH3)2 + Ph-N(CH3)Cl (d) Ph-N(CH3)2 + Ph-N(CH3)Cl + Ph-NHCH3

129. p-Tol-NH2 + Ph-N2Cl -> (A) -> (B) + (C)  
 Product (B) of this reaction is :  
 (a) Ph-N(CH3)2 (b) Ph-N(CH3)Cl (c) Ph-N(CH3)2 + Ph-N(CH3)Cl (d) Ph-N(CH3)2 + Ph-N(CH3)Cl + Ph-NHCH3

130. p-NO2-C6H4-CHO + aq. NH3 -> (A) -> (B) -> (C)  
 Product (C) of the above reaction is :  
 (a) p-NO2-C6H4-CHO (b) p-NO2-C6H4-CH2OH (c) p-NO2-C6H4-CH2NH2 (d) p-NO2-C6H4-CH2NHC(=O)CH3

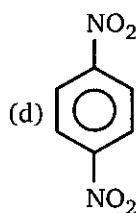
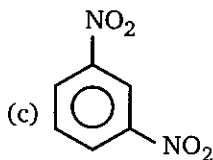
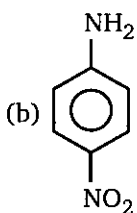
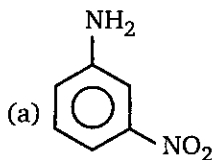
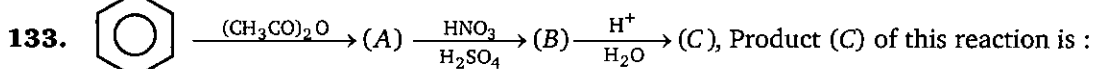
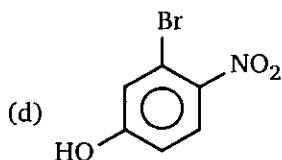
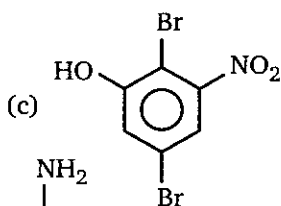
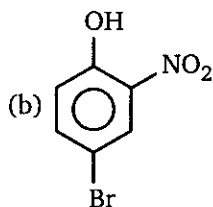
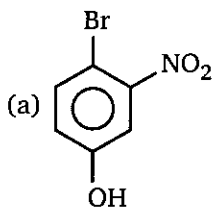
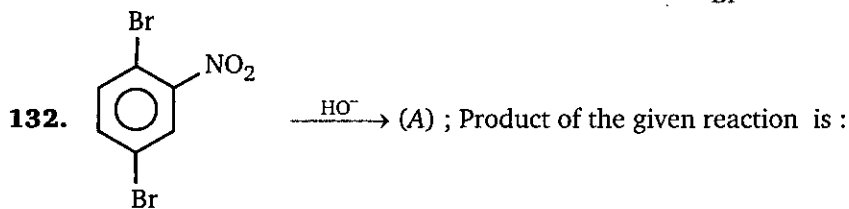
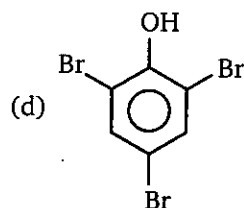
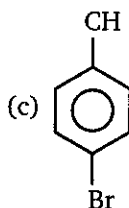
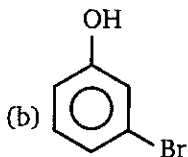
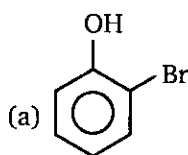
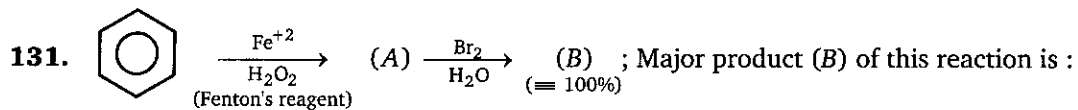
131. p-NO2-C6H4-NH2 + Ph-N2Cl -> (A) -> (B) + (C)  
 Product (B) of this reaction is :  
 (a) Ph-N(CH3)2 (b) Ph-N(CH3)Cl (c) Ph-N(CH3)2 + Ph-N(CH3)Cl (d) Ph-N(CH3)2 + Ph-N(CH3)Cl + Ph-NHCH3

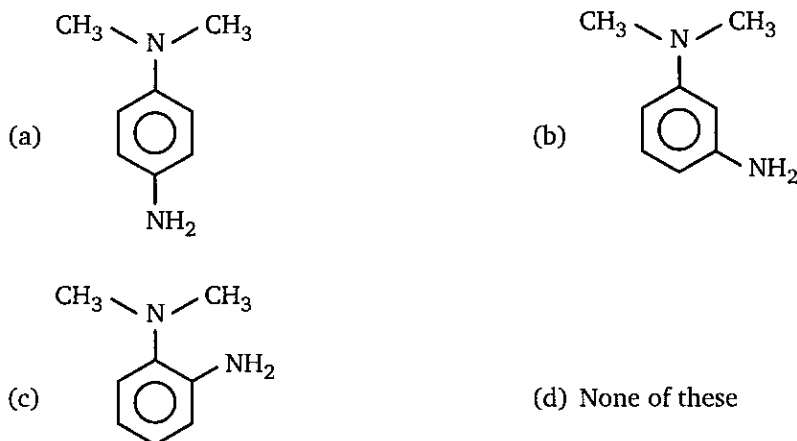
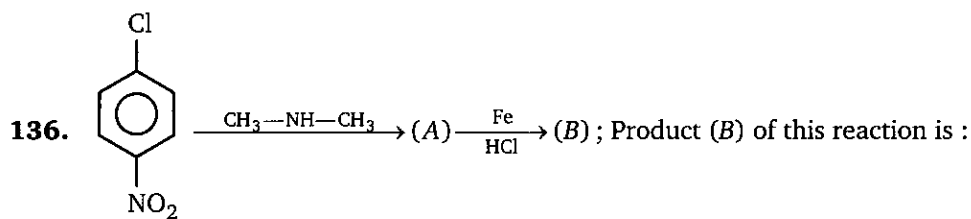
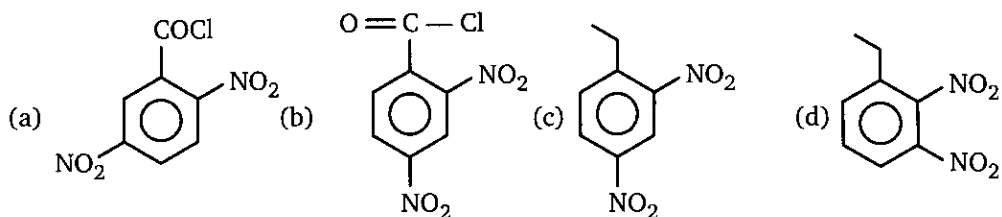
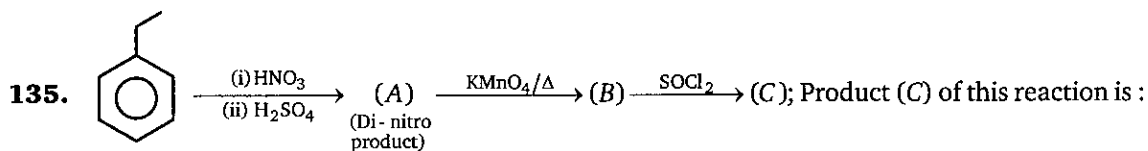
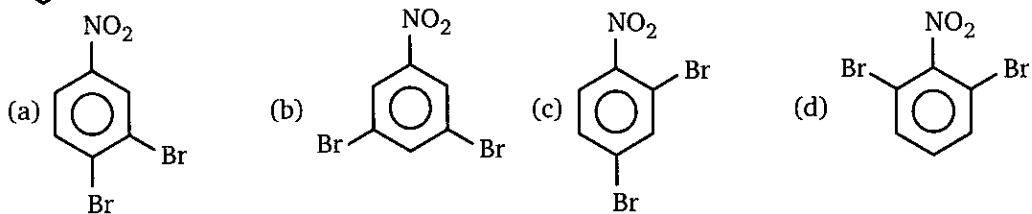
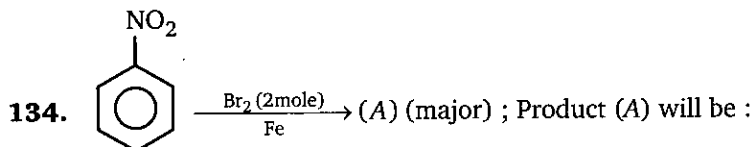
132. p-NO2-C6H4-NH2 + Ph-N2Cl -> (A) -> (B) + (C)  
 Product (B) of this reaction is :  
 (a) Ph-N(CH3)2 (b) Ph-N(CH3)Cl (c) Ph-N(CH3)2 + Ph-N(CH3)Cl (d) Ph-N(CH3)2 + Ph-N(CH3)Cl + Ph-NHCH3

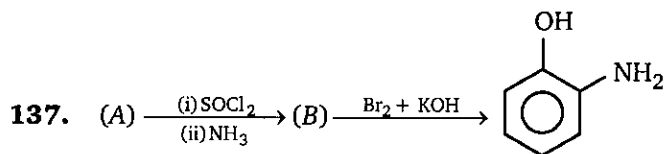
133. p-NO2-C6H4-NH2 + Ph-N2Cl -> (A) -> (B) + (C)  
 Product (B) of this reaction is :  
 (a) Ph-N(CH3)2 (b) Ph-N(CH3)Cl (c) Ph-N(CH3)2 + Ph-N(CH3)Cl (d) Ph-N(CH3)2 + Ph-N(CH3)Cl + Ph-NHCH3

134. p-NO2-C6H4-NH2 + Ph-N2Cl -> (A) -> (B) + (C)  
 Product (B) of this reaction is :  
 (a) Ph-N(CH3)2 (b) Ph-N(CH3)Cl (c) Ph-N(CH3)2 + Ph-N(CH3)Cl (d) Ph-N(CH3)2 + Ph-N(CH3)Cl + Ph-NHCH3

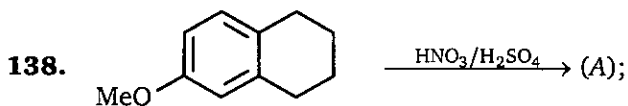
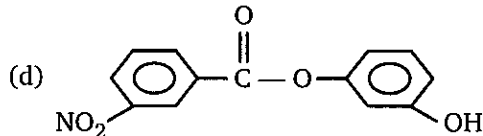
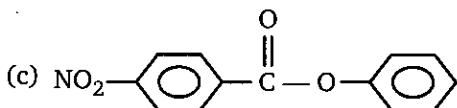
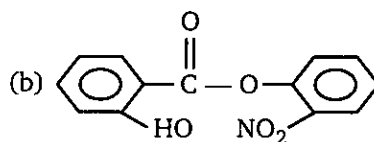
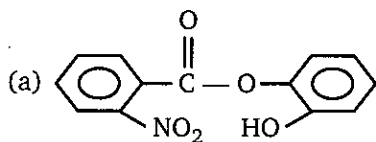
135. p-NO2-C6H4-NH2 + Ph-N2Cl -> (A) -> (B) + (C)  
 Product (B) of this reaction is :  
 (a) Ph-N(CH3)2 (b) Ph-N(CH3)Cl (c) Ph-N(CH3)2 + Ph-N(CH3)Cl (d) Ph-N(CH3)2 + Ph-N(CH3)Cl + Ph-NHCH3



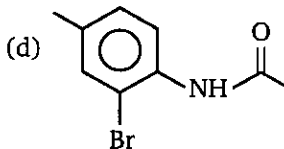
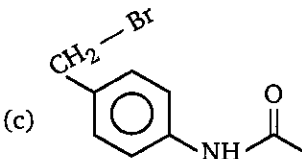
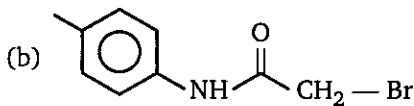
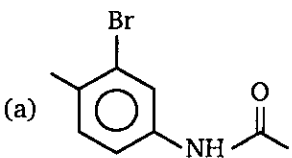
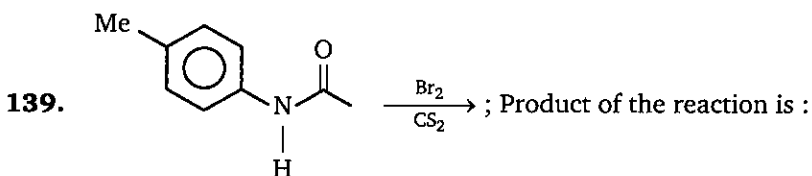
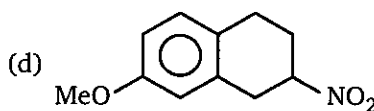
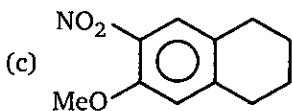
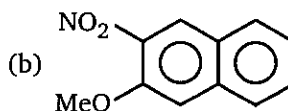
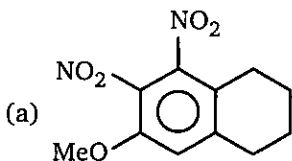


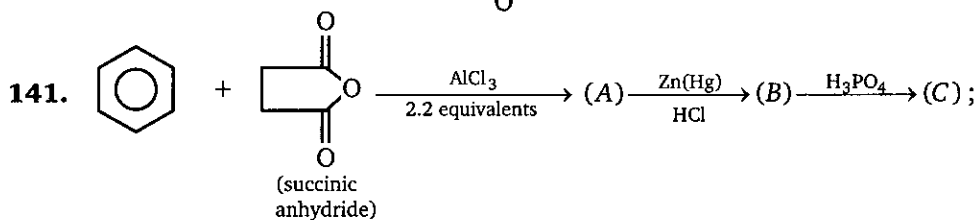
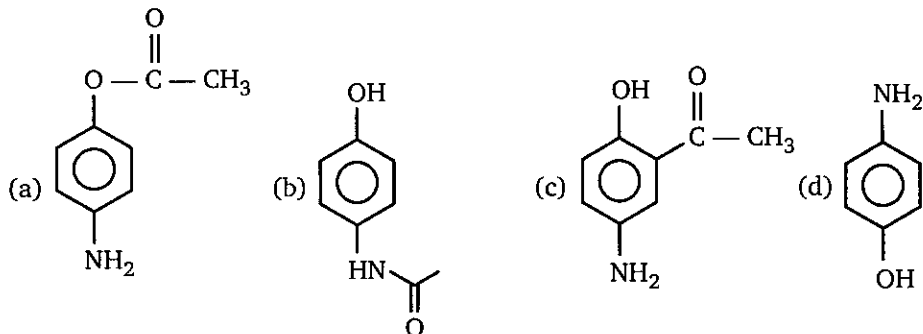
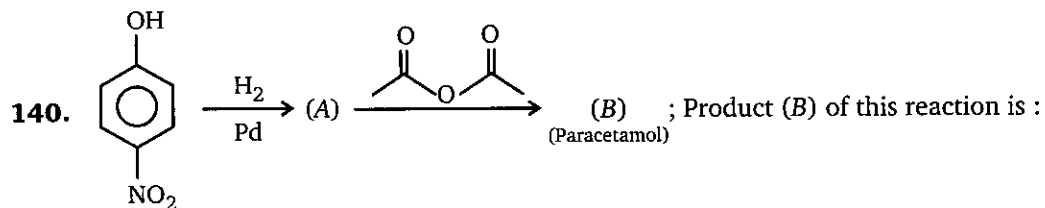


Which of the following compound on hydrolysis gives reactant (A) :

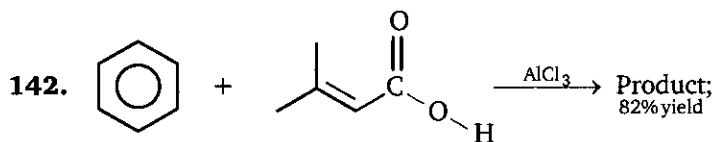
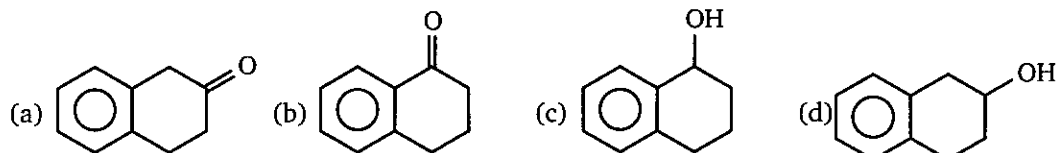


Product (A) of the above reaction is :

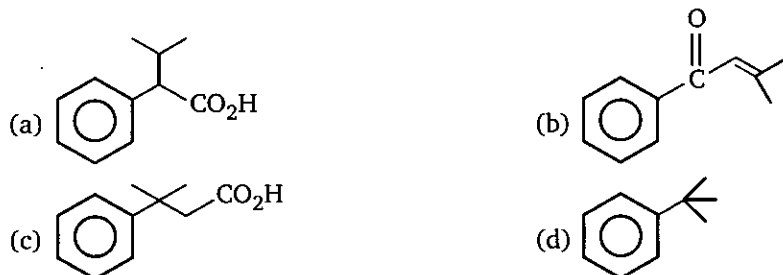




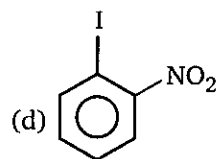
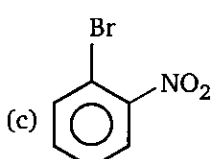
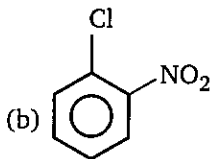
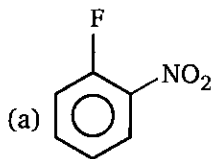
Product (C) of the above reaction is :



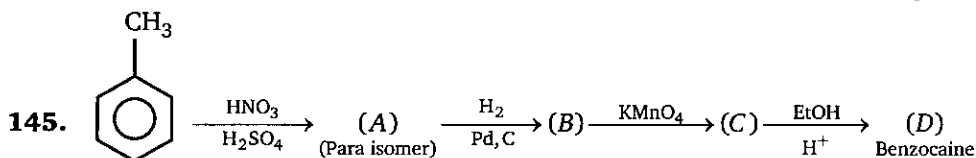
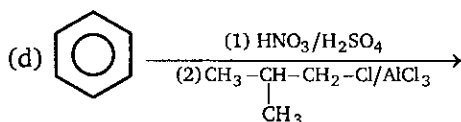
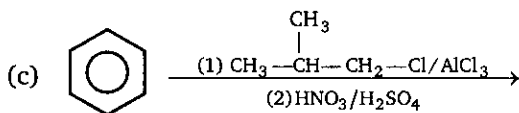
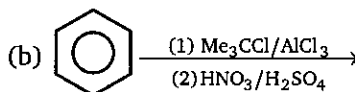
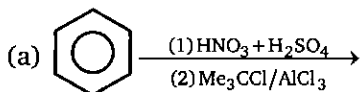
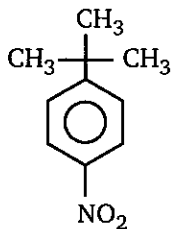
Product of the above Friedel-Craft reaction is :



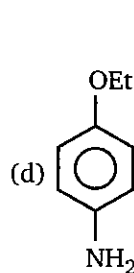
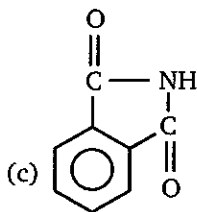
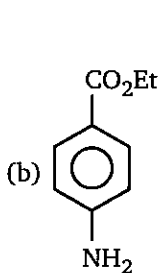
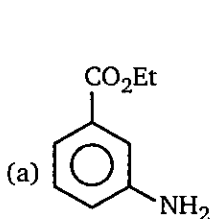
143. Which of the following 2-halo nitrobenzene is most reactive towards nucleophilic aromatic substitution ?



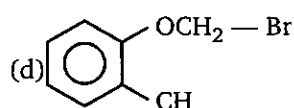
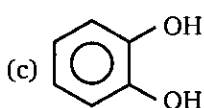
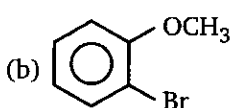
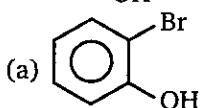
144. Choose the best method to prepare given compound :

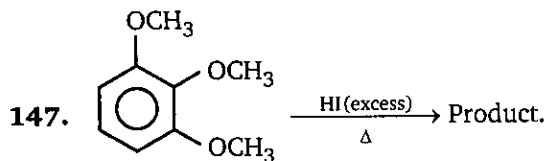


Benzocaine has been used as a component of appetite suppressants, burn and sunburn remedies. Benzocaine is :

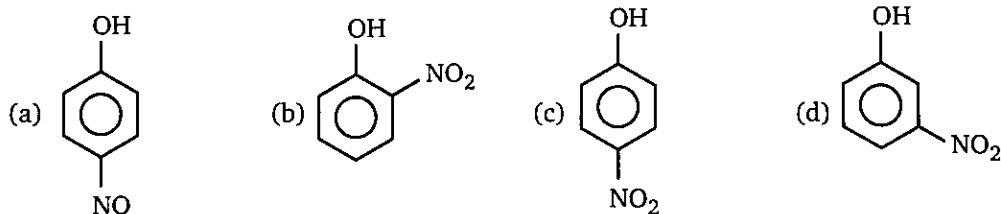
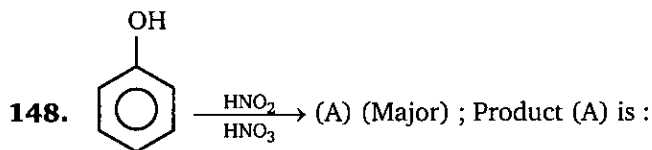
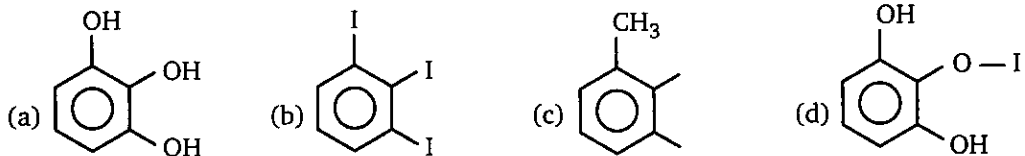


146.  $\xrightarrow[\Delta]{\text{HBr}}$  (A) ; Product (A) of this reaction is :

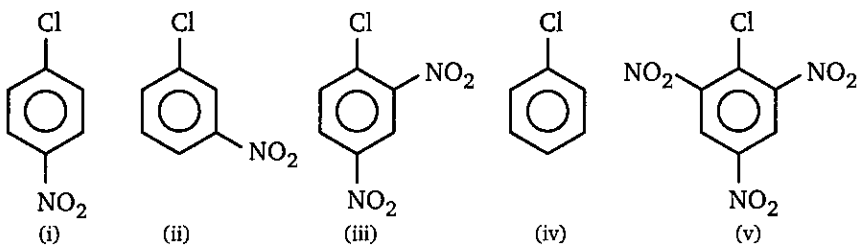




Predict major product of the above reaction is :



149. Arrange in their decreasing order of rate in  $\text{S}_{\text{N}}\text{Ar}$ .



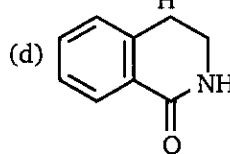
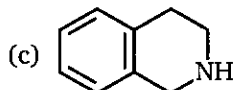
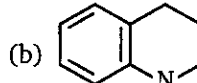
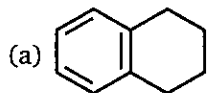
(a)  $i > ii > iv > iii > v$

(b)  $ii > i > iii > v > iv$

(c)  $v > iii > i > ii > iv$

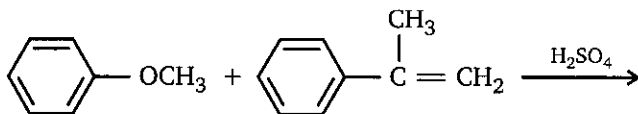
(d)  $v > iii > ii > i > iv$

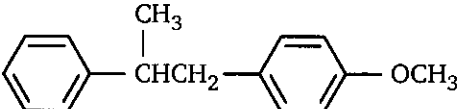
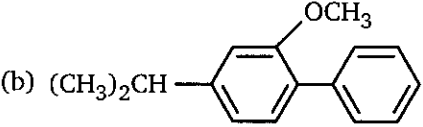
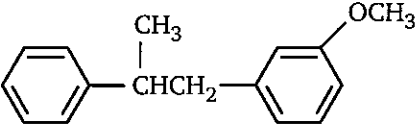
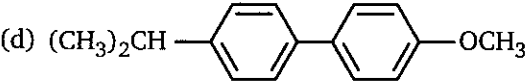
150. Which one of the following compounds undergoes bromination of its aromatic ring (electrophilic aromatic substitution) at the fastest rate ?



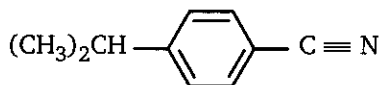


151. What is the product of the following reaction ?



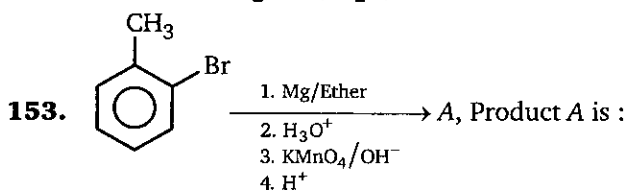
- (a)  (b) 
- (c)  (d) 

152. Which sequence represents the best synthesis of 4-isopropylbenzonitrile ?

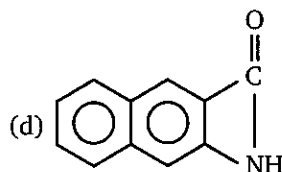
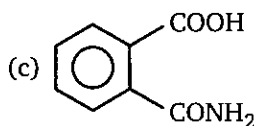
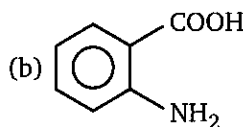
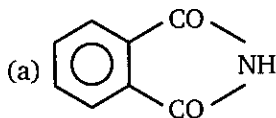
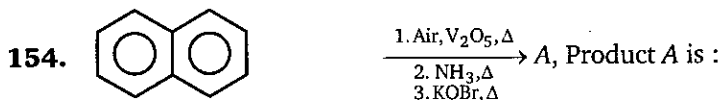


4-Isopropylbenzonitrile

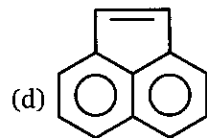
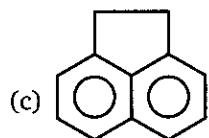
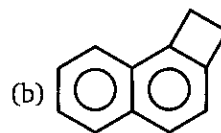
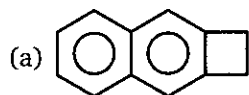
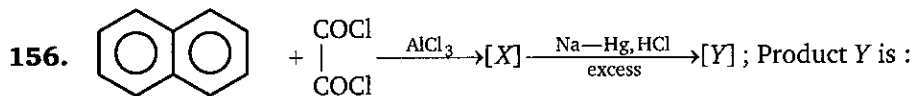
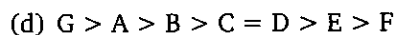
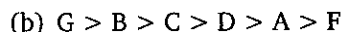
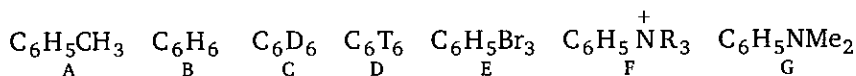
- (a) 1. Benzene +  $(\text{CH}_3)_2\text{CHCl}$ ,  $\text{AlCl}_3$ ;      2.  $\text{Br}_2$ ,  $\text{FeBr}_3$ ;      3. KCN  
 (b) 1. Benzene +  $(\text{CH}_3)_2\text{CHCl}$ ,  $\text{AlCl}_3$ ;      2.  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$ ;      3. Fe, HCl;  
       4. NaOH      5.  $\text{NaNO}_2$ , HCl,  $\text{H}_2\text{O}$   
 (c) 1. Benzene +  $(\text{CH}_3)_2\text{CHCl}$ ,  $\text{AlCl}_3$ ;      2.  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$ ;      3. Fe, HCl;  
       4.  $\text{NaNO}_2/\text{HCl}$       5. KCN  
 (d) 1. Benzene +  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$ ;      2.  $(\text{CH}_3)_2\text{CHCl}$ ,  $\text{AlCl}_3$ ;      3. Fe, HCl;  
       4.  $\text{NaNO}_2$ , HCl,  $\text{H}_2\text{O}$ ;      5. CuCN



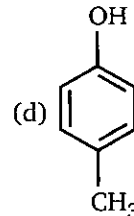
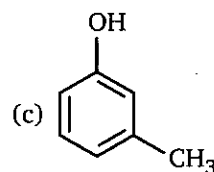
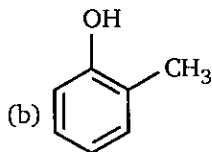
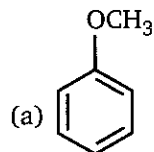
- (a)  (b) 
- (c)  (d) 



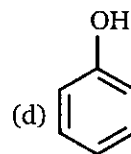
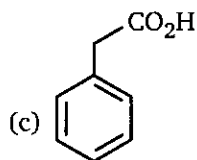
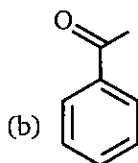
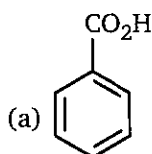
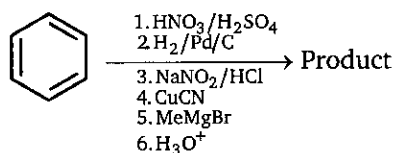
155. What is correct order of rate of nitration of the following compounds ?



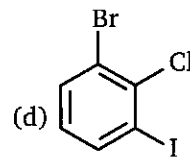
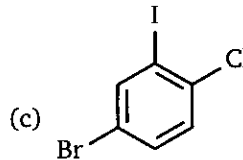
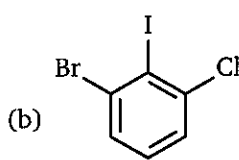
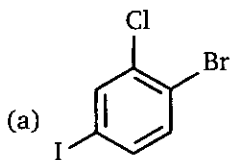
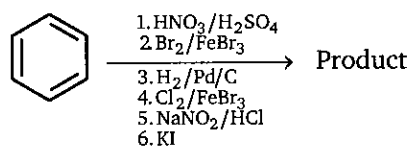
157. Compound A ( $\text{C}_7\text{H}_8\text{O}$ ) is insoluble in water, dilute HCl & aqueous  $\text{NaHCO}_3$ , but it dissolves in dilute NaOH. When A is treated with  $\text{Br}_2$  water it is converted into a compound  $\text{C}_7\text{H}_5\text{OBr}_3$  rapidly. The structure of A is :



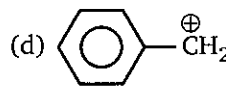
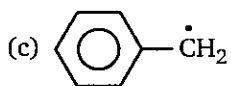
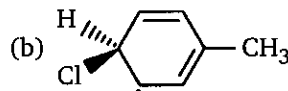
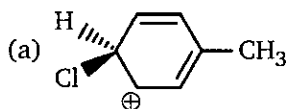
158. Give the product of the following reaction sequence :



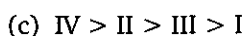
159. Give the product of the following reaction sequence:



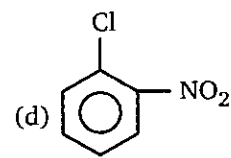
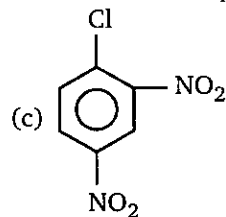
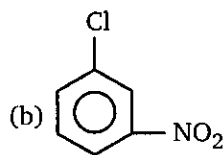
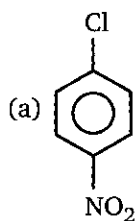
160. Which represents an intermediate formed in the reaction of toluene and chlorine at elevated temperature in sunlight ?



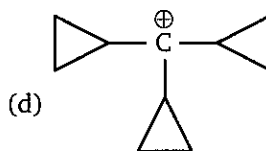
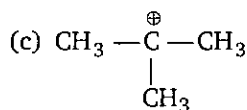
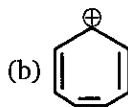
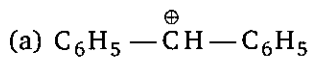
161. The decreasing order of reactivity of *m*-nitrobromobenzene (I), 2, 4, 6-trinitrobromobenzene (II), *p*-nitrobromobenzene (III), and 2,4-dinitrobromobenzene (IV), towards  $\text{OH}^-$  ions is :



162. Which one of the following compounds is most reactive for  $\text{ArS}_{\text{N}_2}$  reaction ?



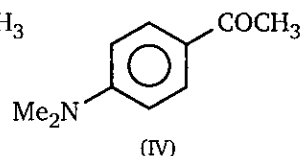
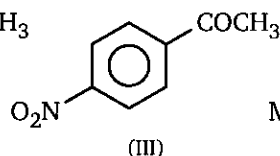
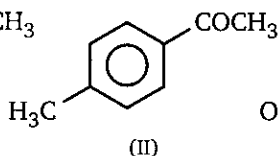
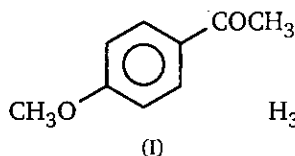
163. Which one amongst the following carbocations is most stable ?



164. Cyclopentadiene is much more acidic than cyclopentane. The reason is that :

- (a) cyclopentadiene has conjugated double bonds  
 (b) cyclopentadiene has both  $sp^2$  and  $sp^3$  hybridized carbon atoms  
 (c) cyclopentadiene is a strain-free cyclic system  
 (d) cyclopentadienide ion, the conjugate base of cyclopentadiene, is an aromatic species and hence has higher stability

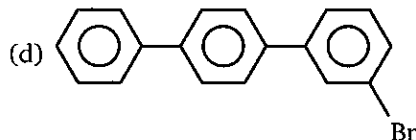
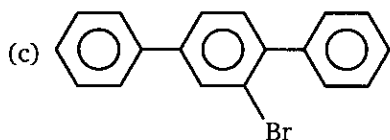
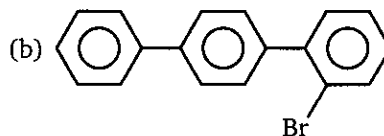
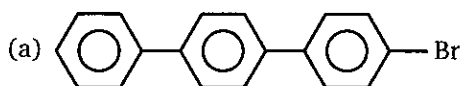
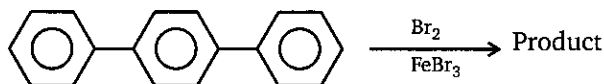
165.



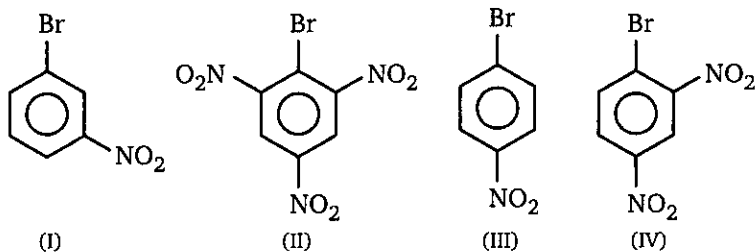
Friedel-Crafts acylation reaction can be used to obtain the compounds

- (a) II, III and IV  
 (b) I, III and IV  
 (c) I and II  
 (d) II and III

166. The major product of the reaction is :



167. The decreasing order of reactivity of given compound towards nucleophilic substitution with aqueous NaOH is :



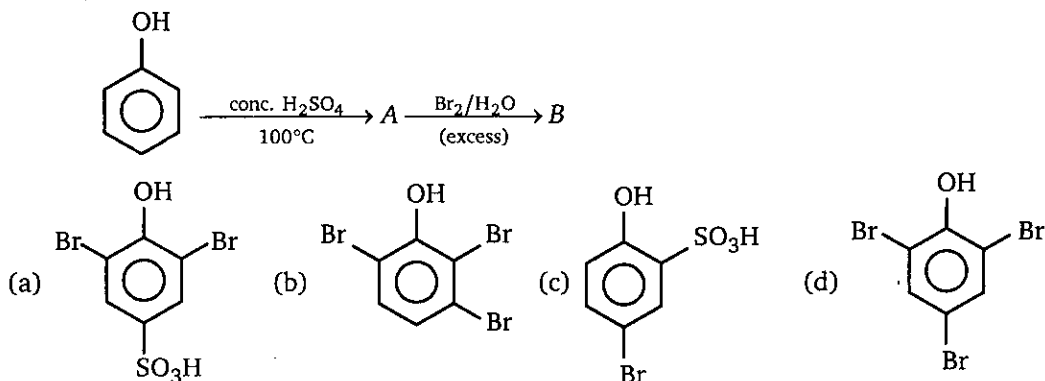
(a) I > II > III > IV

(b) II > IV > III > I

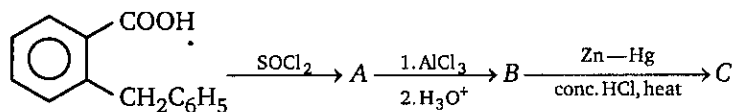
(c) IV > II > III > I

(d) II > IV > I > III

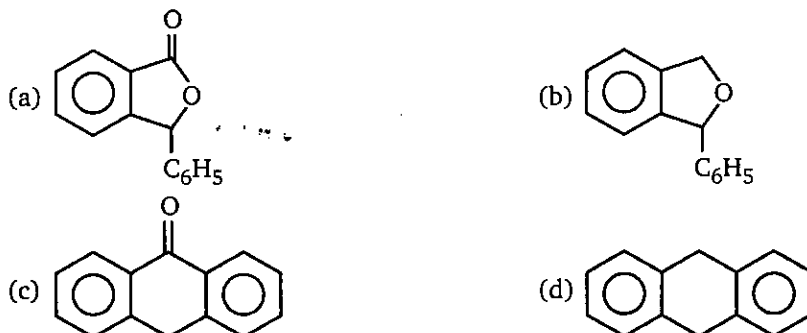
168. Identify the end product (B) of the following sequence of reactions.



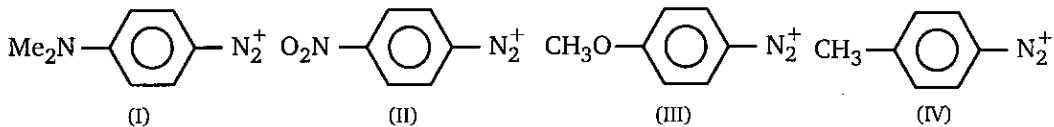
169. Consider the following sequence of reactions :



The end product (C) is :



170. For the diazonium ions the order of reactivity towards diazo-coupling with phenol in the presence of dilute NaOH is :



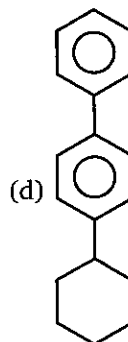
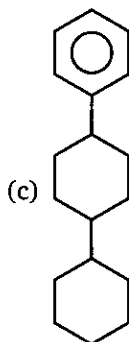
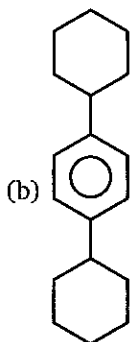
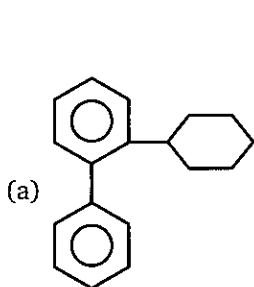
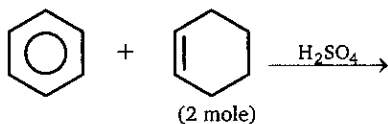
(a) I < IV < II < III


(b) I < III < IV < II

(c) III < I < II < IV

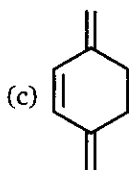
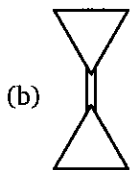
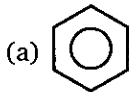
(d) III < I < IV < II

171. Major product obtained in given reaction is :

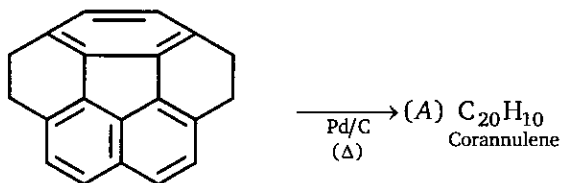


172.   $\xrightarrow[\text{or AlCl}_3 \text{ (major)}]{\text{H}^\oplus}$  (B) ; (A) & (B) are isomers. Product (B) is :

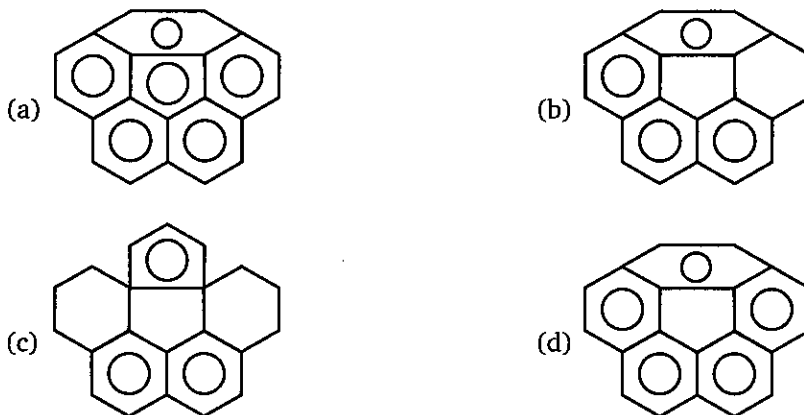
Dewar's Benzene



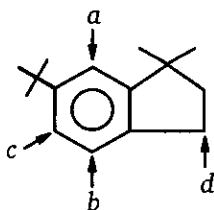
173. The step shown below is a recent synthesis of corannulene.



Product (A) is :

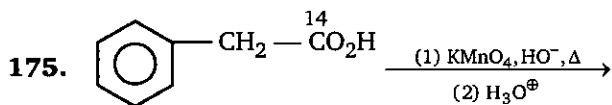


174.



Identify the position where E.A.S. will take place :

- (a) *a* (b) *b*  
 (c) *c* (d) all the position are identical

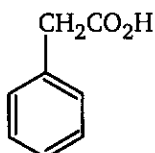


The labelled carbon goes with :

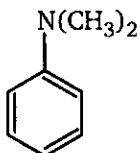
- (a)  $\text{Ph}-\overset{14}{\text{C}}\text{O}_2\text{H}$  (b)  $\overset{14}{\text{C}}\text{O}_2$   
 (c)  $\text{Ph}-\overset{14}{\text{C}}\text{H}_2-\text{CO}_2\text{H}$  (d)  $\overset{14}{\text{C}}\text{H}_4$

176. What is the expected order of reactivity of the following compounds in electrophilic chlorination ( $\text{Cl}_2 + \text{FeCl}_3$ ) ?

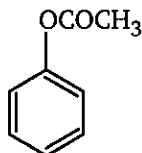
(more reactive > less reactive)



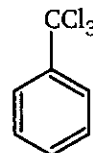
I



II



III



IV

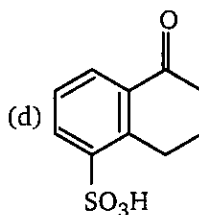
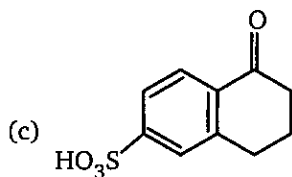
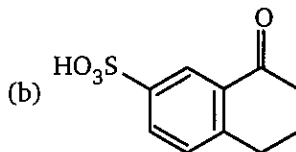
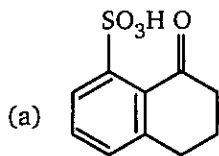
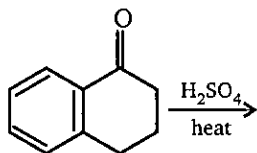
(a) I > II > III > IV

(b) IV > III > II > I

(c) III > I > IV > II

(d) II > III > I > IV

177. Which of the following is the major product from sulfonation of  $\alpha$ -tetralone ?



178. Which of the following procedures would be best for the preparation of phenyl benzyl ether ?



(a)  $\text{C}_6\text{H}_5\text{Cl} + \text{C}_6\text{H}_5\text{CH}_2\text{O}^{(-)}\text{Na}^{(+)}$

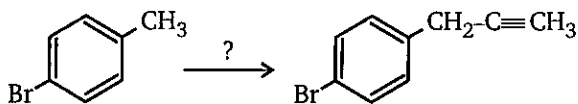
(b)  $\text{C}_6\text{H}_5\text{O}^{(-)}\text{Na}^{(+) + \text{C}_6\text{H}_5\text{CH}_2\text{Cl}$

(c)  $2\text{C}_6\text{H}_5\text{Cl} + \text{Na}_2\text{O}$

(d)  $2\text{C}_6\text{H}_5\text{MgBr} + \text{CH}_2\text{O}$

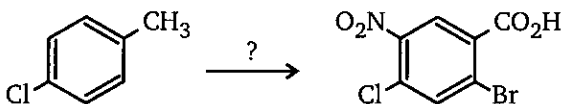


179. Which of the following procedures would be best for achieving the following reaction ?



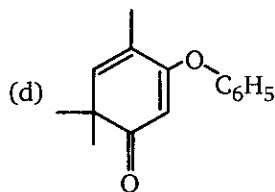
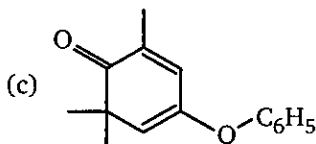
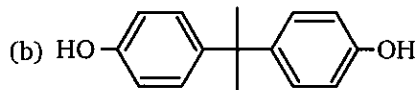
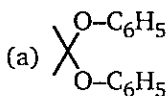
- (a) (i) KOH and heat (ii)  $\text{CH}_3\text{C}\equiv\text{C}-\text{Br}$   
 (b) (i)  $\text{KMnO}_4$  and heat (ii)  $\text{CH}_3\text{C}\equiv\text{C}^{\ominus}\text{Na}^{\oplus}$  (iii) excess  $\text{H}_2\text{O}$   
 (c) (i) NBS in  $\text{CCl}_4$  and heat (ii)  $\text{CH}_3\text{C}\equiv\text{C}^{\ominus}\text{Na}^{\oplus}$   
 (d) (i) Mg in ether (ii)  $\text{CH}_3\text{C}\equiv\text{CBr}$  (iii) excess  $\text{H}_3\text{PO}_4$

180. Which of the following procedures would be best for achieving the following reaction ?



- (a) (i)  $\text{Br}_2 + \text{FeBr}_3$  (ii)  $\text{KMnO}_4$  and heat (iii)  $\text{HNO}_3$  and  $\text{H}_2\text{SO}_4$   
 (b) (i)  $\text{KMnO}_4$  and heat (ii)  $\text{Br}_2 + \text{FeBr}_3$  (iii)  $\text{HNO}_3$  and  $\text{H}_2\text{SO}_4$   
 (c) (i) NBS in  $\text{CCl}_4$  and heat (ii)  $\text{KMnO}_4$  and heat (iii)  $\text{HNO}_3$  and  $\text{H}_2\text{SO}_4$   
 (d) (i) NBS in  $\text{CCl}_4$  and heat (ii)  $\text{NaNO}_2$  and heat

181. Phenol reacts with acetone in the presence of conc. sulphuric acid to form a  $\text{C}_{15}\text{H}_{16}\text{O}_2$  product. Which of the following compounds is this product ?



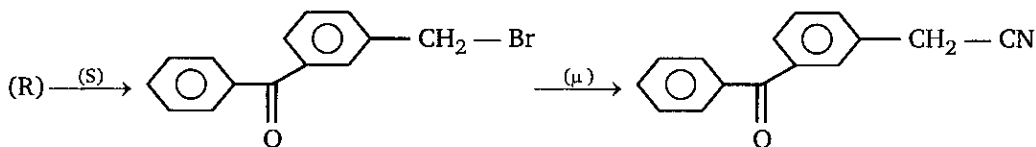
182. Heating benzene in a large excess of 80%  $\text{D}_2\text{SO}_4$  in  $\text{D}_2\text{O}$  results in what product ?

- (a)  $\text{C}_6\text{H}_5\text{SO}_3\text{D}$  (b)  $\text{C}_6\text{H}_5\text{OD}$  (c)  $\text{C}_6\text{H}_5\text{D}$  (d)  $\text{C}_6\text{D}_6$

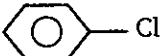


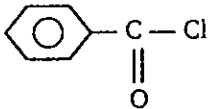
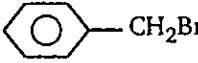
183. A solution of cyclohexene in benzene is stirred at  $0^\circ\text{C}$  while concentrated sulphuric acid is added. After washing away the acid and removing the excess benzene, what product is isolated?

- (a) cyclohexylbenzene (b) 1-cyclohexylcyclohexene  
 (c) *trans*-1,2-diphenylcyclohexane (d) 1,1-diphenylcyclohexane

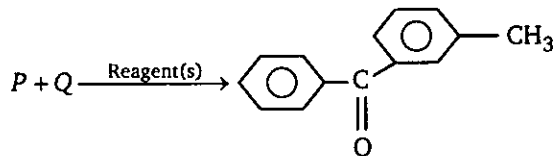
184. Identify the reagents S and  $\mu$  in the scheme below in which R is converted to the nitrite V via the benzylic halide T.



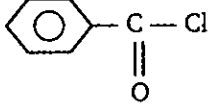
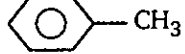
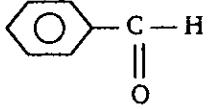


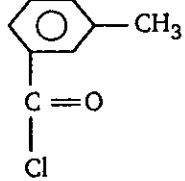

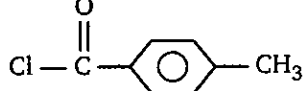
R, S and  $\mu$  respectively are :

R	S	$\mu$
(a) 	$\text{H}-\text{C}(\text{O})-\text{C}_6\text{H}_4-\text{CH}_2\text{Br}$ ( $\text{AlCl}_3$ )	HCN
(b) 	$\text{Cl}-\text{C}(\text{O})-\text{C}_6\text{H}_4-\text{CH}_2\text{Br}$ ( $\text{AlCl}_3$ )	HCN
(c) 	$\text{Cl}-\text{C}(\text{O})-\text{C}_6\text{H}_4-\text{CH}_2\text{Br}$ ( $\text{AlCl}_3$ )	KCN
(d) 	 ( $\text{AlCl}_3$ )	KCN

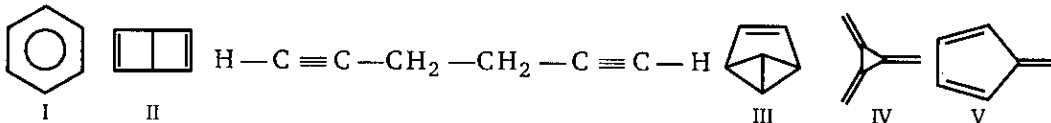
185. Two aromatic compounds P and Q give product R.



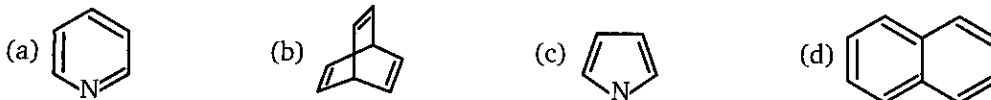
Reactant P, Q and reagent used in above reaction are :

P	Q	Reagent
(a) 		$\text{AlCl}_3$
(b) 		$\text{AlCl}_3$
(c) 		$\text{AlCl}_3$
(d) 		$\text{ZnCl}_2$

186. Which of the following  $C_6H_6$  compounds has a single set of structurally equivalent hydrogen atoms ?



- (a) I and II  
(b) I and IV  
(c) I and V  
(d) I, II and III
187. Which of the following compounds would not be considered aromatic in its behaviour?



188. A  $C_8H_{10}$  hydrocarbon is nitrated by  $HNO_3$  and sulphuric acid. Two, and only two,  $C_8H_9NO_2$  isomers are obtained. Which of the following fits this evidence ?

- (a) ethyl benzene  
(b) *ortho*-xylene  
(c) *meta*-xylene  
(d) *para*-xylene

189. Which of the following benzene ring substituents is deactivating but *ortho-para* directing ?

- (a)  $-N=O$   
(b)  $-OCH_3$   
(c)  $-COCH_3$   
(d)  $-NO_2$

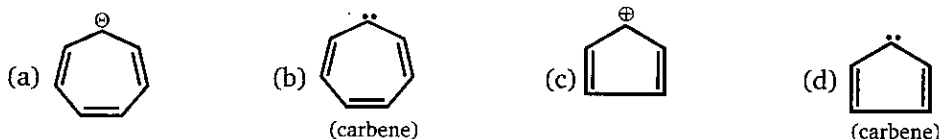
190. Which of the following compounds forms *ortho*-benzenedicarboxylic acid when oxidized by hot aqueous potassium permanganate ?



191. Which of the following organic chlorides will not give a Friedel-Craft alkylation product when heated with benzene and  $AlCl_3$  ?

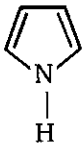
- (a)  $(CH_3)_3CCl$   
(b)  $CH_2=CHCH_2Cl$   
(c)  $CH_3CH_2Cl$   
(d)  $CH_2=CHCl$

192. Which of the following is aromatic ?



193. Which of the following substance will increase the acidity of phenol ?

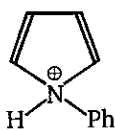
- (a) Dil.  $\text{H}_2\text{SO}_4$       (b) Dil.  $\text{HCl}$       (c) Conc.  $\text{H}_2\text{SO}_4$       (d) Conc.  $\text{CH}_3\text{COOH}$

194.  +  $\text{PhMgBr} \longrightarrow E + F$

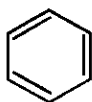
  
Pyrrole

$E + \text{MeCl} \longrightarrow G + H$

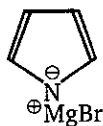
$F + \text{MeCl} \longrightarrow$  no reaction without a catalyst



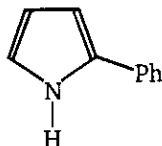
1



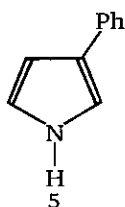
2



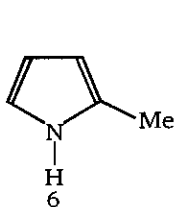
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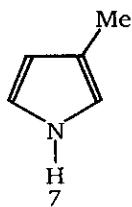
4



5



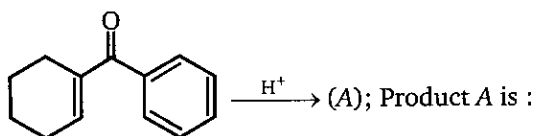
6

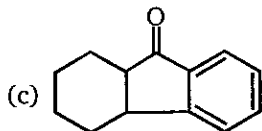
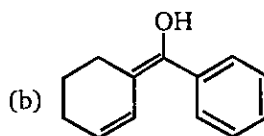
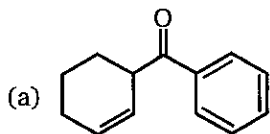


7

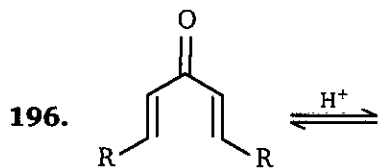
The structure of products  $E - H$ , respectively are

- (a) 3, 2, 6, 7      (b) 4, 5, 6, 1  
(c) 3, 4, 5, 2      (d) 3, 2, 4, 5

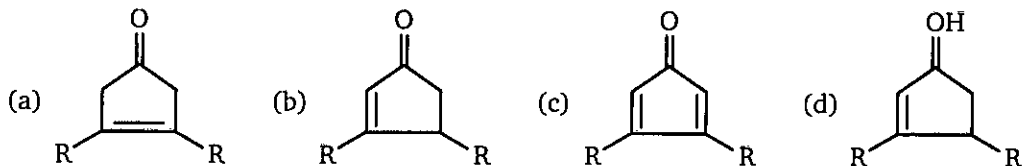
195.   $\xrightarrow{\text{H}^+} (A)$ ; Product A is :



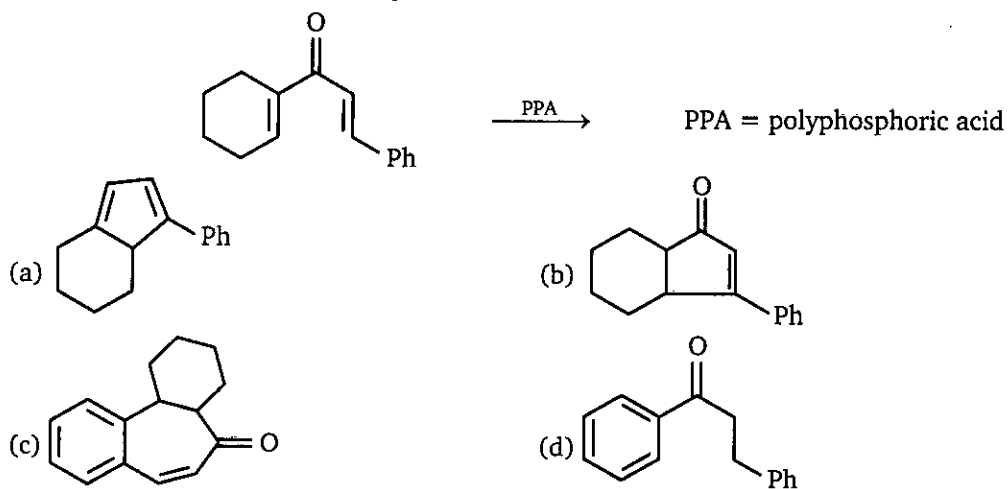
(d) none of these



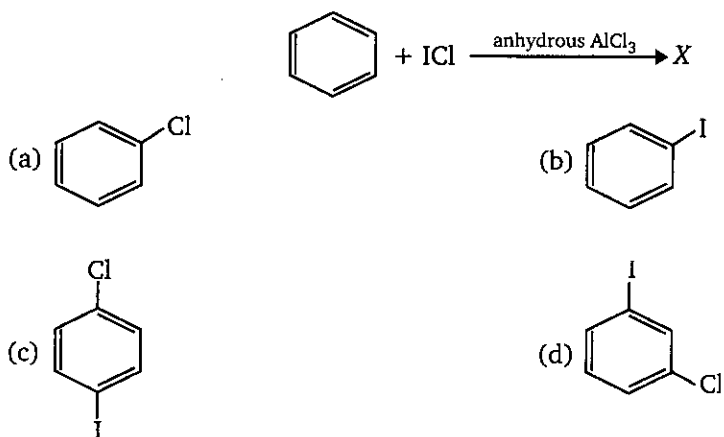
Identify the product of the above rearrangement reaction.

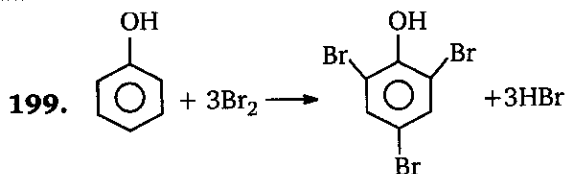


197. Product obtained in the following transformation is :



198. The compound X in the reaction.





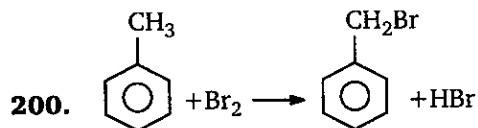
(a) Nucleophilic addition

(c) Electrophilic addition

(e) Free radical substitution

(b) Nucleophilic substitution

(d) Electrophilic substitution



(a) Nucleophilic addition

(c) Electrophilic addition

(e) Free radical substitution

(b) Nucleophilic substitution

(d) Electrophilic substitution

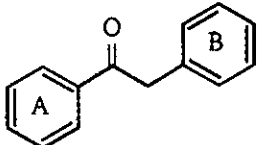
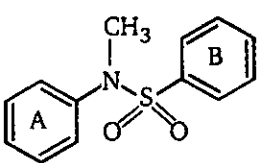
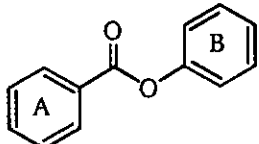
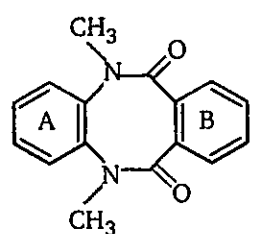
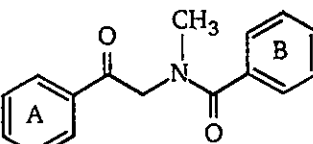
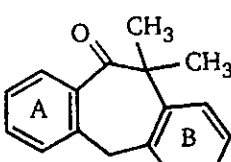
## ANSWERS — LEVEL 1

1.	(b)	2.	(d)	3.	(b)	4.	(c)	5.	(a)	6.	(b)	7.	(c)	8.	(b)
9.	(d)	10.	(d)	11.	(a)	12.	(a)	13.	(a)	14.	(a)	15.	(a)	16.	(b)
17.	(b)	18.	(a)	19.	(b)	20.	(b)	21.	(c)	22.	(c)	23.	(b)	24.	(b)
25.	(d)	26.	(c)	27.	(c)	28.	(b)	29.	(b)	30.	(b)	31.	(b)	32.	(a)
33.	(b)	34.	(d)	35.	(c)	36.	(c)	37.	(a)	38.	(c)	39.	(a)	40.	(b)
41.	(b)	42.	(c)	43.	(c)	44.	(b)	45.	(c)	46.	(b)	47.	(b)	48.	(b)
49.	(b)	50.	(b)	51.	(b)	52.	(a)	53.	(c)	54.	(c)	55.	(a)	56.	(a)
57.	(d)	58.	(b)	59.	(b)	60.	(b)	61.	(c)	62.	(b)	63.	(b)	64.	(b)
65.	(a)	66.	(a)	67.	(c)	68.	(b)	69.	(a)	70.	(d)	71.	(b)	72.	(a)
73.	(a)	74.	(c)	75.	(a)	76.	(d)	77.	(c)	78.	(b)	79.	(c)	80.	(b)
81.	(b)	82.	(c)	83.	(a)	84.	(c)	85.	(d)	86.	(b)	87.	(d)	88.	(b)
89.	(d)	90.	(d)	91.	(d)	92.	(d)	93.	(d)	94.	(b)	95.	(c)	96.	(d)
97.	(b)	98.	(d)	99.	(b)	100.	(b)	101.	(b)	102.	(c)	103.	(d)	104.	(a)
105.	(b)	106.	(d)	107.	(c)	108.	(b)	109.	(b)	110.	(b)	111.	(c)	112.	(b)
113.	(c)	114.	(a)	115.	(b)	116.	(b)	117.	(a)	118.	(b)	119.	(b)	120.	(c)
121.	(b)	122.	(b)	123.	(c)	124.	(b)	125.	(b)	126.	(b)	127.	(c)	128.	(c)
129.	(c)	130.	(b)	131.	(d)	132.	(b)	133.	(b)	134.	(a)	135.	(b)	136.	(a)
137.	(b)	138.	(c)	139.	(d)	140.	(b)	141.	(b)	142.	(c)	143.	(a)	144.	(b)
145.	(b)	146.	(c)	147.	(a)	148.	(c)	149.	(c)	150.	(b)	151.	(d)	152.	(c)
153.	(c)	154.	(b)	155.	(c)	156.	(c)	157.	(c)	158.	(b)	159.	(c)	160.	(c)
161.	(b)	162.	(c)	163.	(d)	164.	(d)	165.	(c)	166.	(c)	167.	(b)	168.	(d)
169.	(d)	170.	(b)	171.	(b)	172.	(a)	173.	(a)	174.	(b)	175.	(b)	176.	(d)
177.	(b)	178.	(b)	179.	(c)	180.	(a)	181.	(b)	182.	(d)	183.	(a)	184.	(c)
185.	(c)	186.	(b)	187.	(b)	188.	(b)	189.	(a)	190.	(b)	191.	(d)	192.	(b)
193.	(c)	194.	(a)	195.	(c)	196.	(b)	197.	(b)	198.	(b)	199.	(d)	200.	(e)



1. Each of the six compounds shown at the bottom of the page has two aromatic (benzene) rings. In each case the two rings are different and are labeled A & B. If an **electrophilic substitution, such as nitration or bromination**, is carried out on each compound, then identify which ring (A or B) will be preferentially attacked, and indicate the orientation of the substitution (ortho/para, meta or all sites).

Compound	Reactivity	Substitution	Compound	Reactivity	Substitution
1.	A	ortho/para	2.	A	ortho/para
	B	meta		B	meta
		all sites			all sites
3.	A	ortho/para	4.	A	ortho/para
	B	meta		B	meta
		all sites			all sites
5.	A	ortho/para	6.	A	ortho/para
	B	meta		B	meta
		all sites			all sites

Compound		Compound	
1.		2.	
3.		4.	
5.		6.	



2. When given substituents on a benzene ring, as activating or de-activating and as ortho-para or meta directing for electrophilic aromatic substitution fill the following by appropriate (✓) right or (X) wrong.

	Substituent	Activating	De-activating	Ortho/para	Meta
1.	$-\text{OCH}_3$				
2.	$\begin{array}{c} \text{O} \\    \\ -\text{C}-\text{O}-\text{CH}_3 \end{array}$				
3.	$\begin{array}{c} -\text{O}-\text{C}-\text{CH}_3 \\    \\ \text{O} \end{array}$				
4.	$-\text{CH}_3$				
5.	$-\text{F}$				
6.	$-\text{Ph}$				
7.	$\begin{array}{c} \text{O} \\    \\ -\text{NH}-\text{C}-\text{CH}_3 \end{array}$				
8.	$\begin{array}{c} \text{O} \\    \\ -\text{C}-\text{NH}-\text{CH}_3 \end{array}$				
9.	$-\text{Br}$				
10.	$-\text{CN}$				
11.	$-\text{CF}_3$				
12.	$\begin{array}{c} \text{O} \\    \\ -\text{C}-\text{NH}_2 \end{array}$				
13.	$\begin{array}{c} \text{O} \\    \\ -\text{C}-\text{OH} \end{array}$				
14.	$-\text{CH}=\text{CH}_2$				

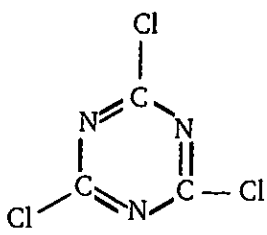
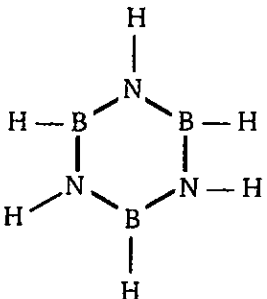
15.	$\begin{array}{c} \text{O} \\    \\ -\text{CH} = \text{CH} - \text{C} - \text{OH} \end{array}$				
16.	$\begin{array}{c} \text{O} \\    \\ -\text{CH} = \text{CH} - \text{C} - \text{H} \end{array}$				
17.	$-\text{S} - \text{Et}$				
18.	$\begin{array}{c} -\text{S} - \text{Et} \\    \\ \text{O} \end{array}$				
19.	$\begin{array}{c} \text{O} \\    \\ -\text{S} - \text{Et} \\    \\ \text{O} \end{array}$				
20.	$-\text{N} = \text{O}$				
21.	$-\text{CH}_2\text{X}$				
22.	$-\text{CHX}_2$				

3. Devise a series of reactions to convert benzene into *meta*-chlorobromobenzene. Select reagents and conditions from the following table, listing them in the order of use.

Compound		Compound		Compound	
1.	sulphuric acid (conc.) heat	5.	Mg in ether	9.	$\text{Cu}_2\text{Br}_2 + \text{HBr}$
2.	$\text{Cl}_2 + \text{FeCl}_3$ and heat	6.	$\text{PBr}_3$	10.	$(\text{CH}_3\text{CO})_2\text{O} + \text{Pyridine}$
3.	$\text{NaNO}_2 + \text{H}_3\text{O}^{(+)}$ $0^\circ\text{C}$	7.	$\text{H}_3\text{PO}_2$		
4.	$\text{H}_2$ Pt catalyst	8.	$\text{HNO}_3(\text{conc.}) +$ $\text{H}_2\text{SO}_4(\text{conc.})$ and heat		

- (a) 1 then 2 then 6  
 (b) 2 then 8 then 4 then 3 then 9  
 (c) 8 then 4 then 10 then 2 then 3 then 9  
 (d) 8 then 2 then 4 then 3 then 9




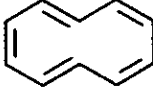
## 4. Match the Column (I) and Column (II). (Matrix)

Column (I)		Column (II)	
(a)		(p)	Aromatic
(b)		(q)	$(4n + 2)\pi$ electron in a single ring
(c)	$\text{Fe}(\text{C}_5\text{H}_5)_2$	(r)	$4n\pi$ electron in a single ring
(d)	$\text{Cr}(\text{C}_6\text{H}_6)_2$	(s)	Effective atomic number of metal = 36





## 5. Match the Column (I) and Column (II).

Column (I)		Column (II)	
Compound (Monocyclic)		Number of $\pi$ - electron	
(a)	$\text{C}_4\text{H}_4^{-2}$	(p)	$2\pi e$
(b)	$\text{C}_4\text{H}_4^{+2}$	(q)	$6\pi e$
(c)	$\text{C}_9\text{H}_9^{+1}$	(r)	$8\pi e$
(d)	$\text{C}_9\text{H}_9^{-1}$	(s)	$10\pi e$

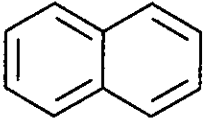

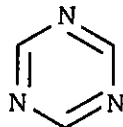






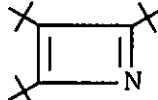
## 6. Match the Column (I), Column (II) and Column (III). (Matrix)

	Column I		Column II		Column III
(a)		(p)	Aromatic	(w)	$(4n + 2)\pi$ electron. $n = 0, 1, 2, 3$
(b)		(q)	Non-aromatic	(x)	$4n\pi$ electron $n = 1, 2, 3$
(c)		(r)	Anti-aromatic	(y)	Non-planar compound
(d)		(s)	Planar compound	(z)	Readily reacts with active metal

## 7. Match the Column (I), Column (II) and Column (III). (Matrix)

	Column I		Column II		Column III
(a)		(p)	Readily react with active metal	(w)	Aromatic
(b)		(q)	Readily undergo Dimerization at room temperature	(x)	Anti-aromatic
(c)		(r)	$(4n + 2)\pi$ electron $n = 0, 1, 2, 3$	(y)	Non-aromatic
(d)		(s)	$4n\pi$ electron	(z)	High dipole

8. Among the following compound.

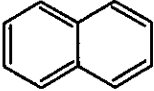


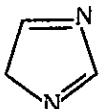


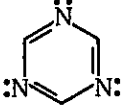


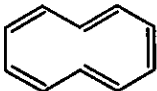
Compound		Compound		Compound	
(a)		(b)		(c)	
(d)		(e)		(f)	
(g)	$C_8H_8^{-2}$	(h)	$C_3H_3^+$	(i)	
(j)		(k)		(l)	

- (a) Number of compounds which are aromatic =  $P$   
 (b) Number of compounds which are anti-aromatic =  $Q$   
 (c) Number of compounds which are non-aromatic =  $R$   
 (d) Number of compounds which readily =  $S$   
 Undergo dimerization at room temperature  
 (e) Number of compound which reacts with active metal =  $T$   
 Sum of  $P + Q + R + S + T =$

9. Of the following compounds which will react with  $Br_2$  at room temperature in dark.

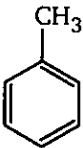
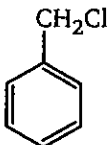

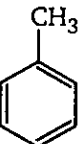
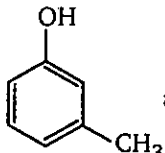
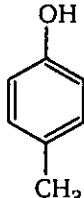
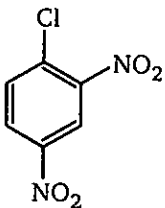
(a)	Benzene ( $C_6H_6$ )	
(b)	Cyclohexene ( $C_6H_{10}$ )	
(c)	Cyclohexane ( $C_6H_{12}$ )	
(d)	Propanoic Acid ( $C_2H_5CO_2H$ )	
(e)	Phenol ( $C_6H_5OH$ )	
(f)	Nitrobenzene ( $C_6H_5NO_2$ )	
(g)	Hexyne ( $C_6H_{10}$ )	
(h)	2,2-dichloropropane ( $C_3H_6Cl_2$ )	

10. Among the following compound.

Compound		Compound		Compound	
(a)		(b)	$C_8H_8^{-2}$	(c)	
(d)		(e)		(f)	
(g)		(h)		(i)	$C_3H_3^{+1}$
(j)		(k)		(l)	

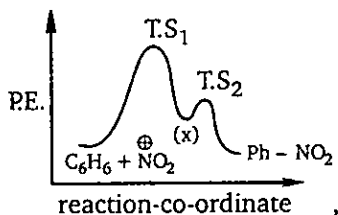
- (a) Number of compounds which are aromatic =  $w$   
 (b) Number of compounds which are non-aromatic =  $x$   
 (c) Number of compounds which are anti-aromatic =  $y$   
 (d) Number of compounds which readily undergo Dimerization at room temperature =  $z$   
 Sum of  $w + x + y + z = \dots$

## 11. Complete the following table.

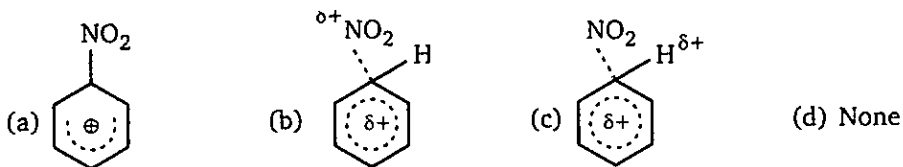
	Reactant	Reagents(s)/Conditions	Major Organic Products
(a)		(A)	
(b)		1. NaNO <sub>2</sub> in dilute H <sub>2</sub> SO <sub>4</sub> /0 - 5°C 2. heat or boiling	(B)
(c)		SO <sub>3</sub> /conc. H <sub>2</sub> SO <sub>4</sub>	(C)
(d)	(D)	1. NaOH heated at 330°C 2. dilute H <sub>3</sub> O <sup>+</sup>	 and 
(e)		1. aqueous NaOH heated at 60°C 2. dilute H <sub>3</sub> O <sup>+</sup>	(E)

## 12. Comprehension

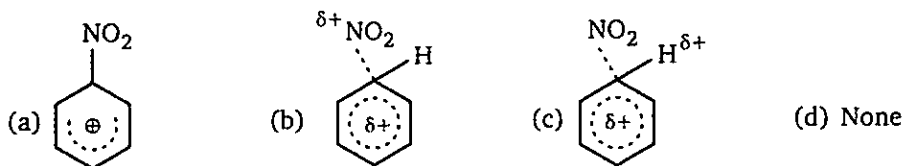
Given is the energy profile diagram of nitration of benzene using mixed acid. ( $\text{HNO}_3 + \text{H}_2\text{SO}_4$ )



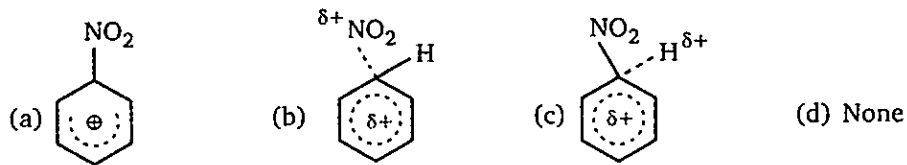
A. Identify (x) in above reaction :



B. Identify T.S<sub>1</sub> in the above reaction.

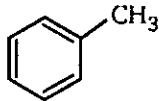
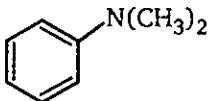
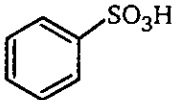
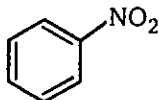
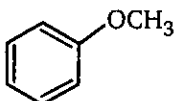
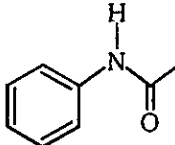
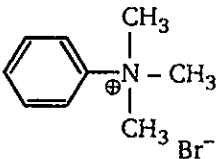
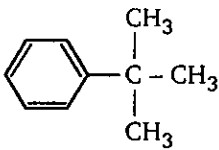
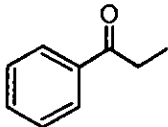
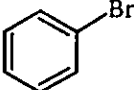


C. Identify T.S<sub>2</sub> in the above reaction :



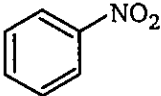
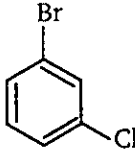
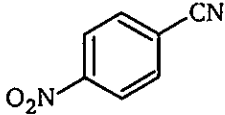
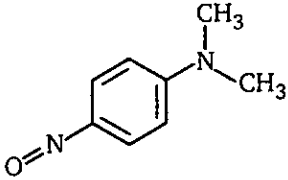
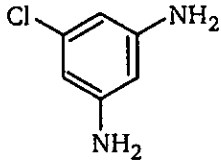
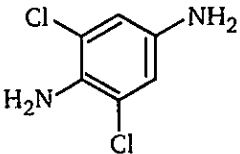


13. Examine the ten structural formulas shown below and select those that satisfy each of the following conditions. Enter one or more letters (a through j) in each answer box, reflecting your choice for each.

Compound		Compound	
a.		b.	
c.		d.	
e.		f.	
g.		h.	
i.		j.	

A.	Which compounds undergo electrophilic nitration more rapidly than benzene ?	
B.	Which compounds give meta substitution under electrophilic bromination conditions ?	

14. Nitrobenzene is a versatile compound that may be converted into a wide variety of substituted benzenes. Five such synthesis are shown below. In each reaction box above an arrow write letters designating the reagents and conditions, selected from the list at the bottom of the page, that would effect the transformation. The reagents must be written in the answer box in the correct order of their use. You may assume appropriate heating or cooling takes place, and more than one equivalent of the reagent may be used if needed.

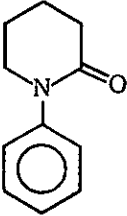
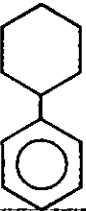
Reactant	Reagent		Product	
 nitrobenzene	a.	→	v.	
	b.	→	w.	
	c.	→	x.	
	d.	→	y.	
	e.	→	z.	

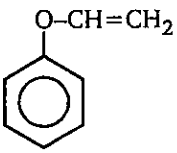
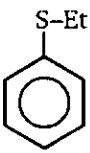
Reagents		Reagents	
A.	H <sub>2</sub> , Ni catalyst	F.	Cl <sub>2</sub> & FeCl <sub>3</sub>
B.	KBr & Cu <sub>2</sub> Br <sub>2</sub>	G.	NaOH 10% solution
C.	KCN & Cu <sub>2</sub> (CN) <sub>2</sub>	H.	(CH <sub>3</sub> CO) <sub>2</sub> O, pyridine
D.	HNO <sub>2</sub> 0°C	I.	HNO <sub>3</sub> /H <sub>2</sub> SO <sub>4</sub>
E.	CH <sub>3</sub> I & pyridine		

15. Match the column I and II.

Column (I)		Column (II)	
Group		Effect on phenyl ring	
(a)	$-\text{CH}=\text{CH}-\text{CO}_2\text{H}$	(p)	<i>o/p</i> -directors
(b)	$-\text{O}-\overset{\text{O}}{\parallel}{\text{S}}-\text{CH}_3$	(q)	meta-directors
(c)	$-\text{NH}-\overset{\text{O}}{\parallel}{\text{C}}-\text{CH}_3$	(r)	Activating group
(d)	$-\overset{\text{O}}{\parallel}{\text{S}}-\text{CH}_3$	(s)	De-activating group

16. Match the column I and II.

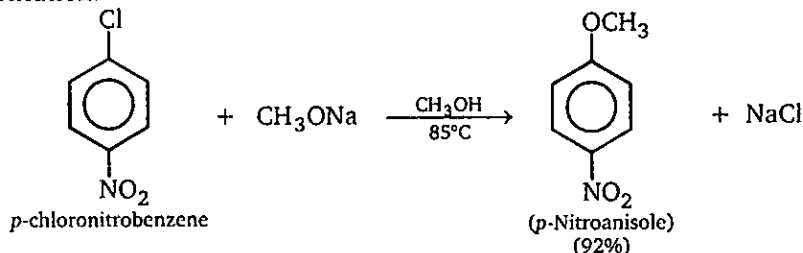
Column (I)		Column (II)	
Group		Effect on phenyl group	
(a)		(p)	Activating group
(b)		(q)	De-activating group

(c)		(r)	<i>o/p</i> -director
(d)		(s)	meta-director

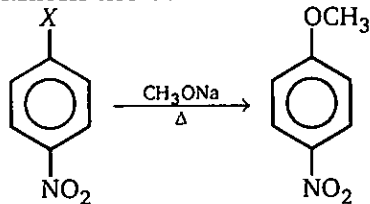
### 17. Comprehension

Nucleophilic Aromatic substitution ( $SN_{Ar}$ ) :

A substituted benzene derivative containing-  $NO_2$  and Cl group at *p*-position is subjected to Nu-substitution.



A. Match the column I and II :

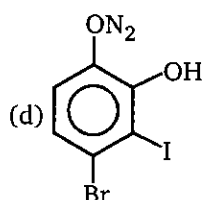
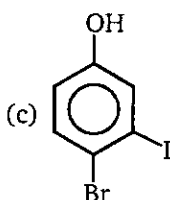
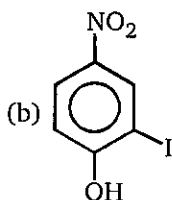
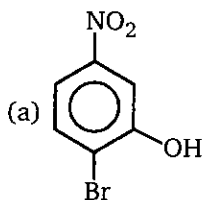
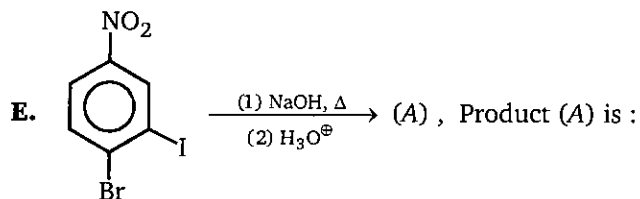
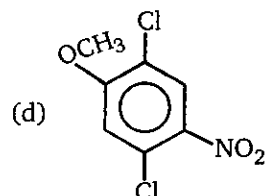
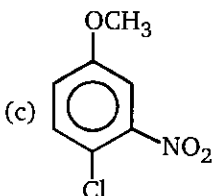
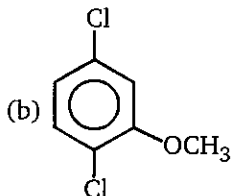
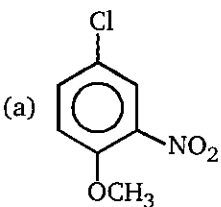
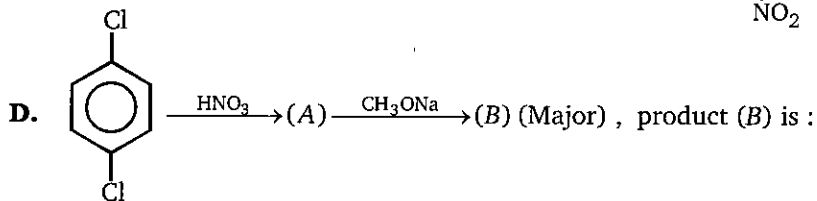
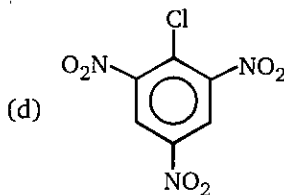
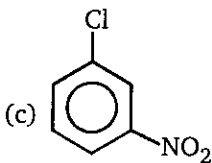
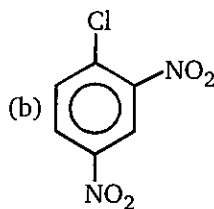
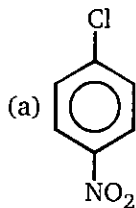


Column (I)		Column (II)	
X = halogen		relative reactivity toward ( $SN_{Ar}$ ).	
(a)	- F	(p)	312
(b)	- Cl	(q)	1
(c)	- Br	(r)	0.8
(d)	- I	(s)	0.6

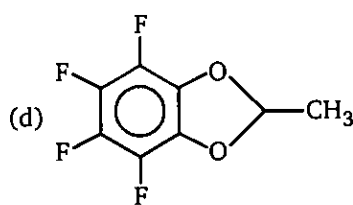
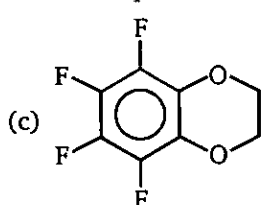
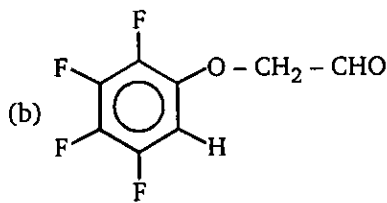
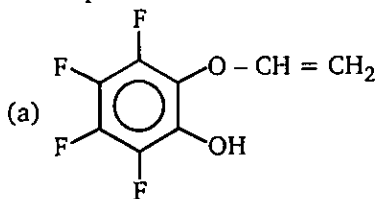
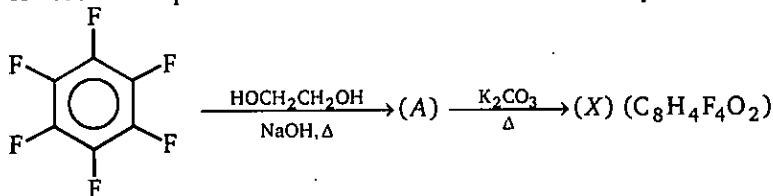
B. If step-2 were rate determining step, which halogen of aryl halide is most reactive toward  $S_NAr$ .

(a) Fluoride (b) Chloride (c) Bromide (D) Iodide

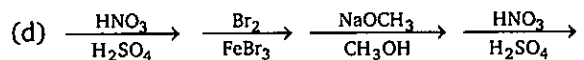
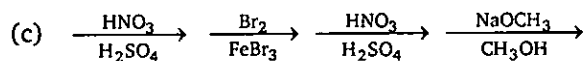
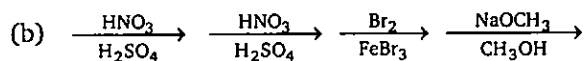
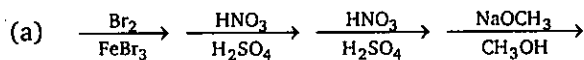
C. Which of the following is most reactive toward  $S_NAr$ .



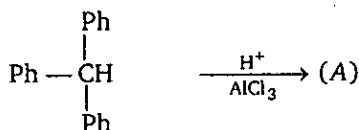
F. The cumulative effect of their fluorine activate the rings of penta and hexa fluorobenzene toward nucleophilic aromatic substitution. What is compound X in the following synthesis ?



G. Which is the best route for the synthesis of starting from benzene of?

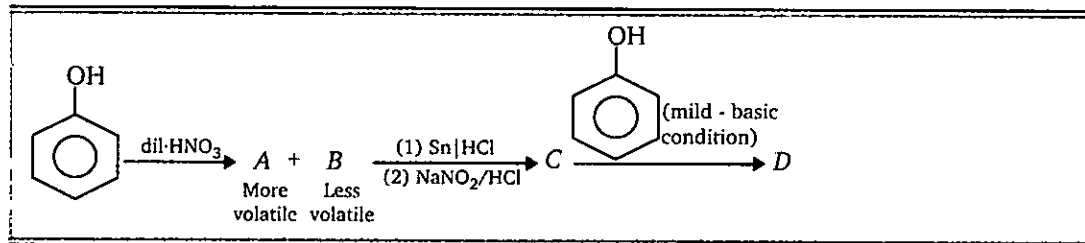


18. Identify product (A) and write its structure.



## SUBJECTIVE PROBLEMS

1.

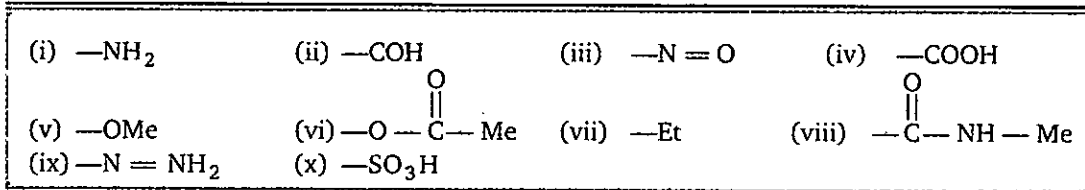


Double bond equivalent of D is :

2. How many isomers 'x' of  $\text{C}_8\text{H}_{10}$  when reacts with hot alkaline  $\text{KMnO}_4$  give only aromatic dicarboxylic acid ? How many isomers 'y' of  $\text{C}_4\text{H}_8$  when reacts with hot alkaline  $\text{KMnO}_4$  give carbondioxide ?

Sum of  $x+y=?$

3. How many groups are *o/p* director in the electrophilic aromatic substitution ?



## ANSWERS — LEVEL 2

1.

Compound	Reactivity	Substitution
1	B	ortho/para
2	A	ortho/para
3	B	ortho/para
4	A	ortho/para
5	B	meta
6	B	ortho/para

2.

	Substituent	Activating	De-activating	Ortho/para	Meta
1.	$-\text{OCH}_3$	✓	X	✓	X
2.	$\begin{array}{c} \text{O} \\    \\ -\text{C}-\text{O}-\text{CH}_3 \end{array}$	X	✓	X	✓
3.	$\begin{array}{c} \text{O} \\    \\ -\text{O}-\text{C}-\text{CH}_3 \end{array}$	✓	X	✓	X
4.	$-\text{CH}_3$	✓	X	✓	X
5.	$-\text{F}$	X	✓	✓	X
6.	$-\text{Ph}$	✓	X	✓	X
7.	$\begin{array}{c} \text{O} \\    \\ -\text{NH}-\text{C}-\text{CH}_3 \end{array}$	✓	X	✓	X
8.	$\begin{array}{c} \text{O} \\    \\ -\text{C}-\text{NH}-\text{CH}_3 \end{array}$	X	✓	X	✓
9.	$-\text{Br}$	X	✓	✓	X
10.	$-\text{CN}$	X	✓	X	✓



11.	$-\text{CF}_3$	X	✓	X	✓
12.	$\begin{array}{c} \text{O} \\    \\ -\text{C}-\text{NH}_2 \end{array}$	X	✓	X	✓
13.	$\begin{array}{c} \text{O} \\    \\ -\text{C}-\text{OH} \end{array}$	X	✓	X	✓
14.	$-\text{CH}=\text{CH}_2$	✓	X	✓	X
15.	$\begin{array}{c} \text{O} \\    \\ -\text{CH}=\text{CH}-\text{C}-\text{OH} \end{array}$	X	✓	✓	X
16.	$\begin{array}{c} \text{O} \\    \\ -\text{CH}=\text{CH}-\text{C}-\text{H} \end{array}$	X	✓	✓	X
17.	$-\text{S}-\text{Et}$	✓	X	✓	X
18.	$\begin{array}{c} -\text{S}-\text{Et} \\    \\ \text{O} \end{array}$	X	✓	✓	X
19.	$\begin{array}{c} \text{O} \\    \\ -\text{S}-\text{Et} \\    \\ \text{O} \end{array}$	X	✓	X	✓
20.	$-\text{N}=\text{O}$	X	✓	✓	X
21.	$-\text{CH}_2\text{X}$	X	✓	X	✓
22.	$-\text{CHX}_2$	X	✓	X	✓

3. d

4. a - p, q; b - p, q; c - p, q, s; d - p, q, s

5. a - q; b - p; c - r; d - s

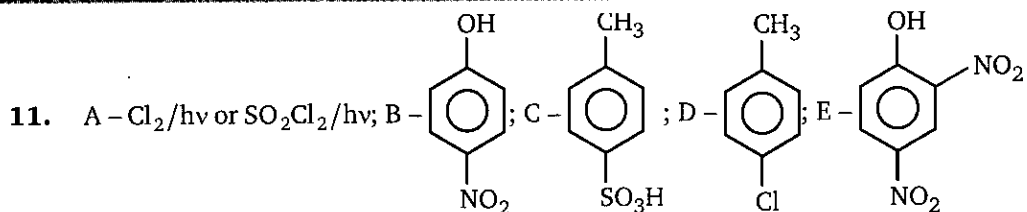
6. a - p, s - w; b - p, s - w; c - q - x, y, z; d - q - w - y

7. a - p, q, s - x; b - p - s - y; c - r - w, z; d - r - w, z

8.  $P+Q+R+S+T=19$

9. b, e, g

10.  $w+x+y+z=14$



12. A - a; B - b; C - c

13. A - a, b, e, f, h; B - c, d, g, i (Note : yet  $\text{C}_6\text{H}_5\text{Br}$  is less reactive than  $\text{C}_6\text{H}_6$  but *o/p* directing)

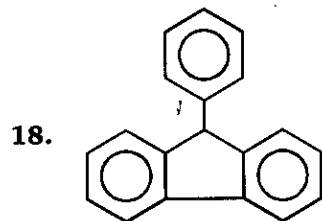
14. v - F, A, D, B; w - A, H, I, G, D, C; x - A, E, D; y - F, I, A or I, F, A;

z - A, H, I, F, G, A or A, H, I, F, A, G

15. a - p, s; b - p, r; c - p, r; d - p, s

16. a - p, r; b - p, r; c - p, r; d - p, r

17. A - a - p, b - q, c - r, d - s; B - d; C - d; D - a; E - b; F - c; G - a

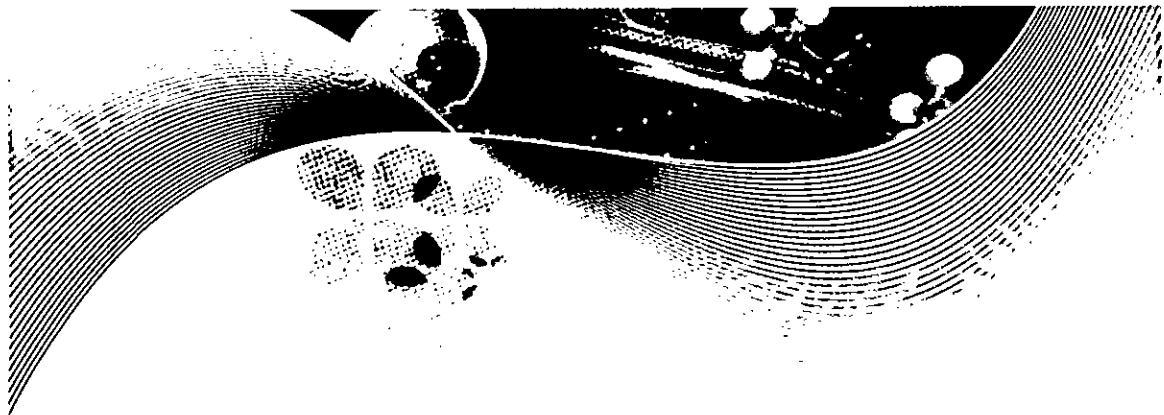


### Subjective Problems

1. 9

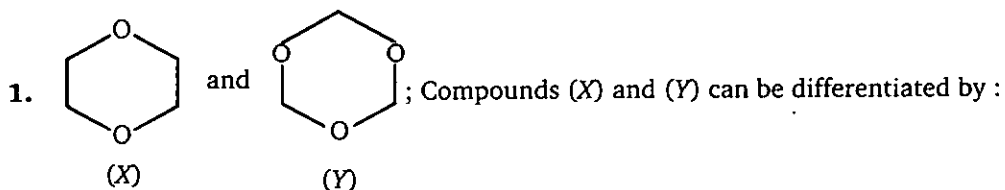
2. 5

3. 6

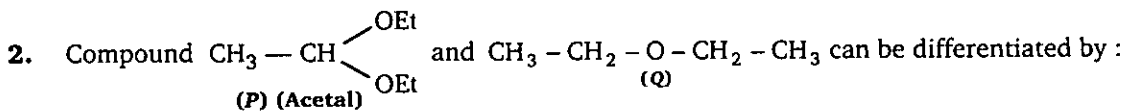


# 13 PRACTICAL ORGANIC CHEMISTRY

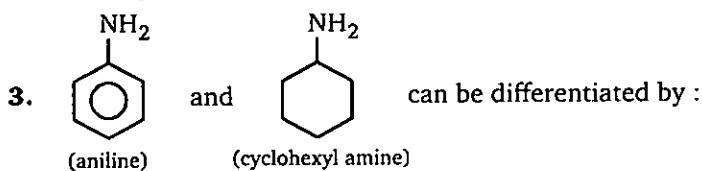
## LEVEL - 1



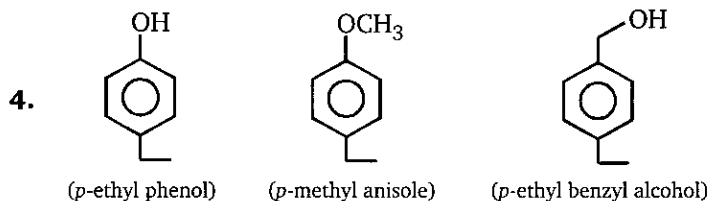
- (a)  $\text{H}_3\text{O}^\oplus$ , NaOI  
 (b)  $\text{H}_3\text{O}^\oplus$ , then Fehling test  
 (c)  $\text{H}_3\text{O}^\oplus$ , then Na  
 (d) Both (b) and (c)



- (a)  $\text{H}_3\text{O}^\oplus$ , Na  
 (b)  $\text{H}_3\text{O}^\oplus$ , Tollens' test  
 (c)  $\text{H}_3\text{O}^\oplus$ , Fehling test  
 (d) All of these

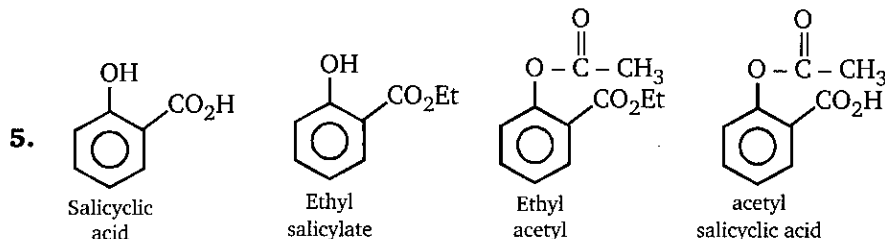


- (a) Hinsberg test  
 (b) Iso-cyanide test  
 (c)  $\text{NaNO}_2$ , HCl, then  $\beta$ -Naphthol  
 (d) NaOH



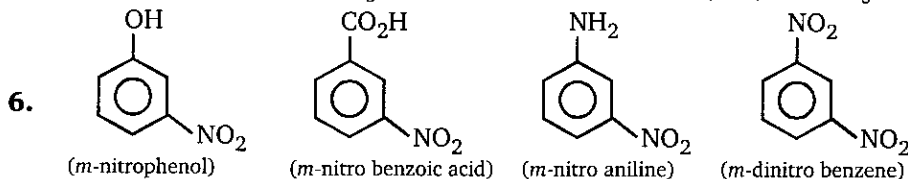
Above compounds can be differentiated by using the reagent:

- (a) NaOH, Tollen's reagent,  $\text{FeCl}_3$       (b)  $\text{CrO}_3$ , Tollen's reagent,  $\text{FeCl}_3$   
 (c) Tollen's reagent,  $\text{CrO}_3$ ,  $\text{FeCl}_3$       (d) Na, Tollen's reagent,  $\text{FeCl}_3$



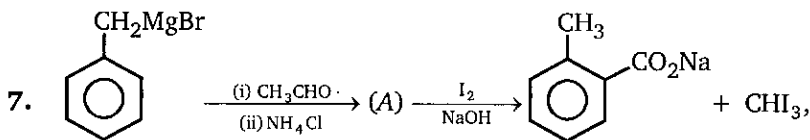
Above compounds can be differentiated by the salicylate. Which of the following chemical test? (used in decreasing order)

- (a) NaOH,  $\text{FeCl}_3$ ,  $\text{NaHCO}_3$       (b) aq.  $\text{NaHCO}_3$ ,  $\text{FeCl}_3$ , NaOH  
 (c) NaOI, NaOH,  $\text{NaHCO}_3$       (d) NaOH, Na,  $\text{NaHCO}_3$

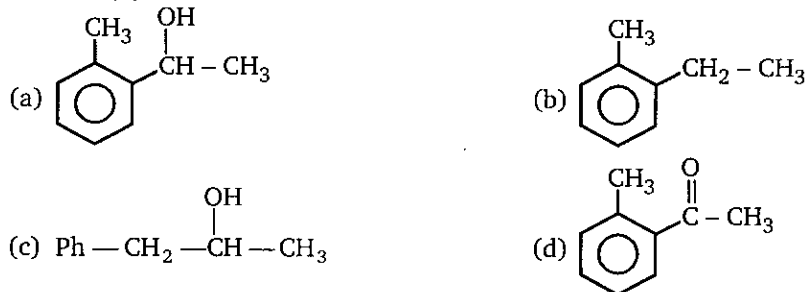


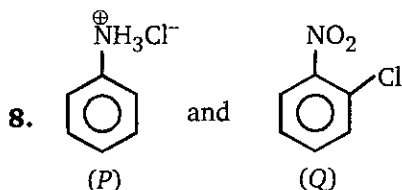
Above compounds can be differentiated by which of the following chemical test ? (used in decreasing order)

- (a) NaOH,  $\text{NaHCO}_3$ , HCl      (b) HCl, NaOH,  $\text{NaHCO}_3$   
 (c)  $\text{NaHCO}_3$ , NaOH, HCl      (d) NaOH, HCl,  $\text{NaHCO}_3$

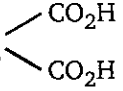
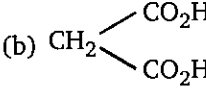
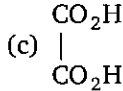
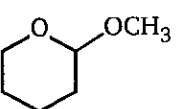
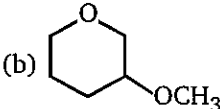
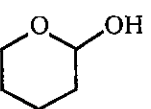
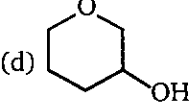


Product (A) in the above reaction is :





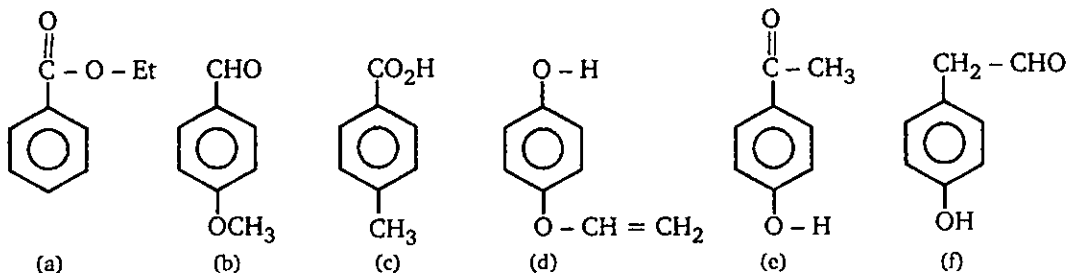
Above compounds (P) & (Q) can be differentiated by :

- (a) amm.  $\text{AgNO}_3$  (b)  $\text{NaOH}$   
 (c)  $\text{FeCl}_3$  (d) Both (a) & (b)
9. Which of following acid give positive Tollen's reagent test.
- (a)  $(\text{CH}_2)_2$   (b)  $\text{CH}_2$   (c)  (d)  $\text{HCO}_2\text{H}$
10. Which of following compounds give positive Tollen's test?
- (a)  (b)  (c)  (d) 
11. Give a simple test to differentiate cyclohexane and cyclohexene
- (a)  $\text{Br}_2/\text{H}_2\text{O}$  (b) Bayer's reagent  
 (c) Tollen's reagent (d) Both (a) and (b)
12. Give test to differentiate (Bromobenzene)  $\text{Ph}-\text{Br}$  and benzyl bromide ( $\text{PhCH}_2\text{Br}$ ).
- (a) (i) aq.  $\text{KOH}$  (ii)  $\text{Na}$  (b)  $\text{AgNO}_3$   
 (c)  $\text{KMnO}_4$  (d) All these
13. Give test to differentiate 1,1-dichloroethane and 1, 2-dichloroethane :
- (a) 2,4 -DNP then aq.  $\text{KOH}$  (b) aq.  $\text{KOH}$  then 2, 4-DNP  
 (c)  $\text{NaHSO}_3$  (d) Lucas reagent
14. Test to differentiate between  $(\text{CH}_3\text{OH})$  and  $(\text{Ph}-\text{OH})$  is/are :  
 (methanol) (Phenol)
- (a) Litmus test (b)  $\text{FeCl}_3$   
 (c)  $\text{Br}_2/\text{H}_2\text{O}$  (d) All of these
15. Acetaldehyde and benzaldehyde can be differentiated by :
- (a) Fehling test (b) Iodoform test  
 (c) Tollen's reagent (d) both (a) and (b)
16. Ethylamine and diethylamine cannot be differentiated by :
- (a) Hinsberg test (b) carbylamine test  
 (c) Iodoform test (d) both (a) and (b)
17. Lassaigne's test for the detection of nitrogen will fail in the case of :
- (a)  $\text{NH}_2\text{CONH}_2$  (b)  $\text{NH}_2\text{CONHNH}_2 \cdot \text{HCl}$   
 (c)  $\text{NH}_2\text{NH}_2 \cdot \text{HCl}$  (d)  $\text{C}_6\text{H}_5\text{NHNH}_2 \cdot 2\text{HCl}$

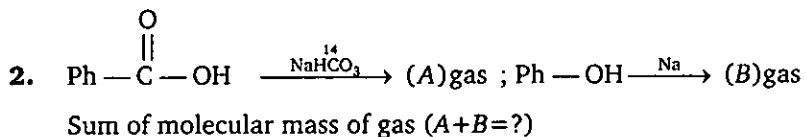


## LEVEL-2

## 1. Comprehension

 Given are the isomers of  $C_8H_8O_2$ .


- A.** Which isomer gives positive iodoform test ?  
 (a) a (b) b  
 (c) d (d) e
- B.** Which isomer gives +ive Tollen's test, also reacts with  $FeCl_3$ ?  
 (a) b (b) f  
 (c) c (d) d
- C.** Which isomer reacts with  $NaHCO_3$  ?  
 (a) c (b) d  
 (c) e (d) f
- D.** Which isomer on hydrolysis gives 1, 4-di hydroxybenzene ?  
 (a) a (b) d  
 (c) e (d) f



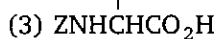
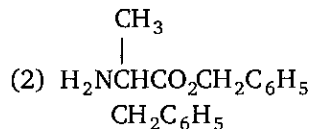
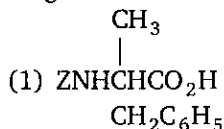
## ANSWERS — LEVEL 2

1. A - d; B - b; C - a; D - b  
 2. 48

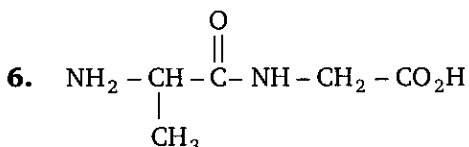




4. An amino acid may be represented by general formula  $\text{H}_2\text{N}-\overset{\text{R}}{\text{C}}\text{H}-\text{COOH}$ . If  $\text{R} = -\text{CH}_2\text{C}_6\text{H}_5$  then it is phenylalanine (Phe) and if  $\text{R} = \text{CH}_3$  then it is alanine (Ala). Find the sequence of reagents from those given below to synthesize Phe-Ala.

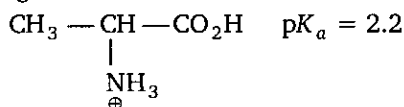


- (a) 1 and 2                      (b) 1 and 4                      (c) 2 and 3                      (d) 3 and 4
5. Iso-electric point of alanine is (pH = 6). At which pH, maximum concentration of zwitter ion of alanine will be present ?
- (a) pH > 6                      (b) pH < 6                      (c) pH = 6                      (d) pH = 7



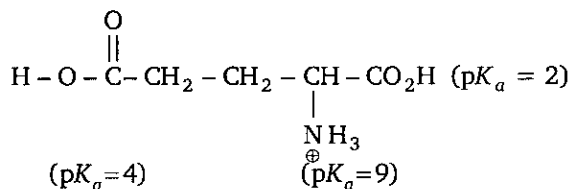
Identify the amino acid obtained by hydrolysis of the above compound:

- (a) Glycine                      (b) Alanine                      (c) Both (a) and (b)                      (d) None of these
7. At iso-electric point :
- (a) conc. of cation is equal to conc of anion  
(b) Net charge is zero.  
(c) Maximum conc. of di-polar ion (Zwitter ion) will be present  
(d) All of the above
8. Which of following amino acid has lowest iso-electric point ?
- (a) Glycine                      (b) Alanine                      (c) Aspartic acid                      (d) Lysine
9. Find iso-electric point of given amino acid



$$\text{p}K_b = 4.4$$

- (a) 3.3                      (b) 5.9                      (c) 9.6                      (d) 11.8
10. Find iso-electric point of the given amino acid



- (a) 5.5                      (b) 6.5                      (c) 3                      (d) 5

11.  $\text{H}-\text{C}\equiv\text{C}-\text{H} \xrightarrow[\text{H}_2\text{SO}_4]{\text{HgSO}_4} (\text{A}) \xrightarrow[\text{(2) H}_3\text{O}^{\oplus}]{\text{(1) NH}_3+\text{HCN}} (\text{B})$ ; Product (B) of given reaction is :

- (a) Glycine (b) Alanine  
(c) valine (d) Leucine

12. Which amino acid does not contain chiral centre ?

- (a) Valine (b) Leucine (c) Glycine (d) Iso-leucine

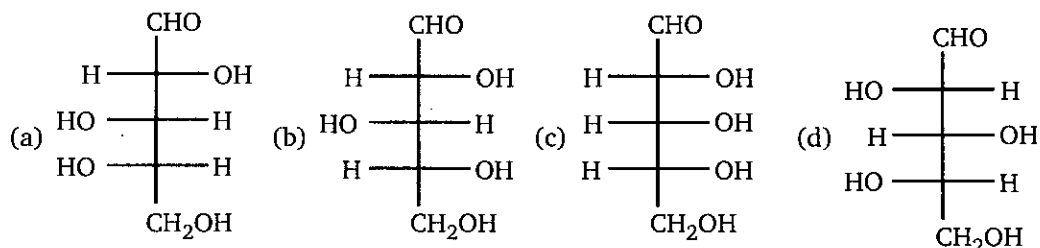
13. Which of the following is Sanger reagent ?

- (a) 2,4-Di-nitro fluobenzene (b) Phenyl isocyanate  
(c) 2, 4-Di-nitro chlorobenzene (d) 2, 4-Di-nitro iodobenzene

14. A D-carbohydrate is :

- (a) Always dextrorotatory  
(b) Always laevorotatory  
(c) Always the mirror of the corresponding L-carbohydrate  
(d) None of these

15. Which L-sugar on oxidation gives an optically active dibasic acid (2 COOH groups) ?



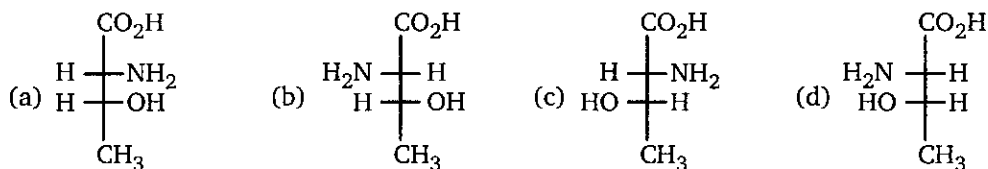
16.  $\begin{array}{c} \text{CH} = \text{N} - \text{NH} - \text{Ph} \\ | \\ \text{C} = \text{N} - \text{NH} - \text{Ph} \\ | \\ \text{HO} - \text{C} - \text{H} \\ | \\ \text{H} - \text{C} - \text{OH} \\ | \\ \text{H} - \text{C} - \text{OH} \\ | \\ \text{CH}_2\text{OH} \end{array}$  The given osazone can be obtained by :

- (a) D-glucose (b) D-mannose (c) D-Idose (d) Both (a) & (b)

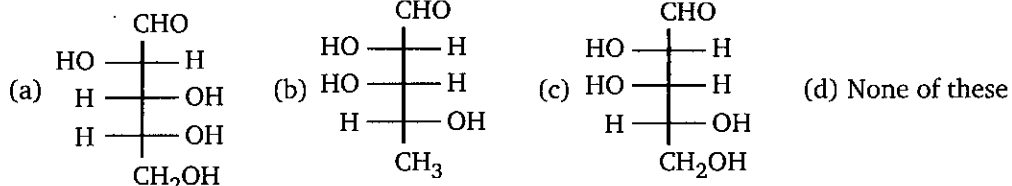
17. Which of the following pair gives same phenyl osazone ?

- (a) D-Glucose and D-Allose (b) D-Glucose and D-Alfrose  
(c) D-Glucose and D-Mannose (d) D-Glucose and D-Talose

18. Which of the following is the Fischer projection of L-threonine (also known as (2S, 3R)-2-amino-3-hydroxybutanoic acid) ?



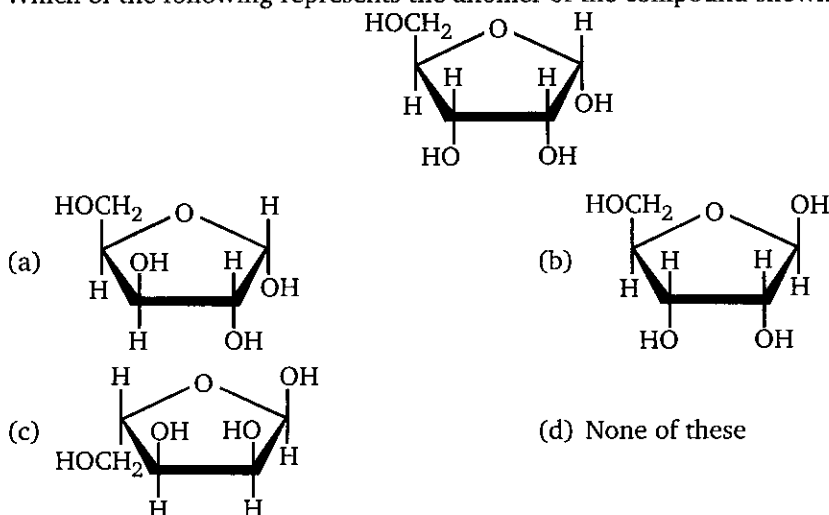
19. Among the three compounds shown below, two yield the same product on reaction with warm  $\text{HNO}_3$ . The exception is :



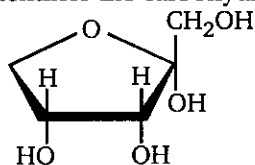
20. The optical rotation of the  $\alpha$ -form of a pyranose is  $+150.7^\circ$ , that of the  $\beta$ -form is  $+52.8^\circ$ . In solution an equilibrium mixture of these anomers has an optical rotation of  $+80.2^\circ$ . The percentage of the  $\alpha$ -form in equilibrium mixture is :

- (a) 28%                      (b) 32%                      (c) 68%                      (d) 72%

21. Which of the following represents the anomer of the compound shown ?



22. Which set of terms correctly identifies the carbohydrate shown ?



- (1) Pentose                      (2) Pentulose                      (3) Hexulose                      (4) Hexose  
 (5) Aldose                      (6) Ketose                      (7) Pyranose                      (8) Furanose  
 (a) 2, 6, 8                      (b) 2, 6, 7  
 (c) 1, 5, 8                      (d) A set of terms other than these

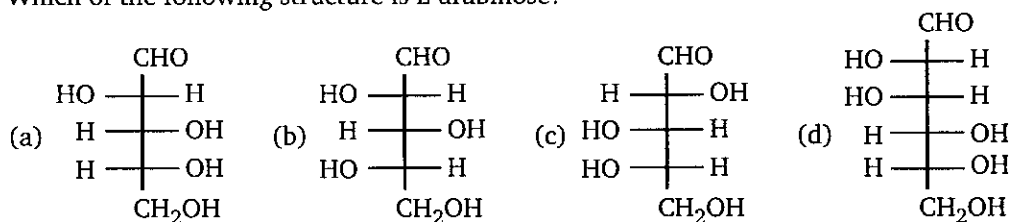
23. For the complex conversion of D-glucose into the corresponding osazone, the minimum number of equivalents of phenyl hydrazine required is :

- (a) two                      (b) three                      (c) four                      (d) five

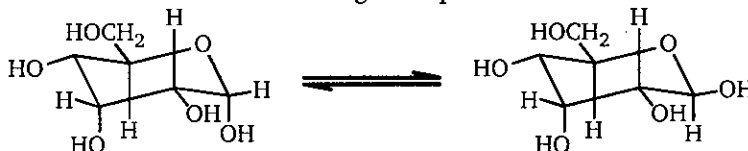
24. Which one of the following compounds will form an osazone derivative ?

- (a)  $\text{CH}_3\text{CH}_2\text{COCH}_2\text{OH}$                       (b)  $\text{CH}_3\text{COCH}_2\text{CH}_2\text{OH}$   
 (c)  $\text{CH}_3\text{CH}_2\text{CHOHCH}_2\text{OH}$                       (d)  $\text{CH}_3\text{CH}_2\text{COCH}_2\text{OCH}_3$

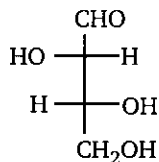
25. Which of the following structure is L-arabinose?



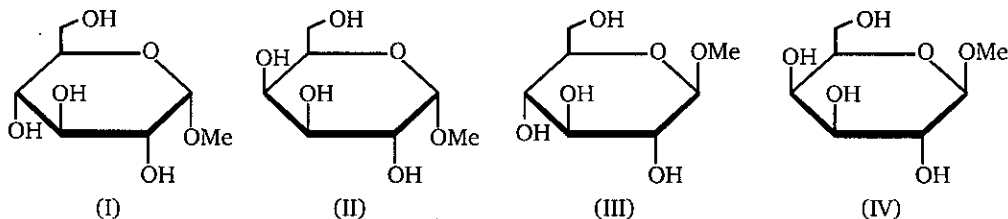
26. Which one of the statements concerning the equilibrium shown is true ?



- (a) The two structures are enantiomers of each other. They have equal but opposite optical rotations and racemize slowly at room temperature
- (b) The two structures are enantiomers of each other. They racemize too rapidly at room temperature for their optical rotations to be measured
- (c) The two structures are diastereomers of each other. Their interconversion is called mutarotation
- (d) The two structures are diastereomers of each other. Their interconversion does not require breaking and making bonds, only a change in conformation
27. The configurations of the chirality centres in D-threose (shown) are :

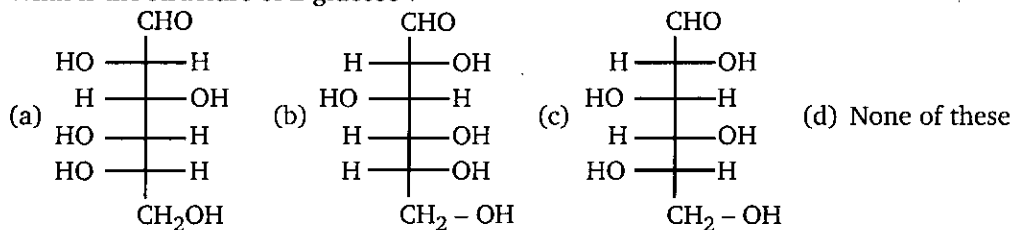


- (a) 2R, 3R      (b) 2R, 3S      (c) 2S, 3R      (d) 2S, 3S
28. Rapid interconversion of  $\alpha$ -D-glucose and  $\beta$ -D-glucose in solution is known as :
- (a) racemization      (b) asymmetric induction
- (c) fluxional isomerization      (d) mutarotation
29. Identify the correct set of stereochemical relationships amongst the following monosaccharides I-IV.

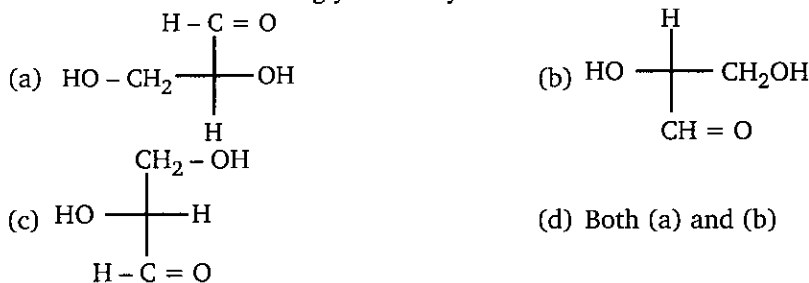


- (a) I and II are anomers ; III and IV are epimers
- (b) I and III are epimers ; II and IV are anomers
- (c) I and II are epimers ; III and IV are anomers
- (d) I and III are anomers ; I and II are epimers

30. What is the structure of L-glucose ?



31. What is the structure of L-glyceraldehyde?



32. 
$$\begin{array}{c} \text{HC} - \text{OH} \\ || \\ \text{C} - \text{OH} \\ | \\ \text{HO} - \text{C} - \text{H} \\ | \\ \text{H} - \text{C} - \text{OH} \\ | \\ \text{H} - \text{C} - \text{OH} \\ | \\ \text{CH}_2\text{OH} \end{array}$$
, the given is enol form of :

- (a) D-glucose      (b) D-mannose      (c) D-fructose      (d) All of these

33. D-glucose  $\xrightleftharpoons{\text{HO}^-}$  A + B; A and B are :

- (a) D-mannose & D-mannitol      (b) D-mannose & D-Fructose  
(c) D-Allose & D-Altrose      (d) D-Glucose & D-Idose

34. Stereoisomers of aldohexose is (a) and stereoisomers of ketohexose is (b).

Ratio of a/b is :

- (a)  $\frac{1}{2}$       (b)  $\frac{2}{1}$       (c)  $\frac{4}{1}$       (d)  $\frac{1}{4}$

35. D-Glucose  $\xrightarrow[\Delta]{\text{HNO}_3}$  (A); Product (A) is :

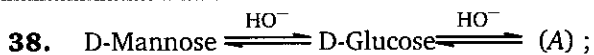
- (a) D-Gluconic acid      (b) D-Glucitol      (c) D-Fructose      (d) D-Glucaric acid

36. D-glucose & D-fructose can be differentiated by :

- (a) Fehling solution      (b) Tollens reagent  
(c) Benedict test      (d)  $\text{Br}_2/\text{H}_2\text{O}$

37. D-Glucose exist in x different forms. The value of x (stereoisomer) is :

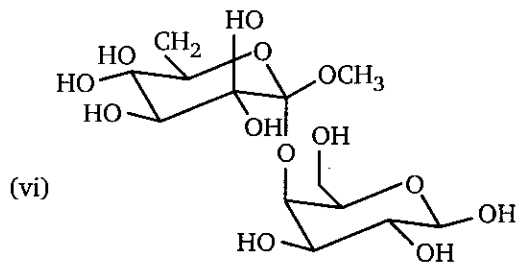
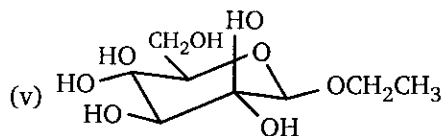
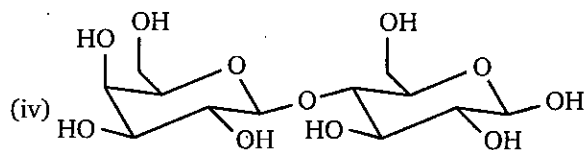
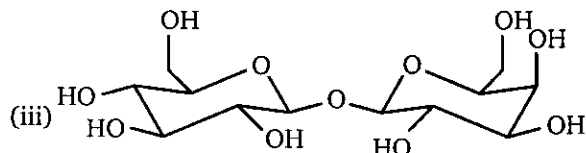
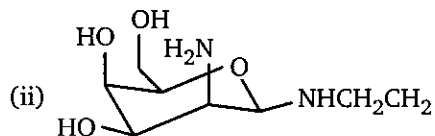
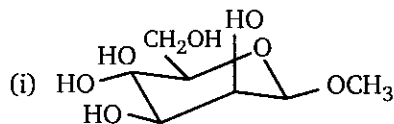
- (a) 2      (b) 3  
(c) 4      (d) 5



Product (A) of above reaction is :

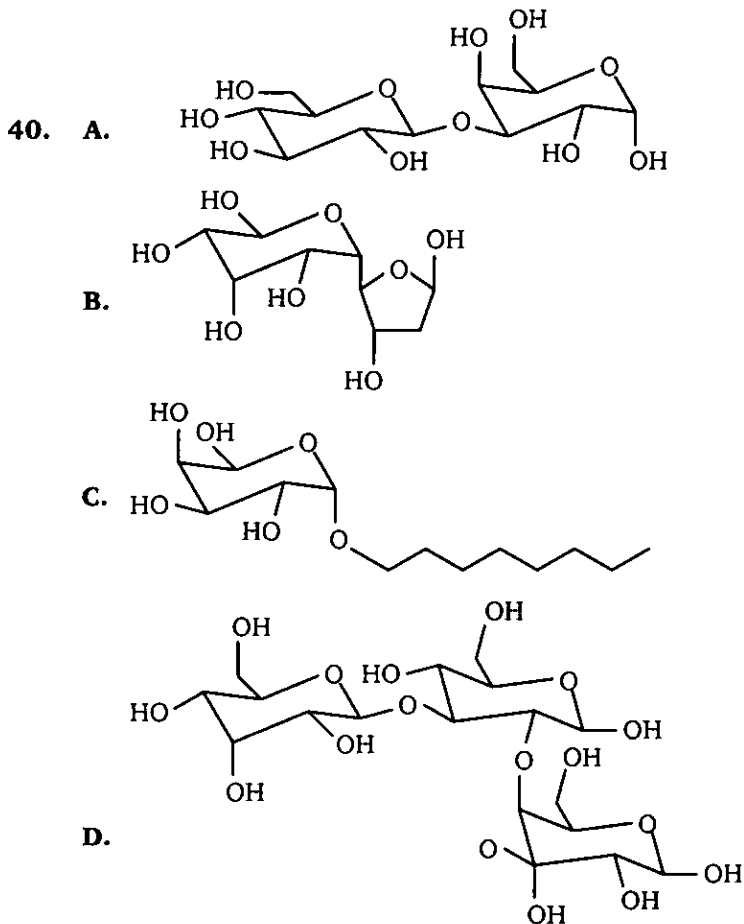
- (a) D-glucose (b) D-fructose  
(c) D-talose (d) D-idose

39. Which of the molecules below will react with  $\text{Ag}^+$  ?



- (a) (i), (iii) and (v)  
(c) (iv) and (vi)

- (b) (ii) and (iv)  
(d) (i), (ii), (iii) and (vi)



Which of the compounds (A-D) depicted above is NOT a hemiacetal linkage ?

- (a) Compound A
- (b) Compound B
- (c) Compound C
- (d) Compound D
- (e) None of the above (they are all hemiacetals)

ANSWERS — LEVEL 1

1.	(b)	2.	(a)	3.	(b)	4.	(c)	5.	(c)	6.	(c)	7.	(d)	8.	(c)
9.	(b)	10.	(c)	11.	(b)	12.	(c)	13.	(a)	14.	(d)	15.	(a)	16.	(d)
17.	(c)	18.	(b)	19.	(b)	20.	(a)	21.	(b)	22.	(a)	23.	(b)	24.	(a)
25.	(c)	26.	(c)	27.	(c)	28.	(d)	29.	(d)	30.	(a)	31.	(d)	32.	(d)
33.	(b)	34.	(a)	35.	(d)	36.	(d)	37.	(b)	38.	(b)	39.	(c)	40.	(e)

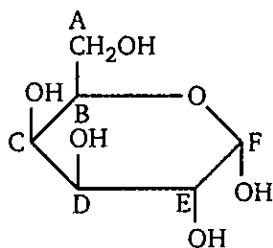


## 1. Match the Column (I) and Column (II). (Matrix)

Column (I)		Column (II)	
	Molecule		Configuration
(a)	$  \begin{array}{c}  \text{CHO} \\    \\  \text{H} - \text{C} - \text{OH} \\    \\  \text{CH}_2\text{OH}  \end{array}  $	(p)	R- (Rectus)
(b)	$  \begin{array}{c}  \text{CHO} \\    \\  \text{HO} - \text{C} - \text{H} \\    \\  \text{CH}_2\text{OH}  \end{array}  $	(q)	S- (Sinister)
(c)	$  \begin{array}{c}  \text{NH}_2 \\    \\  \text{H} - \text{C} - \text{CO}_2\text{H} \\    \\  \text{CH}_3  \end{array}  $	(r)	D
(d)	$  \begin{array}{c}  \text{NH}_2 \\    \\  \text{H} - \text{C} - \text{CH}_3 \\    \\  \text{CO}_2\text{H}  \end{array}  $	(s)	L

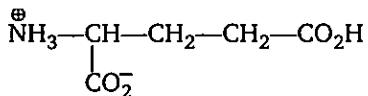


## 2. Comprehension



One cyclic acetal form of D-galactose is shown above.

- A. Which atom is the anomeric carbon ?  
 (a) Atom A                      (b) Atom B                      (c) Atom C                      (d) Atom D  
 (e) Atom E                      (f) Atom F
- B. Which name most completely describes this cyclic acetal form ?  
 (a)  $\alpha$ -D-Galactofuranose                      (b)  $\beta$ -D-Galactofuranose  
 (c)  $\alpha$ -D-Galactopyranose                      (d)  $\beta$ -D-Galactopyranose
3. How many compound which is given below is isomer of D-Glucose ?  
 D-Mannose, D-Fructose, D-Gulose, D-Idose, D-Galactose, D-Arabinose, D-Ribose.
4. How many acidic group is present in given amino acid ?

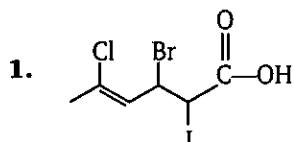


## ANSWERS — LEVEL 2

1. a - p, r; b - q, s; c - q, s; d - p, r
2. A - f; B - c
3. 5
4. 2

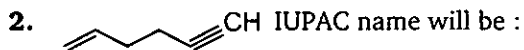
# 15 IUPAC NAME

## LEVEL-1

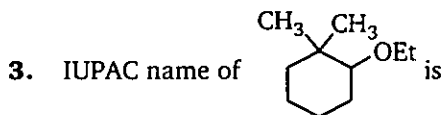


Total number of substituent present in the above compound :

- (a) 1 (b) 2  
(c) 3 (d) 4

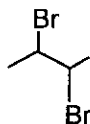


- (a) Hex-5-en-1-yne (b) Hex-1-en-5-yne  
(c) Hex-6-en-1-yne (d) Hex-1-en-6-yne

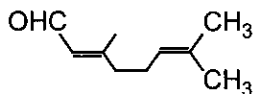


- (a) 1-Ethoxy-2, 2-dimethylcyclohexane (b) 2-ethoxy-1, 1-dimethyl cyclohexane  
(c) 1, 1-Dimethyl-2-ethoxycyclohexane (d) 2-methyl-1, 1-ethoxy cyclohexane

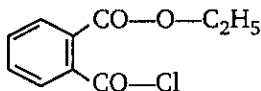
4. How many secondary carbon and hydrogen atoms are present in the molecule given below respectively ?



- (a) 2, 3                      (b) 2, 2                      (c) 3, 3                      (d) 2, 0
5. Which IUPAC name is correct for the given compound ?

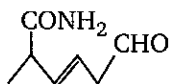


- (a) 3, 7-dimethylocta-2, 6-dienal                      (b) 2, 6-dimethyloct-2, 6-dienal-8  
 (c) 7-formyl-2, 6-dimethylhept-2, 6-diene                      (d) 7-aldo-2,6-dimethylhept-2, 6-diene
6. Write the IUPAC name of the following compound :



- (a) ethyl-2-(chlorocarbonyl) benzoate                      (b) ethyl-2-(chlorocarbonyl) hexanoate  
 (c) 2-(thoxycarbonyl) benzoyl chloride                      (d) None of these
7. The IUPAC name of the compound is :
- (a) *trans*-2-chloro-3-iodo-2-pentene                      (b) *cis*-2-chloro-3-iodo-2-pentene  
 (c) *trans*-3-iodo-4-chloro-3-pentene                      (d) *cis*-3-iodo-4-chloro-3-pentene

8. The IUPAC name of the compound is :



- (a) 2-methyl-6-oxohex-3-enamide                      (b) 6-keto-2-methyl hexanamide  
 (c) 2-carbamoylhexanal                      (d) 2-carbamoylhex-3-enal

9. The IUPAC name of is:

- (a) 1-Bromo-2-chloro-3-fluoro-6-iodo benzene  
 (b) 2-Bromo-1-chloro-5-fluoro-3-iodo benzene  
 (c) 4-Bromo-2-chloro-5-iodo-1-fluoro benzene  
 (d) 2-Bromo-3-chloro-1-iodo-5-fluoro benzene

10. The IUPAC name of  $\text{CH}_3\text{—CH}_2\text{—CH}(\text{C}_2\text{H}_5)\text{—C}(=\text{O})\text{—OCH}_3$  is:
- (a) Methyl 2-ethylbutanoate (b) 1-methoxy-2-ethylbutanone  
(c) 3-Methoxycarbonylpentane (d) 1-methoxy-2-ethylbutanal
11. The IUPAC name of  $\text{CH}_3\text{—CH}=\text{CH—C}(=\text{O})\text{—OH}$  is:
- (a) But-1-en-4-oic acid (b) 1-hydroxybut-2-en-1-one  
(c) But-2-en-1-oic acid (d) But-2-en-4-oic acid
12. The IUPAC name of  $\text{CH}_3\text{—CH}=\text{C}(\text{OCH}_3)\text{—CH}_3$  is:
- (a) 1-Methoxy-1-methylpropene (b) 2-Methoxybut-2-ene  
(c) dimethylpropeneether (d) none of these
13. The IUPAC name of  $\text{CH}_2=\text{C}(\text{Me})\text{—C}(=\text{O})\text{—OC}_2\text{H}_5$  is:
- (a) Ethyl 2-methylprop-2-enoate (b) Ethyl 2-methylprop-1-enoate  
(c) 1-Ethoxy-2-methylprop-2-enone (d) 1-Ethoxy-2-methylprop-2-enal
14. The IUPAC name of  $\text{CH}_3\text{—CH}(\text{CH}_3)\text{—CH}(\text{CH}_3)\text{—CH}_2\text{NH}_2$  is:
- (a) 2, 3-Dimethylbutan-4-amine (b) 2, 4-Dimethylbutan-1-amine  
(c) 2,4-Dimethylbutan-4-amine (d) 2, 3-Dimethylbutan-1-amine
15. The IUPAC name of  $\text{CH}_3\text{—C}(=\text{O})\text{—CH}(\text{C}_2\text{H}_5)\text{—CH}(\text{CH}_3)\text{—CH}_3$  is:
- (a) 3-(Methylethyl) pentan-2-one (b) 3-(Methylethyl)pentan-4-one  
(c) 3-Ethyl-4-methylpentan-2-one (d) 3-Ethyl-2-methylpentan-4-one
16. The IUPAC name of  $\text{CH}_3\text{—CH}(\text{CH}_3)\text{—CH}_2\text{—C}(=\text{O})\text{—Br}$  is:
- (a) 2-Methylbutanoyl bromide (b) 2-Methylbutan-4-oyl bromide  
(c) 1-Bromo-3-Methylbutanone (d) 3-Methylbutanoyl bromide

17. The IUPAC name of  $\text{CH}_3 - \underset{\substack{| \\ \text{C}_6\text{H}_5}}{\text{CH}} - \text{CH}_2 - \text{OH}$  is:

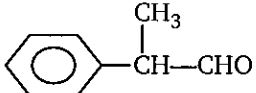
- (a) 2-Phenylpropan-1-ol (b) 2-Phenylpropan-3-ol  
(c) 1-(2-Hydroxy-1-methylethyl) benzene (d) 1-((Hydroxymethyl)ethyl) benzene

18. The IUPAC name of  $\text{CH}_3 - \underset{\substack{| \\ \text{CH}_3}}{\overset{\substack{| \\ \text{CH}_3}}{\text{C}}} - \underset{\substack{| \\ \text{CH}_3}}{\text{CH}} - \underset{\substack{| \\ \text{I}}}{\text{CH}} - \text{CH}_2 - \text{CH}_3$  is:

- (a) 3-Iodo-4,5,5-trimethylhexane (b) 4-Iodo-1, 1, 3-trimethylhexane  
(c) 4-Iodo-2, 2-dimethylheptane (d) 4-Iodo-2, 2, 3-trimethylhexane

19. The IUPAC name of  $\text{CH}_3 - \text{CH}_2 - \underset{\substack{| \\ \text{Cl}}}{\text{CH}} - \underset{\substack{| \\ \text{CH}_3}}{\text{CH}} - \underset{\substack{| \\ \text{OH}}}{\overset{\substack{| \\ \text{CH}_3}}{\text{C}}} - \text{CH}_3$  is:

- (a) 4-Chloro-2, 3-dimethylhexane-2-ol (b) 4-Chloro-2-hydroxy-2, 3-dimethylhexane  
(c) 4-Chloro-1, 1, 2-trimethylpentan-2-ol (d) 3-Chloro-2, 3-dimethylhexane-2-ol

20. The IUPAC name of  is:

- (a) 2-Phenylpropan-3-al (b) Formylethylbenzene  
(c) 2-Phenylpropanal (d) Ethylformylbenzene

21. The IUPAC name of  $\text{CH}_3 - \overset{\text{O}}{\parallel}{\text{C}} - \text{CH} \begin{matrix} \text{CH}_3 \\ \text{CH}_3 \end{matrix}$  is:

- (a) 2-Methylbutan-3-one (b) 3-Methylbutan-2-al  
(c) 2-Methylbutan-3-al (d) 3-Methylbutan-2-one

22. The IUPAC name of  $\begin{matrix} \text{CH}_3 - \text{CO} \\ \text{CH}_3 - \text{CH}_2 - \text{CO} \end{matrix} \text{O}$  is:

- (a) Ethanoic propanoic anhydride (b) Propanoic ethanoic anhydride  
(c) 1-Ethanoyloxypropanone (d) 3-Ethanoyloxypropan-3-one

23. The IUPAC name of  $\text{CH}_3 - \underset{\substack{| \\ \text{OH}}}{\text{CH}} - \underset{\substack{| \\ \text{C}_2\text{H}_5}}{\text{CH}} - \text{CH}_2 - \text{OH}$  is:

- (a) 3-Ethylbutane-2, 4-diol (b) 2-Ethylbutane-1, 3-diol  
(c) 3-Ethylbutane-1, 3-diol (d) 2-Ethyl-1-methylpropane-1, 3-diol

24. The IUPAC name of  $\text{CH}_3 - \underset{\text{O}}{\underset{\parallel}{\text{C}}} - \underset{\text{O}}{\underset{\parallel}{\text{C}}} - \text{CH}_3$  is:

- (a) Butane-2, 3-dial (b) Butane-1, 3-dione  
(c) Butane-2, 3-dione (d) 1, 2-dimethylethanedione

25. The IUPAC name of  $\text{CH}_2 = \text{CH} - \text{CH} = \text{CH}_2$  is:

- (a) Butane (b) Buta-1, 3-diene (c) Butane-1, 3-diene (d) none of these

26. The IUPAC name of  $\text{CH}_2 - \text{CH}_2 - \text{CH}_2$  is:  
 $\begin{array}{c} | \qquad \qquad | \\ \text{COOH} \qquad \text{COOH} \end{array}$

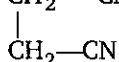
- (a) Pentane-1, 5-dioic acid (b) Pentane-1, 5-dicarboxylic acid  
(c) Propane-1, 3-dioic acid (d) none of these

27. The IUPAC name of  $\text{CH}_2 - \text{CH} = \text{CH} - \text{CHO}$  is:



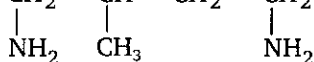
- (a) propene-1, 3-dial (b) Propene-1, 3-dicarbaldehyde  
(c) Pent-3-ene-1, 5-dial (d) Pent-2-ene-1, 5-dial

28. The IUPAC name of  $\text{CH}_2 - \text{CN}$  is:



- (a) Butane-1, 4-dicarbonitrile (b) Ethane-1, 2-dicarbonitrile  
(c) Ethane-1, 2-dinitrile (d) Butane-1, 4-dinitrile

29. The IUPAC name of  $\text{CH}_2 - \text{CH} - \text{CH}_2 - \text{CH}_2$  is:



- (a) 2-Methylbutane-1, 4-diamine  
(b) 3-Methylbutane-1, 4-diamine  
(c) 3-(Aminomethyl)butanamine  
(d) 2-(Aminomethyl)butan-4-amine

30. The IUPAC name of  $\text{CH}_2 - \text{CH} - \text{CH}_2$  is:  
 $\begin{array}{c} \qquad \qquad \text{CH}_2\text{Cl} \\ | \qquad \qquad | \\ \text{Cl} \qquad \qquad \text{Cl} \end{array}$

- (a) Tris(chloromethyl) methane  
(b) 1, 3-Dichloro-2 (chloromethyl) propane  
(c) 1-Chlorobis(chloromethyl) ethane  
(d) none of these

31. The IUPAC name of  $\text{CH}_3 - \underset{\text{OH}}{\text{CH}} - \underset{\text{CH}_3}{\text{CH}} - \underset{\text{OH}}{\text{CH}} - \overset{\text{CH}_3}{\underset{\text{CH}_3}{\text{C}}} - \text{CH}_3$  is:
- (a) 3, 5, 5-Trimethylhexane-2, 4-diol      (b) 2, 2, 4-Trimethylhexane-3, 5-diol  
 (c) 1, 2, 4, 4-Tetramethylpentane-1, 3-diol      (d) 2, 2, 4, 5-Tetramethylpentane-3, 5-diol
32. The IUPAC name of  $\text{HOOC} - \text{CH} = \text{CH} - \text{COOH}$  is:
- (a) But-2-ene-1, 4-dicarboxylic acid      (b) But-2-ene-1, 4-dioic acid  
 (c) Ethene dicarboxylic acid      (d) Ethene dioic acid
33. The IUPAC name of  $\text{CH}_3 - \overset{\text{OCH}_3}{\text{CH}} - \text{CHO}$  is:
- (a) 1-Formyl-1-methoxyethane      (b) 2-Methoxypropan-3-one  
 (c) 2-Methoxypropanal      (d) 2-Methoxypropan-3-al
34. The IUPAC name of  $\text{CH}_2 = \overset{\text{CH}_3}{\text{C}} - \text{COOCH}_3$  is:
- (a) Methyl-2-methylprop-1-en-3-oate      (b) 2-Methoxycarbonylpropene  
 (c) 2-Methoxycarbonylprop-2-ene      (d) Methyl-2-methylprop-2-enoate
35. The IUPAC name of  $\text{CH}_3 - \text{CH} = \text{CH} - \text{COOH}$  is:
- (a) But-2-ene-1-oic acid      (b) But-1-ene-1-oic acid  
 (c) But-2-ene-1-carboxylic acid      (d) Propene-1-carboxylic acid
36. The IUPAC name of  $\text{CH}_3 - \overset{\text{OH}}{\text{CH}} - \text{COOH}$  is:
- (a) 2-Hydroxypropanoic acid      (b) 1-Hydroxypropanoic acid  
 (c) 1-Hydroxyethane carboxylic acid      (d) 1-Hydroxyethanoic acid
37. The IUPAC name of  $\text{HO} - \overset{\text{OH}}{\text{CH}} - \text{COOH}$  is:
- $\text{HO} - \underset{\text{OH}}{\text{CH}} - \text{COOH}$
- (a) 2, 3-Dihydroxybutane-1, 4-carboxylic acid  
 (b) 2, 3-Dihydroxybutane-1, 4-dioic acid  
 (c) 1, 2-Dihydroxyethane dicarboxylic acid  
 (d) none of these

38. The IUPAC name of  $\text{CH}_3\text{---CH---C---COOH}$  is:

$$\begin{array}{c} \text{CH}_3 \quad \quad \quad \text{O} \\ | \quad \quad \quad || \\ \text{CH}_3 \quad \quad \quad \text{O} \end{array}$$

- (a) 3-Methyl-2-oxobutanecarboxylic acid      (b) 2-Methyl-3-oxobutan-4-oic acid  
(c) 3-Methyl-2-oxobutanoic acid              (d) 3-Methyl-1,2-dioxobutanoic acid

39. The IUPAC name of  $\text{NC---CH}_2\text{---CH}_2\text{---COOH}$  is:

- (a) 3-Carboxy propanenitrile                      (b) 4-Cyanobutanoic acid  
(c) 2-Cyanoethane Carboxylic acid              (d) 3-Cyanopropanoic acid

40. The IUPAC name of  $\begin{array}{c} \text{CH}_2\text{COOH} \\ | \\ \text{C} \begin{array}{l} \text{OH} \\ \text{COOH} \end{array} \\ | \\ \text{CH}_2\text{COOH} \end{array}$  is:

- (a) 3-Carboxy-3-hydroxypentanedicarboxylic acid  
(b) 2-Hydroxypropane-1, 2, 3-tricarboxylic acid  
(c) 2-Hydroxypropane-1, 2, 3-trioic acid  
(d) 3-Hydroxypropane-1, 2, 3-tricarboxylic acid

41. The IUPAC name of  $\text{CH}_3\text{---C---CH---CH}_2\text{---C}$  is:

$$\begin{array}{c} \text{O} \\ || \\ \text{C} \\ | \\ \text{OH} \end{array}$$

$$\begin{array}{c} \text{COOC}_2\text{H}_5 \\ | \\ \text{C} \\ | \\ \text{CH}_3 \end{array}$$

- (a) 4-ethoxycarbonylpent-3-enoic acid  
(b) 4-ethanoyloxy-pent-3-enoic acid  
(c) 3-ethoxycarbonylbut-2-enecarboxylic acid  
(d) 3-ethoxycarbonylpent-3-enoic acid

42. The IUPAC name of  $\text{CH}_3\text{---CH---C---C---NH}$  is:

$$\begin{array}{c} \text{CH}_3 \quad \quad \quad \text{O} \quad \quad \quad \text{O} \quad \quad \quad \text{Br} \\ | \quad \quad \quad || \quad \quad \quad || \quad \quad \quad | \\ \text{CH}_3 \quad \quad \quad \text{O} \quad \quad \quad \text{O} \quad \quad \quad \text{Br} \end{array}$$

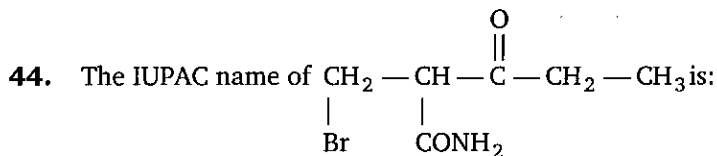
- (a) (*N*-Bromo)-2-keto-3-methylbutanamide  
(b) (*N*-Bromo)-2-keto-4-methylbutanamide  
(c) (*N*-Bromo)-1, 2-diketo-3-methylbutanamine carboxamide  
(d) (*N*-Bromo)-1-keto-2-methylpropane

43. The IUPAC name of  $\text{CH}_2\text{---C---CH---CH}_2\text{OH}$  is:

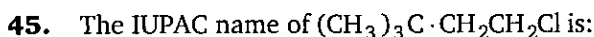
$$\begin{array}{c} \text{Cl} \quad \quad \quad \text{CH}_3 \\ | \quad \quad \quad | \\ \text{Cl} \quad \quad \quad \text{CH}_3 \end{array}$$

- (a) 4-Chloro-3-methylbut-2-en-1-ol              (b) 1-Chloro-2-methylbut-2-en-4-ol  
(c) 4-Chloro-1-hydroxy-3-methylbut-2-ene      (d) 1-Chloro-4-hydroxy-2-methylbut-2-ene

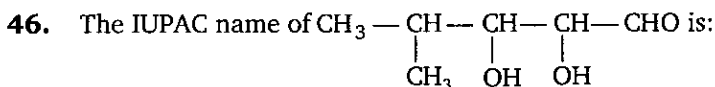




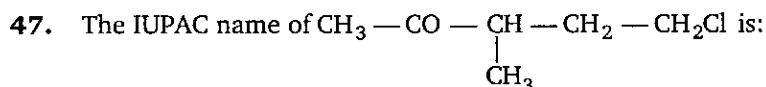
- (a) 2-(Bromomethyl)-3-oxopentane carboxamide  
 (b) 1-Bromo-2-carbamoylpentan-3-one  
 (c) 5-Bromo-4-carbamoylpentan-3-one  
 (d) 2-(Bromomethyl)-3-oxopentanamide



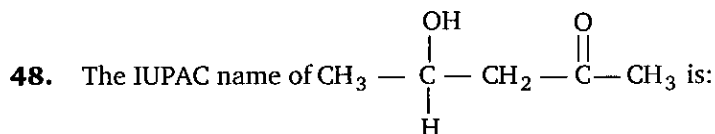
- (a) 2, 2-Dimethyl-4-chloro butane  
 (b) 1-Chloro-3, 3-dimethylbutane  
 (c) 4-Chloro-2, 2-dimethyl butane  
 (d) none of these



- (a) 2, 3-Dihydroxy-4-methylpentanal  
 (b) 1-oxo-2, 3-Dihydroxy-4-methylpentane  
 (c) 2,3-Dihydroxy-4-methylpentanone  
 (d) 1, 2-Dihydroxy-3-methylbutanecarbaldehyde



- (a) 1-Chloro-3-methylpentan-4-one  
 (b) 1-Chloro-2-(oxoethyl)butane  
 (c) 5-Chloro-3-methylpentan-2-one  
 (d) 3-(2-Chloroethyl)butan-2-one



- (a) 2-Hydroxypentan-4-one  
 (b) 4-Hydroxypentan-2-one  
 (c) 4-oxopentan-2-ol  
 (d) 2-oxopentan-4-ol

49. The IUPAC name of  $\text{CH}_3 - \underset{\text{Cl}}{\text{CH}} - \underset{\text{Br}}{\text{CH}} - \underset{\text{OH}}{\text{CH}} - \text{CH}_3$  is:

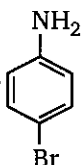
- (a) 3-Bromo-4-chloropentan-2-ol  
 (b) 3-Bromo-2-chloro-4-hydroxypentane  
 (c) 3-Bromo-2-chloropentane-4-ol  
 (d) none of these

50. The IUPAC name of  $\text{CH}_3 - \text{CH}_2 - \underset{\text{OH}}{\overset{\text{Br}}{\text{C}}} - \overset{\text{Cl}}{\text{CH}} - \text{CH}_2 - \text{Cl}$  is:

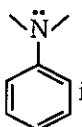
- (a) 3-Bromo-4, 5-dichloropentan-3-ol  
 (b) 3-Bromo-1, 2-dichloro-3-hydroxypentane  
 (c) 3-Bromo-1, 2-dichloropentan-3-ol  
 (d) 3-Bromo-4, 5-dichloro-3-hydroxypentane

51. The IUPAC name of  $\text{CH}_3 - \underset{\text{OH}}{\text{CH}} - \text{CH}_2 - \text{O} - \text{C}_2\text{H}_5$  is:

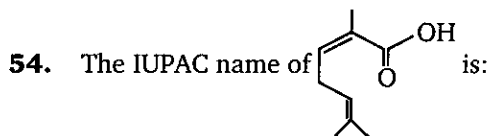
- (a) 1-Ethoxypropan-2-ol  
 (b) 3-Ethoxypropan-2-ol  
 (c) 1-Ethoxy-2-hydroxypropane  
 (d) none of these

52. The IUPAC name of  is:

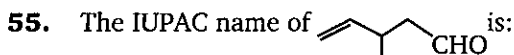
- (a) 4-Bromo benzenamine  
 (b) 4-Amino-1-bromobenzene  
 (c) 4-Bromo benzenamide  
 (d) 1-Bromo benzencarboxamide

53. The IUPAC name of  is:

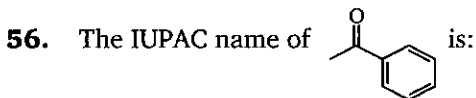
- (a) *N,N*-Dimethyl aminobenzene  
 (b) *N,N*-Dimethyl benzenamine  
 (c) (a) and (b) both are correct  
 (d) none of these



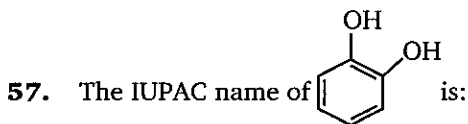
- (a) 2, 6-Dimethylhepta-2, 5-dienoic acid  
 (b) 3, 7-Dimethylhepta-2, 5-dienoic acid  
 (c) 1-Hydroxy-2, 6-dimethylhepta-2, 5-dienone  
 (d) none of these



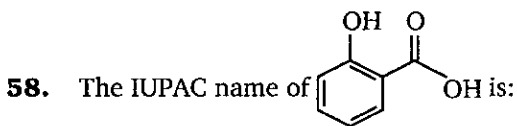
- (a) 3-Methylpent-1-en-4-al  
 (b) 3-Methylpent-4-enal  
 (c) 3-Methylpent-4-carbaldehyde  
 (d) 3-Methyl-5-oxopent-1-ene



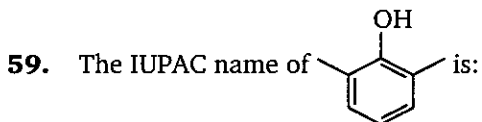
- (a) 2-Phenyl ethanone  
 (b) 1-Phenyl ethanone  
 (c) 1-(Oxoethyl)benzene  
 (d) 1-(Ethyloxo)-benzene



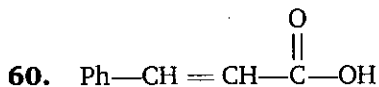
- (a) 2-Hydroxybenzenol  
 (b) 1, 2-Dihydroxybenzene  
 (c) Benzene-1, 2-diol  
 (d) 2-Hydroxyphenol



- (a) 2-Carboxyphenol  
 (b) 2-Hydroxybenzoic acid  
 (c) 1-Carboxy-2-hydroxybenzene  
 (d) 2-Carboxy-1-hydroxybenzene

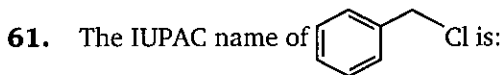


- (a) 1,3-Dimethyl phenol  
 (b) 1-Hydroxy-2-6-dimethyl benzene  
 (c) 2, 6-Dimethyl benzenol  
 (d) 2-Hydroxy-1-3-dimethylbenzene



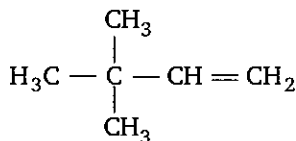
The IUPAC name is :

- (a) 3-phenyl prop-2-enoic acid                      (b) 3-phenol prop-1-enoic acid  
(c) 3-carboxy-prop-1-ene benzene              (d) but-2-enoic acid



- (a) Chloromethylbenzene                      (b) Chlorophenylmethane  
(c) (a) and (b) both                      (d) none of these

62. The IUPAC name of the compound having the formula is :



- (a) 3, 3, 3-Trimethylprop-1-ene              (b) 1, 1, 1-Trimethylprop-2-ene  
(c) 3, 3-Dimethylbut-1-ene              (d) 2, 2-Dimethylbut-3-ene

63. The IUPAC name of the compound  $\text{CH}_2 = \text{CH} - \text{CH}(\text{CH}_3)_2$  is :

- (a) 1, 1-Dimethylprop-2-ene              (b) 3-Methylbut-1-ene  
(c) 2-Vinyl propane                      (d) none of these

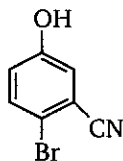
64. The number of sigma and pi-bonds in 1-butene 3-yne are :

- (a) 5 sigma and 5 pi                      (b) 7 sigma and 3 pi  
(c) 8 sigma and 2 pi                      (d) 6 sigma and 4 pi

65. The IUPAC name of  $\text{C}_6\text{H}_5\text{COCl}$  is :

- (a) Benzoyl Chloride                      (b) Benzene chloro ketone  
(c) Benzene carbonyl chloride              (d) Chloro phenyl ketone

66. The IUPAC name of the following compound is :

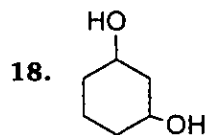
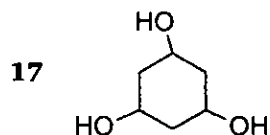
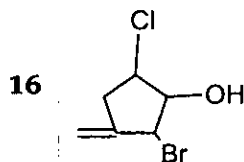
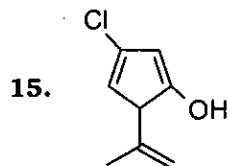
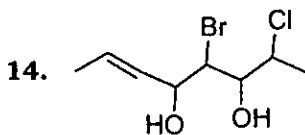
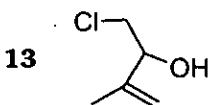
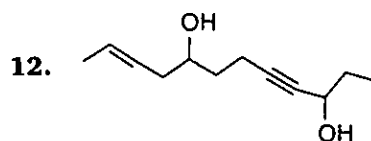
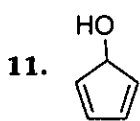
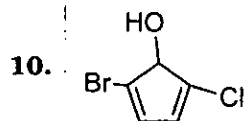
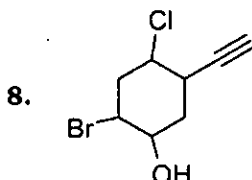
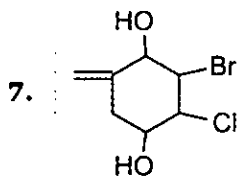
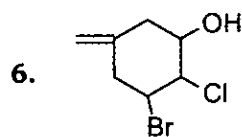
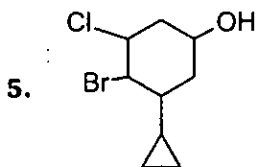
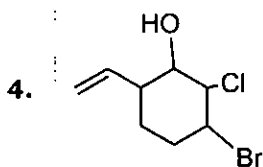
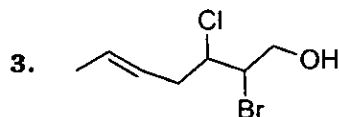
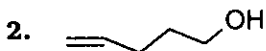
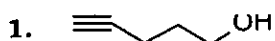


- (a) 4-Bromo-3-cyanophenol              (b) 2-Bromo-5-hydroxybenzonitrile  
(c) 2-Cyano-4-hydroxybromobenzene              (d) 6-Bromo-3-hydroxybenzonitrile



## LEVEL-2

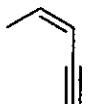
Give the IUPAC name of the following compounds



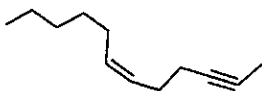
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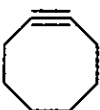
22.



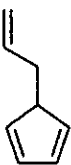
25.



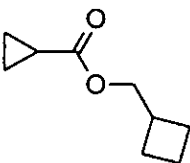
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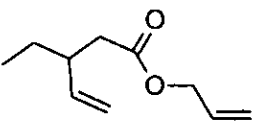
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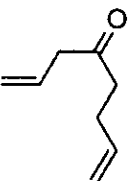
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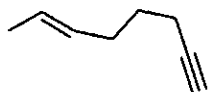
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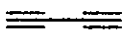
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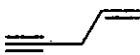
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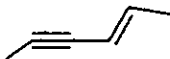
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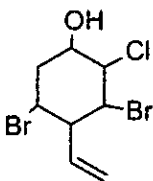
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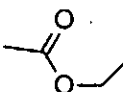
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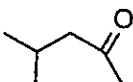
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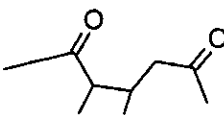
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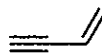
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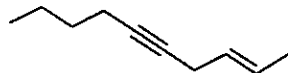
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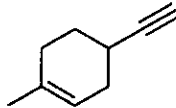
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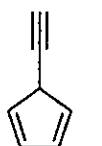
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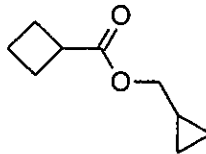
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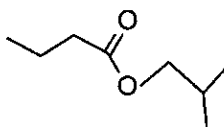
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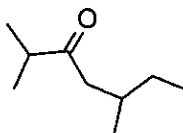
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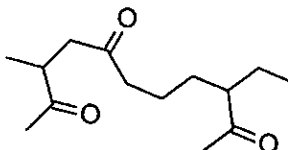
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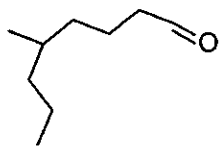
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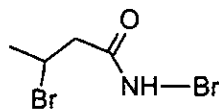
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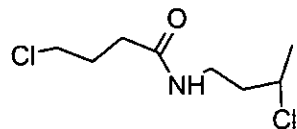
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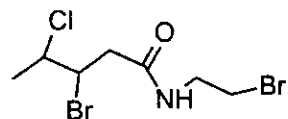
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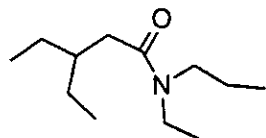
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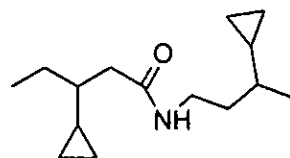
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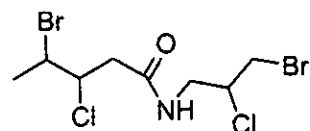
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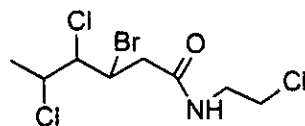
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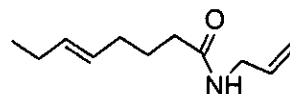
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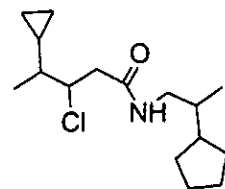
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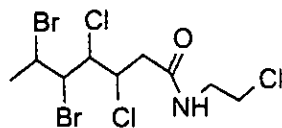
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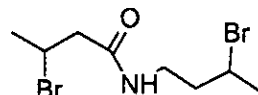
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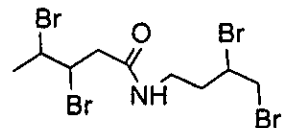
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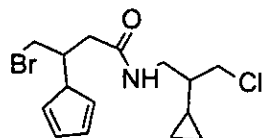
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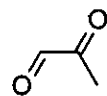
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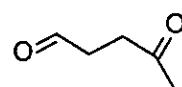
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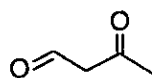
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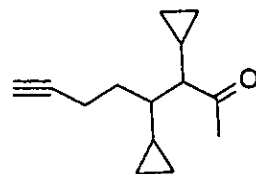
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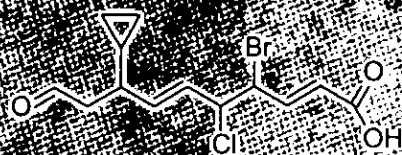


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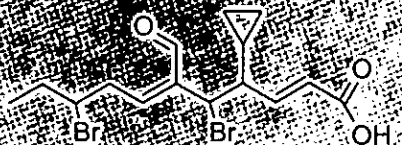




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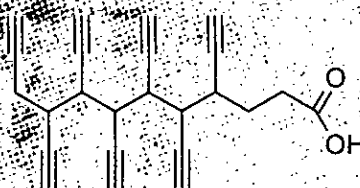
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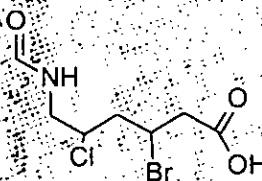
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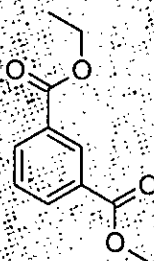
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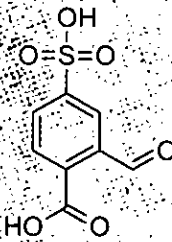
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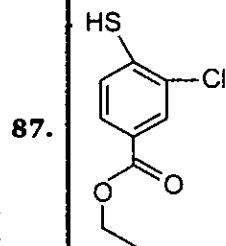
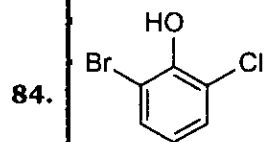
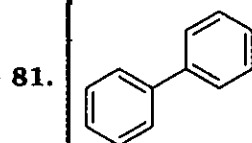
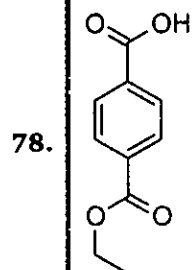
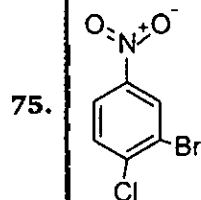
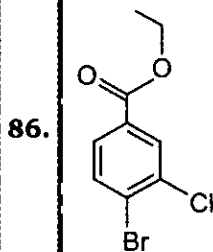
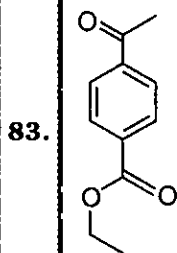
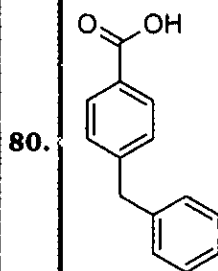
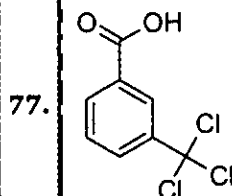
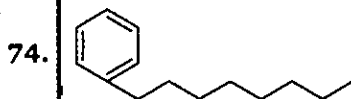
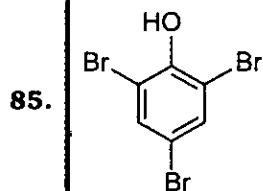
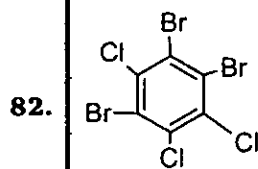
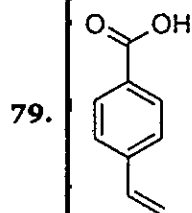
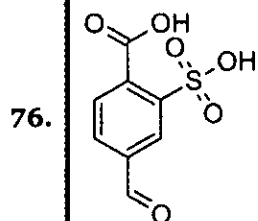
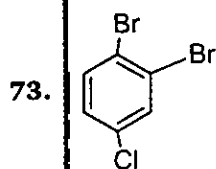


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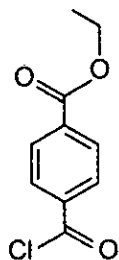


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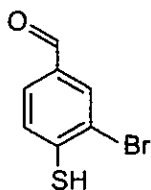




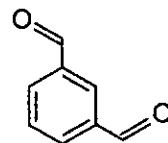
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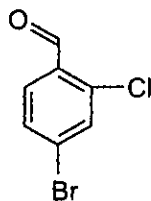
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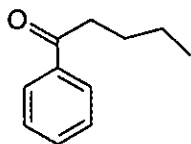
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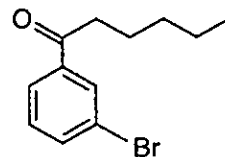
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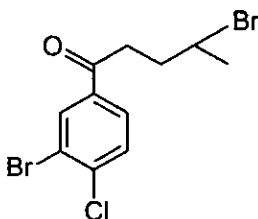
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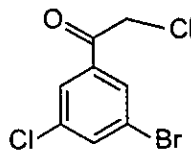
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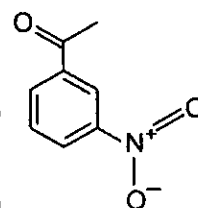
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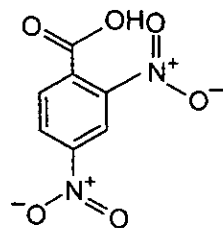
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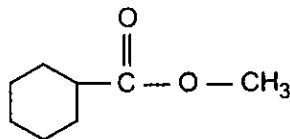
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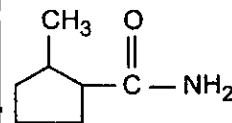
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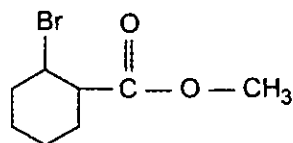
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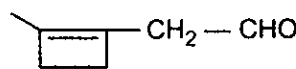
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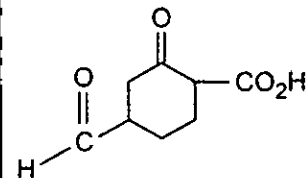
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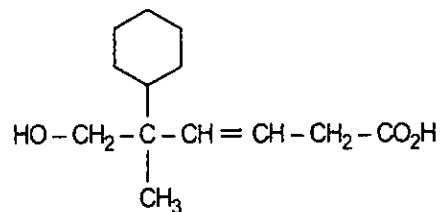
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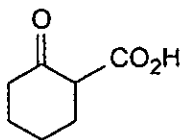
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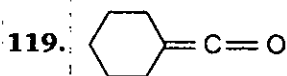
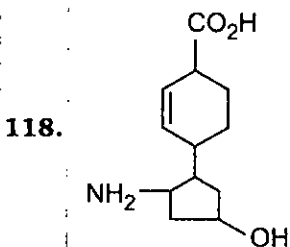
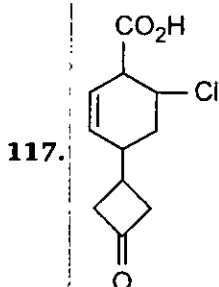
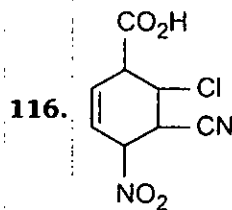
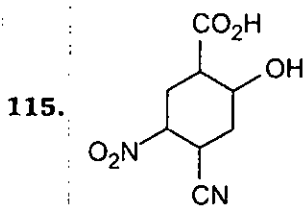
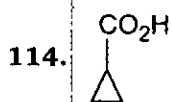
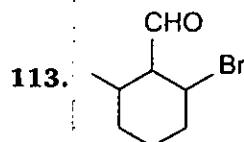
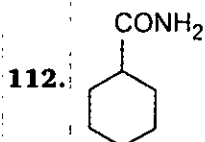
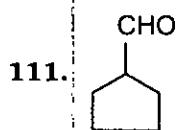
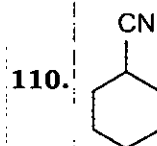
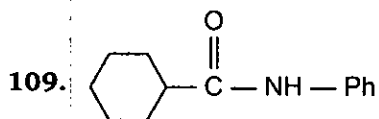
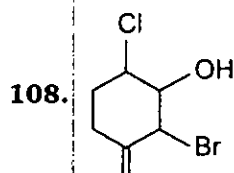
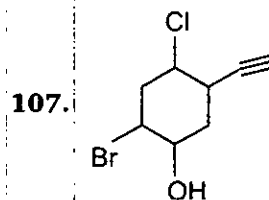
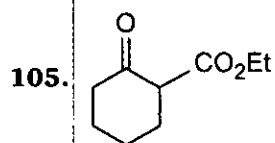


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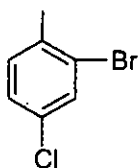


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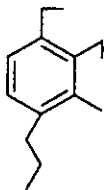




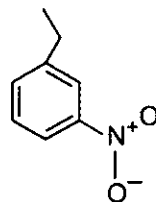
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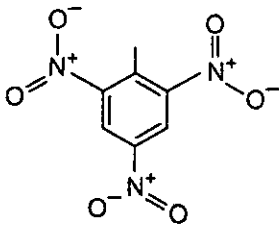
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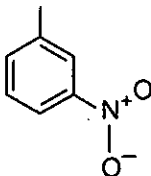
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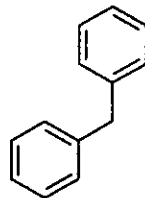
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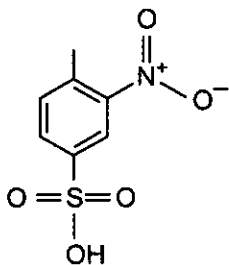
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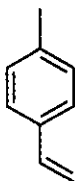
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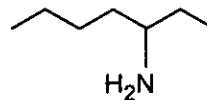
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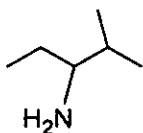
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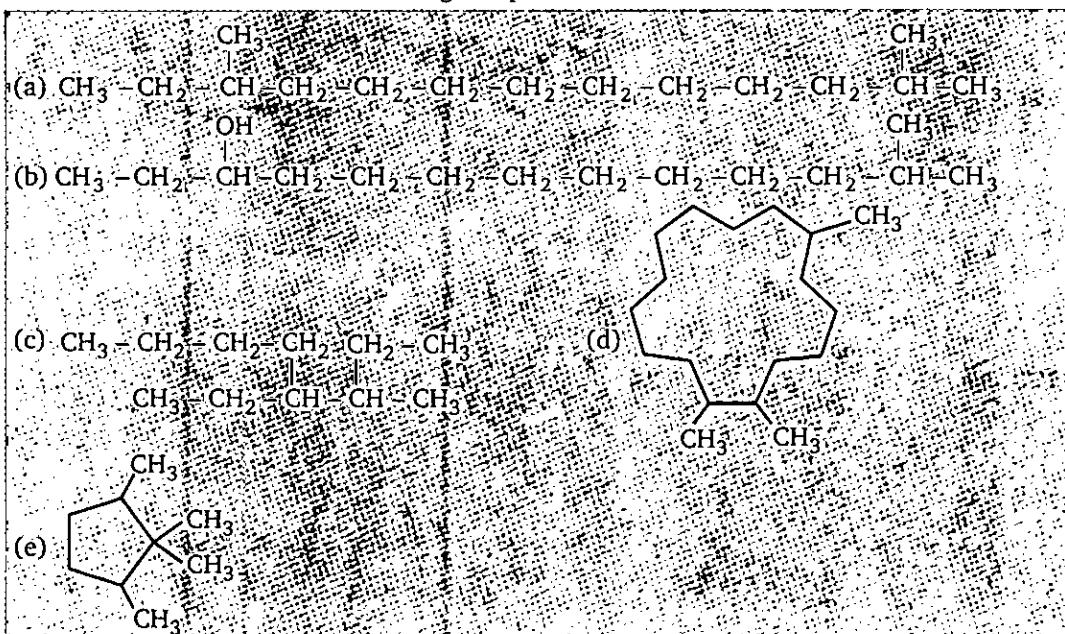
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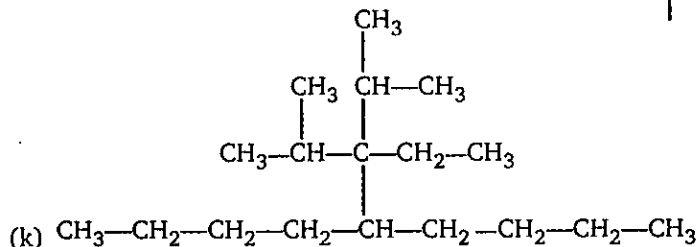
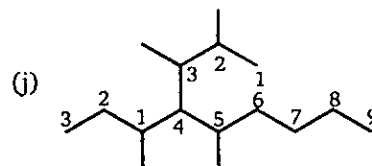
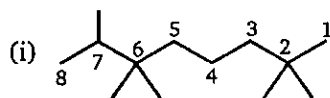
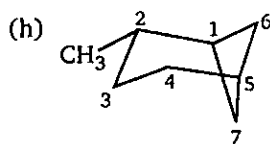
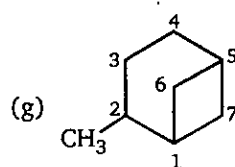
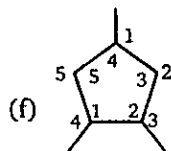
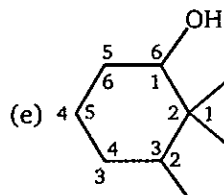
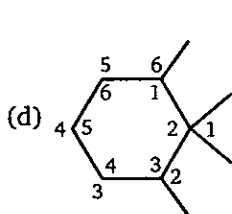
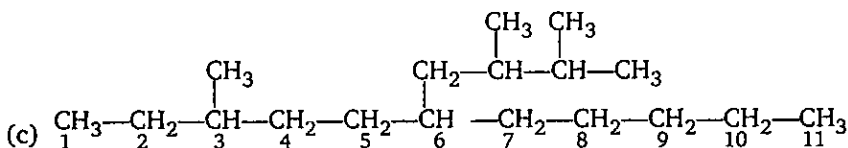
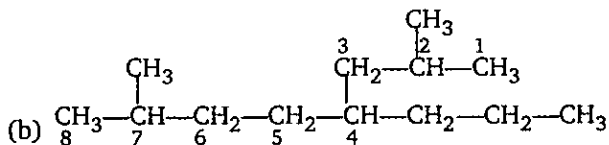
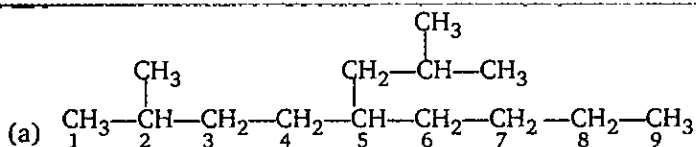
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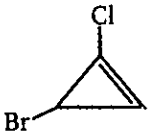
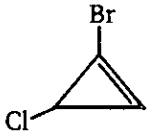
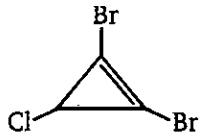
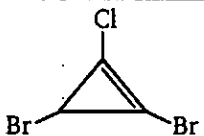
130. Give the IUPAC name of the following compounds :



131. Give the IUPAC name of the following :



132. Match the Column :

Column (I)		Column (II)	
	Compound		IUPAC Name
(a)		(p)	1, 3-dibromo-2-chlorocyclopropane
(b)		(q)	1, 2-dibromo-3-chlorocyclopropene
(c)		(r)	3-bromo-1-chlorocyclopropene
(d)		(s)	1-bromo-3-chlorocyclopropene



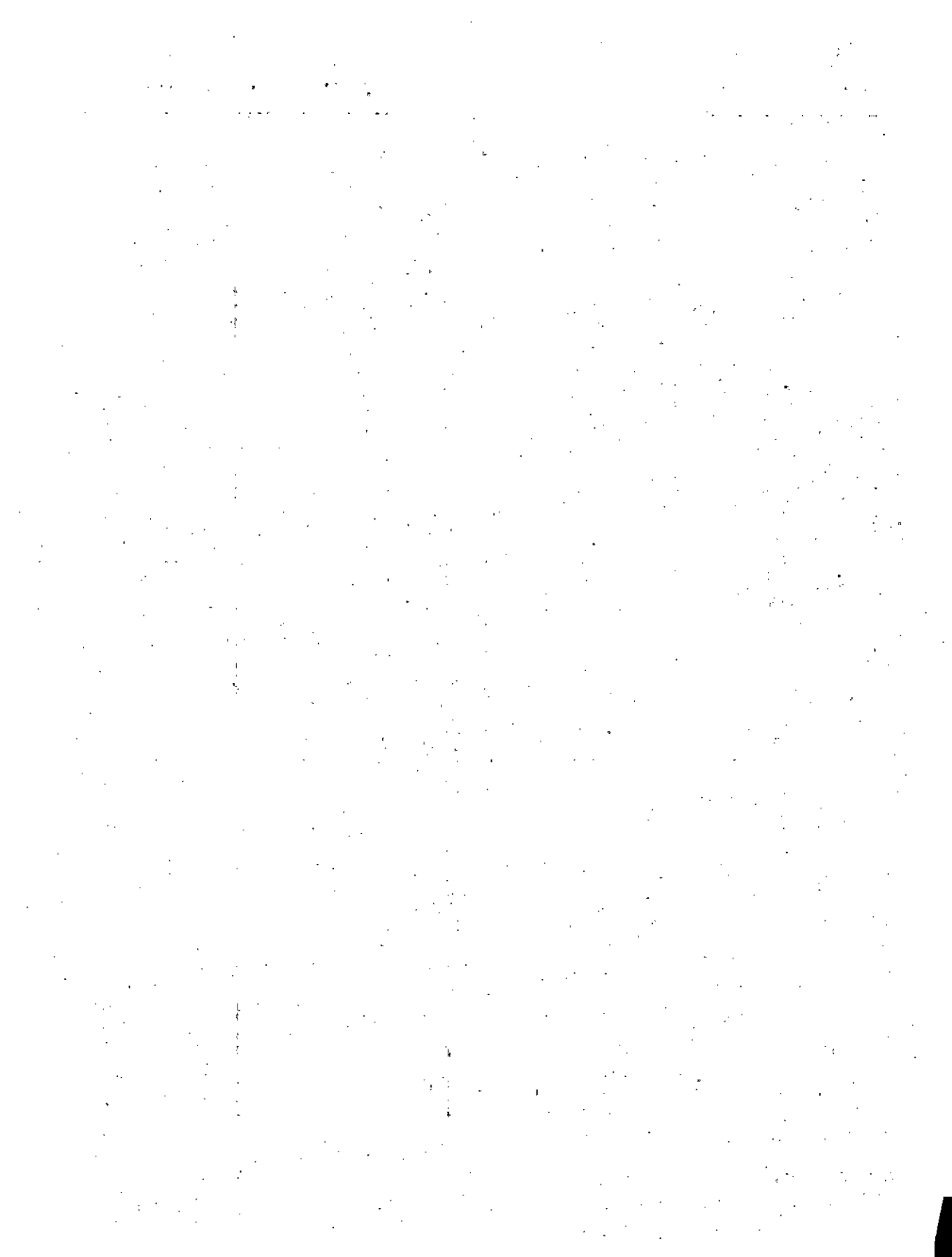
## ANSWERS – IUPAC Name

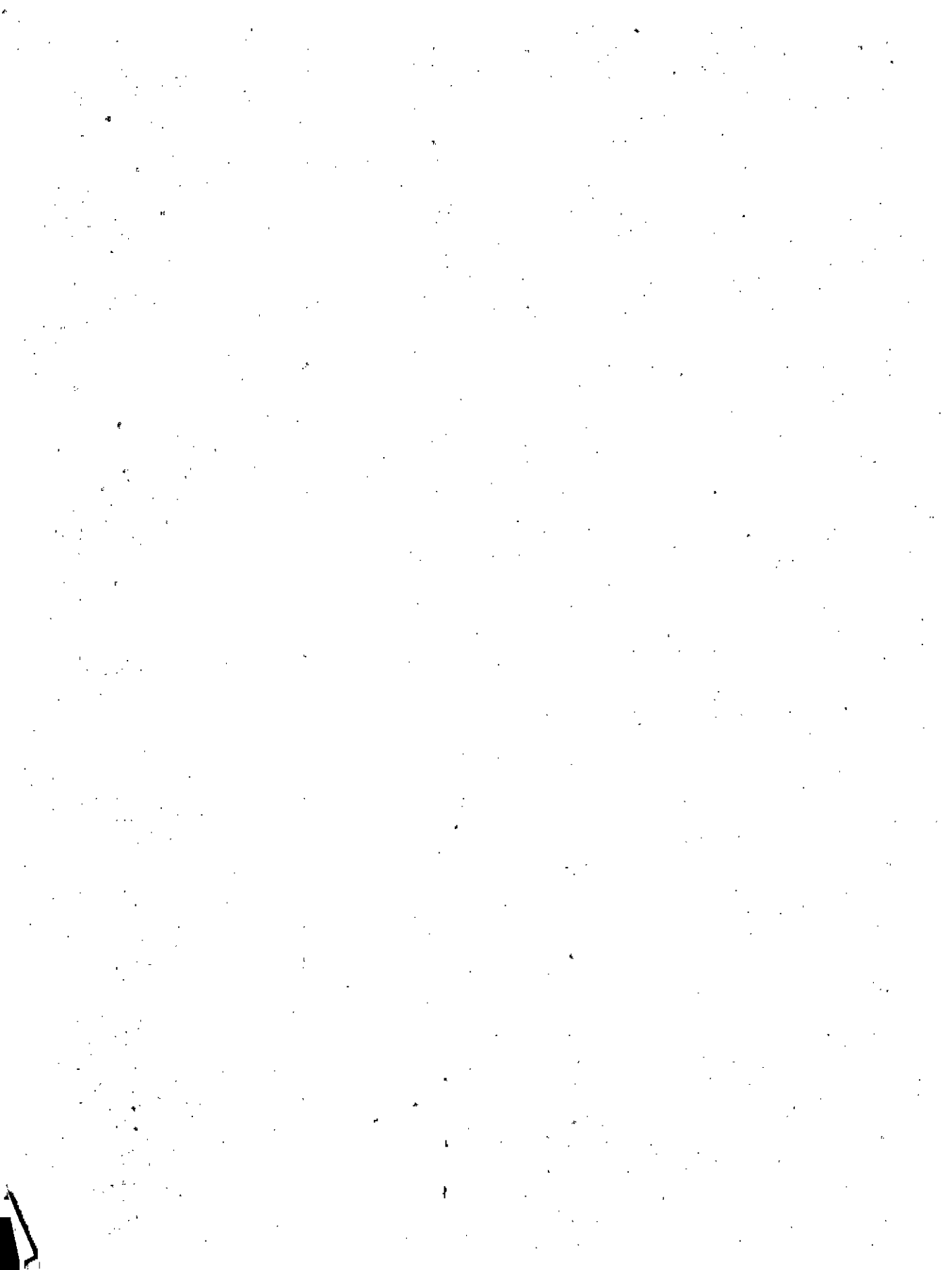
1.	pent-4-yn-1-ol	2.	pent-4-en-1-ol
3.	(5 <i>E</i> )-2-bromo-3-chlorohept-5-en-1-ol	4.	3-bromo-2-chloro-6-ethenylcyclohexanol
5.	4-bromo-3-chloro-5-cyclopropylcyclohexanol		
6.	3-bromo-2-chloro-5-methylidenecyclohexanol		
7.	3-bromo-2-chloro-5-methylidenecyclohexane-1,4-diol		
8.	2-bromo-4-chloro-5-ethynylcyclohexanol	9.	cyclopenta-1,3-dien-1-ol
10.	2-bromo-5-chlorocyclopenta-2,4-dien-1-ol		
11.	cyclopenta-2,4-dien-1-ol	12.	dodec-10-en-4-yne-3,8-diol
13.	1-chloro-3-methylbut-3-en-2-ol	14.	4-bromo-2-chlorooct-6-ene-3,5-diol
15.	3-chloro-5-(1-methylethenyl)cyclopenta-1,3-dien-1-ol		
16.	2-bromo-5-chloro-3-methylidenecyclopentanol		
17.	cyclohexane-1,3,5-triol	18.	cyclohexane-1,3-diol
19.	cyclopenta-1,3-diene	20.	(6 <i>E</i> )-oct-6-en-1-yne
21.	but-1-en-3-yne	22.	(3 <i>Z</i> )-pent-3-en-1-yne
23.	buta-1,3-diyne	24.	(2 <i>E</i> )-dec-2-en-5-yne
25.	(6 <i>Z</i> )-dodec-6-en-2-yne	26.	pent-1-en-4-yne
27.	4-ethynyl-1-methylcyclohexene	28.	cyclooctyne
29.	(2 <i>E</i> )-hex-2-en-4-yne	30.	5-ethynylcyclopenta-1,3-diene
31.	5-(prop-2-enyl) cyclopenta-1,3-diene		
32.	3,5-dibromo-2-chloro-4-ethenylcyclohexanol		
33.	cyclopropylmethyl cyclobutanecarboxylate		
34.	cyclobutylmethyl cyclopropanecarboxylate		
35.	ethyl ethanoate	36.	2-methylpropyl butanoate
37.	prop-2-enyl 3-ethylpent-4-enoate	38.	4-methylpentan-2-one
39.	2,5-dimethylheptan-3-one	40.	octa-1,7-dien-4-one
41.	3,4-dimethylheptane-2,6-dione	42.	9-ethyl-3-methylundecane-2,5,10-trione

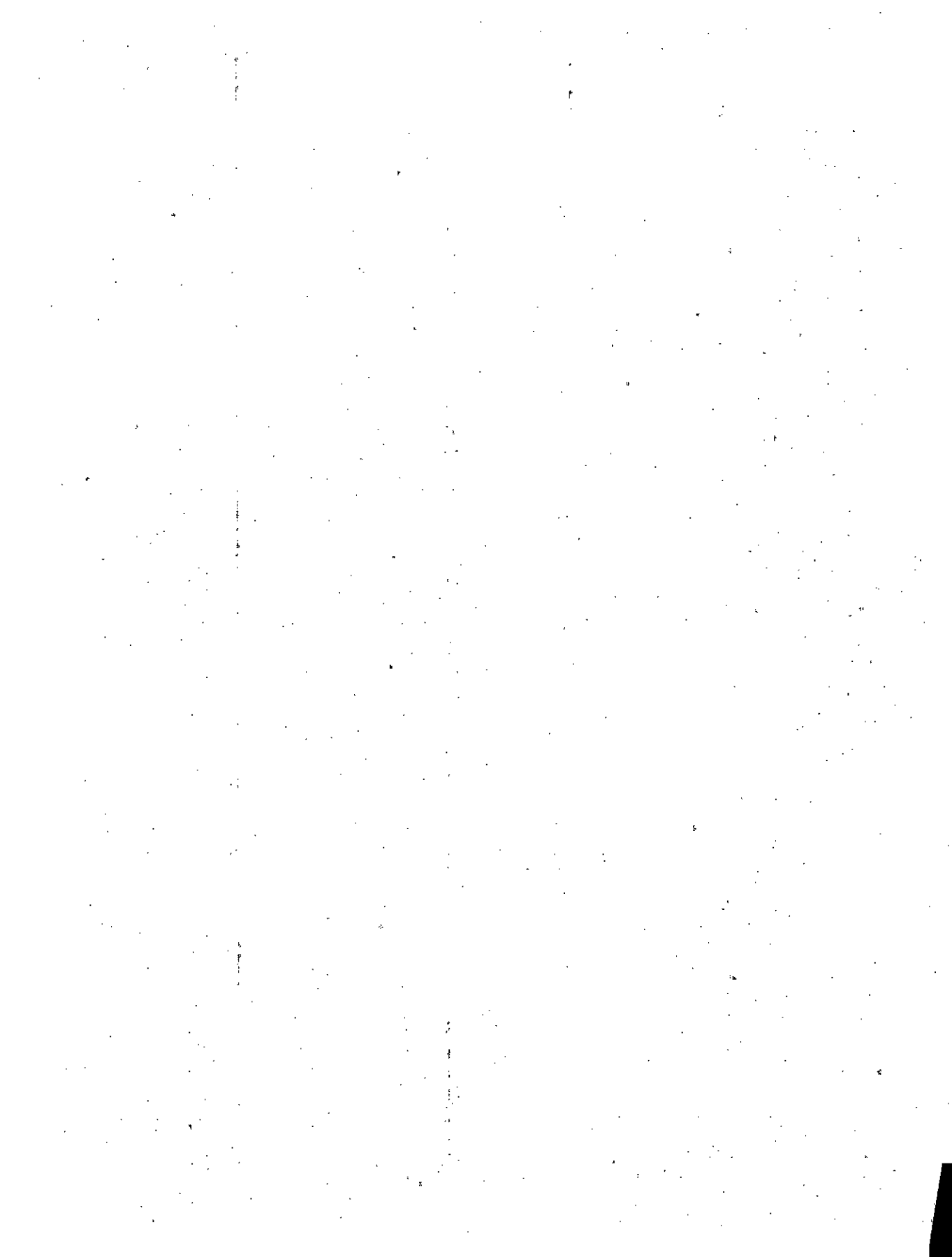
43.	5-methyloctanal	44.	but-3-enal
45.	3-ethylheptanal	46.	N,3-dibromobutanamide
47.	4-chloro-N-(3-chlorobutyl)butanamide		
48.	3-bromo-N-(2-bromoethyl)-4-chloropentanamide		
49.	N,3-diethyl-N-propylpentanamide		
50.	3-cyclopropyl-N-(3-cyclopropylbutyl)pentanamide		
51.	4-bromo-N-(3-bromo-2-chloropropyl)-3-chloropentanamide		
52.	3-bromo-4,5-dichloro-N-(2-chloroethyl)hexanamide		
53.	(5E)-N-(prop-2-en-yl)oct-5-enamide		
54.	3-chloro-N-(2-cyclopropylpropyl)-4-cyclopropylpentanamide		
55.	5,6-dibromo-3,4-dichloro-N-(2-chloroethyl)heptanamide		
56.	3-bromo-N-(3-bromobutyl)butanamide		
57.	3,4-dibromo-N-(3,4-dibromobutyl)pentanamide		
58.	4-bromo-N-(3-chloro-2-cyclopropylpropyl)-3-(cyclopenta-2,4-dien-yl)butanamide		
59.	2-oxopropanal	60.	4-oxopentanal
61.	3-oxobutanal	62.	3,4-dicyclopropyloct-7-yn-2-one
63.	(2E,6E)-4-bromo-5-chloro-8-cyclopropyl-10-oxodeca-2,6-dienoic acid		
64.	4,5,6,7,8,9-hexaethynyldodec-11-ynoic acid		
65.	(2E,6E)-5,9-dibromo-4-cyclopropyl-6-formylundeca-2,6-dienoic acid		
66.	3-bromo-5-chloro-6-(formylamino)hexanoic acid		
67.	ethyl 3-phenylpropanoate	68.	ethyl methyl benzene-1,3-dicarboxylate
69.	ethenylbenzene	70.	benzoyl chloride
71.	methyl 4-acetyl-2-nitrobenzoate	72.	2-formyl-4-sulphobenzoic acid
73.	1,2-dibromo-4-chlorobenzene	74.	octylbenzene
75.	2-bromo-1-chloro-4-nitrobenzene	76.	4-formyl-2-sulphobenzoic acid
77.	3-(trichloromethyl)benzoic acid	78.	4-(ethoxycarbonyl)benzoic acid

<b>79.</b>	4-ethenylbenzoic acid	<b>80.</b>	4-benzylbenzoic acid
<b>81.</b>	biphenyl	<b>82.</b>	1,2,5-tribromo-3,4,6-trichlorobenzene
<b>83.</b>	ethyl 4-acetylbenzoate	<b>84.</b>	2-bromo-6-chlorophenol
<b>85.</b>	2, 4, 6-tribromophenol	<b>86.</b>	ethyl 4-bromo-3-chlorobenzoate
<b>87.</b>	ethyl 3-chloro-4-mercapto/sulpho benzoate	<b>88.</b>	ethyl 4-(chlorocarbonyl)benzoate
<b>89.</b>	3-bromo-4-sulphobenzaldehyde	<b>90.</b>	benzene-1, 3-dicarbaldehyde
<b>91.</b>	4-bromo-2-chlorobenzaldehyde	<b>92.</b>	1-phenylpentan-1-one
<b>93.</b>	1-(3-bromophenyl)hexan-1-one		
<b>94.</b>	4-bromo-1-(3-bromo-4-chlorophenyl)pentan-1-one		
<b>95.</b>	1-(3-bromo-5-chlorophenyl)-2-chloroethanone		
<b>96.</b>	1-(3-nitrophenyl)ethanone	<b>97.</b>	2,4-dinitrobenzoic acid
<b>98.</b>	methylcyclohexane carboxylate	<b>99.</b>	2-methylcyclopentane carboxamide
<b>100.</b>	methyl-2-bromocyclohexane carboxylate	<b>101.</b>	2-(2-methylcyclobut-1-enyl)ethanal
<b>102.</b>	4-formyl-2-oxocyclohexane-1-carboxylic acid		
<b>103.</b>	5-cyclohexyl-6-hydroxy-5-methylhex-3-en-1-oic acid		
<b>104.</b>	2-oxocyclohexane-1-carboxylic acid	<b>105.</b>	ethyl-2-oxocyclohexane-1-carboxylate
<b>106.</b>	<i>N</i> -methylethanamide	<b>107.</b>	2-bromo-4-chloro-5-ethynylcyclohexanol
<b>108.</b>	2-bromo-6-chloro-3-methylidene-cyclohexanol		
<b>109.</b>	<i>N</i> -phenylcyclohexane carboxamide	<b>110.</b>	cyclohexane carbonitrile
<b>111.</b>	cyclopentanecarbaldehyde	<b>112.</b>	cyclohexanecarboxamide
<b>113.</b>	2-bromo-6-methyl-cyclohexanecarbaldehyde		
<b>114.</b>	cyclopropane carboxylic acid		
<b>115.</b>	4-cyno-2-hydroxy-5-nitrocyclohexane carboxylic acid		
<b>116.</b>	6-chloro-5-cyno-4-nitrocyclohex-2-ene carboxylic acid		
<b>117.</b>	6-chloro-4-(3-oxo cyclobutyl)cyclohex-2-ene carboxylic acid		
<b>118.</b>	4-(2-amino-4-hydroxycyclopentyl cyclohex-2-enecarboxylic acid		

<b>119.</b>	cyclohexyldienemethanone	<b>120.</b>	2-bromo-4-chloro-1-methylbenzene
<b>121.</b>	1,2-diethyl-3-methyl-4-propylbenzene	<b>122.</b>	1-ethyl-3-nitrobenzene
<b>123.</b>	2-methyl-1, 3, 5-trinitrobenzene	<b>124.</b>	1-methyl-3-nitrobenzene
<b>125.</b>	Diphenylmethane	<b>126.</b>	4-Methyl-3-nitrobenzene sulphonic acid
<b>127.</b>	1-ethenyl-4-methylbenzene	<b>128.</b>	heptan-3-amine
<b>129.</b>	2-methylpentan-3-amine		
<b>130.</b>	(a) 2,11-dimethyltridecane		
	(b) 12-methyl-tridecan-3-ol		
	(c) 4-ethyl-3-methyloctane		
	(d) 1,2,7-trimethylcyclopentadecane		
	(e) 1,1,2,5-tetramethylcyclopentane		
<b>131.</b>	(a) 5-isobutyl-2-methylnonane, 5-2-methylnonane (2-methylpropyl)		
	(b) 2,7-dimethyl-4-propyloctane		
	(c) 6-(2,3-dimethylbutyl) 3-methyl undecane		
	(d) 1,1,2,6-tetramethylcyclohexane		
	(e) 2,2,3-trimethylcyclohexanol		
	(f) 1,2,4-trimethylcyclopentane		
	(g) 2-methylbicyclo[3.1.1] heptane		
	(h) 2-methylbicyclo[3.1.1] heptane		
	(i) 2,2,6,6,7-pentamethyloctane		
	(j) 4-(1methylpropyl)-2,3,5-trimethyl nonane <b>Not</b> 2-butyl		
	(k) 5-(1-ethyl-2-methyl-1-(1-methylethyl)propyl) nonane		
<b>132.</b>	a - r; b - s; c - q; d - p		

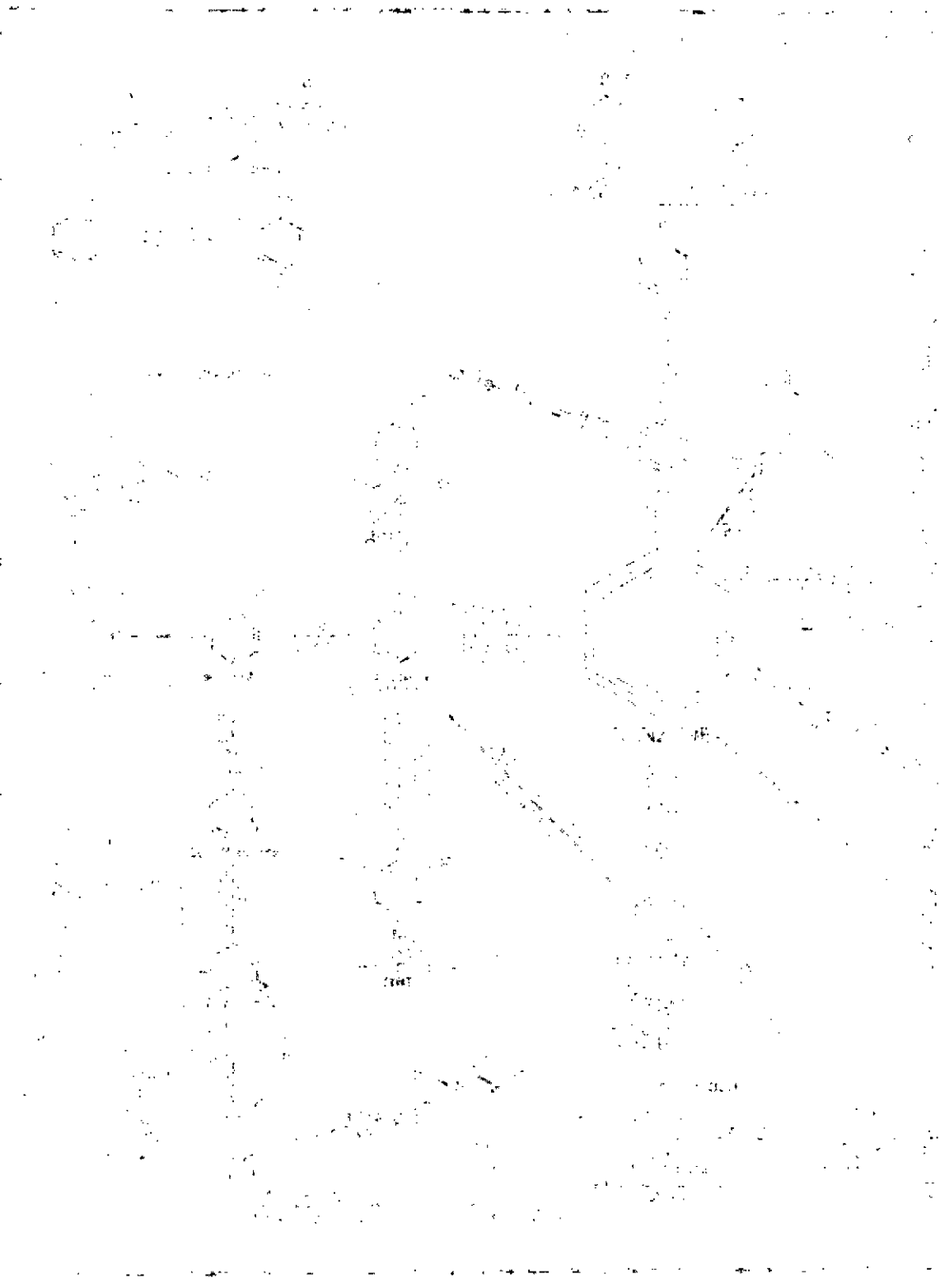












## About the Author



**M.S. Chouhan**, the author, is B.Tech in Chemical Engineering from Mumbai University. Due to his keen interest in teaching, he opted his career in guiding the JEE aspirants. He is highly dedicated to Organic Chemistry and successfully shaping the dreams of IITians, who are the most honoured technocrats and earning the name for themselves and the country.



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