



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) $\text{CH}_3 - \text{COOH} + \text{CH}_3 \text{COONa}$ in water

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

Ans : c) $(\text{NH}_4)_2 \text{SO}_4$

v) For $\text{pH} > 7$ the hydronium ion concentration would be

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

(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

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

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

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

Taking logarithm of both the sides, we write

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

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

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

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

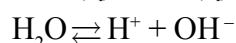
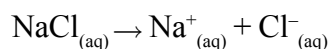
$$= 4 \times 10^{-4} \times 0.025 \times 10^{-1} = 10^{-5} M$$

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

$$pH = 5$$

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

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



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 strong 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 its degree of dissociation in 0.01 M solution?**

Ans : The degree of dissociation is given by

$$\alpha = \sqrt{K_b / c}$$

$$K_b = 1.8 \times 10^{-5}; c = 0.01 = 1 \times 10^{-2} M$$

$$\text{Hence, } \alpha = \sqrt{\frac{1.8 \times 10^{-5}}{1 \times 10^{-2}}} = \sqrt{1.8 \times 10^{-3}}$$

$$= 4.242 \times 10^{-2}$$

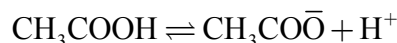
$$\boxed{\alpha = 0.04242}$$

ii) **Write a note on Buffer action.**

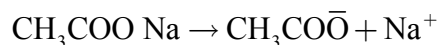
Ans : Resistance of a buffer solution to change its pH when small amount of strong acid or strong base is added is called buffer action. Consider an acidic buffer made by mixing aq.

solutions of CH_3COOH & CH_3COONa

The reactions of the solution are

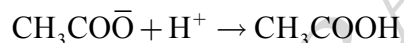


Acid

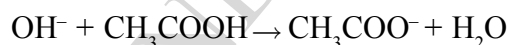


base

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



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



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 α .**

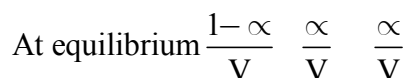
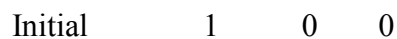
Ans : An electrolyte which dissociates partially in water is called weak electrolyte.

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 dm³ of water and α is degree of dissociation of acid

The dissociation reaction is



The dissociation constant of acid HA is.

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

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

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

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

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

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

OR

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

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

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

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

$$[\text{salt}] = 0.05\text{M} \quad [\text{acid}] = 0.015\text{M}$$

substitution in above equation.

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

$$= 3.1427 + \log 3.33$$

$$= 3.1427 + 0.5185$$

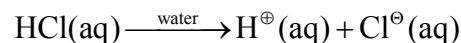
$$= 3.6612$$

$$= 3.67$$

$$\boxed{\text{pH} = 3.67}$$

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.



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.



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

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