
UNIT : 2 STATES OF MATTER

Important Points

The group of molecules is called matter. Matter is made up of small particles. Matter is in three states, Solid, liquid and gas. The other two states are known as Plasma and Bose, Einstein condensate. The physical state of the matter changes by changing temperature. The physical properties of a substance are changed by changing its physical state but the chemical properties do not change, sometimes the rate of chemical reaction changes by changing the physical state. During the chemical calculation, it is most essential to have the information about the physical state of substances (reactant or product) and hence it is essential to study the physical state of matter, factors affecting and related some important laws. The deciding factors of the physical state of matter are intermolecular forces, molecular interaction and the effect of thermal energy on the motion of particles.

The Dutch scientist van der Waals suggested that the weak forces of attraction exist between the molecules, which cannot be explained by any other chemical attraction is known as van der Waals attractive forces. This force is universal. This force of attraction is exerted upto 4.5×10^{-10} m distance in substance. van der Waals forces depend upon the shape of molecules, number of electrons present in molecules, contact surface of molecules and average intermolecular distance. The van der Waals forces of attraction are different like (i) Dispersion forces or London forces. (2) Dipole-dipole forces and (3) Dipole-induced dipole forces.

Dispersion forces of attraction was first of all proposed by the German scientist Fritz London so it is known as London forces. This type of force of attraction is observed in atoms or molecules, there is a temporary dispersion in electron density that affect the electron density of nearby atom or molecule so the force of attraction is developed and so such effect is called dispersion force. The dipole-dipole forces are observed in permanently dipolar molecules. Such dipolar molecules also have interactive London forces so the cumulative effect of both forces are observed. The dipole-dipole force is stronger than London forces. The dipole-induced dipole forces are observed when dipolar molecules come near to non-polar molecules. This type of molecules also have London forces and hence the cumulative effect of both forces are observed. The hydrogen bonding is an important intermolecular force. The first elements of groups 5, 6 and 7 due to their high electronegativity combine with hydrogen to form hydride compounds, in which hydrogen bond is observed. There also exists an intermolecular repulsive forces; and based on that the effect of pressure on solid, liquid and gaseous state explained very easily. The most important factor which decides the physical, state of matter is the effect of thermal energy, on motion of molecules due to this motion of molecules or atoms the energy produced is called thermal energy to keep the molecules near to each other while the thermal energy has tendency to keep the molecules away from each other. By balancing combination of the two opposite factors, the physical state of matter as solid, liquid or gas is decided. Due to weak forces of attraction between molecules of gaseous state have some characteristics. The behaviour of gas is described by the quantitative relation between mass, volume, temperature and pressure and these relations are discovered by experimental observations and such relations are called laws of gases. The relation between pressure and volume of a gas was studied and it is known as Boyle's law. At constant temperature for a fixed amount gas, pressure (P) varies inversely with its volume (V). Mathematically the Boyle's law is written as $PV = K$ or $P_1V_1 = P_2V_2$. The equation $d/P = K$ devised from Boyle's law where d is the density. The Kelvin temperature is accepted as an SI unit. The relation $T = (t + 273.15)$ K is obtained. On the basis of experimental observations a relation between absolute temperature and volume is obtained, which is known as Charles'

law. Mathematically it is written as $\frac{V}{T} = K$ or $\frac{V_1}{T_1} = \frac{V_2}{T_2}$. The relation between pressure and absolute temperature (T) is obtained on the basis of experimental observations by scientist Gay Lussac and is known as Gay Lussac's law. Mathematically it is written as $\frac{P}{T} = K$ or $\frac{P_1}{T_1} = \frac{P_2}{T_2}$. The relation between volume of a gas and number of molecules was given by Avogadro, which is known as Avogadro's law. The mathematical form of it is $V = K \cdot n$. The 0°C or 273 K temperature and 1 bar pressure is accepted as a standard value by SI system and hence these values are known as standard temperature and pressure (STP). 1 mole of gas at STP is having volume 22.4 litre and number of molecules equal to 6.022×10^{23} known as molar volume and Avogadro's number respectively. Combining Boyle's law and Charles' law, the relation obtained $\frac{PV}{T} = K$ or $\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$ is known as combined gas equation. The ideal gas equation, $PV = nRT$ is also known as equation of state and R is called universal gas constant which has different values in different units. The real gas behaves as ideal gas at high temperature and low pressure and are called ideal gases. The behaviour of real gas is deviated from ideal gas and its study came from the study of effect of pressure and temperature and so the ideal gas equation is written as $\left(P + \frac{an^2}{V^2}\right)(V - nb) = nRT$ and this equation is also known as van der Waals equation. The gas can be liquefied by lowering the temperature and increasing pressure at which gas get liquefied is known as critical temperature (T_C) and critical pressure (P_C) respectively and at critical temperature and critical pressure the volume occupied by 1 mole of gas is called critical volume (V_C) and this state is called critical state. The P_C , T_C and V_C values are constant so they are known as critical constants. The liquefaction of gas is explained by isotherm. Maxwell and Boltzmann had studied the distribution of molecules between different possible and plotted graph which is known as Maxwell's distribution curve.

The total pressure of the mixture of two or more than two gases is obtained by the Dalton's law. Total pressure (P) = $p_A + p_B + p_C + p_D \dots$ and the partial pressure (p) is calculated from total pressure by equation $p_1 = X_1 \times P_{\text{total}}$. If the % by volume is given then the partial pressure of gas is calculated using equation.

Partial pressure $p_A = \frac{\% \text{ by volume of gas A} \times \text{total pressure}}{100}$. The Graham's law of gaseous diffusion is

$r \propto \frac{1}{\sqrt{d}}$ and using formula the ratio of rate of diffusion of NH_3 and HCl gas was obtained practically as $1.46 \pm .01$. The application of Graham's law of gaseous diffusion are as given in the text. The Avogadro's hypothesis is useful to calculate the number of molecules, atoms and total number of atoms in given amount of gas.

The liquid state has its physical properties like fixed volume, fluidity, non-compressibility, diffusion, evaporation, vapour pressure, surface tension and viscosity.

M.C.Q.

- What is value of Boyle's temperature of ethane gas when $a = 5.489 \text{ dm}^6 \text{ atm mol}^{-2}$ and $b = 0.0638 \text{ dm}^3 \text{ atm mol}^{-1}$
(a) 1048K (b) 104.8K (c) 209.6K (d) 290.6K
- The value of universal gas constant R depends upon the
(a) Temperature of the gas (b) Volume of the gas
(c) Number moles of the gas (d) none of these
- The Boyle's temperature for the ideal gases is given by
(a) $\frac{a}{R}$ (b) $\frac{a}{bR}$ (c) $\frac{2a}{bR}$ (d) none of these
- The ratio of van der Waals' constants a and b has the dimensions of
(a) atm mole^{-1} (b) L mole^{-1} (c) $\text{atm} \cdot \text{L mole}^{-1}$ (d) atm mole^{-2}
- A gas expands through a porous plug and exhibits cooling if its temperature is
(a) More than inversion temperature (b) Less than inversion temperature
(c) Less than critical temperature (d) Less than Boyle's temperature
- A gas behaves like an ideal gas at
(a) High pressure and low temperature (b) High pressure and high temperature
(c) At low pressure and increasing in volume (d) Decreasing velocity by lowering temperature
- To which of the following gaseous mixture is Dalton's law not applicable?
(a) $\text{He} + \text{Ne} + \text{SO}_2$ (b) $\text{NH}_3 + \text{HCl} + \text{HBr}$ (c) $\text{O}_2 + \text{N}_2 + \text{CO}_2$ (d) $\text{N}_2 + \text{H}_2 + \text{O}_2$
- The degree of dissociation of Cl_2 at 1500K is 0.45 according to the reaction $\text{Cl}_2 \rightarrow 2\text{Cl}$ assuming that both Cl_2 and Chlorine atoms behave like ideal gases, calculate the density of the mixture if the pressure of the mixture is 1.5 atm
(a) 0.596 g. l^{-1} (b) 0.496 g. l^{-1} (c) 0.696 g. l^{-1} (d) 0.396 g. l^{-1}
- A gas is kept at 1 atm pressure. To compress it to $1/4^{\text{th}}$ of its initial volume, the pressure to be applied is
(a) 1 atm (b) 2.0 atm (c) 4.0 atm (d) $\frac{1}{4}$ atm
- The density of a gas at 300K and 1 atm is d pressure remaining constant, at which of the following temperatures will its density become $0.75 d$?
(a) 20°C (b) 30°C (c) 400K (d) 300K
- A mixture contains N_2O_4 and NO_2 in the ratio 2 : 1 by volume. The vapour density of the mixture is
(a) 45.4 (b) 49.8 (c) 32.6 (d) 38.3

12. At extremely low pressure, the vander waals equation for one mole of a gas may be written as
- (a) $PV = RT + pb$ (b) $PV = RT - \frac{a}{v}$ (c) $PV = RT$ (d) $(p + \frac{a}{v})(v - b) = RT$
13. The compressibility of a gas is less than unity at STP Therefore
- (a) $V_m > 22.4 \text{ L}$ (b) $V_m < 22.4 \text{ Litre}$ (c) $V_m = 22.4 \text{ L}$ (d) $V_m = 44.8 \text{ Litre}$
14. The correct order for magnitude of vanderwaals constant b should be
- (a) $C_2H_6 < CO < CO_2 < He$ (b) $CO < C_2H_6 < He < CO_2$
- (c) $C_2H_6 < CO_2 < CO < He$ (d) $He < CO < CO_2 < C_2H_6$
15. The molecular radius of O_2 is $2.88 \times 10^{-10} \text{ m}$ calculate the excluded volume per mol of O_2
- (a) 0.24 dm^3 (b) 0.48 dm^3 (c) 0.024 dm^3 (d) 0.048 dm^3
16. An ideal gas can not be liquefied because
- (a) The intermolecular force of attraction between the gaseous molecules are negligible.
- (b) Its critical temperature is very high
- (c) The vanderwaals constants a and b are very high
- (d) Of all of these
17. The values of 'a' for the gases O_2 , CO_2 , N_2 and CH_4 are respectively 1.36, 3.64, 1.39 and $2.253 \text{ L}^2 \text{ atm mol}^{-1}$ which gas can be most easily liquefied?
- (a) O_2 (b) CO_2 (c) N_2 (d) CH_4
18. The rate of diffusion of H_2 is about
- (a) $\frac{1}{2}$ that of He (b) 1.4 times that of He (c) Twice that of He (d) 4 times that of He
19. Most probable speed, average speed, and RMS (root mean square speed) are related as
- (a) $1 : 1.224 : 1.128$ (b) $1.128 : 1 : 1.224$
- (c) $1 : 1.128 : 1.224$ (d) $1.224 : 1.128 : 1.0$
20. At room temperature the mixture of SO_2 and O_2 gas, compared to the O_2 molecule, the SO_2 molecule will hit the wall with..
- (a) Smaller average speed (b) Greater average speed
- (c) Greater kinetic energy (d) Greater mass
21. Which has maximum value of mean free path?
- (a) CO_2 (b) H_2 (c) O_2 (d) N_2

22. 4.0 gm ideal gas is filled in a bulb having volume 10 dm^3 at a constant temperature T & constant pressure P . If 0.8 gm gas is removed from the bulb to maintain the original pressure at $(T + 125) \text{ K}$ temperature, what would be the value of T for a gas having molar mass 40 gm mole^{-1} .

- (a) 500K (b) 500°C (c) 773K (d) 773°C

23. What would be value of ratio for RMS and average speed of gaseous molecules at a constant temperature?

- (a) 1.086 : 1 (b) 1 : 1.086 (c) 2 : 1.086 (d) 1.086 : 2

Hint - 2 2

Pressure and Temperature are constant

$$\text{So : } n_1 T_1 = n_2 T_2$$

$$\frac{W_1}{M_1} \times T_1 = \frac{W_2}{M_2} T_2 \quad M_1 = M_2$$

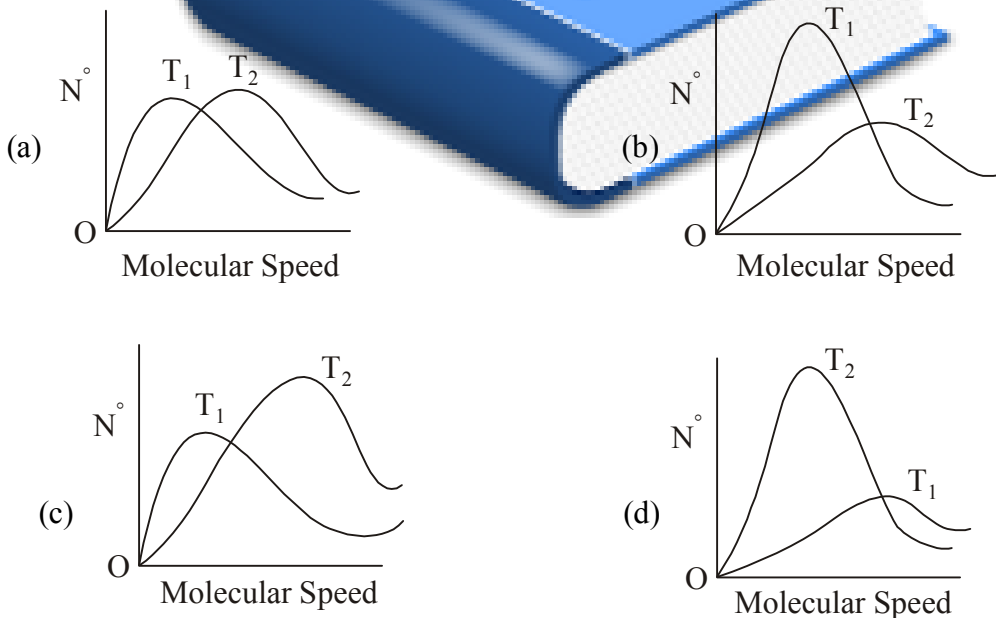
$$W_1 T_1 = 3.2(T + 125)$$

$$4T = 3.2T + 400$$

$$\therefore 0.8T = 400$$

$$\therefore T = 500 \text{ K}$$

24. If temperature $T_2 > T_1$, which graph of maxwell Boltzmann distribution of molecular speed is correct?



25. The RMS velocity of an ideal gas at constant pressure varies with density relates as

- (a) d (b) \sqrt{d} (c) d^2 (d) $\frac{1}{\sqrt{d}}$

26. The ratio of rms (root mean square) velocities for two different gases is

(a) $\frac{\bar{V}_1}{\bar{V}_2} = \sqrt{\frac{M_2}{M_1}}$ (b) $\frac{m_1}{\sqrt{M_2}} = \frac{m_2}{\sqrt{M_1}}$ (c) $\frac{\alpha_1}{\sqrt{M_2}} = \frac{\alpha_2}{\sqrt{M_1}}$ (d) $\frac{\sqrt{M_2}}{m_1} = \frac{\sqrt{M_1}}{m_2}$

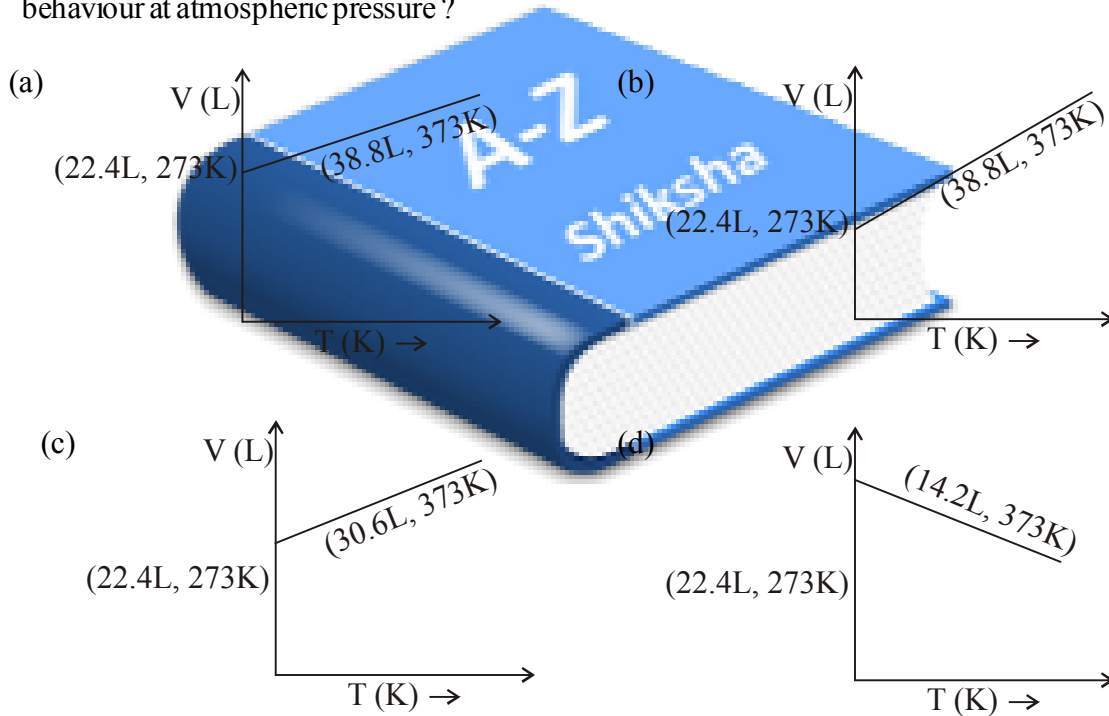
27. At constant temperature, a gas is filled at 1 atm pressure in a closed container. To compress this gas to $\frac{1}{4}$ th of its initial volume, the pressure to be applied is

(a) $\frac{4}{3} atm$ (b) 2 atm (c) $\frac{1}{4}^{th} 4 atm$ (d) $\frac{1}{3} atm$

28. What is the pressure of 380 mm Hg column of a gas in pascal ?

(a) $5.05 \times 10^4 Pa$ (b) $5.06 \times 10^5 Pa$ (c) $0.505 \times 10^3 Pa$ (d) $1.013 \times 10^5 Pa$

29. The graphs plotted $V \rightarrow T$ for one mole of an ideal gas as follows, which graph represent its ideal behaviour at atmospheric pressure ?



30. Helium gas is compressed to half of the volume at 303 K. It should be heated to which temperature for its volume to increase to double of its original volume ?

(a) 303K (b) 606K (c) 1212K (d) 30°C

31. When a gas is heated from 298K to 323K at a constant pressure of 1 atm its volume is

(a) Increases from V to 1.8 V (b) Increases from V to 1.08 V
(c) Increases from V to 1.5 V (d) Increases from V to 2 V

Hint 1

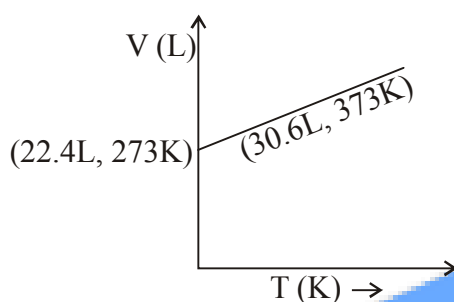
$$380\text{mm} = 380\text{ torr} = \frac{380}{760}\text{ atm}$$

$$\therefore 0.987\text{ atm} = 10^5\text{ Pa}$$

$$\therefore \frac{380}{760}\text{ atm} = (?) \quad \therefore 380\text{ mm} = 5.05 \times 10^4\text{ Pa}$$

Hint 2

At const pressure according to charles law



$$\frac{V_1}{T_1} = \frac{V_2}{T_2} = K$$

$$\therefore \frac{22.4}{273} = 0.082 \dots\dots\dots(I)$$

$$\text{and } \frac{30.6}{373} = 0.082 \dots\dots\dots(II)$$

(I) and (II) constant behaves the gas as an ideal

Hint - 3 : According to Charles' law

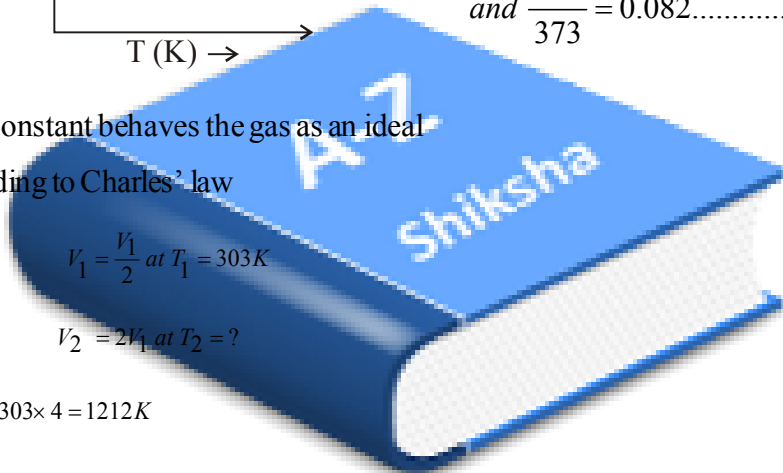
$$\frac{V_1}{T_1} = \frac{V_2}{T_2} = K$$

$$V_1 = \frac{V_2}{2} \text{ at } T_1 = 303\text{K}$$

$$\therefore T_2 = \frac{V_2 T_1}{V_1}$$

$$V_2 = 2V_1 \text{ at } T_2 = ?$$

$$= \frac{2V_1 \times 303}{\frac{V_1}{2}} = 303 \times 4 = 1212\text{K}$$



Hint 4 : According to Charles' law

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

$$\frac{V_1}{298} = \frac{V_2}{323}$$

$$\therefore V_2 = \frac{323}{298} V_1 = 1.08 V_1$$

32. At 20° and 760 torr, the sample of air contains 20% O₂ & 80% N₂ gaseous mixture, find the density of the air (Molarmass O₂ = 32 g/mol, N₂ = 28 g/mole R = 0.082 liter mole⁻¹ K⁻¹)

- (a) 1.918 gL⁻¹ (b) 2.198 gL⁻¹ (c) 1.198 gL⁻¹ (d) 1.394 gL⁻¹

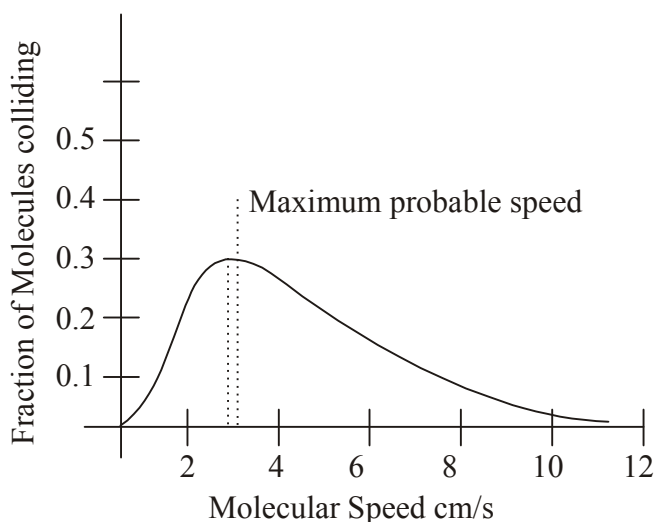
33. The ratio of velocities of diffusion of gas A and B is 1 : 4, if the ratio of their masses in a mixtare is 2:3, calculate the ratio of their mole fractions (BIT 1990)

- (a) 1 : 12 (b) 1 : 24 (c) 1 : 6 (d) 4 : 3

34. Under same conditions of temperature and pressure the volumes of 14g N_2 and 36g of O_3 are related as :
- (a) $2V_{N_2} = 3V_{O_3}$ (b) $3V_{N_2} = 2V_{O_3}$ (c) $3V_{N_2} = 4V_{O_3}$ (d) $4V_{N_2} = 3V_{O_3}$
35. Equal masses of Hydrogen and oxygen gases are placed in a closed container, at a pressure of 3.4 atm. The contribution of hydrogen gas to the total pressure is
- (a) 1.7 atm (b) 0.2 atm (c) 3.2 atm (d) 3.02 atm
36. The kinetic energy of 4.0 moles of N_2 gas at $127^\circ C$ is ($R = 2 \text{ cal mole}^{-1} K^{-1}$)
- (a) 4400 cal (b) 3200 cal (c) 4800 cal (d) 1524 cal
37. The critical temperature of H_2O is higher than CO_2 because (IIT 1997)
- (a) fewer electrons than CO_2 (b) It contains 2- covalent bonds
(c) Molecular shape is V- shape (d) dipole moment of H_2O
38. The compressibility factor of an ideal gas is
- (a) zero (b) 1 (c) 2 (d) 4
39. A 10 L cylinder of nitrogen at 4.0 atm pressure and $27^\circ C$ developed a leak. When the leak was repaired 2.36 atm of nitrogen remained in the cylinder at $27^\circ C$. How many grams of nitrogen escaped?
- (a) 18.7g (b) 0.67g (c) 52.6g
(d) 10.0g
40. Calculate percentage of NO_2 by weight in N_2O_4 which has vapour density of 36.
- (a) 27.7% (b) 67.7% (c) 52.6% (d) 25.7%
41. Two gases A and B having the same temperature T, same pressure P and same volume V are mixed. If the mixture is at the same temperature T and occupied a volume V, the pressure of the mixture is ..
- (a) 2P (b) P (c) P/2 (d) 4P
42. The density of nitrogen is maximum at
- (a) STP (b) 273K and 2 atm (c) 546K and 1 atm (d) 546 K and 2 atm
43. The temperature at which real gases obey the ideal gas laws over a wide range of pressure is called
- (a) Critical temperature (b) Inversion of temperature
(c) Boyle's temperature (d) Reduced Temperature
44. Which of the following gases with have the highest rate of diffusion
- (a) O_2 (b) CO_2 (c) NH_3 (d) N_2
45. At a given temperature $Qx = 39y$ and $My = 2Mx$ where Q and M stand for density and molar mass respectively the ratio of Pressures p_x/p_y would be
- (a) $\frac{1}{4}$ (b) $\frac{4}{1}$ (c) $\frac{6}{1}$ (d) $\frac{1}{6}$

46. The density of methane at 2.0 atmosphere pressure at 27°C is
 (a) 0.13 g l⁻¹ (b) 0.26 g l⁻¹ (c) 1.30 g l⁻¹ (d) 26.0 g l⁻¹
47. The diffusion of methane at a given temperature is twice that of gas x. The molecular weight and the gas is
 (a) 64.0 SO₂ (b) 32.0 (O₂) (c) 4.0 (He) (d) 30.0(C₂H₆)
48. The compressibility factor of an ideal gas is (AIIMS - 1997, IIT91997)
 (a) 0 (b) 0.1 (c) 0.2 (d) 0.4
49. As temperature is raised from 20°C to 40°C, the average kinetic energy of neon atoms changes by a factor of which of the following?
 (a) $\frac{1}{2}$ (b) 2 (c) $\frac{313}{293}$ (d) $\sqrt{\frac{313}{293}}$
50. If V_{rms} is 30 R^{1/2} at 27°C calculate the molar mass of the gas in kilogram (DPMT 2005)
 (a) 1 (b) 2 (c) 4 (d) 0.001
51. Gas equation PV=nRT is obeyed by (BHV 200)
 (a) only isothermal process (b) only adiabatic process (c) both a and b (d) none of these
52. The average kinetic energy of an ideal gas per molecule in SI unit at 25°C will be (CBSE 1996)
 (a) 6.17 x 10⁻²¹ KJ (b) 6.17 x 10⁻²¹ J (c) 6.17 x 10⁻²⁰ J (d) 7.17 x 10⁻²⁰ J
53. The vapour density of pure ozone would be
 (a) 48 (b) 32 (c) 24 (d) 16
54. Equal masses of CH₄ and H₂ are mixed in an empty container at 25°C. The fraction of the total pressure exerted by H₂ is
 (a) $\frac{1}{2}$ (b) $\frac{8}{9}$ (c) $\frac{1}{9}$ (d) $\frac{16}{17}$
55. The ratio between the root mean square (rms) velocity of H₂ at 50L that of at 800 K is?
 (a) 2 (b) 4 (c) 1 (d) $\frac{1}{4}$
56. A real gas behaves more ideally at (IIT JEE 1993)
 (a) Low temperature and low pressure (b) Low temperature and high pressure
 (c) high temperature and low pressure (d) high temperature and high pressure

57. According to the kinetic theory of gases (IIT 1991)
- The pressure exerted by a gas is proportional to mean square velocity of the molecules.
 - The pressure exerted by the gas is proportional to the root mean square velocity of the molecules.
 - The root mean square velocity is inversely proportional to the temperature
 - The mean translational K.E of molecule is directly proportional to the absolute temperature
58. The value of van der Waals constant a for gases O_2 , N_2 , NH_3 and CH_4 are 1.36, 1.39, 4.37 and $2.253 \text{ L}^2\text{atm mol}^{-1}$ respectively the gas which can be liquefied most easily will be
- O_2
 - N_2
 - NH_3
 - CH_4
59. A certain sample of a gas volume 0.24 Liter measured at 1.0 atm pressure and 273°C its volume will be (BHU 2005)
- 0.4L
 - 0.8L
 - 27.8L
 - 55.6L
60. If a volume containing gas is compressed to half, how many moles of gas remained in the vessel
- Just double
 - just half
 - same
 - more than double
61. At constant Volume for a fixed number of moles of a gas, the pressure of the gas increases with the rise in temperature due to (IIT 1992)
- Increase in average molecules speed
 - Increase rate of collisions amongst
 - Increase in molecular attraction
 - Increase in mean free path
62. Equal mass of methane and oxygen are mixed in an empty container at 250°C the fraction of the total pressure exerted by O_2 is
- $\frac{1}{2}$
 - $\frac{2}{3}$
 - $\frac{1}{3} \times \frac{273}{298}$
 - $\frac{1}{3}$
63. Find the true and false statements from the following on the basis of given graph



1. Maxwell and Boltzmann had studied the distribution of molecules between different possible speeds
 2. This graph is known as Maxwell's distribution curve in which kinetic energy and molecular speed of gas is studied.
 3. The fraction of molecules with very high or very low speed is very high
 4. Increasing the speed fraction also increases which becomes maximum and then decreases.
 5. The top portion of the curve indicates maximum fraction of molecules and the speed of molecules is called most probable speed which is indicated by ∞
 6. On increasing temperature the collision of molecules increases and speed of molecules decreases
 - (a) TTFTTF
 - (b) TFTTFT
 - (c) FTTFFT
 - (d) TTTTFF
64. When a real gas behaves as an ideal gas ?
- (a) Inter molecular attraction among molecules are negligible then
 - (b) At very low pressure and high temperature then
 - (c) When molecular size is very very small and negligible to the volume of container then
 - (d) In all the above conditions
65. What is the ratio of diffusion rate of $^{238}\text{UF}_6$ and $^{235}\text{UF}_6$ when these gases are diffused under the same condition of temperature and pressure ?
- (a) 0.09953
 - (b) 1.0047
 - (c) 1.0
 - (d) 10487
66. Molecular mass of SO_2 gas is 4 times that of CH_4 therefore
- (a) Being SO_2 and CH_4 both gases, they diffuse with same rate
 - (b) SO_2 gas will diffuse 4 times faster than that of CH_4
 - (c) Diffusion of SO_2 gas is half that of CH_4
 - (d) CH_4 gas diffuses 4 times faster than SO_2
67. 50 ml O_2 gas diffused in 80 sec, What time will be required to diffuse same volume of He gas?
- (a) 22.89 sec
 - (b) 28.29 sec
 - (c) 92.82 sec
 - (d) 24.29 sec
68. What is the mass (weight) of 6.022×10^{22} oxygen molecules ?
- (a) 32 gms
 - (b) 3.2 gms
 - (c) 16 gms
 - (d) 1.6 gms
69. How many molecules of SO_2 gas will be present in 5.6 litre volume of STP ?
- (a) 1.5×10^{23}
 - (b) 6.002×10^{23}
 - (c) 7.52×10^{23}
 - (d) 3.01×10^{23}
70. Molar mass of $\text{CaCO}_3 = 100 \text{ gm/mole}$, how many molecules are present in 20 gm (CaCO_3) ?
- (a) 12.44×10^{23}
 - (b) 1.2044×10^{23}
 - (c) 1.2044×10^{25}
 - (d) 1.2044×10^{22}
71. For an ideal gas if pressure is (P), temperature (T) and gas constant is (R) then how many moles of gas

will be available in its 10 litre volume ?

- (a) $10 \times \frac{P}{RT}$ (b) $\frac{P}{RT} \times \frac{1}{10}$ (c) $10 \times \frac{RT}{P}$ (d) $\frac{RT}{P} \times \frac{1}{10}$

STP

$$P_1 = 1.5 \text{ bar}$$

$$P_2 = 1$$

$$V_1 = 200 \text{ ml}$$

$$V_2 = ?$$

$$T_1 = 400\text{K}$$

$$T_2 = 273$$

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$

$$V_2 = \frac{P_1 V_1}{T_1} \times \frac{T_2}{P_2}$$

$$\frac{1.5 \times 200 \times 273}{400 \times 1}$$

72. At constant temperature 27°C and pressure, 5 litre gas is raised its temperature by 1°C , What will be the change in its volume ?

(a) $\frac{1}{234}$ part of its original volume will be increased.

(b) The volume at 300K acquired by a gas will be increased of its $\frac{1}{234}$ part

(c) The volume of a gas acquired at 0°C , will be increased of its $\frac{1}{234}$

(d) $\frac{1}{234}$ part of volume of a gas at 0°C , will be increased.

73. At 400 K temperature, pressure of 200 ml N_2 gas is 1.5 bar , What is its volume at STP?

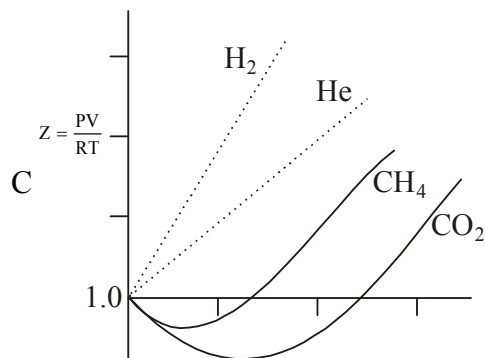
(a) 204.7 ml

(b) 20.47 ml

(c) 402.7 ml

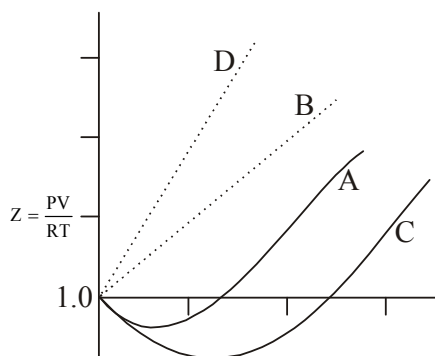
(d) 40.27 ml

74. What is correct prediction from the given graph ?



- (a) H_2 gas is less compressible than an ideal gas as its $z > 1.0$
- (b) CO_2 gas is more compressive than the ideal gas as $Z > 1.0$
- (c) CH_4 gas is higher compressive its $Z < 1$ than the ideal gas
- (d) a and c both

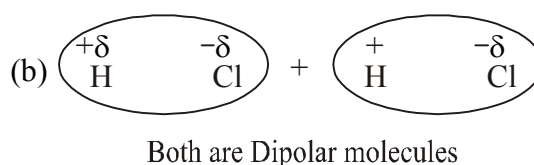
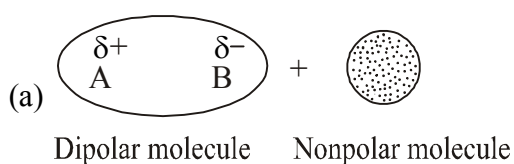
75. It A, B, C, and D are the graphs plotted for H_2 , He, CH_4 and CO_2 gases which graph is related for H_2 and CH_4 compared to an ideal gases

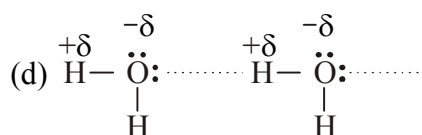
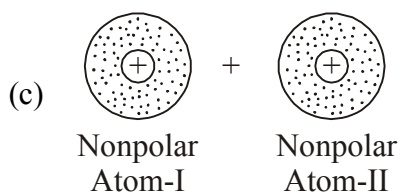


- (a) D and A
 - (b) A and B
 - (c) A and D
 - (d) B and C
76. which state of matter whose the intermolecular attractive force do not exist ?
- (a) solid
 - (b) liquid
 - (c) gas
 - (d) none
77. Which word of the following does not used for states of matter ?
- (a) Bose - Einstein
 - (b) Boyle - Einstein
 - (c) plasma
 - (d) solid, gas, liquid
78. 14.2 kg LPG is diffused in a gas cylinder at 2.5 atm. If 50% of LPG gas is used up then what will be the pressure of gas will remain in cylinder ?
- (a) 2.5 atm
 - (b) 1.25 atm
 - (c) 5.0 atm
 - (d) $\frac{14.2 \times 2.5}{7.1 \times V}$
79. When the unit of $R = 8.314 \times 10^7 \text{ erg} \cdot \text{mole}^{-1} \cdot \text{K}^{-1}$. What are the units of pressure and volume of a gas ?
- (a) P - dyne cm^{-2} , V- cm^3
 - (b) P - paxal, V- cm^3
 - (c) P - newton m^{-2} , V- cm^3
 - (d) P - atm, V- cm^3
80. unit of R in CGS system is
- (a) $8.314 \times 10^7 \text{ erg} \cdot \text{K}^{-1} \cdot \text{mole}^{-1}$
 - (b) $8.314 \text{ JK}^{-1} \cdot \text{mole}^{-1}$
 - (c) $0.082 \text{ litre atm mole}^{-1} \cdot \text{K}^{-1}$
 - (d) $1.987 \text{ cal mole}^{-1} \cdot \text{K}^{-1}$
81. What is the value of gas constant R $\text{cal} \cdot \text{mol}^{-1} \cdot \text{K}^{-1}$?
- (a) 0.082
 - (b) 1.987
 - (c) 8.314
 - (d) 8.314×10^7

82. What is not related to Z ?
- (a) $z=1$ states the ideal behaviour of the gas
 (b) Gases which has $z = 1$ are an ideal gases
 (c) z is the ratio of $\frac{PV}{nRT}$ known as compressibility factor
 (d) When $z < 1$ or $z > 1$, the gases convert into their liquid state
83. Which equation is the ideal gas equation for the real gases ?
- (a) $PV = nRT$ (b) $PV = iRT$
 (c) $(P + \frac{am^2}{v^2})(V - nb) = nRT$ (d) $(P - \frac{am^2}{v^2})(V - nb) = nRT$
84. Proportion of O_2 , U_2 and N_2 gases are 3 :2: 5, and the Total pressure of this gas mixture container is 50 bar, What are the partial pressure of Cl_2 and N_2 gases respectively?
- (a) 10 bar, 25 bar (b) 10 bar, 15 bar (c) 15 bar, 25 bar (d) 25 bar, 15 bar
85. Which factor is the deciding factor of physical state of matter ?
- (a) inter molecular forces (b) molecular interaction
 (c) effect of thermal energy on the motion of particles (d) Given all.
86. Which physical state is acquired by water in between temperature above than 273 K and below 373 K?
- (a) plasma (b) liquid (c) solid (d) Gas
87. Which physical state of water is more compressible applying pressure at constant temperature ?
- (a) Ice (b) water (c) Vapour (d) Plasma
88. Which substance can be easily poured from one container into the other at room temperature ?
- (a) Kerosene (b) Ice (c) salt (d) all
89. Match column I with column II
- | column I | column II |
|----------------------------|--|
| i) Gas | (a) Easily poured from one container to the other |
| ii) Liquid | (b) definite shape and fixed volume like a container is acquired |
| iii) Solid | (c) starts to melt at a definite temperature |
| | (d) At constant pressure the increasing in temperature raises Volume effectively |
| (A) i - b, ii - a, iii - c | (B) i - a, ii - b, iii - c |
| (C) i - d, ii - c, iii - b | (D) i - a, ii - c, iii - b |

90. Observation on physical state of water at 273K up to 373K are given as below, find the Correct option.
- (A) changing the temperature of water above 273K upto 373K, composition of water is changing gradually.
- (B) When temp is changed to rise from 273K on ward the physical state of water changes from solid - liquid to vapour state.
- (C) Heating water at 373K temperature, proportion of hydrogen with oxygen is changed
- (D) Molar mass of water decreases with changing its physical states solid - liquid gaseous on raising the temperature
91. What is meant by Bose Einstein condensate ?
- [A] It is the specific state of matter
- [B] Showing relation $E = MC^2$ for the matter
- [C] It is an electronic device developed by Bose and Einstein
- [D] It is an energy of radiation
92. Which phenomenon will occur when temperature of the matter is changed ?
- [A] Physical state of matter changes.
- [B] specific arrangement of molecules in a matter changes
- [C] chemical properties are not changing but density is changing
- [D] Given all
93. Physical state of matter depend on...
- [A] Intermolecular forces which keeps molecules near to each other
- [B] Thermal energy of kinetic molecules which keeps molecules away from each other
- [C] By balancing of combination of two opposite factors is intermolecular forces and thermal energy decide the physical state of matter
- [D] Given all
94. What is negative electrical charge on F atom in HF the permanent dipole molecule ?
- [A] higher than $1.6 \times 10^{-19} \text{ C}$
- [B] less than $1.6 \times 10^{-10} \text{ C}$
- [C] less than $1.6 \times 10^{-19} \text{ C}$
- [D] higher than $1.6 \times 10^{-10} \text{ C}$
95. State Figure showing dipole - Induced dipole forces in the following ?





96. HCl polar molecule comes closer to He molecule, which effect of vander waals forces will be created ?
 [A] Dipole - induced dipole forces [B] Dipole induced dipole forces with London forces
 [C] London forces [D] dipole - dipole forces with London forces
97. Melting point of Rhomic Salphar is higher than phosphorus because ...state
 [A] size and number of electrons in Rhombic sulphur is more compared to phosphorus
 [B] sulphur S_8 has metallic properties while P_4 is nonmetal
 [C] Inter attraction forces are lower compared to thermal energy in sulphur than that of in phosphorus
 [D] Given all
98. Statement (A) : In liquid state molecules are arranged little for form each other compared to its solid state. hence the effect of pressure is observed in liquid.
 statement (R) : At 293 K temperature and 1000 bar pressure applied on water than the volume reduced by 4%
 [A] statement (A) and (R) both correct, statement (R) is the explanation to statement (A)
 [B] statement (A) and (R) both correct, statement (R) is not the explanation to statement (A)
 [C] statement (A) is correct, statement (R) is wrong
 [D] statement (A) is wrong, statement (R) is correct
99. Common physical states and other two physical states of matter are....
 [A] plasma, liquid, Gas are common but solid state and Bose Einstein conden sate are spcial.
 [B] Bose Einistein condensate and plasma are the other. rtwo states than common physical states gas, liquid and solid.
 [C] solid, liquid and Gas states are the only physical states : no other state is included.
 [D] Bose Einistein condensate and plasma are the main rules to decided the common physical states solid, liquid and Gas
100. Which statement is correct in the following.
 [A] Matter is existing as a individual single moleule
 [B] A group of matter is called molecule
 [C] a group of moleules is called matter
 [D] combination of group of different moleules form the same type of matter

-
101. Which of the following statements is false
- [A] Matter is made of small particles always exist in solid state
[C] matter in solid state possess fixed volume with definite shape
[B] matter of the same substance in liquid state has more volume compared to its solid state
[D] Beyond solid, liquid and gaseous state, two other physical states are also known as plasma and Bose Einstein condensate.
102. The density of neon will be maximum at (IIT 1990)
- (a) NTP (b) 0°C , 2 atm (c) 273°C , 1 atm (d) 273°C , 2 atm
103. Pressure of a mixture of 4 g of O_2 and 2g of H_2 combined in a bulb of 1 litre at 0°C is (AIIMS - 2000)
- (a) 25.215 atm (b) 31.205 atm (c) 45.215 atm (d) 15.210 atm
104. The temperature at which real gases obeys the ideal gas laws over a wide range of pressure is called.
- (a) critical temperature (b) Boyle's temperature
(c) Inversion temperature (d) Reduced temperature
105. A bottle of NH_3 and a square of dry HCL connected through a long tube are opened simultaneously at both ends, the white ammonia chloride ring first formed will be (IIT - 1988)
- (a) At the centre of tube (b) near the hydrogen chloride bottle
(c) near the NH_3 bottle (d) through out the length of the tube
106. At 100°C and 1 atm, if the density of liquid water is 1.0 g cm^{-3} and that of water vapour is 0.006 g cm^{-3} , then the volume of water molecules in 1 L of steam at this temperature is (IIT - 2000)
- (a) 6 cm^3 (b) 60 cm^3 (c) 0.6 cm^3 (d) 0.06 cm^3
107. Two separate bulbs contains gas A and gas B the density of A is twice as that of gas B. The molecular mass of gas A is half as that of B. If two gases are at same temp, the ratio of the pressure of A to that of B is
- (a) 2 (b) $\frac{1}{2}$ (c) 4 (d) $\frac{1}{4}$
108. 50 ml of a gas A diffuse through a membrane in the same time as for this diffusion of 40 ml of a gas B under identical pressure temperature conditions. If the molecular weight of A = 64, that of B would be (CBSC - 1992)
- (a) 100 (b) 250 (c) 200 (d) 80
109. Which of the following statement is false? (BHD - 1994)
- (a) The product of volume pressure of fixed amount of a gas is independent of temperature
(b) Molecules of different gases have the same K.E. at a given temperature
(c) The gas equation is not valid at high pressure and low temperature
(d) The gas constant per molecule is known as Boltzmann Constant.

110. Density ratio of O_2 and H_2 gas is 16 : 1 The ratio of their rms velocities will be
 (a) 4 : 1 (b) 1 : 16 (c) 1 : 4 (d) 16 : 1
111. at constant temperature and pressure, the rate of diffusion D_A and D_B of gases A and B having densities P_A and P_B are related by the expressions (IIT Screening - 1993)

(a) $D_A = \left[D_B \frac{\rho_A}{\rho_B} \right]^{\frac{1}{2}}$ (b) $D_A = \left[D_B \frac{\rho_B}{\rho_A} \right]^{\frac{1}{2}}$ (c) $D_A = \left[D_B \frac{\rho_A}{\rho_B} \right]^{\frac{1}{2}}$ (d) $D_A = \left[D_B \frac{\rho_B}{\rho_A} \right]^{\frac{1}{2}}$

112. If 300ml of gas at $27^\circ C$ is cooled to $7^\circ C$ at constant pressure Its final volume will be (AIIMS - 2000)
 (a) 135 ml (b) 540 ml (c) 350 ml (d) 280 ml
113. Positive deviation from ideal gas behaviour takes place. because of

- a) Molecular interaction between atoms and $\frac{PV}{nRT} > I$
 b) Molecular interaction between atoms and $\frac{PV}{nRT} < I$
 c) Finite size of the atoms and $\frac{PV}{nRT} > I$
 d) Finite size of the atoms and $\frac{PV}{nRT} < I$

114. Kinetic energy of 2 moles of N_2 at $27^\circ C$ is ($R = 8.324 \text{ JK}^{-1}\text{mol}^{-1}$)
 (a) 5491.6 J (b) 6491.6 J (c) 7491.6 J (d) 8882.4 J
115. The root mean square velocity of one mole mass of a monoatomic as having molarmass M is U_{rms} . The relation between average kinetic energy (E) of the gas and U_{rms} is (IIT screening - 2004)

(a) $\mu_{rms} = \sqrt{\frac{3E}{2M}}$ (b) $\mu_{rms} = \sqrt{\frac{2E}{3M}}$ (c) $\mu_{rms} = \sqrt{\frac{2E}{3M}}$ (d) $\mu_{rms} = \sqrt{\frac{E}{3M}}$

116. Triple point of water is
 (a) 273 K (b) 373 K (c) 203 K (d) 193 K
117. The root mean square velocity of an ideal gas at constant pressure varies with density (d) as (IIT - 2001)
 (a) d^2 (b) d (c) \sqrt{d} (d) $\frac{1}{\sqrt{d}}$

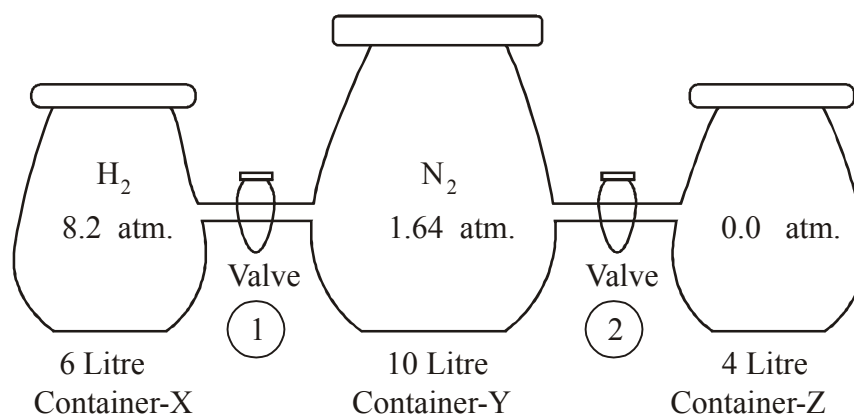
Read the following paragraph carefully and give correct choice to the option for the questions asked related to the paragraph

In the following given figure three glass containers X, Y, and Z are connected by valves 1 and 2 having negligible volume at 300K and 1.0 atmosphere pressure.

When valves 1 and 2 are closed, container X contains H_2 gas at 8.2 atmosphere pressure in volume 6.0

litre, container Y contains N_2 gas at 1.64 atm pressure in 10 litre volume, and container Z is evacuated with pressure Zero atmosphere

external pressure = 1.0 atm, temperature = 300 K



118. What relative effect will be observed in average velocity of gaseous molecules when valve -1 is opened between two containers X and Y?
- (a) $V_x = V_y$ (b) $V_x < V_y$ (c) $V_x > V_y$ (d) $V_x = 2V_y$
119. What pressure will be exerted in container X when valve -1 is opened
- (a) 4.1 atm (b) 8.2 atm (c) 2.05 atm (d) 3.84 atm
120. Keeping valve -1 closed, on opening valve 2 between container Z and Y, on expansion of gas how much work will be done by process ?
- (a) 1.0 litre atm (b) 14 - litre atm (c) -14.0 litre atm (d) zero
121. Opening valve 1 and 2, on connecting all the three X, Y, Z containers with each other, What would be the kinetic energy of all gaseous molecules? ($R = 0.082 \text{ litre atm / molK} = 8.314 \text{ J/molK}$)
- (a) 6842 J (b) 9974 J (c) 4988 J (d) 3832 J
122. Connecting all the three containers by opening valves 1 and 2, if internal pressure of containers are obtained 1.0 atmosphere by lowering temperature of the system, what would be the contribution of partial pressure of H_2 gas and N_2 gas respectively ?
- (a) 0.85 atm, 0.15 atm (b) 0.15 atm, 0.85 atm
(c) 0.75 atm, 0.25 atm (d) 0.25 atm, 0.75 atm

Paragraph - 2

The gases which do not obey general gas equation at all temperatures and pressures are called non ideal or real gases. But such gases show ideal behaviour at low pressure and high temperatures.

According to vander waals, the following are two faulty assumptions in kinetic theory of gases.

- (1) molecules of gas are considered as point masses and the volume occupied by the gas molecules is negligible in comparison to the total volume of gas.

(2) It was also assumed that there are no intermolecular attractive forces and the molecules of gas move independently.

Hence the vanderwaals equation for non-ideal (real) gases becomes

$$\left(P + \frac{a}{V^2}\right)(v-b) = RT \text{ for 1 moles and}$$

$$\left(P + \frac{an^2}{V^2}\right)(v-nb) = nRT \text{ for } n \text{ moles}$$

here a, and b are vanderwaals constants. a is a measure of intermolecular forces in a given gas. It is a measure of incompressibility volume per mole of gas.

Deviation of gases from ideal behaviour is studied by plotting graph $\frac{PV}{nRT}$ (z) vs P here quantity z is called compressibility factor.

for H_2 and He gases $\frac{PV}{nRT} = z$ is always > 1 . They show the deviation but for N_2, O_2, CH_4 and CO_2 gases $z < 1$ show -ve deviation at low pressure expected them ideal behaviour value of compressibility factor Z at critical always < 1 and real gases show negative deviation as per vander waals equation at critical point

$$z = \frac{P_c V_c}{T_c} = \frac{\left(\frac{a}{27b^2}\right)(3b)}{R\left(\frac{8a}{27Rb}\right)} = \frac{3}{8}$$

thus Z is less than 1 at critical point show negative deviation of real gases compare to ideal behaviour here in the above derivation at critical points

$$T_c = \left(\frac{8a}{27Rb}\right), P_c = \frac{a}{27b^2} \text{ and } V_c = 3b$$

alternatively, constants

$$b = \frac{V_c}{3}, a = 3P_c V_c^2, R = \frac{8P_c V_c}{3T_c}$$

The units of a : $\text{atm L}^2 \text{mole}^{-2}$

b : l mole^{-1}

question (1)

123. Which statements are correct in the following ?

- (a) The real gases donot obey the ideal behaviour at all temperatures and pressures
- (b) The gases which donot obey general gas equation are called non - ideal gases
- (c) Molecules were considered mass and volume less hence They donot occupy volume compared to total volume in the derivation of vander waals equation
- (d) vanderwaals proposed the gas equation for 1 note gas is

$$\left(P + \frac{a}{n^2} \right) (v - nb) = RT$$

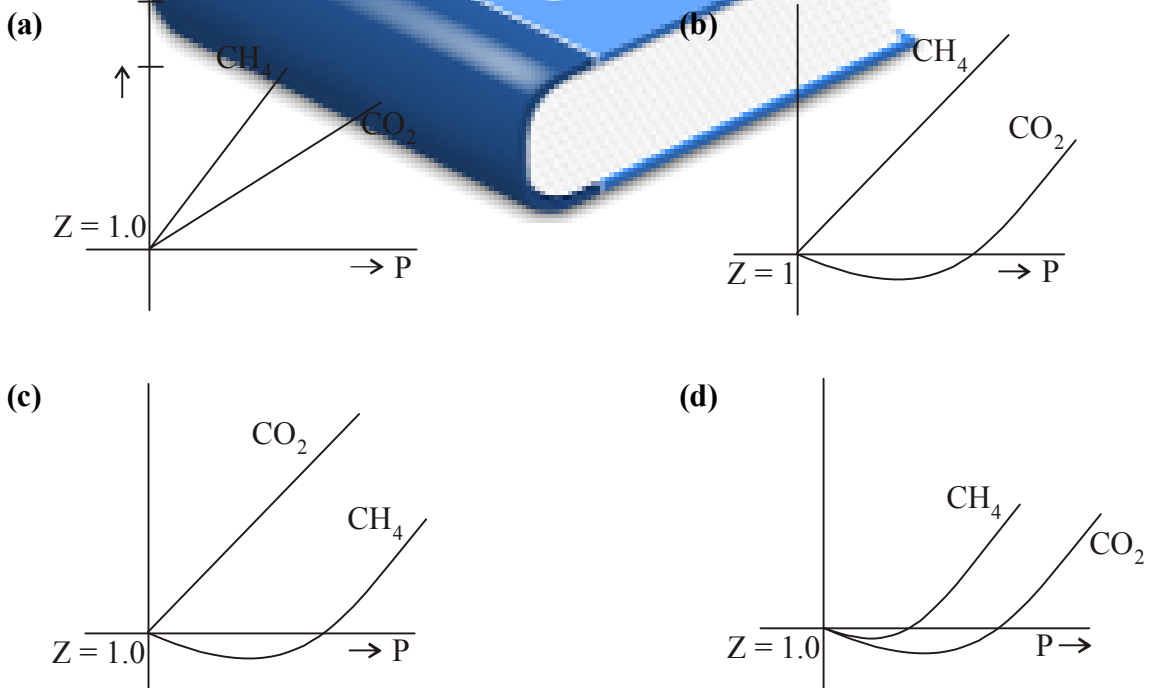
- (A) a,b
- (B) b,c
- (C) c,d
- (D) a,d

124. (2) question : (2) on what bases the deviation of gases from ideal behaviour is studied ?

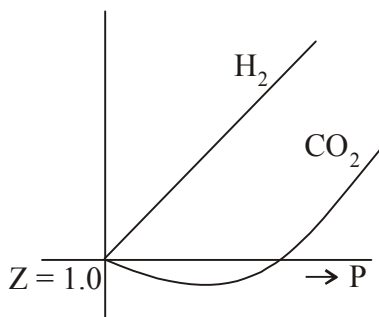
- (a) by plotting graph PV vs T
- (b) by plotting graph Z vs T
- (c) by plotting graph Z vs P
- (d) by plotting graph $\frac{PV}{nRT}$ vs P

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

125. When a graph Z plotted against P for CH₄ and CO₂ gases then the graph obtained as ...



126. What is indicated by the given graph for the behaviour of H_2 and CO_2 gases correctly ?



- (a) H_2 has value $z > 1$ show positive deviation from ideal behaviour
- (b) Value of $z = \frac{PV}{nRt}$ for H_2 gas is greater than zero but less than 1
- (c) value of $z = \frac{PV}{nRT}$ for CO_2 gas is greater than zero but less than 1 shows its negative deviation of its ideal behaviour
- (d) value of Z for H_2 is greater than 1 and for CO_2 it is less than one hence at high pressure CO_2 gas is more compressible but at low pressure it is less compressible than expected from ideal behaviour

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

127. At critical point the value of T_c, P_c and C_c in terms of van der Waals equation are respectively.

- (a) $\frac{8a}{27Rb}, \frac{a}{27b^2}, 3b$ (b) $\frac{3a}{8Rb}, \frac{8a}{27b}, \frac{3b}{v^2}$ (c) $\frac{8a^2}{27Rb}, \frac{a}{27b^2}, 3nb$ (d) $\frac{3a}{8Rb}, \frac{8a}{27b}, \frac{3b}{v^2}$

128. Match gases under specified conditions listed in column I with their properties in column II

Column I

Column II

1) H_2 (g) ($P = 200$ atm, $T = 273$ K)

a) $z = \frac{PV}{RT} \neq 1$

2) H_2 (g) ($P = 0$), $T = 273$ K)

b) Attractive forces are dominant

3) CO_2 (g) ($p = 1$ atm, $T = 273$ K)

c) $PV = nRT$

4) real gas SO_2 with bigger size of its volume

d) $P(V - nb) = nRT$

A) 1 - a, 2 - c, 3 - d, 4 - b

B) 1 - b, 2 - d, 3 - c, 4 - a

C) 1 - a, 2 - d, 3 - b, 4 - c

D) 1 - a, 2 - c, 3 - b, 4 - d

129. column I

- 1) If force of attraction among the gaseous molecules are negligible
- 2) If the volume of the gas molecules are negligible
- 3) At STP
- 4) At low pressure and high temperature

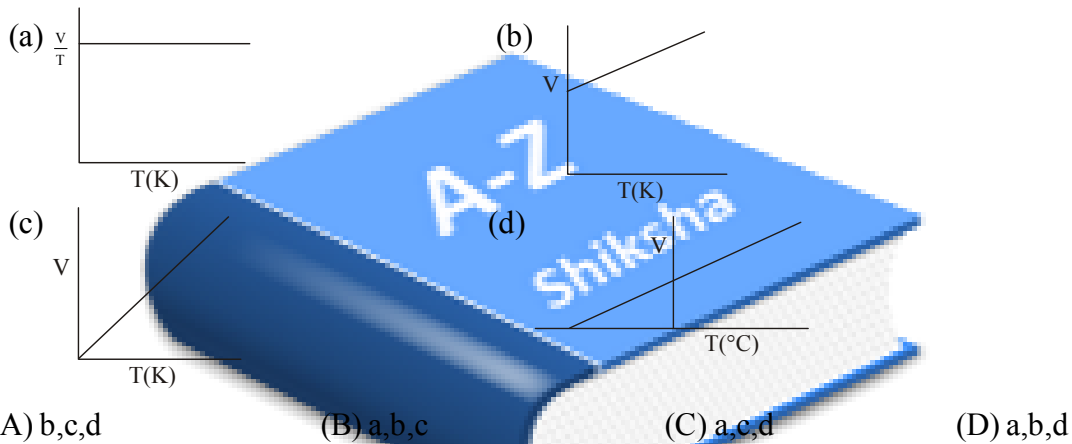
- A) 1) - c, 2) - b, 3) - a, 4) - d
 C) 1 - c, 2 - a, 3 - b, 4 - d

column II

- a) $\left(P + \frac{a}{v^2}\right)(v - b) = RT$
- b) $PV = RT - \frac{a}{v}$
- c) $PV = RT + PB$
- d) $PV = RT$.

- B) 1 - d, 2 - b, 3 - c, 4 - a
 D) 1 - b, 2 - a, 3 - d, 4 - c

130. for a fixed mass of a gas and constant pressure, which of the following graphs are related to $V \propto T$, the charles law ?



131. Which of the following statements is / are correct ?

- (a) At high pressure, all real gases are less compressible than ideal gas.
- (b) H_2 and He gases are more compressible than ideal gas for all values of pressure
- (c) compressibility factor $z = \left(\frac{PV}{nRT}\right)$ is less than 1 for all real gases at low pressure except H_2 and He
- (d) The compressibility factor z of real gases are quite independent of temperature therefore z is not effected with change in temperature.

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

Passage

A gas Undergoes dissociation as $M_{4(g)} \rightarrow 4M(g)$ in a closed rigid container having volume 22.4L at 273K If the initial moles of M_4 taken before dissociation is 1 then.

132. The total pressure (in atm) after 50% completion of the reaction assuming ideal behaviour is
 (a) 0.5 (b) 2.5 (c) 2.8 (d) 3.8

133. If the gases are not ideal at the beginning total pressure observed is less than 1 atm then

(a) $z = \frac{PV}{RT}$ of $M_4 > 1$ (b) $z = \frac{PV}{RT}$ of $M_4 < 1$

(c) $z = \frac{PV}{RT}$ of $M_4 = 1$ (d) $z = \frac{PV}{RT}$ of $M > 1$

134. If the gases are not ideal and after 100 % dissociation total pressure is greater than 4 atm, then

- (a) Compressing of M(q) is easier than an ideal gas
- (b) The compression of M(q) is difficult than an ideal gas
- (c) The compression of m(g) is the same as an ideal gas
- (d) A gas is non compressible

Answer Key

1	a	2	d	3	b	4	c	5	b	6	a	7	b
8	d	9	c	10	c	11	d	12	b	13	b	14	d
15	a	16	a	17	b	18	b	19	c	20	d	21	b
22	a	23	a	24	b	25	d	26	b	27	d	28	a
29	b	30	c	31	b	32	c	33	b	34	b	35	c
36	c	37	d	38	b	39	a	40	a	41	a	42	b
43	c	44	c	45	c	46	c	47	a	48	b	49	c
50	d	51	c	52	b	53	c	54	b	55	c	56	c
57	d	58	c	59	a	60	a	61	a	62	d	63	a
64	d	65	b	66	c	67	b	68	b	69	a	70	b
71	a	72	d	73	a	74	d	75	c	76	c	77	b
78	a	79	a	80	a	81	b	82	d	83	d	84	c
85	d	86	b	87	c	88	a	89	a	90	b	91	a
92	d	93	d	94	c	95	a	96	b	97	a	98	a
99	b	100	c	101	a	102	b	103	a	104	b	105	b
106	b	107	c	108	c	109	a	110	c	111	d	112	d
113	a	114	c	115	c	116	a	117	d	118	c	119	a
120	d	121	b	122	c	123	a	124	c	125	d	126	c
127	a	128	c	129	a	130	c	131	a	132	b	133	b
												134	b