SHIKSHA CLASSES

Subject : Chemistry **BOARD ANSWER PAPER** **Total Marks : 20**

Class : XII **Topic : 3. Ionic Equilibria**

Section (A)

Q.1 : a) Select and write the most appropriate answer from the following alternative of each sub question. (05)

i) What is Hydronium ion concentration of a 0.25 M acid HA solution ($K = 4 \times 10^{-8}$)?

Ans : a) 10^{-4}

ii) The pH of 10^{-8} M of HCl is

Ans : c) less than 7

iii) Which of the following is Buffer solution?

Ans : c) CH_3 - COOH + CH_3 COONa in water

iv) Which of the following aqueous solution is acidic in nature?

Ans : c) $(NH_4)_2\ SO_4$

v) For pH > 7 the hydronium ion concentration would be

Ans : b) $< 10^{-7}$ M

(b) Very short answer type Question (02)

i) Define strong electrolyte.

Ans : The electrolytes which ionises almost completely in water are called strong electrolyte e.g. strong acid, strong bases.

ii) What is the pH value of pure water?

Ans : pH of pure water is 7.0.

Section (B)

Q.2 : Answer the following questions. (Any three) (06)

i) Explain degree of dissociation.

Ans : The degree of dissociation of an electrolyte is defined as a fraction of total number of moles of the electrolyte that dissociates into its ions when the equilibrium is attained. It is denoted by α symbol and given by

$$\alpha = \frac{\text{number of moles dissociated}}{\text{total number of moles present initially}}$$

ii) Derive relationship between pH and pOH.

Ans : The ionic product of water is

$$K_w = [H^{\oplus}][OH^{\ominus}] = 10^{-14}$$

Now, $K_w = 1 \times 10^{-14}$ at 298 and thus

$$[H^{\oplus}][OH^{\ominus}] = 1 \times 10^{-14}$$

Taking logarithm of both the sides, we write

$$\log_{10}[H^{\oplus}] + \log_{10}[OH^{\ominus}] = -14$$

$$-\log_{10}[H^{\oplus}] + (-\log_{10}[OH^{\ominus}]) = 14$$

$$\boxed{pH + pOH = 14}.$$

iii) A weak mono basic acid 0.04% dissociated in 0.025 M solution what is pH of solution?

Ans : A weak monobasic acid HA dissociates as :

$\% \alpha = 0.04$

$$= \frac{0.04}{100} = 4 \times 10^{-4}$$

Now $[H^{\oplus}] = \propto \times c$

$$= 4\times10^{-4}\times0.025\times10^{-1} = 10^{-5}M$$

$$\therefore pH = -\log_{10}[H^{\oplus}] = -\log_{10}[10^{-5}]$$

$$pH = 5$$

iv) Why the aqueous solution of NaCl is neutral in nature? Explain.

Ans : The dissociation reactions in the aq. solution of NaCl are

$NaCl_{(aq)} \rightarrow Na^{+}_{(aq)} + Cl^{-}_{(aq)}$

$H_2O \rightleftharpoons H^{+} + OH^{-}$

Na^+ ions will not combine with OH^- ions because NaOH is strong base it will dissociate completely in water.

Similarly H^+ ions will not combine with Cl^- ions because HCl is stong acid it will dissociate completely in water.

Hence solution contains equal no. of H^+ & OH^- ions and thus it is neutral in nature.

Section (C)

Q.3 : Answer the following question. (Any One) (03)

i) The dissociation constant of NH_4OH is 1.8×10^{-5}. Calculate it's degree of dissociation in 0.01 M solution?

Ans : The degree of dissociation is given by $\propto = \sqrt{K_b / c}$.

$K_b = 1.8\times10^{-5}$; $c = 0.01 = 1\times10^{-2}$ M

Hence, $\propto = \sqrt{\dfrac{1.8\times10^{-5}}{1\times10^{-2}}} = \sqrt{1.8\times10^{-3}}$

$= 4.242\times10^{-2}$

$\boxed{\propto = 0.04242}$.

ii) Write a note on Buffer action.

Ans : Resistance of a buffer solution to change its pH when small amount of strong acid or stong base is added is called buffer action. Consider a acidic buffer made by mixing aq. solutions of CH_3COOH & $CH_3COO\,Na$

The reactions of the solution are

$CH_3COOH \rightleftharpoons CH_3CO\bar{O} + H^+$
Acid

$CH_3COO\,Na \rightarrow CH_3CO\bar{O} + Na^+$
base

When small amount of strong acid (HCl) is added then added H^+ ions are neutralise by basic part of buffer

$CH_3CO\bar{O} + H^+ \rightarrow CH_3COOH$

When small amount of strong base (NaOH) is added then added OH^- ions are neutralise by acidic part of buffer

$OH^- + CH_3COOH \rightarrow CH_3COO^- + H_2O$

Hence pH of solution does not change.

Section (D)

Q.4 : Answer the following question. (Any one) (04)

i) What is weak electrolyte? State Ostwald's dilution law and derive the expression for weak acid showing relation between K_a and $\propto$.

Ans : A electrolyte which dissociates partially in water is called weak electrolyte.

Ostwald's dilution law :

Degree of dissociation of weak electrolyte is directly proportional to square root of dilution and inversely proportional to the square root of concentration.

Let 1 mol of weak acid HA is dissolved in V dm^3 of water amd $\propto$ is degree of dissociation of acid

The dissociation reaction is

$\therefore$	HA $\rightleftharpoons$	H^+ +	A^-
Initial	1	0	0
At equilibrium	$\dfrac{1-\propto}{V}$	$\dfrac{\propto}{V}$	$\dfrac{\propto}{V}$

The dissociation constant of acid HA is.

$$K_a = \frac{[H^+][A^-]}{[HA]} = \frac{\frac{\propto}{V} \times \frac{\propto}{V}}{\frac{1-\propto}{V}}$$

$$= \frac{\propto^2 \times V}{V^2 \times (1-\propto)}$$

$$= \frac{\propto^2}{V(1-\propto)}$$

$$\boxed{K_a = \frac{\propto^2}{V(1-\propto)}}$$

But $\frac{1}{V} = C =$ concentration

$$\therefore \boxed{K_a = \frac{\propto^2 C}{1-\propto}}$$

OR

ii) a) Calculate the pH of buffer solution containg 0.05 mol NaF per litre and 0.015 mole HF per litre [$K_a = 7.2 \times 10^{-4}$].

Ans : $pH = pK_a + \log_{10}\frac{[salt]}{[acid]}$

$$\therefore pK_a - \log_{10}K_a = -\log_{10} 7.2 \times 10^{-4}$$

$$= 4 - \log_{10} 7.2 = 4 - 0.8573 = 3.1427$$

$[salt] = 0.05M$ $\quad$ $[acid] = 0.015M$

substitution in above equation.

$$pH = 3.1427 + \log_{10}\frac{0.05}{0.015}$$

$$= 3.1427 + \log 3.33$$

$$= 3.1427 + 0.5185$$

$$= 3.6612$$

$$= 3.67$$

$$\boxed{pH = 3.67}$$

b) Explain Arrhenius theory of Acid and bases.

Ans : Acid : Acid is a substance which contains hydrogen and gives rise to $H^{\oplus}$ ions in aqueous solution.

$$HCl(aq) \xrightarrow{water} H^{\oplus}(aq) + Cl^{\ominus}(aq)$$

Arrhenius described $H^{\oplus}$ ions in water as bare ions; they hydrate in aqueous solutions and thus represented as hydronium ions $H_3O^{\oplus}$.

Base : Base is a substance that contains $OH^{\ominus}(aq)$ ions in aqueous solution.

$$NaOH(aq) \longrightarrow Na^{\oplus}(aq) + OH^{\ominus}(aq)$$

Arrhenius theory accounts for properties of different acids and bases and is applicable only to aqueous solutions.

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