
UNIT : 7 EQUILIBRIUM

Important Points

It is said that equilibrium is established when number of molecules moving from liquid state to vapour state and number of molecules moving from vapour state to liquid state are same and it is dynamic. Equilibrium is established in both physical and chemical types of reactions. At this point of time the rates of forward and reverse reactions become equal. Equilibrium constant K_c is expressed as the ratio of the multiplication of concentration of products to the multiplication of concentration of reactants; concentration of each can be expressed as power of their stoichiometric coefficient.

For reaction $aA + bB \rightleftharpoons cC + dD$

$$K_c = \frac{[C]^c [D]^d}{[A]^a [B]^b}$$

Equilibrium constant has constant value at constant temperature and at this stage macroscopic properties like concentration, pressure, etc become constant. For gaseous reaction K_p is taken instead of K_c and partial pressure of gaseous reactants and products are expressed instead of concentrations. The relation between K_p and K_c is expressed as $K_p = K_c(RT)^{\Delta n_g}$. In which direction reaction will occur (forward or reverse) can be expressed by reaction quotient Q_c which is equal to K_c at equilibrium. Le Chatelier's principle, mentions that if the equilibrium gets disturbed by change in factors like concentration, temperature, pressure etc., then equilibrium will move in the direction whereby the effect has been minimised or made negligible and the value of equilibrium constant will not change. This can be used in industries to know how equilibrium can be obtained by study of changes in factors like concentration, pressure, temperature, inert gas etc. In industries, we can change or control factors accordingly so that reaction shifts from reactants to products (left to right). If catalyst is used, only the rate of required reaction will increase but no change will occur in amounts of reactants or products because the effect on forward and reverse reactions will be the same and so equilibrium constant will not change.

The substances which allow the electric current to pass through their aqueous solutions are called electrolytes. Acid, base and salt are electrolytes because their aqueous solutions conduct electric current. The reason for the conduction of electric current in aqueous solution of electrolyte is the formation of ions due to dissociation or ionisation which conducts electric current. While the weak electrolytes are incompletely dissociated and so the equilibrium is established between its ions and undissociated molecules. This is called ionic equilibrium.

According to Arrhenius ionisation theory, acid is called a substance which gives hydrogen ion (H^+) and base is called a substance which gives hydroxyl ion (OH^-) on ionisation. According to Bronsted - Lowry theory, acid is defined as a proton donor and base is defined as proton acceptor. Each acid has its conjugate base and each base has its conjugate acid. Hence, it is known as conjugate acid - base or proton - transfer theory. Proton is transferred between acid and base.

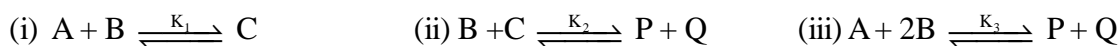
Bronsted - Lowry is more general than Arrhenius definition. According to Lewis' definition, acid means a substance which accepts a pair of electrons and base is a substance which donates a pair of electrons. This definition can be applied to organic chemistry, complex compounds chemistry in addition to acid-base. Hence, it is considered universally acceptable. Ionisation constant is also an equilibrium constant. The ionisation constants of weak acid (K_a) and weak base (K_b) can be determined. Concentration of acid can be expressed as $\text{pH} = -\log_{10}[\text{H}_3\text{O}^+]$. Hence, pH scale is determined for acid - base. Similarly, concentration of OH^- can be expressed as $\text{pOH} = -\log_{10}[\text{OH}^-]$, ionisation constant of water as $\text{p}K_w = -\log_{10}K_w$ $[\text{H}_3\text{O}^+]$ and $[\text{OH}^-]$ can be calculated by the use of relation $\text{p}K_w = \text{pH} + \text{pOH}$. If $\text{pH} < 7$ solution will be acidic, $\text{pH} > 7$ solution will be basic and $\text{pH} = 7$ solution will be neutral.

Different salts can be obtained by neutralisation of strong or weak acid and strong or weak base. In such salts, acidic, basic and neutral salts are included. When such salts react with water, hydration (hydrolysis) reaction occurs and solution obtained can be acidic, basic or neutral. This is also an equilibrium reaction and so corresponding equilibrium constant for it can be determined. Hydrolysis constant is expressed as K_h . pH or pOH can be calculated from the values of K_a and K_b and the value of K_h characteristic for the particular salt. Some solutions are such whose pH does not change by addition of small amount of acid or base or in case they are being diluted. Such solutions are called buffer solutions which can be acidic, basic or of neutral type. The control of pH is useful in the control of biological reactions in our body and chemical reactions in analytical chemistry, industries etc.

Sparingly soluble salts (whose solubility is less than 0.01M in water) dissolve in water depending on their solubility and equilibrium is established. Hence, equilibrium constant for this can be obtained which is known as solubility product constant or solubility product of the sparingly soluble salt. The study of effect of common ion, acid, etc. on the solubility of sparingly soluble salt can be carried out by application of Le Chatelier's principle. Generally, the solubility of sparingly soluble salt decreases due to effect of common ion. This is used in qualitative analysis. By mixing two solutions, whether precipitates will be obtained or not, can be predicted by comparing concentration product I_p with the solubility product K_{sp} . If $I_p > K_{sp}$ precipitation will occur and if $I_p < K_{sp}$ the precipitation will not occur and if $I_p = K_{sp}$, the precipitation will not occur but solution will remain in saturated state.

M.C.Q.

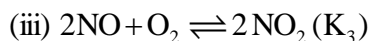
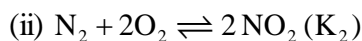
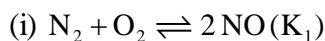
1. Three gaseous equilibria have values of equilibrium constants as k_1, k_2, k_3 resp.



What is the relation between k_1, k_2, k_3 . (?)

- (a) $K_3 = \frac{K_1}{K_2}$ (b) $K_3 = K_1 \times K_2$ (c) $K_1 = K_2 \times K_3$ (d) $K_1 \times K_2 \times K_3 = 1$

2. Three gaseous equilibria have value of equilibrium constants as K_1, K_2, K_3 respectively.



What is the relation between K_1, K_2 and K_3 (?)

- (a) $K_3 = K_1 \times K_2$ (b) $K_1 = K_2 \times K_3$ (c) $K_2 = K_1 \times K_3$ (d) $K = K_1 \times K_2 \times K_3$

3. The equilibrium constant for the reaction,

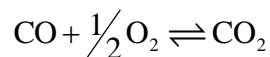


is 4.4×10^{-4} at 2000K temp.

In presence of a catalyst, equilibrium is attained ten times faster. Therefore the equilibrium constant, in presence of catalyst at 2000K is.....

- (a) 4.4×10^{-4} (b) 4.4×10^{-5} (c) 4.4×10^{-3} (d) difficult to compute

4. For the following reaction in gaseous phase



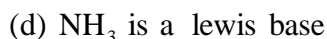
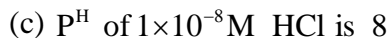
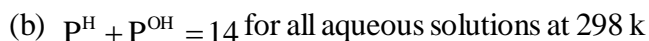
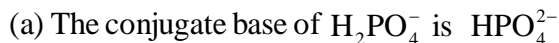
K_c/K_p is

- (a) $(RT)^{1/2}$ (b) $(RT)^{-1/2}$ (c) RT (d) $(RT)^{-1}$

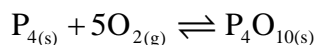
5. For the reaction equilibrium, $N_2O_{4(g)} \rightleftharpoons 2NO_{(g)}$ the concentration of N_2O_4 and NO_2 at equilibrium are 4.8×10^{-2} and $1.2 \times 10^{-2} \text{ mol L}^{-1}$ respectively. The value of K_c for the reaction is:

- (a) $3.3 \times 10^2 \text{ mol L}^{-1}$ (b) $3 \times 10^1 \text{ mol L}^{-1}$ (c) $3 \times 10^{-3} \text{ mol L}^{-1}$ (d) $3 \times 10^3 \text{ mol L}^{-1}$

6. Which one of the following statements is not true ?

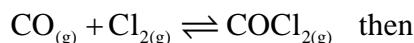


7. What is the equilibrium expression for the reaction.



(a) $K_c = \frac{[P_4O_{10}]}{[P_4][O_2]^5}$ (b) $K_c = \frac{1}{[O_2]^5}$ (c) $K_c = \frac{[P_4O_{10}]}{5[P_4][O_2]}$ (d) $K_c = [O_2]^5$

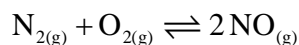
8. For the reaction



$\frac{K_p}{K_c}$ is equal to

(a) $\frac{1}{RT}$ (b) RT (c) \sqrt{RT} (d) 1.0

9. The equilibrium constant for the reaction



at temperature. 300 k is 4×10^{-4} The value of K_c for the reaction

$NO_{(g)} \rightleftharpoons \frac{1}{2}N_{2(g)} + \frac{1}{2}O_{2(g)}$ at the same temperature is:

(a) 2.5×10^2 (b) 4×10^{-4} (c) 0.02 (d) 50

10. Hydrogen ion concentration in $\frac{\text{mol}}{\text{L}}$ in a solution of $p^H = 5.4$ will be,

(a) 3.98×10^{-6} (b) 3.68×10^{-6} (c) 3.88×10^6 (d) 3.98×10^8

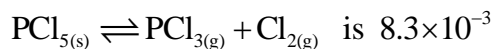
11. The equilibrium constants K_{p1} and K_{p2} for the reactions, $X \rightleftharpoons 2Y$ and $Z \rightleftharpoons P + Q$ respectively. are in the ratio of 1:9. If the degree of dissociation of x and z are equal then the ratio of total pressure at these equilibria is.

(a) 1:36 (b) 1:1 (c) 1:3 (d) 1:9

12. In a reaction, $CO_{(g)} + 2H_{2(g)} \rightleftharpoons CH_3OH_{(g)}$ $\Delta H^0 = -92 \text{ KJ mol}^{-1}$ concentration of hydrogen, carbon monoxide and methanol become constant at equilibrium. what will happen if an inert gas is added to the system.?

(a) reaction becomes fast (b) reaction becomes slow
(c) equilibrium state disturbs (d) equilibrium state remains undisturbed

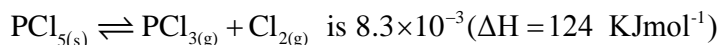
13. At 473 k, equilibrium constant K_c for the reaction



what is the value of K_c for the reverse reaction at the same temperature ?

(a) 8.3×10^{-3} (b) 120.48 (c) 16.6×10^{-3} (d) 4.15×10^{-3}

14. At 473 k, equilibrium constant K_c for a reaction,



What would be the effect on K_c if

(i) more PCl₅ is added

- (ii) the pressure is increased
 (iii) the temp is increased
 (a) K_c remains unchanged, unchanged, increase.
 (b) K_c increases, increases, decreases.
 (c) K_c remains unchanged, increase, unchanged.
 (d) K_c decreases, increases, unchanged.
15. The equilibrium constant for the reaction,

$$\text{N}_{2(g)} + \text{O}_{2(g)} \rightleftharpoons 2\text{NO}_{(g)}$$
 is 4×10^{-4} at 2000 k temperature. what is the value of K_c for the reaction

$$\frac{3}{2}\text{N}_{2(g)} + \frac{3}{2}\text{O}_{2(g)} \rightleftharpoons 3\text{NO}_{(g)}$$
- (a) 4×10^{-4} (b) 8×10^{-6} (c) 8×10^{-4} (d) 16×10^{-4}
16. For the reversible reaction

$$\text{N}_{2(g)} + 3\text{H}_{2(g)} \rightleftharpoons 2\text{NH}_{3(g)}$$
 at 500°C the value of K_p is 1.44×10^{-5} . what would be the value of K_c for the same reaction
- (a) $1.44 \times 10^{-5} / (0.082 \times 500)^{-2}$ (b) $1.44 \times 10^{-5} / (8.314 \times 773)^{-2}$
 (c) $1.44 \times 10^{-5} / (0.082 \times 773)^2$ (d) $1.44 \times 10^{-5} / (0.082 \times 773)^{-2}$
17. The following equilibria are given

$$\text{N}_2 + 3\text{H}_2 \rightleftharpoons 2\text{NH}_3 \text{ --- } K_1$$

$$\text{N}_2 + \text{O}_2 \rightleftharpoons 2\text{NO} \text{ --- } K_2$$

$$\text{H}_2 + \frac{1}{2}\text{O}_2 \rightleftharpoons \text{H}_2\text{O} \text{ --- } K_3$$

$$2\text{NH}_3 + \frac{5}{2}\text{O}_2 \rightleftharpoons 2\text{NO} + 3\text{H}_2\text{O}$$
 The equilibrium constant of the reaction in terms of k_1 , k_2 and k_3 is
- (a) $k_1 k_2 / k_3$ (b) $k_1 k_3^2 / k_2$ (c) $k_2 k_3^3 / k_1$ (d) $k_1 k_2 k_3$
18. The $\text{p}K_a$ of a weak acid HA is 4.80 The $\text{p}K_b$ of a weak base BOH is 4.78 The p^H of an aqueous solution of the corresponding salt BA will be
 (a) 9.58 (b) 4.79 (c) 7.01 (d) 9.22
19. The equilibrium constant for the reaction

$$\text{SO}_{3(g)} \rightleftharpoons \text{SO}_{2(g)} + \frac{1}{2}\text{O}_{2(g)}$$
 $K_c = 4.9 \times 10^{-2}$
 The value for the K_c of the reaction

$$2\text{SO}_{2(g)} + \text{O}_{2(g)} \rightleftharpoons 2\text{SO}_{3(g)}$$
 will be
 (a) 416 (b) 2.40×10^{-3} (c) 9.8×10^{-2} (d) 4.9×10^{-2}
20. p^H of 0.1 M solution of weak acid is 3. The value of ionisation constant K_a of acid is
 (a) 3×10^{-1} (b) 1×10^{-3} (c) 1×10^{-5} (d) 1×10^{-7}

21. A vessel contains CO_2 at 1000k temperature with a pressure 0.5 atm. some of CO_2 is converted in to CO on addition of graphite. If total pressure at equilibrium is 0.8 atm the value of K_p is:
 (a) 3 atm (b) 0.3 atm (c) 0.18 atm (d) 1.8 atm
22. Three reactions involving H_2PO_4^- are given below.
 (i) $\text{H}_3\text{PO}_4 + \text{H}_2\text{O} \rightleftharpoons \text{H}_3\text{O}^+ + \text{H}_2\text{PO}_4^-$
 (ii) $\text{H}_2\text{PO}_4^- + \text{H}_2\text{O} \rightleftharpoons \text{HPO}_4^{2-} + \text{H}_3\text{O}^+$
 (iii) $\text{H}_2\text{PO}_4^- + \text{OH}^- \rightleftharpoons \text{H}_3\text{PO}_4 + \text{O}^{2-}$
 In which of the above does H_2PO_4^- act as an acid.
 (a) (i) only (b) (ii) only (c) (i) and (ii) (d) (iii) only
23. For the reaction

$$2\text{NO}_{2(g)} \rightleftharpoons 2\text{NO}_{(g)} + \text{O}_{2(g)}$$

 $K_c = 1.8 \times 10^{-6}$ at 184°C $R = 0.0831 \text{ KJ/mol.K}$
 When K_p and K_c are compared at 184°C it is found that :
 (a) whether K_p is greater than less than or equal to K_c depends upon the total gas pressure
 (b) $K_p = K_c$
 (c) $K_p < K_c$
 (d) $K_p > K_c$
24. Water is a
 (a) Protophobic solvent (b) Protophilic solvent
 (c) Amphiprotic solvent (d) Aprotic acid
25. Ammonium ion is
 (a) Conjugate acid (b) Conjugate base
 (c) Neither an acid nor a base (d) both an acid and a base.
26. Species acting both as bronsted acid and a base is
 (a) HSO_4^- (b) Na_2CO_3 (c) NH_3 (d) OH^-
27. A solution of an acid has $\text{p}^{\text{H}} = 4.70$ find out the concentration of OH^- $\text{p}K_w = 14$
 (a) $5 \times 10^{-10} \text{ M}$ (b) $4 \times 10^{-10} \text{ M}$ (c) $2 \times 10^{-5} \text{ M}$ (d) $9 \times 10^{-4} \text{ M}$
28. The conjugate base of H_2PO_4^- is
 (a) PO_4^{3-} (b) HPO_4^- (c) H_3PO_4 (d) HPO_4^{2-}
29. What is the conjugate base of OH^- ?
 (a) O_2 (b) H_2O (c) O^- (d) O^{2-}
30. An example for lewis acid is
 (a) Ammonia (b) Aluminium chloride
 (c) Pyridine (d) Amines.
31. Which of the following molecule act as a lewis acid ?
 (a) $(\text{CH}_3)_2\text{O}$ (b) $(\text{CH}_3)_3\text{P}$ (c) $(\text{CH}_3)_3\text{N}$ (d) $(\text{CH}_3)_3\text{B}$

32. In a given system, water and ice are in equilibrium. If pressure is applied to the above system, then,
 (a) More ice is formed (b) Amount of ice and water will remain same
 (c) More ice is melted (d) Either (a) or (c)
33. In $2\text{HI} \rightleftharpoons \text{H}_2 + \text{I}_2$ $\Delta H > 0$ the forward reaction is affected by change in
 (a) Catalyst (b) Pressure (c) Volume (d) Temp
34. In which case K_p is less than K_c (?)
 (a) $\text{PCl}_{5(g)} \rightleftharpoons \text{PCl}_{3(g)} + \text{Cl}_{2(g)}$ (b) $\text{H}_{2(g)} + \text{Cl}_{2(g)} \rightleftharpoons 2\text{HCl}_{(g)}$
 (c) $2\text{SO}_2 + \text{O}_2 \rightleftharpoons 2\text{SO}_{3(g)}$ (d) all of these.
35. If K_1 and K_2 are respective equilibrium constants for two reaction,
 $\text{XeF}_{6(g)} + \text{H}_2\text{O}_{(g)} \rightleftharpoons \text{XeOF}_{4(g)} + 2\text{HF}_{(g)}$
 $\text{XeF}_{4(g)} + \text{XeF}_6 \rightleftharpoons \text{XeOF}_{4(g)} + \text{XeO}_3\text{F}_{2(g)}$
 the equilibrium constant for the reaction
 $\text{XeF}_{4(g)} + 2\text{HF}_{(g)} \rightleftharpoons \text{XeO}_3\text{F}_{2(g)} + \text{H}_2\text{O}_{(g)}$ will be
 (a) $K_1 - K_2$ (b) $K_2 - K_1$ (c) K_2 / K_1 (d) K_1 / K_2
36. For a homologous reaction,
 $4\text{NH}_3 + 5\text{O}_2 \rightleftharpoons 4\text{NO} + 6\text{H}_2\text{O}$
 the dimensions of equilibrium constant K_c is
 (a) conc.^{+10} (b) conc.^{+1} (c) conc.^{-1} (d) It is dimensionless
37. For a reversible reaction, if the concentration of the reactants are doubled, the equilibrium constant will be
 (a) The same (b) Halved (c) Doubled (d) One fourth
38. The molar solubility of a sparingly soluble salt AB_4 is 's' $\frac{\text{mol}}{\text{lit}}$. The corresponding solubility product K_{sp} is given in terms of K_{sp} by the relation
 (a) $S = \left(\frac{K_{sp}}{128} \right)^{1/4}$ (b) $S = (128 K_{sp})^{1/4}$ (c) $S = (256 K_{sp})^{1/5}$ (d) $S = (K_{sp} / 256)^{1/5}$
39. The solubility product of a salt having general formula MX_2 in water is 4×10^{-12} . The concentration of M^{2+} ions in an aqueous solution of the salt is:
 (a) $4.0 \times 10^{-10} \text{ M}$ (b) $1.6 \times 10^{-4} \text{ M}$ (c) $1.0 \times 10^{-4} \text{ M}$ (d) $2.0 \times 10^{-6} \text{ M}$
40. pH of 0.005 M calcium acetate (pK_a of $\text{CH}_3\text{COOH} = 4.74$) is
 (a) 7.04 (b) 9.37 (c) 9.26 (d) 8.37
41. One of the following equilibria is not affected by change in volume of the flask.
 (a) $\text{PCl}_{5(g)} \rightleftharpoons \text{PCl}_{3(g)} + \text{Cl}_{2(g)}$ (b) $\text{N}_{2(g)} + 3\text{H}_{2(g)} \rightleftharpoons 2\text{NH}_{3(g)}$
 (c) $\text{N}_{2(g)} + \text{O}_{2(g)} \rightleftharpoons 2\text{NO}_{(g)}$ (d) $\text{SO}_2\text{Cl}_{2(g)} \rightleftharpoons \text{SO}_{2(g)} + \text{Cl}_{2(g)}$

42. Equal volumes of two solutions of pH 3 and 4 are mixed. The pH of the resulting solution will be
 (a) 7 (b) 3.5 (c) 2.96 (d) 3.26
43. pH of 10^{-8} M solution of HCl in water is
 (a) 8 (b) -8 (c) between 7 and 8 (d) between 6 and 7
44. A certain buffer solution contains equal concentration of X^- and HX . K_a for HX is 10^{-8} . The pH of buffer is
 (a) 3 (b) 8 (c) 11 (d) 14
45. The solubility product of AgCl is 4×10^{-10} at 298 K. The solubility of AgCl in 0.04 M CaCl_2 will be
 (a) 2×10^{-5} M (b) 1×10^{-4} M (c) 5×10^{-9} M (d) 2.2×10^{-4} M
46. Calculate concentration of sodium acetate which should be added to 0.1 M solution of CH_3COOH ($\text{p}K_a = 4.5$) to give a solution of pH 5.5
 (a) 1.0 M (b) 0.1 M (c) 0.2 M (d) 10.0 M
47. Which of the following is a base according to lowry-bronsted concept ?
 (a) I^- (b) H_3O^+ (c) HCl (d) NH_4^+
48. According to lowry-bronsted concept which one of the following is considered as an acid ?
 (a) H_3O^+ (b) BF_3 (c) OH^- (d) Cl^-
49. The conjugate acid of NH_2^- is
 (a) NH_4^+ (b) NH_3 (c) N_2H_4 (d) NH_2OH
50. conjugate base of hydrazoic acid is
 (a) HN_3^- (b) N_2^- (c) N_3^- (d) N^{3-}
51. In which of the following reaction NH_3 acts as acid ?
 (a) $\text{NH}_3 + \text{HCl} \rightarrow \text{NH}_4\text{Cl}$ (b) $\text{NH}_3 + \text{H}^+ \rightarrow \text{NH}_4^+$
 (c) $\text{NH}_3 + \text{Na} \rightarrow \text{NaNH}_2 + \frac{1}{2} \text{H}_2$ (d) NH_3 cannot act as acid.
52. Consider the following reactions.
 (i) $\text{CO}_3^{2-} + \text{H}_2\text{O} \rightleftharpoons \text{HCO}_3^- + \text{OH}^-$
 (ii) $\text{CO}_2 + \text{H}_2\text{O} \rightleftharpoons \text{H}_2\text{CO}_3$
 (iii) $\text{NH}_3 + \text{H}_2\text{O} \rightleftharpoons \text{NH}_4\text{OH}$.
 (iv) $\text{HCl} + \text{H}_2\text{O} \rightleftharpoons \text{Cl}^- + \text{H}_3\text{O}^+$
 Which of the pairs of reaction proves that water is amphoteric in character ?
 (a) (i) and (ii) (b) (ii) and (iii) (c) (iii) and (iv) (d) (i) and (iii)
53. One of the following is a bronsted acid but not a bronsted base :
 (a) H_2S (b) H_2O (c) HCO_3^- (d) NH_3

54. The conjugate base in the following reaction
 $\text{H}_2\text{SO}_4 + \text{H}_2\text{O} \rightleftharpoons \text{H}_3\text{O}^+ + \text{HSO}_4^-$ are
 (a) H_2O , H_3O^+ (b) HSO_4^- , H_2O (c) H_3O^+ , H_2SO_4 (d) H_2SO_4 , HSO_4^-
55. With increase in temperature, ionic product of water
 (a) Decreases (b) Increases
 (c) Remains same (d) May increase or decrease.
56. EDTA is a/an
 (a) Arrhenius acid (b) Bronsted base.
 (c) Lewis base (d) All of above
57. The units of ionic product of water (K_w) are :
 (a) $\text{mol}^{-1} \text{L}^{-1}$ (b) $\text{mol}^{-2} \text{L}^{-2}$ (c) $\text{mol}^{-2} \text{L}^{-1}$ (d) $\text{mol}^2 \text{L}^{-2}$
58. Which of the following is the weakest?
 (a) $\text{C}_6\text{H}_5\text{NH}_2 : K_b = 3.8 \times 10^{-10}$ (b) $\text{NH}_4\text{OH} : K_b = 1.6 \times 10^{-5}$
 (c) $\text{C}_2\text{H}_5\text{NH}_2 : K_b = 5.6 \times 10^{-4}$ (d) $\text{C}_9\text{H}_7\text{N} : K_b = 6.3 \times 10^{-10}$
59. On adding ammonia to water,
 (a) Ionic product will increase (b) Ionic product will decrease
 (c) $[\text{H}_3\text{O}^+]$ will increase (d) $[\text{H}_3\text{O}^+]$ will decrease
60. According to lowry and bronsted system, the chloride ion (Cl^-) in aqueous solution is a
 (a) Weak base (b) Strong base
 (c) Weak acid (d) Strong acid
61. The p^H of a buffer containing equal molar concentration of a weak base and its chlorides is (K_b for weak base = 2×10^{-5}) ($\log 2 = 0.3010$)
 (a) 5 (b) 9 (c) 4.7 (d) 9.3
62. Solution of 0.1 N NH_4OH and 0.1 N NH_4Cl has p^H 9.25. Then P_{K_b} is
 (a) 9.25 (b) 4.75 (c) 3.75 (d) 8.25
63. The solubility of product barium sulphate is 1.5×10^{-9} at 18°C . Its solubility in water at 18°C is
 (a) $1.5 \times 10^{-9} \text{ mol L}^{-1}$ (b) $1.5 \times 10^{-5} \text{ mol L}^{-1}$
 (c) $3.9 \times 10^{-9} \text{ mol L}^{-1}$ (d) $3.9 \times 10^{-5} \text{ mol L}^{-1}$
64. The least soluble compound (salt) of the following is
 (a) $\text{ZnS} (K_{sp} = 1.2 \times 10^{-23})$ (b) $\text{OH}^- > \text{Cl}^- > \text{CH}_3\text{COO}^-$
 (c) $\text{CsCl} (K_{sp} = 1 \times 10^{-12})$ (d) $\text{PbCl}_2 (K_{sp} = 1.7 \times 10^{-5})$
65. What is the value of p^H of 0.01 M glycine solution? For glycine $K_{a_1} = 4.5 \times 10^{-3}$ and $K_{a_2} = 1.7 \times 10^{-10}$ at 298k.
 (a) 3.0 (b) 10.0 (c) 6.1 (d) 7.06

66. Solid $\text{Ba}(\text{NO}_3)_2$ is gradually dissolved in 1.0×10^{-4} M Na_2CO_3 solution. At what concentration of will precipitate ?
 K_{sp} of $\text{BaCO}_3 = 5.1 \times 10^{-9}$
 (a) 4.1×10^{-5} M (b) 5.1×10^{-5} M (c) 8.1×10^{-5} M (d) 8.1×10^{-7} M
67. What is the $[\text{OH}^-]$ in the final solution prepared by mixing of 20.0 ml of 0.05 M HCl with 30.0 ml of 0.1 M $\text{Ba}(\text{OH})_2$ (?)
 (a) 0.4 M (b) 0.05 M (c) 0.12 M (d) 0.1 M
68. The ionisation constant of NH_4OH is 1.77×10^{-5} at 298 K. Hydrolysis constant of it is
 (a) 6.5×10^{-12} (b) 5.65×10^{-13} (c) 5.65×10^{-12} (d) 5.65×10^{-10}
69. The dissociation constant of a substituted benzoic acid at 25°C is 1.0×10^{-4} . The p^{H} of 0.01 M solution of its sodium salt is
 (a) 0 (b) 1 (c) 7 (d) 8
70. Number of H^+ ions present in 500 ml of lemon juice of $\text{p}^{\text{H}} = 3$ is
 (a) 1.506×10^{22} (b) 3.012×10^{20} (c) 3.102×10^{22} (d) 1.506×10^{20}
71. Equimolar solution of the following were prepared in water separately. Which one of the solutions will record the highest p^{H} (?)
 (a) SrCl_2 (b) BaCl_2 (c) MgCl_2 (d) CaCl_2
72. Solubility products constants (K_{sp}) of the salt types MX , MX_2 and M_3X at temp T. are 4×10^{-8} , 3.2×10^{-14} and 2.7×10^{-15} respectively. Solubility of the salts at temp. T are in the order,
 (a) $\text{MX} > \text{M}_3\text{X} > \text{MX}_2$ (b) $\text{MX}_2 > \text{M}_3\text{X} > \text{MX}$
 (c) $\text{M}_3\text{X} > \text{MX}_2 > \text{MX}$ (d) $\text{MX} > \text{MX}_2 > \text{M}_3\text{X}$
73. When H^+ ion concentration of a solution increases
 (a) p^{H} increases (b) p^{H} decreases (c) no change in p^{H} (d) p^{OH} decreases
74. At 25°C temp. the value of $\text{p}K_b$ for NH_3 in aqueous solution is 4.7. what is the value of p^{H} of 0.1 M aqueous solution of NH_4Cl with 0.1 M NH_3 (?)
 (a) 8.3 (b) 9 (c) 9.5 (d) 10
75. The aqueous solution of HCOO Na , $\text{C}_6\text{H}_5\text{NH}_3\text{Cl}$, and KCN are respectively
 (a) Acidic, acidic, basic (b) Acidic, basic, neutral
 (c) Basic, acidic, basic (d) Basic, neutral, basic
76. K_{sp} of AgIO_3 is 1×10^{-8} at a given temperature what is the mass of AgIO_3 in 100 ml of its saturated solution ?
 (a) 1.0×10^{-4} gm (b) 28.3×10^{-2} gm (c) 2.83×10^{-3} gm (d) 1.0×10^{-7} gm

77. PH of a solution containing 50 mg of sodium hydroxide in 10 dm³ of the solution is
 (a) 9 (b) 3.9031 (c) 10.0969 (d) 10
78. Which one of the following has the lowest p^H value ?
 (a) 0.1 M HCl (b) 0.1 M KOH (c) 0.01 M HCl (d) 0.01 M KOH
79. Equal volumes of three basic solutions of 11,12 and 13 are mixed in a vessel. what will be the H⁺ ion concentration in the mixture ?
 (a) $1.11 \times 10^{-11} \text{ M}$ (b) $3.7 \times 10^{-12} \text{ M}$ (c) $3.7 \times 10^{-11} \text{ M}$ (d) $1.11 \times 10^{-12} \text{ M}$
80. **Column I** (Buffer Solution)
 (A) 0.1M CH₃COOH + 0.01M CH₃COONa
 (B) 0.01M CH₃COOH + 0.1M CH₃COONa
 (C) 0.1M CH₃COOH + 0.1M CH₃COONa
 (D) 0.1M CH₃COONH₄
 (P^{ka} Of CH₃COOH = P^{kb} of NH₄OH = 4.8)
 (a) A-r, B-q, C-s, D-p
 (b) A-q, B-p, C-s, D-r
 (c) A-q, B-p, C-r, D-s
 (d) A-r, B-q, C-s, D-p
- Column II**
 p^H
 (p) 3.8
 (q) 5.8
 (v) 7.0
 (s) 4.8
81. P^H of a soda water bottle is
 (a) > 7 (b) = 7
 (c) < 7 (d) unpredictable.
82. Statement : 1 P^H of 10⁻⁸ HCl solution is not equal to 8
 Statement : 2 HCl does not dissociate properly in very dilute solution.
 (a) Statement - 1 is true.
 Statement - 2 is true.
 Statement - 2 is a correct explanation for statement - 1
 (b) Statement - 1 is true.
 Statement - 2 is true.
 Statement - 2 is not a correct explanation of statement - 1
 (c) Statement - 1 is true.
 Statement - 2 is false.
 (d) Statement - 1 is false.
 Statement - 2 is true.
83. For preparing a buffer solution of P^H 6 by mixing sodium acetate and acetic acid, the ratio of concentration of salt and acid should be, (K_a = 10⁻⁵)
 (a) 1:10 (b) 10:1
 (c) 100:1 (d) 1:100
84. The K_{sp} of CuS, Ag₂S and HgS are 10⁻³², 4 × 10⁻⁴⁵ and 10⁻⁵⁴ respectively. The solubility of these sulphides are in order of
 (a) Ag₂S > HgS > CuS (b) Ag₂S > CuS > HgS
 (c) HgS > Ag₂S > CuS (d) CuS > Ag₂S > HgS

85. The p^H of neutral water is 6.8. Then the temperature of H_2O
- (a) is $25^\circ C$ (b) is more than $25^\circ C$
 (c) is less than $25^\circ C$ (d) can not be predicted.
86. On adding 0.1 M solution each of Ag^+ , Ba^{2+} and Ca^{2+} ions. in a Na_2SO_4 solution. species first precipitated is
 (K_{SP} of $BaSO_4 = 10^{-11}$, K_{SP} of $CaSO_4 = 10^{-6}$, K_{SP} of $Ag_2SO_4 = 10^{-5}$)
- (a) $BaSO_4$ (b) $CaSO_4$ (c) Ag_2SO_4 (d) all of these
87. The solubility of A_2B_3 is $x \text{ mol L}^{-1}$. Its solubility product is
- (a) $6x^5$ (b) $64x^5$ (c) $36x^5$ (d) $108x^5$
88. How much volume of 0.1 M CH_3COOH should be added to 50ml of 0.2 M CH_3COONa If we want to prepare a buffer Solution of p^H 4.91. given pK_a for acetic acid is 4.76
- (a) 80.92 ml (b) 100 ml (c) 70.92 ml (d) 60.92 ml
89. The ionization constant of formic acid is 7.8×10^{-4} . Calculate ratio of sodium formate & formic acid in a buffer of p^H 4.25
- (a) 9.63 (b) 3.24 (c) 6.48 (d) 3.97
90. The ionization constants of HF is 6.8×10^{-4} . Calculate ionization constant of corresponding conjugate base.
- (a) 1.9×10^{-10} (b) 1.7×10^{-10} (c) 1.5×10^{-11} (d) 2.9×10^{-11}
91. The ionization constant of formic acid is 1.8×10^{-4} around what p^H will its mixture with sodium formate give buffer solution of highest capacity
- (a) 3.74 (b) 7.48 (c) 4.37 (d) 3.96
92. What is PH of our blood ? why does it remains constant inspite the variety of the foods and spices we eat ?
- (a) of blood is 5.4. It remains constant because.it is acidic.
 (b) of blood is 7.4. It remains constant because.it is buffer.
 (c) of blood is 10.8.It remains constant because.it is basic.
 (d) of blood is 7.0. It remains constant because it is neutial.
93. The precipitate of CaF_2 ($K_{SP} = 1.7 \times 10^{-10}$) is obtained when equal volumes of the following are mixed.
- (a) $10^{-4} M Ca^{2+} + 10^{-4} M F^-$ (b) $10^{-2} M Ca^{2+} + 10^{-3} M F^-$
 (c) $10^{-5} M Ca^{2+} + 10^{-3} M F^-$ (d) $10^{-3} M Ca^{2+} + 10^{-5} M F^-$
94. A certain buffer solution contains equal concentrations of X^- and HX . The K_a for HX is 10^{-8} The p^H of buffer is
- (a) 8 (b) 3 (c) 7 (d) 4

95. The correct order of increasing $[H_3O^+]$ in the following aqueous solution is.
- (a) $0.1 \text{ M } H_2S < 0.1 \text{ M } H_2SO_4 < 0.1 \text{ M } NaCl < 0.1 \text{ M } NaNO_2$
 (b) $0.1 \text{ M } H_2SO_4 < 0.1 \text{ M } NaCl < 0.1 \text{ M } NaNO_2 < 0.1 \text{ M } H_2S$
 (c) $0.1 \text{ M } NaNO_2 < 0.1 \text{ M } NaCl < 0.1 \text{ M } H_2S < 0.1 \text{ M } H_2SO_4$
 (d) $0.1 \text{ M } NaNO_2 < 0.1 \text{ M } H_2S < 0.1 \text{ M } H_2SO_4 < 0.1 \text{ M } NaCl$
96. What is the % hydrolysis of NaCN in N/80 solution when dissociation constant for HCN is 1.3×10^{-9} & $K_w = 1 \times 10^{-14}$
- (a) 2.48 (b) 8.2 (c) 5.26 (d) 9.6
97. The K_{sp} of AgCl is 4.0×10^{-10} at 298 k. solubility of AgCl is 0.04 M CaCl₂ will be
- (a) $2 \times 10^{-5} \text{ M}$ (b) $1 \times 10^{-4} \text{ M}$ (c) $5 \times 10^{-9} \text{ M}$ (d) $2.2 \times 10^{-4} \text{ M}$
98. How much sodium acetate should be added to 0.1 M solution of CH₃COOH to give a solution of p^H 5.5 (pKa of CH₃COOH = 4.5)
- (a) 0.1 M (b) 1.0 M (c) 0.2 M (d) 10.0 M
99. The p^H of solution obtained by mixing 50ml 0.4 N HCl & 50ml 0.2 N NaOH is
- (a) $-\log 2$ (b) 1.0 (c) $-\log 0.2$ (d) 2.0
100. Ionisation constant of CH₃COOH is 1.7×10^{-5} and concentration of H⁺ ions is 3.4×10^{-4} The initial concentration of CH₃COOH molecules is
- (a) 3.4×10^{-4} (b) 3.4×10^{-3} (c) 6.8×10^{-3} (d) 1.7×10^{-3}
101. In the reversible reaction $A + B \rightleftharpoons C + D$, the concentration of each C and D at equilibrium was 0.8 mol/litre, then the equilibrium constant K_c will be.
- (a) 6.4 (b) 0.64 (c) 0.16 (d) 16.0
102. 4 moles of A are mixed with 4 moles of B. At equilibrium for the reaction $A + B \rightleftharpoons C + D$ 2 moles of C and D are formed. The equilibrium constant for reaction will be
- (a) $\frac{1}{4}$ (b) 4 (c) $\frac{1}{2}$ (d) 1
103. A reversible chemical reaction having two reactants in equilibrium. If the concentration of the reactants are doubled, then equilibrium constant will
- (a) become double (b) become half
 (c) become 4 times (d) remains same
104. Two moles of PCl₅ are heated in a closed vessel of 2L capacity. At equilibrium, 40% of PCl₅ is dissociated into PCl₃ & Cl₂. The value of equilibrium constant is,
- (a) 0.266 (b) 0.53 (c) 2.66 (d) 5.3
105. The dissociation constant for acetic acid and HCN at 25°C are 1.5×10^{-5} and 4.5×10^{-10} respectively. the equilibrium constant for reaction $CN^- + CH_3COOH \rightleftharpoons HCN + CH_3COO^-$
- (a) 3×10^5 (b) 3×10^{-5} (c) 3×10^{-4} (d) 3×10^4

106. $A + B \rightleftharpoons C + D$ if finally the concentration of A and B are both equal but at equilibrium concentration of Δ will be twice of that of A. Then what will be equilibrium constant of the reaction.

- (a) $\frac{4}{9}$ (b) $\frac{9}{4}$ (c) $\frac{1}{9}$ (d) 4

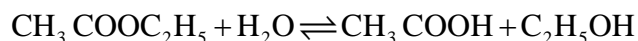
107. If in the reaction $N_2O_4 \rightleftharpoons 2NO_2$, α is that part of N_2O_4 will dissociate, then the number of moles at equilibrium will be,

- (a) 3 (b) $(1 + \alpha)$ (c) $(1 - \alpha)$ (d) 1

108. 4.5 moles each of hydrogen and iodine heated in a sealed ten litre vessel. At equilibrium, 3 moles of HI were found. The equilibrium constant for $H_{2(g)} + I_{2(g)} \rightleftharpoons 2HI(g)$ is

- (a) 1 (b) 5 (c) 10 (d) 0.33

109. The rate constant for forward and backward reaction of hydrolysis of ester are 1.1×10^{-2} & 1.5×10^{-3} per minute respectively. Equilibrium constant for reaction is,



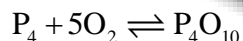
- (a) 4.33 (b) 5.33 (c) 6.33 (d) 7.33

110. Two moles of NH_3 , when put in to a previously evacuated vessel (1 Litre), partially dissociate in to

N_2 and H_2 . If at equilibrium one mole of NH_3 is present, the equilibrium constant is,

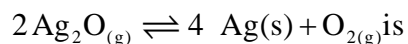
- (a) $\frac{3}{4} \text{ mol}^2 \text{ Litre}^{-2}$ (b) $\frac{27}{64} \text{ mole}^2 \text{ Litre}^{-2}$
 (c) $\frac{27}{32} \text{ mole}^2 \text{ Litre}^{-2}$ (d) $\frac{27}{16} \text{ mol}^2 \text{ Litre}^{-2}$

111. What is equilibrium expression for the reaction



- (a) $K_c = [O_2]^5$ (b) $K_c = \frac{[P_4O_{10}]}{5[A][O_2]}$
 (c) $K_c = \frac{[P_4O_{10}]}{[P_4][O_2]^5}$ (d) $K_c = 1/[O_2]^5$

112. Partial pressure of O_2 in

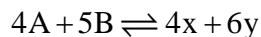


- (a) kp (b) \sqrt{kp} (c) $3\sqrt{kp}$ (d) $2kp$

113. For reaction $H_{2(g)} + CO_{2(g)} \rightleftharpoons CO_{(g)} + H_2O_{(g)}$, If the initial concentration of $[H_2] = [CO_2]$ and x moles / litre of hydrogen is consumed at equilibrium, the correct expression of K_p is

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

114. Consider the imaginary equilibrium



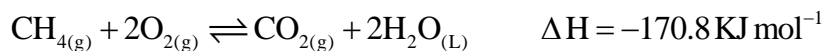
The equilibrium constant K_c has unit

- (a) $\text{mole}^2 \text{ Litre}^{-2}$ (b) Litre mole^{-1} (c) mole litre^{-1} (d) $\text{Litre}^2 \text{ mole}^{-2}$

115. For reaction $\text{CO}_{(g)} + \frac{1}{2}\text{O}_{2(g)} \rightleftharpoons \text{CO}_{2(g)}$ $\frac{K_p}{K_c}$ is equivalent to

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

116. For the reaction

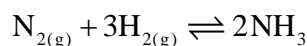


Which of following statement is not true

- (a) Adding of $\text{CH}_{4(g)}$ on $\text{O}_{2(g)}$ at equilibrium will cause a shift to the right
(b) Thee reaction is exothermic
(c) At equilibrium, concentrations of $\text{CO}_{2(g)}$ and $\text{H}_2\text{O}_{(L)}$ are not equal.

(d) Equilibrium constant for the reaction is given by $K_p = \frac{[\text{CO}_2]}{[\text{CH}_4][\text{O}_2]}$

117. The reaction Quetient (Q) for the reaction



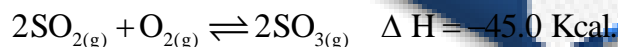
is given by $Q = \frac{[\text{NH}_3]^2}{[\text{N}_2][\text{H}_2]^3}$ The reaction will proceed from right to left is:

- (a) $Q = 0$ (b) $Q = K_c$ (c) $Q < K_c$ (d) $Q > K_c$

118. If concentration of reactants is increased by 'x' then k become

- (a) $\ln(k/x)$ (b) k/x (c) $k+x$ (d) k

119. Which of following is not favourable for forming SO_3 formation



- (a) High pressure (b) Decreasing SO_3 concentration
(c) High temperature (d) Increasing reactants concentration

120. The most important buffer in blood consists of

- (a) HCl and Cl^- (b) H_2CO_3 and Cl^- (c) H_2CO_3 and HCO_3^- (d) HCl and HCO_3^-

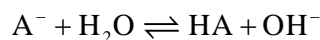
121. Given that dissociation constant for H_2O is $K_w = 1 \times 10^{-14}$ moles² / Litre² What is p^H of 0.001 M NaOH

- (a) 10^{-11} (b) 10^{-3} (c) 11 (d) 3

122. Select the pK_a value of strongest acid from following

- (a) 1.0 (b) 3.0 (c) 2.0 (d) 4.5

123. The degre of hydrolysis equilibrium

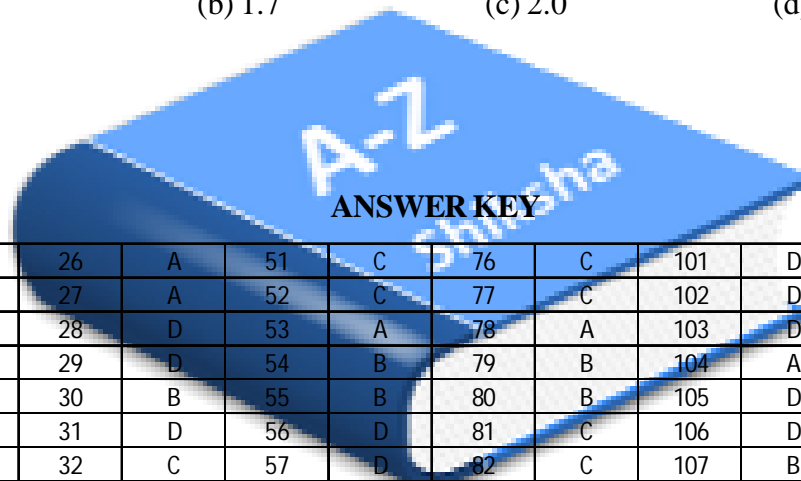


at salt concentration of 0.001 M is ($K_a = 1 \times 10^{-5}$)

- (a) 1×10^{-3} (b) 1×10^{-4} (c) 6.75×10^{-4} (d) 5.38×10^{-2}

124. If pK_b for fluoride ion at 25°C is 10.83, the ionisation constant of hydrofluoric acid in water at this temperature is
 (a) 1.74×10^{-3} (b) 3.52×10^{-3} (c) 6.75×10^{-4} (d) 5.38×10^{-2}
125. Henderson's equation is $p^H = pka + \log \frac{[\text{Salt}]}{[\text{Acid}]}$ If acid gets half neutralised the value of p^H will be [$pka=4.30$]
 (a) 4.3 (b) 2.15 (c) 8.60 (d) 7
126. The p^H of a 0.01 M solution of acetic acid having degree of dissociation 1.25% is
 (a) 5.623 (b) 2.903 (c) 3.723 (d) 4.503
127. By adding 20 ml 0.1 N HCl to 20 ml 0.1 N KOH the p^H of obtained solution will be :
 (a) 0 (b) 7 (c) 2 (d) 9
128. If the K_b value in the hydrolysis reaction $B^+ + H_2O \rightleftharpoons BOH + H^+$ is 1.0×10^{-6} then hydrolysis constant of salt would be
 (a) 1.0×10^{-6} (b) 1.0×10^{-7} (c) 1.0×10^{-8} (d) 1.0×10^{-9}
129. For a sparingly soluble salt $A_p B_q$ relationship of its solubility product (K_{sp}) with its solubility (s) is.
 (a) $K_{sp} = S^{p+q} P^p Q^q$ (b) $K_{sp} = S^{p+q} P^q Q^p$ (c) $K_{sp} = S^{pq} P^p Q^q$ (d) $K_{sp} = S^{pq} (pq)^{p+q}$
130. How many grams CaC_2O_4 (mw = 128) on dissolving in distilled water will give saturated solution [$K_{sp} (\text{CaC}_2\text{O}_4) = 2.5 \times 10^{-9} \text{ mol}^2 \text{ l}^{-2}$]
 (a) 0.0064 gm (b) 0.1280 gm (c) 0.0128 gm (d) 1.2800 gm
131. If the concentration of CrO_4^{2-} ion in a saturated solution of silver chromate is 2×10^{-4} solubility product of silver chromate will be
 (a) 4×10^{-8} (b) 8×10^{-12} (c) 12×10^{-12} (d) 32×10^{-12}
132. According to bronsted-lowry concept. correct order of relative strength of bases follows the order
 (a) $\text{Cl}^- > \text{CH}_3\text{COO}^- > \text{OH}^-$ (b) $\text{Cl}^- > \text{OH}^- > \text{CH}_3\text{COO}^-$
 (c) $\text{OH}^- > \text{CH}_3\text{COO}^- > \text{Cl}^-$ (d) $\text{OH}^- > \text{Cl}^- > \text{CH}_3\text{COO}^-$
133. $\text{HSO}_4^- + \text{OH}^- \rightarrow \text{SO}_4^{2-} + \text{H}_2\text{O}$ Which is correct about conjugate acid base pair ?
 (a) HSO_4^- is Conjugate acid of base SO_4^{2-}
 (b) HSO_4^- is Conjugate base of acid SO_4^{2-}
 (c) SO_4^{2-} is Conjugate base of acid HSO_4^-
 (d) None of these
134. Which of following base is weakest
 (a) $\text{NH}_4\text{OH} : K_b = 1.6 \times 10^{-6}$ (b) $\text{C}_6\text{H}_5\text{NH}_2 : K_b = 3.8 \times 10^{-10}$
 (c) $\text{C}_2\text{H}_5\text{NH}_2 : K_b = 5.6 \times 10^{-4}$ (d) $\text{C}_2\text{H}_7\text{N} : K_b = 6.3 \times 10^{-10}$

135. HClO is a weak acid. concentration of H^+ ion in 0.1 M solution of HClO ($K_a = 5 \times 10^{-8}$) will be
 (a) 7.07×10^{-5} M (b) 5×10^{-9} M (c) 5×10^{-7} M (d) 7×10^{-4} M
136. Upto what p^H must a solution containing a precipitate of $(Cr(OH)_3)$ be adjusted so that all precipitate dissolves
 (a) upto 4.4 (b) upto 4.1 (c) upto 4.2 (d) upto 4.0
137. NH_4Cl is acidic because
 (a) On hydrolysis NH_4Cl give weak base NH_4OH and strong acid HCl
 (b) Nitrogen donates a pair of e^-
 (c) It is a salt of weak acid and strong base
 (d) On hydrolysis NH_4Cl gives strong base and weak acid
138. 100 ml of 0.04 N HCl aqueous solution is mixed with 100 ml of 0.02 N NaOH solution. The p^H of resulting solution is
 (a) 1.0 (b) 1.7 (c) 2.0 (d) 2.3



1	B	26	A	51	C	76	C	101	D	126	B
2	C	27	A	52	C	77	C	102	D	127	B
3	A	28	D	53	A	78	A	103	D	128	C
4	A	29	D	54	B	79	B	104	A	129	A
5	C	30	B	55	B	80	B	105	D	130	A
6	C	31	D	56	D	81	C	106	D	131	D
7	B	32	C	57	D	82	C	107	B	132	C
8	A	33	D	58	A	83	B	108	A	133	C
9	D	34	C	59	D	84	B	109	D	134	B
10	A	35	C	60	A	85	B	110	B	135	A
11	A	36	B	61	D	86	A	111	D	136	D
12	D	37	A	62	B	87	D	112	A	137	A
13	B	38	D	63	D	88	C	113	A	138	C
14	A	39	C	64	B	89	B	114	C		
15	B	40	D	65	D	90	C	115	C		
16	D	41	C	66	B	91	A	116	D		
17	C	42	D	67	D	92	B	117	D		
18	C	43	D	68	D	93	B	118	D		
19	A	44	B	69	D	94	A	119	C		
20	C	45	C	70	B	95	C	120	C		
21	B	46	A	71	B	96	A	121	C		
22	B	47	A	72	A	97	C	122	A		
23	D	48	A	73	B	98	B	123	A		
24	C	49	B	74	A	99	B	124	C		
25	A	50	C	75	C	100	C	125	A		

Hint : Chemical equilibrium .

Hint :

1. Addition of (1) and (2) gives (3) then

$$K_1 \times K_2 = \frac{[C]}{[A][B]} \times \frac{[P][Q]}{[B][C]}$$
$$= \frac{[P][Q]}{[A][B]^2} = K_3$$

$$\therefore K_3 = K_1 \times K_2$$

when the addition of equilibria leads to another equilibria then the product of their equilibria constants gives the equilibria constant of the resultant equilibrium.

3. The value of equilibrium constant does not change in presence of catalyst.
4. Formula :

$$K_p = K_c(RT)^{\Delta n_{(g)}}$$
$$\Delta n_{(g)} = n_p - n_r$$

6. H_2O is also present in 1×10^{-8} M HCl solution. So due to self ionisation of H_2O ,



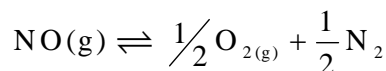
$$1 \times 10^{-7} \text{ M at } 298 \text{ K}$$

so conc. of H^+ ion in solution increase due to self ionisation of H_2O Hence P^H of HCl solution decreases and its value is less than 7.

9. $N_{2(g)} + O_{2(g)} \rightleftharpoons 2NO_{(g)}$

$$K_p = \frac{P_{NO}^2}{P_{N_2} \times P_{O_2}}$$

For reaction,



$$K_p' = \frac{P_{O_2}^{1/2} \times P_{N_2}^{1/2}}{P_{NO}} = \frac{1}{(K_p)^{1/2}} = \frac{1}{(4 \times 10^{-4})^{1/2}} = 50$$

- 10.

$$P^H = 5.4$$

$$P^H = -\log[H^+]$$

$$5.4 = -\log[H^+]$$

$$\bar{6}.6 = 3.981 \times 10^{-6} = [H^+]$$

11 For a reaction $X \rightleftharpoons 2Y$

initial mol 1 0
 at equilibrium mol 1-x 2x
 Total moles = 1-x+2x = 1+x

$$\therefore K_{p1} = \frac{P_Y^2}{P_x} = \frac{\left(\frac{2x}{1+x}P_1\right)^2}{\left(\frac{1-x}{1+x}\right)P_1} = \frac{4x^2 \cdot P_1}{(1+x)(1-x)} \text{-----(1)}$$

For a reaction $Z \rightleftharpoons P + Q$

Initial 1 0 0
 at eqm. 1-x x x
 Total moles = 1+x

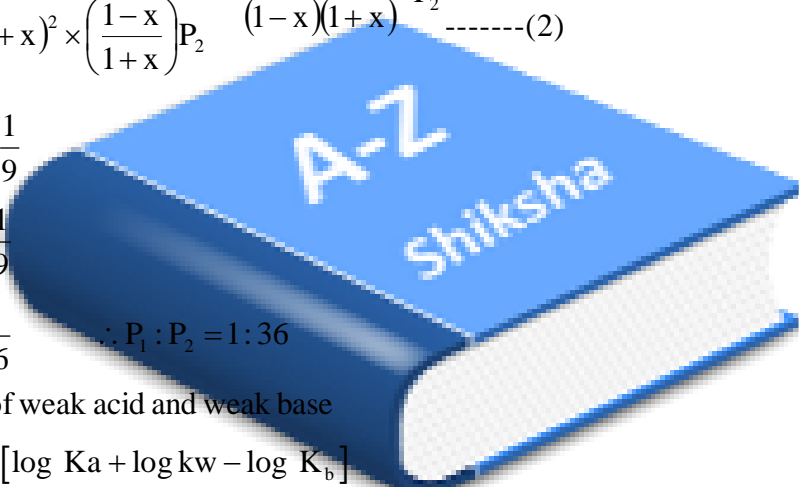
$$K_{p2} = \frac{x \cdot P_2 \times x \cdot P_2}{(1+x)^2 \times \left(\frac{1-x}{1+x}\right)P_2} = \frac{x^2}{(1-x)(1+x)} \cdot P_2 \text{-----(2)}$$

$$\therefore \frac{K_{p1}}{K_{p2}} = \frac{1}{9}$$

$$\therefore \frac{4P_1}{P_2} = \frac{1}{9}$$

$$\therefore \frac{P_1}{P_2} = \frac{1}{36}$$

$\therefore P_1 : P_2 = 1 : 36$



18. For salt of weak acid and weak base

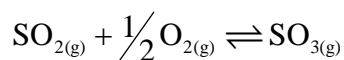
$$p^H = -\frac{1}{2}[\log K_a + \log k_w - \log K_b]$$

$$= +\frac{1}{2} pK_a + \frac{1}{2} pk_w - \frac{1}{2} pk_b$$

$$= \frac{1}{2} \times 4.8 + \frac{1}{2} \times 14 - \frac{1}{2} \times 4.78$$

$$= 7.01$$

19. Equilibrium constant for the reaction



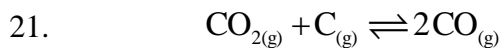
$$K_c = \frac{1}{4.9 \times 10^{-2}}$$

and for reaction $2SO_{2(g)} + O_{2(g)} \rightleftharpoons 2SO_{3(g)}$

$$K_c = \left(\frac{1}{4.9 \times 10^{-2}}\right)^2 = 416.49$$

20. $P^H = 3 \therefore [H_3O^+] = 1 \times 10^{-3}$

$$K_a = \frac{[H_3O^+]^2}{C} = \frac{(1 \times 10^{-3})^2}{0.1} = 1 \times 10^{-5}$$



initial pressure 0.5 atm 0

final pressure (0.5-x) 2x

Total pressure = 0.5 - x + 2x = 0.5 + x = 0.8 atm

$$\therefore x = 0.3 \text{ atm.}$$

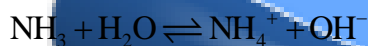
$$K_p = \frac{(P_{CO})^2}{(P_{CO_2})} = \frac{(0.6)^2}{0.2} = 1.8 \text{ atm.}$$

22. According to lowry-bronsted acid base theory in (ii) reaction $H_2PO_4^-$ donates H^+ ion to H_2O so it acts as an acid.

23. $K_p = K_c(RT)^{\Delta n(g)} \quad \Delta n(g) = 1$
 $= K_c \times 0.0831 \times 457$ It means $K_p > K_c$

24. Water is an amphoteric solvent as it can accept protons as well as give protons.

25. Ammonium ion (NH_4^+) is a conjugate acid of NH_3

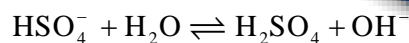


Bronsted base Conjugate acid

26. HSO_4^- can act as a bronsted acid as well as bronsted base.



Acid



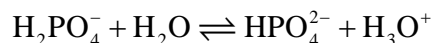
Base

27. $P^H = 4.7 \therefore [H_3O^+] = 1.995 \times 10^{-5}$ $pK_w = 14 \therefore K_w = 1 \times 10^{-14}$

$$= -\log[H_3O^+] \quad \text{Now } K_w = [H_3O^+][OH^-]$$

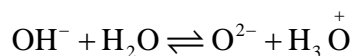
$$\therefore [OH^-] = \frac{1 \times 10^{-14}}{1.995 \times 10^{-5}} = 5 \times 10^{-10} \text{ M}$$

28. conjugate base of $H_2PO_4^-$ is HPO_4^{2-}



Acid

29. conjugate base of OH^-



30. Lewis acid always accepts a pair of e^- here $AlCl_3$ accepts a pair of e^- .
31. $(CH_3)_3B$ accept a pair of e^- so lewis acid
32. Pressure on equilibrium system increses ,so volume decreases. volume of ice is more than liquid H_2O so more ice is malted
33. For endothermic ($\Delta H > 0$) reaction, change in temperature affects the equilibrium system and forward reaction takes place . by increasing temp .

$$34. \quad K_1 = \frac{[XeOF_4][HF]^2}{[XeF_6][H_2O]} \quad K_2 = \frac{[XeOF_4][XeO_3F_2]}{[XeF_4][XeF_6]}$$

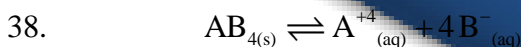
and $K = \frac{[XeO_3F_2][H_2O]}{[XeF_4][HF]^2}$ is obtained by

$$\frac{K_2}{K_1}$$

$$\therefore K = \frac{K_2}{K_1}$$

$$36. \quad K_c = \frac{[NO]^4 [H_2O]^6}{[NH_3]^4 [O_2]^5} = (\text{conc.})^{4+6-(4+5)} = \text{conc}^{-1}$$

37. According to Le -chatelliers principle, if conc. of reactant become doubled, then forward reaction takes place and concentration of product also increases. so equilibrium constant also remains same.

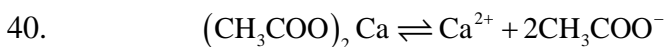


$$K_{SP} = [A^{+4}][B^{-}]^4 = S \times (4S)^4 = 256S^5$$

$$\therefore S = \left(\frac{K_{SP}}{256} \right)^{\frac{1}{5}}$$

$$39. \quad K_{SP} = [M^{2+}][X^{-}]^2 = 4S^3$$

$$\therefore [M^{2+}] = S = \left(\frac{K_{SP}}{4} \right)^{\frac{1}{3}} = \left(\frac{4 \times 10^{-12}}{4} \right)^{\frac{1}{3}} = 1 \times 10^{-4}$$

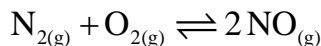


$$0.005 \quad 2 \times 0.005 = 0.01M.$$

$$P^H = -\frac{1}{2}(\log K_w + \log K_a - \log C)$$

$$\begin{aligned}
&= -\frac{1}{2}\log K_w - \frac{1}{2}\log K_a + \frac{1}{2}\log c \\
&= \frac{1}{2}\times pK_w + \frac{1}{2} + pK_a + \frac{1}{2}\log 1 \times 10^{-2} \\
&= \frac{1}{2}\times 14 + \frac{1}{2}\times 4.74 + \frac{1}{2}(-2) \\
&= 7 + 2.37 - 1 = 8.37
\end{aligned}$$

41. change in volume affects number of moles per unit volume. In a reaction



no. of moles of reactants and product are equal so volume change does not affect the equilibrium.

42. $p^H = 3$ means $[H^+] = 10^{-3} M$

$p^H = 4$ means $[H^+] = 10^{-4} M$

After mixing equal volume total $[H^+] = \frac{1 \times 10^{-3} + 10^{-4} \times 1}{2}$

$$= \frac{0.1 \times 10^{-4} + 1 \times 10^{-4}}{2}$$

$$= \frac{1.1 \times 10^{-3}}{2} = 5.5 \times 10^{-4}$$

$$[H^+] = 5.5 \times 10^{-4} M$$

$$p^H = -\log[H^+] = -\log(5.5 \times 10^{-4}) = 4 - 0.7404 = 3.26$$

43. p^H of HCl should be less than 7. due to self ionisation of H_2O

from acid $[H^+] = 10^{-8} M$ from $H_2O [H^+] = 10^{-7} M$

Total $[H^+] = 10^{-8} + 10^{-7} = 10^{-8}(1 + 10) = 11 \times 10^{-8} M$

$$p^H = -\log[H^+] = -\log(11 \times 10^{-8}) = -(1.0414 - 8)$$

$$= 6.96$$

$$p^H = 6.96$$

44. p^H of buffer solution

$$= pK_a + \log \frac{[\text{salt}]}{[\text{Acid}]}$$

$$= -\log K_a + \log 1$$

$$= -\log 10^{-8} + 0 = +8$$

45. if x is the solubility of AgCl in 0.04 M CaCl_2 ,

$$\text{then } [\text{Ag}^+] = x \text{ mol L}^{-1}$$

$$[\text{Cl}^-] = 2 \times 0.04 + x = 0.08 + x \cong 0.08 \text{ M}$$

$$K_{\text{sp}} \text{ of AgCl} = [\text{Ag}^+][\text{Cl}^-]$$

$$4 \times 10^{-10} / 0.08 = [\text{Ag}^+] = 5 \times 10^{-9} \text{ M}$$

46.
$$\text{p}^{\text{H}} = \text{p}K_{\text{a}} + \log \frac{[\text{CH}_3\text{COONa}]}{[\text{CH}_3\text{COOH}]}$$

$$5.5 = 4.5 + \log \frac{[\text{CH}_3\text{COONa}]}{0.1}$$

$$5.5 = 4.5 + \log[\text{CH}_3\text{COONa}] + 1$$

$$\therefore \log[\text{CH}_3\text{COONa}] = 0$$

$$\therefore [\text{CH}_3\text{COONa}] = 1 \text{ M}$$

47. I^- can accept protons and hence is a base.

50. $\text{N}_3\text{H} \rightleftharpoons \text{N}_3^- + \text{H}^+$ Hydrazoic acid = N_3H

53. H_2S can donate proton but can't accept proton.

55. With increase in temperature, ionic product increases. because self ionisation of is endothermic process

56. EDTA is Arrhenius acid as it can give H^+ ions in aqueous solution, bronsted base. as it can accept protons and lewis base because N and O in it can donate lone paris of electrons.

57.
$$K_{\text{w}} = [\text{H}^+][\text{OH}^-]$$

$$= \text{mol L}^{-1} \times \text{mol L}^{-1} = \text{mol}^2 \text{ L}^{-2}$$

58. Smaller the K_{b} value, weaker is the base.

59. On adding NH_3 to water, $[\text{OH}^-]$ will increse,

$$K_{\text{w}} = [\text{H}_3\text{O}^+][\text{OH}^-] \text{ is constant.}$$

Therefore $[\text{H}_3\text{O}^+]$ will decrease

61.
$$\therefore \text{p}^{\text{OH}} = \text{p}K_{\text{b}} + \log \frac{[\text{Salt}]}{[\text{Base}]} \quad [\text{Salt}] = [\text{Base}]$$

$$= -\log(2 \times 10^{-5}) + \log 1$$

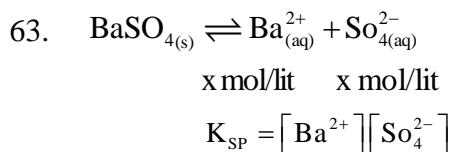
$$= -0.3010 + 5.000 + 0 = 4.6990$$

$$\text{p}^{\text{H}} = 14 - \text{p}^{\text{OH}} = 14 - 4.6990 = 9.3010$$

$$62. \quad p^{OH} = pK_b + \log \frac{[\text{Salt}]}{[\text{Base}]} \quad p^{OH} = 14 - p^H = 4.75$$

$$4.75 = p^{kb} + \log 1$$

$$\therefore pk_b = 4.75 \quad (\because \log 1 = 0)$$



$$K_{sp} = x^2$$

$$\therefore x = (k_{sp})^{1/2} = (1.5 \times 10^{-9})^{1/2} = 3.9 \times 10^{-5} \text{ molL}^{-1}$$

64 Hint : As value of K_{sp} is less , solubility is also less.

65. glycine ($\text{NH}_2\text{CH}_2\text{COOH}$) is more acidic than basic.
overall ionisation constant

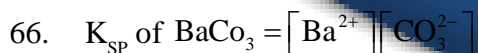
$$K = K_{a1} \times K_{a2} = 4.5 \times 10^{-3} \times 1.7 \times 10^{-10}$$

$$= 7.65 \times 10^{-13}$$

$$[\text{H}^+] = \sqrt{K \cdot C} = \sqrt{7.65 \times 10^{-13} \times 0.01}$$

$$= 0.87 \times 10^{-7} \text{ M}$$

$$p^H = -\log(8.7 \times 10^{-8}) = 7.0605$$

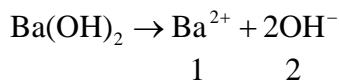


$$\therefore [\text{Ba}^{2+}] = \frac{5.1 \times 10^{-9}}{1 \times 10^{-4}} = 5.1 \times 10^{-5} \text{ M}$$



2 mol HCl neutralize 1 mole $\text{Ba}(\text{OH})_2$

\therefore 1 mol HCl neutralize 0.5 mole $\text{Ba}(\text{OH})_2$



$$\therefore \text{no. of moles of } \text{Ba}(\text{OH})_2 = 3 = 1 + 2$$

$$\therefore \text{Ba}(\text{OH})_2 \text{ left} = 3 - 0.5 = 2.5$$

$$\therefore [\text{Ba}(\text{OH})_2] = \frac{2.5}{50} = 0.05 \text{ M}$$

$$\text{or } [\text{OH}^-] = 2 \times 0.05 \text{ M} = 0.1 \text{ M}$$

$$68. \quad K_h = \frac{K_w}{K_b} = \frac{1.0 \times 10^{-14}}{1.7 \times 10^{-5}} = 5.65 \times 10^{-10}$$

$$69. \quad P^H = +\frac{1}{2}(P^KW + P^Ka + \log C)$$

$$= \frac{1}{2} \times 14 + \frac{1}{2} \times 4 + \frac{1}{2} \log 10^{-2}$$

$$= 7 + 2 - 1 = 8$$

$$70. \quad P^H = 3 \text{ means } [H^+] = 10^{-3} \text{ M}$$

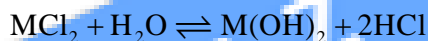
1000 ml juice contains 10^{-3} mole H^+ ions

$$\therefore \text{no. of } H^+ \text{ ions} = 10^{-3} \times 6.022 \times 10^{23} \text{ in 1000 ml}$$

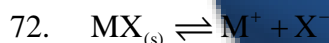
$$\therefore 500 \text{ ml juice contains } H^+ \text{ ions} = \frac{10^{-3} \times 6.022 \times 10^{23} \times 500}{1000}$$

$$= 3.011 \times 10^{20}$$

71. All alkaline earth metal chlorides (MCl_2) on hydrolysis will produce acidic solution

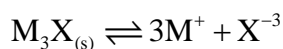


because $M(OH)_2$ is a weak base and HCl is a strong acid. but as we go down the group, basic character of hydroxides increases. Hence acidic character decreases. So $BaCl_2$ will have the highest P^H .



$$K_{SP} = S^2 \therefore S = (K_{SP})^{1/2} = (4 \times 10^{-8})^{1/2} = 2 \times 10^{-4} \text{ M.}$$

$$MX_{2(s)} \rightleftharpoons M^{2+} + 2X^- \quad K_{SP} = 4S^3 \therefore S = \left(\frac{K_{SP}}{4}\right)^{1/3} = 2 \times 10^{-5} \text{ M.}$$



$$K_{SP} = 27S^4 \therefore S = \left(\frac{K_{SP}}{27}\right)^{1/4} = \left(\frac{2.7 \times 10^{-15}}{27}\right)^{1/4} = 1 \times 10^{-4} \text{ M}$$

$$\therefore 2 \times 10^{-4} > 1 \times 10^{-4} > 2 \times 10^{-5}$$

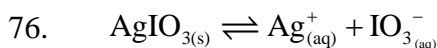
$$\therefore MX > M_3X > MX_2.$$

$$74. \quad P^{OH} = pK_b + \log \frac{[\text{Salt}]}{[\text{weak base}]}$$

$$= 4.7 + \log \frac{0.1}{0.01} = 5.7$$

$$P^H = 14 - 5.7 = 8.3$$

75. HCOONa is a Salt of weak acid (HCOOH) and Strong base (NaOH) So it is basic. $\text{C}_6\text{H}_5\text{NH}_3\text{Cl}$ is a Salt of weak base ($\text{C}_6\text{H}_5\text{NH}_2$) and strong acid (HCl) so it is acidic. KCN is a Salt of Strong base (KOH) and weak acid (HCN) so it is basic.



$$K_{\text{SP}} = S^2$$

$$\therefore S = (K_{\text{SP}})^{1/2} = (1.0 \times 10^{-8})^{1/2} = 1 \times 10^{-4} \text{ mol/lit}$$

$$\therefore S = 1 \times 10^{-4} \times 283 = 283 \times 10^{-4} \text{ gm/lit}$$

1000 ml contains 283×10^{-4} gm of AgIO_3

\therefore 100 ml contains 28.3×10^{-4} gm of AgIO_3

77. Molar concentration of $\text{NaOH} = \frac{50 \times 10^{-3} \text{ gm}}{40 \text{ gm mol}^{-1} \times 10 \text{ dm}^3} = 1.25 \times 10^{-4} \text{ M}$

$$P^{\text{OH}} = -\log(1.25 \times 10^{-4})$$

$$= -0.0969 + 4.0 = 3.9031$$

$$\therefore P^{\text{H}} = 14 - 3.9031 = 10.0969$$

78. 0.1 M HCl means $[\text{H}^+] = 10^{-1} \therefore P^{\text{H}} = 1$

0.1 M KOH means $[\text{OH}^-] = 10^{-1} P^{\text{OH}} = 1 \therefore P^{\text{H}} = 13$

0.01 M HCl means $[\text{H}^+] = 10^{-2} \therefore P^{\text{H}} = 2$

0.01 M KOH means $[\text{OH}^-] = 10^{-2} \therefore P^{\text{OH}} = 2 \therefore P^{\text{H}} = 12$

79. $[\text{H}^+]$ ion concentrations are 10^{-11} , 10^{-12} and 10^{-13} on mixing equal volumes, $[\text{H}^+]$ in final solution

$$= \frac{10^{-11} \times 10^{-12} \times 10^{-13}}{3} = \frac{10 \times 10^{-12} + 1 \times 10^{-12} + 0.1 \times 10^{-12}}{3}$$

$$= \frac{11.1 \times 10^{-12}}{3} = 3.7 \times 10^{-12} \text{ M.}$$

80. (A) $P^{\text{H}} = \text{pka} + \log \frac{[\text{Salt}]}{[\text{acid}]} = 4.8 + \log \frac{0.1}{0.01} = 4.8 + 1 = 5.8$

(B) $P^{\text{H}} = 4.8 + \log \frac{0.01}{0.1} = 4.8 + \log 10^{-1} = 4.8 - 1 = 3.8$

(C) $P^{\text{H}} = 4.8 + \log \frac{0.1}{0.1} = 4.8 + 0 = 4.8$

(D) $P^{\text{H}} = 7 + \frac{1}{2}(\text{pka} - \text{pkb}) = 7 + \frac{1}{2}(4.8 - 4.8) = 7.0$

81. Soda water contains weak acid H_2CO_3 So its $\text{p}^{\text{H}} < 7$

$$83. \text{p}^{\text{H}} = \text{p}^{\text{K}}_{\text{a}} + \log \frac{[\text{Salt}]}{[\text{acid}]}$$

$$6 = 5 + \log \frac{[\text{Salt}]}{[\text{acid}]}$$

$$\therefore \log \frac{[\text{Salt}]}{[\text{acid}]} = 1 \quad \text{or} \quad \frac{[\text{Salt}]}{[\text{acid}]} = 10.$$

84. Solubility of $\text{CuS} = (\text{ksp})^{1/2} = (1 \times 10^{-32})^{1/2} = 1 \times 10^{-16} \text{ M}$

$$\text{Solubility of } \text{Ag}_2\text{S} = \left(\frac{\text{ksp}}{4}\right)^{1/3} = \left(\frac{4 \times 10^{-45}}{4}\right)^{1/3} = 1 \times 10^{-15} \text{ M}$$

$$\text{Solubility of } \text{HgS} = (\text{ksp})^{1/2} = (4 \times 10^{-54})^{1/2} = 1 \times 10^{-27} \text{ M}$$

85. At 25°C temp p^{H} of $\text{H}_2\text{O} = 7$ $[\text{H}^+] = 10^{-7} \text{ M}$

$\text{p}^{\text{H}} = 6.8$ means $\text{p}^{\text{H}} < 7$ $\therefore [\text{H}^+]$ is more than 10^{-7} M

Self ionisation of H_2O is endothermic so by increasing temp $[\text{H}^+]$ ion increases.

86. ksp for $\text{BaSO}_4 = [\text{Ba}^{2+}][\text{SO}_4^{2-}]$

$$10^{-11} = 0.1 \times [\text{SO}_4^{2-}]$$

$$\therefore [\text{SO}_4^{2-}] = 10^{-10} \text{ M}$$

ksp for $\text{CaSO}_4 = [\text{Ca}^{2+}][\text{SO}_4^{2-}]$

$$10^{-6} / 0.1 = 10^{-5} \text{ M} = [\text{SO}_4^{2-}]$$

ksp for $\text{Ag}_2\text{SO}_4 = [\text{Ag}^+]^2[\text{SO}_4^{2-}]$

$$10^{-5} / (0.1)^2 = 10^{-3} \text{ M} = [\text{SO}_4^{2-}]$$

As $[\text{SO}_4^{2-}] = 10^{-10} \text{ M}$ in BaSO_4 (least value)

it can be precipitated first

87. $\text{A}_2\text{B}_{3(s)} \rightleftharpoons 2\text{A}^{3+} + 3\text{B}^{2-}$

$$2x \quad 3x$$

$$\text{ksp} = [\text{A}^{3+}]^2 [\text{B}^{2-}]^3$$

$$= (2x)^2 \times (3x)^3$$

$$= 4x^2 \times 27x^3 = 108x^5$$

$$88. \quad P^H = P^{K_a} + \log \frac{[\text{Salt}]}{[\text{Acid}]}$$

$$4.91 = 4.76 + \log \frac{[\text{Salt}]}{[\text{Acid}]}$$

$$\therefore \log \frac{[\text{Salt}]}{[\text{Acid}]} = 0.15 \quad \therefore \frac{[\text{Salt}]}{[\text{Acid}]} = \text{antilog of } 0.15 = 1.41$$

$$\therefore \frac{\frac{0.2}{1000} \times 50}{\frac{0.1}{1000} \times V} = 1.41 \quad \therefore V = 70.92 \text{ ml}$$

$$89. \quad pK_a = -\log(1.8 \times 10^{-4}) = 3.74$$

$$\log \frac{[\text{Salt}]}{[\text{Acid}]} = P^H - pK_a = 4.25 - 3.74 = 0.51$$

$$\therefore \frac{[\text{Salt}]}{[\text{Acid}]} = \text{antilog of } 0.51 = 3.24$$

$$90. \quad K_b = \frac{K_w}{K_c} = \frac{10^{-14}}{6.8 \times 10^{-4}} = 1.47 \times 10^{-11}$$

91. Buffer Solution of highest capacity is formed at which
 $P^H = pK_a = -\log(1.8 \times 10^{-4}) = 3.74$

93. Ionic Product of CaF_2

$$\text{in (i) } IP = [\text{Ca}^{2+}][\text{F}^-]^2 = 10^{-12} < K_{sp}$$

$$\text{(ii) } IP = 10^{-2} \times (10^{-3})^2 = 10^{-8} > K_{sp} \quad \therefore \text{ppt. obtain}$$

$$\text{(iii) } IP = 10^{-5} \times (10^{-3})^2 = 10^{-11} < K_{sp}$$

$$\text{(iv) } IP = 10^{-3} \times (10^{-5})^2 = 10^{-13} < K_{sp}$$

$$94. \quad P^H = pK_a + \log \frac{[\text{Salt}]}{[\text{Acid}]} \quad [\text{Salt}] = [\text{Acid}]$$

$$= 8 + \log 1 = 8$$

95. H_2S = weak acid H_2SO_4 = Strong acid

NaCl = neutral NaNO_2 = basic

Hence $[\text{H}_3\text{O}^+]$ will be in the order of

$\text{NaNO}_2 < \text{NaCl} < \text{H}_2\text{S} < \text{H}_2\text{SO}_4$

96. NaCN is Salt of weak acid (HCN) and Strong base (NaOH) Hence

$$h = \sqrt{\frac{kw}{k_a C}} = \sqrt{\frac{10^{-14}}{(1.3 \times 10^{-9}) \times \frac{1}{80}}} = 2.48 \times 10^{-2}$$

$$\therefore \text{Per cent tan ge Hydrolysis} = (2.48 \times 10^{-2})100 = 2.48$$

97. If x is Solubility of AgCl in 0.04 M CaCl₂, then

$$[Ag^+] = x \text{ mol L}^{-1}$$

$$[Cl^-] = (0.04 \times 2) + x \cong 0.08M$$

$$0.08(x) = 4 \times 10^{-10}$$

$$x = 5.0 \times 10^{-9} M$$

98.
$$p^H = pka + \frac{\log [CH_3COONa]}{1[CH_3COOH]}$$

$$5.5 = 4.5 + \log \frac{[CH_3COONa]}{0.7}$$

$$= 4.5 + \log [CH_3COONa] + 1$$

$$\therefore \log [CH_3COONa] = 0$$

$$\therefore [CH_3COONa] = 7 M$$

99. 50 ml of 0.4 N HCl = $\frac{0.4}{1000} \times 50 = 0.02 \text{ g eq.}$

$$50 \text{ ml of } 0.2 \text{ N NaOH} = \frac{0.2}{1000} \times 50 = 0.01 \text{ g eq.}$$

0.01 g eq of NaOH will Neutralise 0.01 g eq of HCl

\therefore HCl left unneutralised = 0.01 g eq

$$\text{vol of Sol.} = 50 + 50$$

$$= 100 \text{ ml}$$

$$\therefore [HCl] = \frac{0.01}{100} \times 1000 = 0.1 N$$

$$\text{or } [H^+] = 0.1 M$$

$$\therefore p^H = \log(0.1) = 1.0$$



$$\text{at eq } (a - 3.4 \times 10^{-4}) \quad 3.4 \times 10^{-4} \quad 3.4 \times 10^{-4}$$

$$\frac{(3.4 \times 10^{-4})(3.4 \times 10^{-4})}{(a - 3.4 \times 10^{-4})} = 1.7 \times 10^{-5} \text{ (Given)}$$

$$\therefore a = 6.8 \times 10^{-3}$$

101.



initial 1 1 0 0

conc.

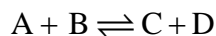
Ateqm(1-0.8) 0.8 0.8

conc.(1-0.8)

=0.2 =0.2

$$K_c = \frac{[C][D]}{[A][B]} = \frac{0.8 \times 0.8}{0.2 \times 0.2} = 16.0$$

102.



initial 4 4 0 0

conc.

Ateqm(4-2) 2 2

conc.(4-2)

= 2 =2

$$K_c = \frac{[C][D]}{[A][B]} = \frac{2 \times 2}{2 \times 2} = 1$$

103. K_c remains same because K_c is a characteristic constant.

104.



2 0 0

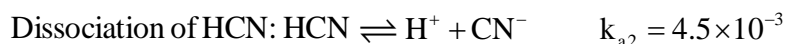
$\frac{2 \times 60}{100}$ $\frac{2 \times 40}{100}$ $\frac{2 \times 40}{100}$

moles = 1.2 0.8 0.8

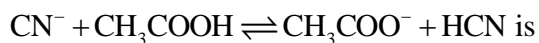
conc. = $\frac{\text{mol}}{\text{lit}} = 1.2/2$ $0.8/2$ $0.8/2$

$$\therefore K_c = \frac{[PCl_3][Cl_2]}{[PCl_5]} = \frac{0.4 \times 0.4}{0.6} = 0.266$$

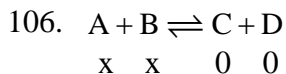
105. Dissociation of CH_3COOH



for a reaction

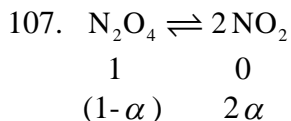


$$K_a = \frac{K_{a1}}{K_{a2}} = \frac{1.5 \times 10^{-3}}{4.5 \times 10^{-10}} = 3.33 \times 10^4$$



$$2x \quad 2x$$

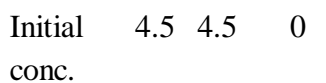
$$K_c = \frac{[C][D]}{[A][B]} = \frac{2x \times 2x}{x \times x} = 4$$



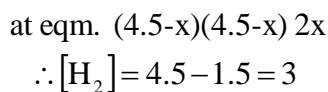
Total moles = $1 - \alpha + 2\alpha = 1 + \alpha$



from equation $2x=3$

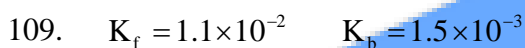


$\therefore x = \frac{3}{2} = 1.5$

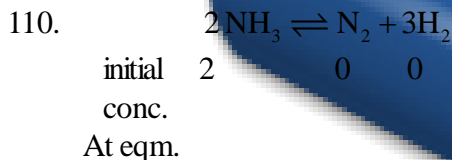


$$[I_2] = 4.5 - 1.5 = 3$$

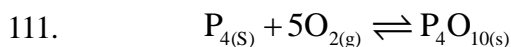
$$K_c = \frac{[HI]^2}{[H_2][I_2]} = \frac{3 \times 3}{3 \times 3} = 1$$



$$K_c = \frac{k_f}{k_b} = \frac{1.1 \times 10^{-2}}{1.5 \times 10^{-3}} = 7.33$$



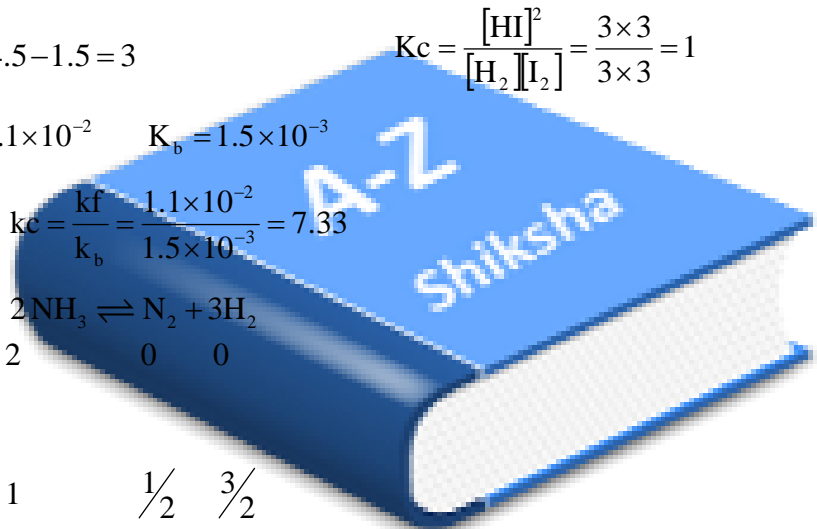
$$K_c = \frac{[N_2][H_2]^3}{[NH_3]^2} = \frac{1/2 \times (3/2)^3}{(1)^2} = 27/64$$

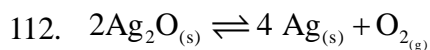


$$K_c = \frac{[P_4O_{10}]}{[P_{4(s)}][O_{2(g)}]^5}$$

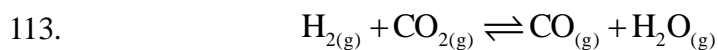
we know that concentration of a solid component is always taken as a unity

$$\therefore K_c = \frac{1}{[O_2]^5}$$





for this reaction $K_p = P_{\text{O}_2}$



initial				
conc.	1	1	0	0
At eqm.	(1-x)	(1-x)	x	x

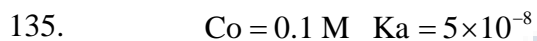
$$K_p = \frac{P_{\text{CO}} \times P_{\text{H}_2\text{O}}}{P_{\text{H}_2} \times P_{\text{CO}_2}} = \frac{x^2}{(1-x)^2}$$



Solubility is PS qS mol/lit

$$K_{sp} = (\text{PS})^p \times (\text{qS})^q$$

$$= \text{S}^{(p+q)} \times \text{P}^p \times \text{q}^q$$



$$[\text{H}^+] = \sqrt{\text{Ka} \cdot \text{Co}}$$

$$= (5 \times 10^{-8} \times 0.1)^{1/2} = (50 \times 10^{-10})^{1/2}$$

$$= 7.07 \times 10^{-5} \text{ M.}$$

