GOVERNMENT OF KARNATAKA
DEPARTMENT OF SCHOOL EDUCATION (PRE-UNIVERSITY)

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CHAPTERWISE MULTIPLE CHOICE QUESTIONS FOR COMPETATIVE EXAM

SUBJECT: I PUC CHEMISTRY

NAME OF THE CHAPTER: UNIT: 06-EQUILIBRIUM

Concept

EQUILIBRIUM

The state at which observable properties of system do not change with time

Physical Equilibrium

The state of equilibrium attained between two physical phases

Characteristics

- Equilibrium is possible only in a closed system
- Both the opposing processes occur at the same rate and there is a dynamic but stable condition.
- All measurable properties of the system remain constant.
- Equilibrium is characterised by constant value of one of the parameters at a given temperature.

Ionic Equilibrium

Solubility product

For reaction $A_xB_y \rightleftharpoons xA^{y+} + yB^{x-}$

Solubility product $(k_{sp}) = [A^{y+}]^x [B^{x-}]^y$

$$\text{Solubility} = \left[\frac{(k_{sp})}{x^x . y^y}\right]^{1/(x+y)}$$

In general, we can neglect the contribution of common ion from the springly soluble salt. e.g., solubility of AgCl in x M NaCl $= \frac{k_{sp}\ AgCl}{[Cl^-]} = \frac{k_{sp}\ AgCl}{x}$

Common ion effect

If the solution of weak electrolyte, is added to a solution of strong electrolyte which furnishes an ion common to that furnished by weak electrolyte the ionization of weak electrolyte is suppressed.

Buffer solution

Solution which resists the change in hydrogen ion concentration on addition of small amount of acid or base.

pH of buffer solution

(Henderson – Hasselbalch equation)

$pH = pK_a + \log \frac{[salt]}{[acid]}$; for base $pH = pK_b + \log \frac{[salt]}{[base]}$

Ionic product of water

$K_w = [H_3O^+][OH^-]$

with increase in temperature degree of ionisation of water increases.

Solubility equilibria of sparingly soluble salts.

Category I	Soluble	solubility > 0.1 M
Category II	Slightly soluble	0.01 M < solubility < 0.1 M
Category III	Sparingly soluble	solubility < 0.01 M

pH Scale

$pH = -\log [H_3O^+]$

pH < 7, acidic solution

pH > 7, basic solution

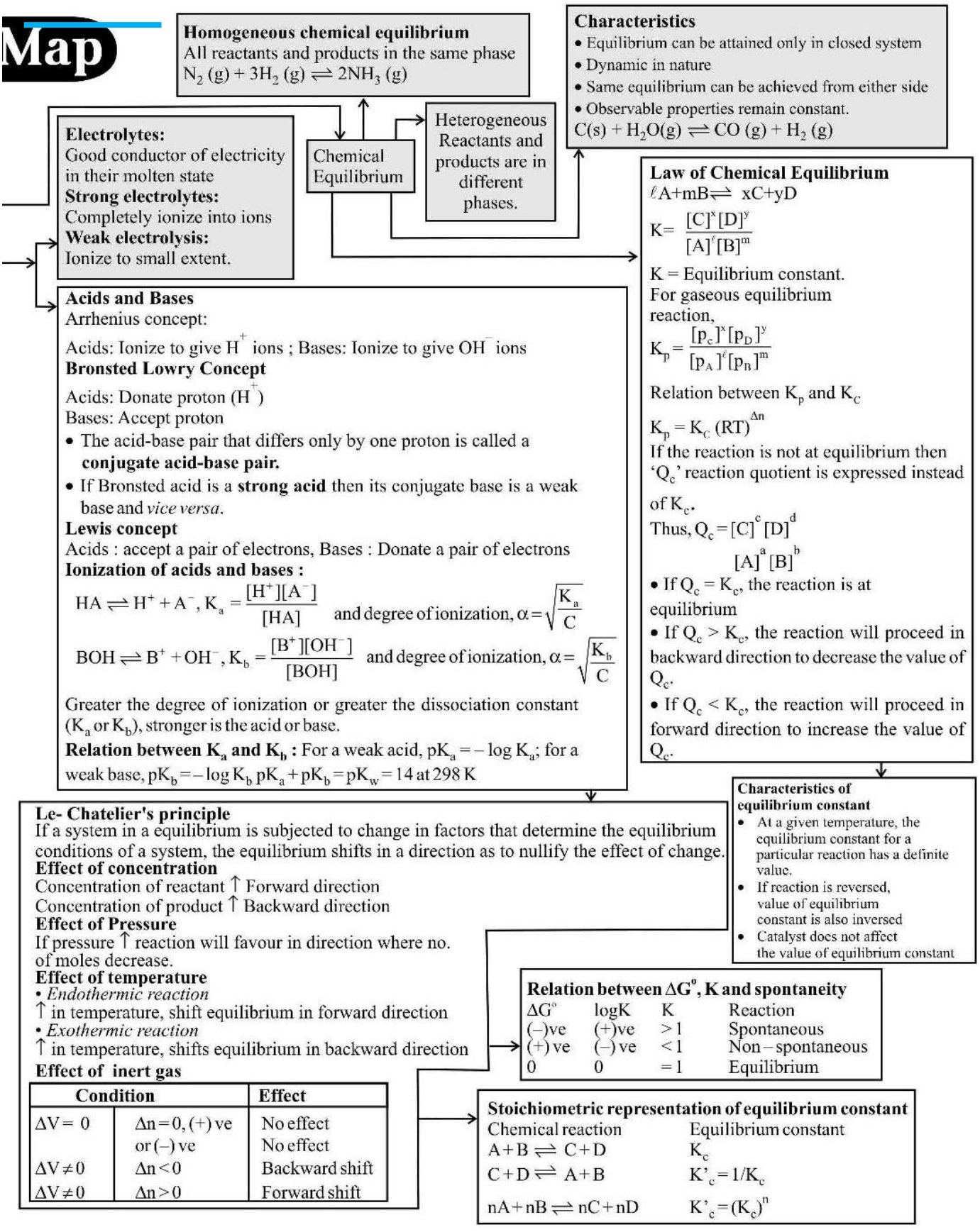
pH = 7 neutral solution

Salt hydrolysis

A process in which a salt reacts with water to produce either acidic or basic or neutral solution.

Salt hydrolysis :

Salt	Hydrolysis	Resulting solution	Hydrolysis constant (K_h)	Degree of Hydrolysis (h)	pH
Weak acid and strong base	Anionic	Alkaline pH > 7	$K_h = \frac{K_w}{K_a}$	$h = \sqrt{\frac{K_h}{C}}$	$pH = \frac{1}{2}[pK_w + pK_a + \log C]$
Strong acid and weak base	Cationic	Alkaline pH < 7	$K_h = \frac{K_w}{K_b}$	$h = \sqrt{\frac{K_h}{C}}$	$pH = \frac{1}{2}[pK_w - pK_b - \log C]$
Weak acid and weak base	Anionic and Cationic both	Neutral, pH < 7 (If $K_a = K_b$)	$K_h = \frac{K_w}{K_a K_b}$	$h = \sqrt{K_h}$	$pH = \frac{1}{2}[pK_w + pK_a - pK_b]$



Important Points to Remember

- **SOLUBILITY PRODUCT (K_{sp})**

  The constant K_{sp} is known as solubility product. It is equal to the product of the concentration of ions in saturated solution.

  For general electrolyte $A_x B_y$

$K_{sp} = \left[A^{+y}\right]^x \left[B^{-x}\right]^y$

- **Factors Affecting Equilibrium Concentrations: Temperature**

- An increase in temperature for exothermic reactions decreases the concentration of products at Equilibrium and vice-versa.
- An increase in temperature for endothermic reactions increases the concentration of products at equilibrium and vice-versa.

Pressure

- An increase in pressure to an equilibrium favours the reaction where number of moles show a decrease and vice-versa.

Effect or pressure (or volume)

Effect of reaction	Effect of pressure (or volume)
• I. $\Delta n = 0$	Equilibrium is not affected
• II. Δn = +ve	Increase in P (or decrease in V) shifts the equilibrium to left
• III. Δn = –ve	Increase in P (or decrease in V) shifts the equilibrium to right

- The density of one mole of gas is given by $D = \frac{MP}{RT}$

Consider dissociation of PCl_5. Let x be degree of dissociation

$$\therefore \frac{D}{d} = \frac{1+x}{1} \therefore x = \frac{D-d}{d}\left(\because D \propto \frac{1}{\text{moles}}\right)$$

Where D is the theoretical vapour density and d is observed vapour density at temperature t °C.

$D = \frac{1}{2}$ Molecular mass

If nx moles of products are formed, then total number of moles after dissociation

$1 - x + nx = 1 + x\,(n - 1)$

$$\therefore \frac{D}{d} = \frac{1+x(n-1)}{1} \therefore x = \frac{D-d}{d(n-1)}$$

- **Calculation of pH Value of Buffers**

Acidic buffer $pH = pK_a + \log\frac{[salt]}{[acid]}$

This is known as Henderson's equation

Basic buffer $pOH = pK_b + \log\frac{[salt]}{[base]}$

A buffer has maximum buffer capacity when $\frac{[salt]}{[acid]}$ or $\frac{[salt]}{[base]} = 1$

- Variation of equilibrium constant with variation of the reaction equation (K = equilibrium constant for original reaction) is given as below:

When the equation	the change in equilibrium constant
Reversed	1/K
Divided by 2	$\sqrt{K}$
Multiplied by 2	K^2
Divided into two steps	$K = K_1 \times K_2$

- Buffer capacity = $\frac{\text{Moles of acid or a base added to 1 litre of buffer}}{\text{Change in pH}}$

- **Calculation of Degree of Dissociation**

Let us consider the following reaction:

$PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$

Initial pressure and temperature are P_1 and T_1. At equilibrium, pressure and temperature are P_2 and T_2,

Respectively. The volume of vessel is constant, equal to 'V'.

	$PCl_5(g) \rightleftharpoons$	$PCl_3(g)$	+ $Cl_2(g)$	n	V	T	P
$t=0$	a	0	0	a	V	T_1	P_1
t_{eq}	$a-a\alpha$	$a\alpha$	$a\alpha$	$a+a\alpha$	V	T_2	P_2

Initial state $P_1V = aRT_1$ ... (*i*)

Equilibrium state $P_2V = (a+a\alpha)RT_2$ ... (*ii*)

Dividing equation (*i*) and (*ii*), we get

$$\frac{P_1}{P_2} = \frac{T_1}{(1+\alpha)T_2} \qquad (1+\alpha) = \frac{T_1P_2}{T_2P_1}$$

$$\therefore \ \alpha = \frac{T_1P_2 - T_2P_1}{T_2P_1}$$

Alternate Method:

$$\frac{\text{Initial moles}}{\text{Moles at equilibrium}} = \frac{\text{Initial pressure after change of temperature}}{\text{Equilibrium pressure}}$$

6.1 EQUILIBRIUM IN PHYSICAL PROCESSES

1. On applying pressure to the equilibrium ice ⇌ water, which phenomenon will happen?

   (a) more ice will be formed (b) more water will be formed

   (c) equilibrium will not be disturbed (d) Water will evaporate

2. Which one of the following statements does not describe the equilibrium state?

   (a) The rate of forward reaction is equal to the rate of the reverse reaction.

   (b) Equilibrium is dynamic and there is no net conversion to reactants and products.

   (c) The concentration of the reactants is equal to the concentration of the products.

   (d) The concentration of the reactants and products reach a constant level.

6.2 EQUILIBRIUM IN CHEMICAL PROCESSES – DYNAMIC EQUILIBRIUM

3. Which statement best describes dynamic equilibrium?

   (a) The reaction stops completely. (b) Only forward reaction occurs.

   (c) Forward and reverse reactions occur at equal rates. (d) Product concentration becomes zero.

6.3 LAW OF CHEMICAL EQUILIBRIUM AND EQUILIBRIUM CONSTANT

4. As a rule which of the following phases are not included in equilibrium constant expression?

   i) pure liquids ii) pure solids iii) aqueous solutions iv) gases

   (a) i and iii (b) i and ii

   (c) ii and iii (d) i and iv

5. Which of the following statements about the equilibrium constant K_P is false?

   (a) Total pressures are used in the equilibrium equation in place of molar concentrations

(b) The units for K_P are usually omitted.

(c) Δ_n = the sum of the coefficients of the gaseous products - the sum of the coefficients of the gaseous reactants.

(d) the relationship between K_P and K_c is: $K_P = K_c \mathbf{RT}^{\Delta n}$

6. One mole of PCl_5 is introduced into a 2 L vessel at equilibrium. $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$ If degree of dissociation is 50%, then K_c is

(a) 0.25 (b) 0.50

(c) 0.125 (d) 1

7. For the reaction $N_{2\,(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$, N_2 and H_2 were taken in molar ratio of 1:3 up to the point of equilibrium 50% each reactant has been reacted. If total pressure at equilibrium is P. The partial pressure of ammonia would be-

(a) P/3 (b) P/6

(c) P/4 (d) P/8

8. For the isomerisation reaction: Butane ⇌ Isobutane Kp equals to 25 at 500^0C. If the initial pressures of butane and isobutane are 10 atm and 0.0 atm respectively, what are the pressures of two gases at equilibrium?

(a) P(butane) = 10atm and P(isobutane) = 0.40atm

(b) P(butane) = 9.8atm and P(isobutane) = 0.38atm

(c) P(butane) = 0.46atm and P(isobutane) = 10atm

(d) P(butane) = 0.38atm and P(isobutane) = 9.6atm

9. In a reaction vessel of 2 litre capacity 3 moles of N_2 reacts with 2 moles of O_2 to produce 1 mole of NO. What is the molar concentration of N_2 at equilibrium?

(a) 1.25 (b) 1.50

(c) 0.75 (d) 2.0

10. 28g of N_2 and 6g of H_2 were mixed. At equilibrium 17g of NH_3 was produced. The weight of N_2 and H_2 at equilibrium respectively,

(a) 11g, 0g (b) 1g, 3g

(c) 14g, 3g (d) 11g, 3g

6.4 HOMOGENEOUS EQUILIBRIA

11. In Haber's process 30 litres of dihydrogen and 30 litres of dinitrogen were taken for reaction which yielded only 50% of the expected product. What will be the composition of gaseous mixture under the aforesaid condition in the end?

(a) 20 litres ammonia, 20 litres nitrogen, 20 litres hydrogen

(b) 10 litres ammonia, 25 litres nitrogen, 15 litres hydrogen

(c) 20 litres ammonia, 10 litres nitrogen, 30 litres hydrogen

(d) 20 litres ammonia, 25 litres nitrogen ,15 litre hydrogen

12. Which equilibrium contains substances in only one phase?
(a) Homogeneous equilibrium (b) Heterogeneous equilibrium
(c) Dynamic equilibrium (d) Ionic equilibrium

13. Which of the following represents a homogeneous equilibrium?
(a) $CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g)$ (b) $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$
(c) $AgCl(s) \rightleftharpoons Ag^+(aq) + Cl^-(aq)$ (d) $NH_4HS(s) \rightleftharpoons NH_3(g) + H_2S(g)$

6.5 HETEROGENEOUS EQUILIBRIA

14. In a heterogeneous equilibrium, the equilibrium constant expression does not include:
(a) Gases (b) Solutes in solution
(c) Pure solids and pure liquids (d) Aqueous ions

6.6 APPLICATIONS OF EQUILIBRIUM CONSTANTS

15. Nitric oxide reacts with oxygen to form nitrogen dioxide $2NO_{(g)} + O_{2(g)} \rightleftharpoons 2NO_{2(g)}$. What is Kc for the reverse reaction if the equilibrium concentration of NO is 0.300M, O_2 is 0.200M, and NO_2 **is 0.530M at 25^{0}C?**
(a) 0.1584 (b) 6.24
(c) 0.0641 (d) 1.641

16. Given the reaction: $2HI \rightleftharpoons H_2 + I_2$
If K_c' for the reverse reaction is 1.85×10^{-2} at 425°C, what is K_c for the forward reaction at the same temperature?
(a) 58.1 (b) 64.2
(c) 54.1 (d) 5.41

17. At a certain temperature, bromine and nitric oxide react to form Nitrosyl bromide:
$Br_{2(g)} + 2NO_{(g)} \rightleftharpoons 2NOBr_{(g)}$ when initial amounts of Br_2, NO and NOBr are mixed the concentration of NOBr increases which of the statement is true?
(a) $K_c = Q$
(b) $K_c < Q$
(c) $K_c > Q$
(d) More information is needed to make a statement about K_c

18. For a gaseous reaction,
$A(g) + 2B(g) \rightleftharpoons C(g)$, If $K_p = 8$ at 500 K, (R = 0.082 L atm mol^{-1} K^{-1}) then K_c is
(a) 8 (b) $\frac{8}{41}$
(c) $\frac{8}{(41)^{-2}}$ (d) 328

19. The value of K_P for the reaction. $2H_2O_{(g)} + 2Cl_{2(g)} \rightleftharpoons 4\ HCl_{(g)} + O_{2(g)}$ is 0.03 atm at 427 ^{0}C, when the partial pressures are expressed in atmosphere the the value of Kc for the same reaction is-
(a) 5.23×10^{-4} (b) 7.34×10^{-4}
(c) 3.2×10^{-3} (d) 5.43×10^{-5}

6.7 RELATIONSHIP BETWEEN EQUILIBRIUM CONSTANT K, REACTION QUOTIENT Q AND GIBBS ENERGY.

20. For a reaction at 300 K, $\Delta G^\circ = -11.4\ kJ\ mol^{-1}$, (R = 8.314 J mol^{-1} K^{-1}) The equilibrium constant is closest to

(a) 10 (b) 50

(c) 100 (d) 1000

6.8 FACTORS AFFECTING EQUILIBRIA

21. Match list I with list II and select the correct option

LIST-I	LIST-II
A. Kp > Q	i) Non- spontaneous
B. ΔG^0< RTln Q	ii) Equilibrium
C. Kp = Q	iii)Spontaneous and endothermic
D.T > $\frac{\Delta H}{\Delta S}$	iv) Spontaneous

(a) A-(i),B-(ii), C-(iii), D-(iv) (b) A-(iii),B-(iv), C-(ii), D-(i)

(c) A-(iv),B-(i), C-(ii), D-(iii) (d) A-(ii),B-(i), C-(iv), D-(iii)

22. In a reaction $A_2(g) + 4B_2(g) \rightleftharpoons 2AB_4(g)$**;** $\Delta H < 0$**.** The formation of $AB_4(g)$ will be favored by

(a) low temperature and high pressure (b) high temperature and high pressure

(c) low temperature and low pressure (d) high temperature and low pressure

23. A crude type of disappearing ink is based on the following endothermic equilibrium: (Colourless) $[Co(H_2O)_6]Cl_{2\ (aq)} \rightleftharpoons [Co(H_2O)_4\ Cl_2]_{(aq)}$ (Blue)+ 2 $H_2O_{(g)}$. If the reactant solution is used to write on a piece of paper and the paper is allowed to partially dry, what can be done to bring out the the coloured handwriting.

(a) Put the paper in the oven (b) Add water

(c) Put the paper in the freezer (d) Decrease the volume

24. Aluminium bromide is a crystalline solid that decomposes endothermically when heated: NH4Br(s) $\rightleftharpoons$ $NH_3(g) + HBr(g)$**.** When solid ammonium bromide is added to an evacuated flask at 300^0C, Which change in reaction conditions below will cause the equilibrium to shift to the right?

(a) Decreases the temperature (b) double the volume of the container

(c) Add more NH_3 (d) Add more NH4Br

25. The pink and blue species below form a violet-coloured mixture at equilibrium : (Pink) $[Co(H_2O)_6]^{2+}{}_{(aq)} + 4Cl^-{}_{(aq)} \rightleftharpoons [CoCl_4]^{2-}{}_{(aq)}$ (Blue)+ $6H_2O_{(g)}$. As the concentration of $[Co(H_2O)_6]^{2+}$ is increased, what happens to the solution?

(a) No colour change is observed (b) The solution becomes colourless

(c) The concentration of $[CoCl_4]^{2-}$ decreases (d) The concentration of $[CoCl_4]^{2-}$ increases

26. The overall reaction of photosynthesis can be represented by the following equation $6H_2O_{(l)} + 6CO_{2(g)} \rightleftharpoons C_6H_{12}O_{6(s)} + 6O_{2(g)}$ .The enthalpy change for this reaction is 2802kJ.Which of the following changes in condition will shift the equilibrium right?

(a) Increase the temperature (b) Remove one half of $C_6H_{12}O_6$

(c) Increase the pressure of O_2 (d) Remove CO_2 by reaction with $CaO_{(s)}$

27. In this three step endothermic reaction

$A_{2(g)} + B_{2(g)} \xrightarrow{step-1} 4C_{(g)} \xrightarrow{step-2} 3D_{(g)} \xrightarrow{step-3} 2E_{(g)}$ *Which of the following statement is/ are correct*

(a) Step-3 is favoured by low temperature and high pressure

(b) Step-1 is favoured by high temperature and low pressure

(c) Step-2 is favoured by low temperature and high pressure

(d) Step-3 is favoured by high temperature and low pressure

28. For the reaction:

$PCl_{5(g)} \rightarrow PCl_{3(g)} + Cl_{2(g)}$ the forward reaction at constant temperature is favored by

(a) Introducing inert gas at constant volume

(b) Introducing Chlorine gas at constant volume

(c) Increasing the pressure of the system

(d) Increasing the volume of the container

6.9 IONIC EQUILIBRIUM IN SOLUTION:
6.10 ACIDS, BASES AND SALTS

29. Which of the following salts are acidic?

(a) NH_4Cl, $CuCl_2$, $AlCl_3$

(b) LiCl, NaCl, KCl

(c) NaCl, NH_4Cl, Na_2CO_3

(d) $NaCH_3CO_2$, KCH_3CO_2, $RbCH_3CO_2$

30. If the acids HA and HB have dissociation constants 1×10^{-3} and 1×10^{-5} respectively, then

(a) HA is five times stronger than HB

(b) HA is ten times stronger than HB

(c) HA is ten times weaker than HB

(d) HA is five times weaker than HB

31. Which is the best choice for weak base-strong acid titration?

(a) Methyl acid

(b) Phenolphthalein

(c) Litmus

(d) Phenol acid

32. The aqueous solution of NH_4CN is slightly alkaline because

(a) It is a salt

(b) CN^- ion hydrolyses to a greater extent than NH_4^+ ion.

(c) NH_4^+ ion hydrolyses to a greater extent than CN^- ion

(d) Both hydrolyses to an equal extent

33. The strongest Bronsted base among the following ions is

(a) CH_3O^-

(b) $C_2H_3O^-$

(c) $(CH_3)_2CHO^-$

(d) $(CH_3)_3CO^-$

34. The best indicator for detection of end point in titration of a weak acid and a strong base is

(a) Methyl red (5 to 6)

(b) Methyl orange (3 to 4)

(c) Phenolphthalein (8 to 9.6)

(d) Bromothymol blue (6 to 7.5)

6.11 IONIZATION OF ACIDS AND BASES

35. Which of the following statements are correct?

1. The pH of 1.0×10^{-8} M solution of HCl is 8
2. The conjugate base of $H_2PO_4^-$ is HPO_4^{2-}
3. Autoprotolysis constant of water increases with temperature

4. When a solution of a weak monoprotic acid is titrated against a strong base at half neutralization point, pH = (1/2) pKa

(a) 2,3 (b) 1,2,3

(c) 3,4 (d) 2,3,4

36. The pH 0.1 M solution the following salts increases in the order

(a) $NaCl < NH_4Cl < NaCN < HCl$ (b) $HCl < NH_4Cl < NaCl < NaCN$

(c) $NaCN < NH_4Cl < NaCl < HCl$ (d) $HCl < NaCl < NaCN < NH_4Cl$

37. The pKa of acetylsalicylic acid (aspirin) is 3.5×10^{-5}. The pH of gastric juice in human stomach is about 2-3 and the pH in the small intestine is about 8. Aspirin will be

(a) Ionized to the stomach and almost unionized in the small intestine

(b) Ionized in the small intestine and almost unionized in the stomach

(c) Unionized in small intestine and in the stomach

(d) Completely ionized in the small intestine and in the stomach.

38. The compound whose 0.1 M solution is basic is

(a) Ammonium acetate (b) Ammonium sulphate

(c) Sodium acetate (d) Ammonium chloride

39. At 25°C, the pH of a vinegar solution is 2.60. What are the values of $[H_3O^+]$ and $[OH^-]$ in the solution?

(a) 2.51×10^{-3} M, 3.99×10^{-12} M (b) 2.30 M, 12.40 M

(c) $3.51 \text{ X } 10^{-4}$ M, $3.99 \text{ X } 10^{-10}$ M (d) $2.51 \text{ X } 10^{-3}$ M, $1.28 \text{ X } 10^{-4}$ M

40. The pKa of HCN is 9.30. The pH of a solution prepared by mixing 2.5 moles of KCN and 2.5 moles of HCN in water and making up the total volume to 500 ml is

(a) 9.30 (b) 8.30

(c) 7.30 (d) 10.30

41. The pH of a 0.1 M aqueous solution of a weak acid (HA) is 3. What is its degree of dissociation?

(a) 1 % (b) 10 %

(c) 50 % (d) 25 %

42. Ammonium cyanide is a salt of NH_4OH of $K_b = 2.5 \times 10^{-5}$ and HCN of $Ka = 4.0 \times 10^{-10}$. The hydrolysis constant of NH_4CN at 25°c is

(a) 4.6 (b) 4.4

(c) 2.4 (d) 1.0

43. HA is a weak acid. The pH of 0.1 M HA solution is 2. What is the degree of dissociation (α) of HA

(a) 0.1 (b) 0.2

(c) 0.4 (d) 0.51

44. In a 50 ml of 0.1 M HCl solution, 10 ml of 0.1 M NaOH is added and the resulting solution is diluted to 100 ml. What is the change in pH of HCl solution?

(a) 4.04 (b) 0.4

(c) 0.1 (d) 0.2

45. Para-aminobenzoic acid acid (PABA), $H_2NC_6H_4(COOH)$, is used in some sunscreens and hair conditioning products. Calculate the pH of an aqueous solution with [PABA] = 0.030 M and Ka = 2.2 x 10^{-5}.

(a) 2.09 (b) 4.98

(c) 6.18 (d) 3.09

46. 20 ml of 0.5 N HCl and 35 ml of 0.1 N NaOH are mixed. The resulting solution will

(a) Turn methyl orange red (b) Turn phenolphthalein solution pink

(c) Be neutral (d) Be basic

47. The dissociation constant of a substituted benzoic acid at 25°C is 1.0 x 10^{-4}. The pH of a 0.01 M solution of its sodium salt is

(a) 6 (b) 8

(c) 7 (d) 4

48. 100 cc of HCl of pH value 1 is mixed with 100 cc of distilled water. The pH of the resultant solution

(a) 1.3 (b) 7

(c) 2.3 (d) 1.9

49. The pKa of a weak acid, HA is 4.80. The pKb of a weak base, BOH is 4.78. The pH of an aqueous solution of the corresponding salt, BA will be

(a) 9.58 (b) 4.79

(c) 7.01 (d) 9.22

50. 50 ml of 0.1 M HCl and 50 ml of 0.2 M NaOH are mixed. The pH of the resulting solution is

(a) 12.7 (b) 10.17

(c) 11.7 (d) 1.30

51. 0.365 g HCl gas was passed through 100 cm^3 of 0.2 M NaOH solution. The pH of the resulting solution would be

(a) 1 (b) 8

(c) 7 (d) 13

52. Which of the following solutions will have pH close to 1.0?

(a) 100 ml of (M/10) HCl + 100 ml of (M/10) NaOH

(b) 55 ml of (M/10) HCl + 45 ml of (M/10) NaOH

(c) 10 ml of (M/10) HCl + 90 ml of (M/10) NaOH

(d) 75 ml of (M/10) HCl + 25 ml of (M/5) NaOH

53. The pH of the solution, produced when an aqueous solution of pH 5 is mixed with an equal volume of an aqueous solution of pH 3, is

(a) 3.3 (b) 4.3

(c) 2.5 (d) 6.3

54. What is the correct relationship between the pHs of isomolar solutions of sodium oxide (pH1), sodium sulphide (pH2), sodium selenide (pH3) and sodium telluride(pH4)?

(a) pH1 > pH2 = pH3 > pH4 (b) pH1 < pH2 < pH3 < pH4

(c) pH1 < pH2 < pH3 = pH4 (d) pH1 > pH2 > pH3 > pH4

55. 75 ml of 0.2 M HCl is mixed with 25 ml of 1 M HCl. To this solution, 300 ml of distilled water is added. What is the pH of the reactant solution?

(a) 1 (b) 2

(c) 4 (d) 0.2

56. When rain is accompanied by thunderstorm, the collected rain water will have a pH value

(a) Slightly lower than that of rain water without thunderstorm

(b) Which depends on the amount of dust in air

(c) Slightly higher than that of rain water without thunderstorm

(d) Uninfluenced by the occurrence of thunderstorm

57. The following reactions are known to occur in the body

$CO_2 + H_2O \leftrightarrow H_2CO_3 \leftrightarrow H^+ + HCO_3^{-1}$

If CO_2 escapes from the system

(a) pH will decrease (b) Hydrogen ion concentration will diminish

(c) H_2CO_3 concentration will remain unchanged (d) The forward reaction will be favoured

58. Which of the following has the highest pH?

(a) 0.1 M NaOH (b) 0.1 M CH_3COOH

(c) 0.01 M NaOH (d) 0.1 M HCl

59. The pH of a 10^{-8} molar solution of HCl in water is

(a) -8 (b) 8

(c) Between 6 and 8 (d) Between 7 and 8

60. At 25°C, the pH of pure water is 7. It dissociates as $H_2O_{(l)} + H_2O_{(l)} \leftrightarrow H_3O^+ + OH^-$, $\Delta H_0 = -13.7$ Kcalmol^{-1}. pH of water at 37°C is expected to be

(a) > 7 (b) = 7

(c) < 7 (d) Cant be predicted

6.12 BUFFER SOLUTIONS

61. Addition of sodium acetate to 0.1 M acetic acid will cause

(a) Increase of pH (b) No change in pH

(c) Change in pH that cannot be predicted (d) Decreases in pH

62. The pH of a buffer solution, containing 0.2 mole per litre of CH_3COONa and 1.5 mol L^{-1} of CH_3COOH is (K_a for acetic acid is 1.8×10^{-5})

(a) 3.45 (b) 4.87

(c) 5.48 (d) 9.23

63. Which of the following compound can form a buffer solution?

(a) Na_2HPO_4 and NaH_2PO_4 (b) HCl and NH_4Cl

(c) CH_3COOH and HCOOH (d) Na_3PO_4 and NaOH

64. A certain buffer solution contains equal concentration of X^- and HX. The Kp for X^- is 10^{-16}. The pH of the buffer is

(a) 6 (b) 10

(c) 4 (d) 14

65. A buffer solution has equal volume of 0.2 M NH_4OH and 0.02 M NH_4Cl. The pKb of the base is 5. The pH is

(a) 4 (b) 10

(c) 7 (d) 9

66. 10 ml of 0.2 M acid is added to 250 ml of a buffer solution with pH = 6.34. The pH of the solution becomes 6.32. The buffer capacity of the solution is

(a) 0.4 (b) 0.3

(c) 0.2 (d) 0.1

67. An acidic buffer solution can be prepared by mixing the solution of

(a) Sodium chloride and sodium hydroxide (b) Sulphuric acid and sodium sulphate

(c) Ammonium chloride and ammonium hydroxide (d) Ammonium acetate and acetic acid

68. 0.15 mole of pyridinium chloride has been added to 500 cm^3 of 0.2 M pyridine solution. What is the pH of the resulting solution assuming no change in volume? (K_b for pyridine = 1.5×10^{-9} M)

(a) 5 (b) 6

(c) 7 (d) 8

6.13 SOLUBILITY EQUILIBRIA OF SPARINGLY SOLUBLE SALTS

69. Three sparingly soluble salts A_2X, AX and AX_3 have the same solubility product. Their solubilities will be in the order

(a) $AX_3 > AX > A_2X$ (b) $AX_3 > A_2X > AX$

(c) $AX > AX_3 > A_2X$ (d) $AX > A_2X > AX_3$

70. Solubility product of $Mg(OH)_2$ at ordinary temperature is 1.96×10^{-11}. pH of a saturated solution of $Mg(OH)_2$ will be

(a) 10.53 (b) 6.78

(c) 3.56 (d) 3.66

71. On adding 1M solution each of Ag^+, Ba^{2+}, Ca^{2+} ions in a Na_2SO_4 solution, species first precipitated is (K_{sp} $BaSO_4 = 10^{-11}$, K_{sp} $CaSO_4 = 10^{-6}$, K_{sp} $Ag_2SO_4 = 10^{-5}$)

(a) $CaSO_4$ (b) Ag_2SO_4

(c) $BaSO_4$ (d) All of these

72. The solubility product of AgI at 25°C is 1.0×10^{-16}. The solubility of AgI in 10^{-4} N solution of KI at 25°C is approximately

(a) 1.0×10^{-6} (b) 1.0×10^{-8}

(c) 1.0×10^{-12} (d) 1.0×10^{-16}

73. H_2S gas when passed through a solution of cations containing HCl precipitates the cations of second group of qualitative analysis but not those belonging to the fourth group. It is because

(a) Solubility product of group II sulphides is more than that of group IV sulphides

(b) Presence of HCl increases the sulphide ion concentration

(c) Sulphides of group IV cations are unstable in HCl.

(d) Presence of HCl decreases the sulphide ion concentration

74. Amongst the following hydroxides, the one which has the lowest value of Ksp at ordinary temperature (about 25°C) is

(a) $Mg(OH)_2$ (b) $Ca(OH)_2$

(c) $Ba(OH)_2$ (d) $Be(OH)_2$

75. The precipitate of CaF_2 (Ksp = 1.7×10^{-10}) is obtained when equal volumes of the following are mixed

(a) 10^{-2} M Ca^{2+} + 10^{-3} M F^- (b) 10^{-3} M Ca^{2+} + 10^{-5} M F^-

(c) 10^{-4} M Ca^{2+} + 10^{-4} M F^- (d) 10^{-5} M Ca^{2+} + 10^{-3} M F^-

76. Out of Ca^{2+}, Al^{3+}, Cr^{3+}, Mg^{2+} and Zn^{2+}, the reagents NH_4Cl and aqueous NH_3 will precipitate

(a) Ca^{2+}, Al^{3+} (b) Al^{3+}, Cr^{3+}

(c) Bi^{3+}, Mg^{2+} (d) Mg^{2+}, Zn^{2+}

Answer Key:

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
b	c	c	b	a	a	a	d	a	c
11.	12.	13.	14.	15.	16.	17.	18.	19.	20.
b	a	b	c	c	c	c	c	a	c
21.	22.	23.	24.	25.	26.	27.	28.	29.	30.
c	a	a	b	d	a	b	d	a	b
31.	32.	33.	34.	35.	36.	37.	38.	39.	40.
a	b	d	c	a	b	b	c	a	a
41.	42.	43.	44.	45.	46.	47.	48.	49.	50.
a	d	a	b	d	a	b	a	c	a
51.	52.	53.	54.	55.	56.	57.	58.	59.	60.
d	d	a	d	a	a	b	a	c	c
61.	62.	63.	64.	65.	66.	67.	68.	69.	70.
a	a	a	c	b	a	d	a	b	a
71.	72.	73.	74.	75.	76.				
c	c	d	d	a	b				

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