ACID BASE CONCEPTS: TITRATIONS

Q. 1. Write a note on common ion effect.

Ans. The phenomenon of lowering the degree of ionization of weak electrolyte by adding to it a solution of strong electrolyte having common ions is known ion effect.

Eg: $NH_4OH \rightleftharpoons NH_4^+ + OH^-$

Applying Law of mass action

$$K = \frac{[NH_4^+][OH^-]}{[NH_4OH]}$$

On Addition of NH_4Cl, NH_4^+ are added to solution. This ion is in common in both & known as common in effect. The value of NH_4^+ increases and because k is constant at any fixed temp. There is increase in value of $[NH_4OH]$ and decrease in value of $[OH^-]$

$NH_4Cl \rightleftharpoons NH_4^+ + Cl^-$

$\therefore$ ionization of NH_4OH is decreased/suppressed by addition of NH_4Cl which gives NH_4^+ common ion.

Eg. Dissociation of H_2S in presence of HCl.

$H_2S \rightleftharpoons 2H^+ + S^-$ H^+ ion being common

$HCl \rightleftharpoons H^+ + Cl^-$

dissociation NH_4OH of in presence of NH_4Cl

$NH_4OH = NH_4^+ + OH^-$ NH_4^+ being common

$NH_4Cl \rightleftharpoons NH_4^+ + Cl^-$

Q. 2. Write a note of pH.

Ans. pH scale was given by 'sorensen'. It is used to express H^+ concentration. The term pH was originally written as pH^+ which represented H^+ potential

pH is defined as log of reciprocal of the H^+ conc.

$$pH = \log 1/H_3O^+ \qquad (1)$$

According to rules of log eq (1) can be written as

$$pH = \log 1 - \log [H_3O^+] \qquad (2)$$

Since log of 1 is zero

$\therefore$ $pH = - \log [H_3O^+]$ (3)

eq. (1) and (3) are identical pH of a solution may be considered in term of numeric scale having value from 0 to 14.

Degree of acidity to 0 to 7

And degree of alkalinity 7 to 14

Value 7 at which H^+ and OH^- ion conc. are equal at room temp is referred as neutral point or neutrality. Neutral pH at 0°C is 7.47 and at 100°C is 6.15 in pure water

$[H^+] = 10^{-7}$ g ion/lit

$\therefore \log [H^+] = \log [10^{-7}] = - 7$

or $\log [H^+] = - \log [10^{-7}] = - (-7) = 7$

- log is denoted by p

$\therefore$ $- \log [H^+] = pH = 7$

Q. 3. What is POH show relation between pH and POH.

Ans. Suppose in a solution, conc. of OH^- is 10^{-5} ion/lit then it's P^{OH} Value will be

$POH = - \log [OH^-] = - \log 10^{-5} = - (-5) = 5$

Relation between pH and POH

We know that ionic product of H_2O, kw at 25°C is $1x10^{-14}$

$\therefore$ PKw will be written as

$PKw = - \log Kw = - \log 10^{-14} = - (-14) = 14$

$Kw = [H^+] [OH^+] = 10^{-14}$

$\therefore \log Kw = \log [H^+] \times \log [OH^-] = \log 10^{-14}$

$\log kw = \log [H^+] + \log [OH^-] = \log 10^{-14}$

Multiplying above equation throughout by (-1)

$- \log kw = - \log [H^+] - \log [OH^-] = - \log 10^{-14}$

$PKw = pH + pOH = - (-14) = 14$

$\therefore$ $pH + POH = 14$

Applicable to all dilute solutions at room temp. If pH value is known, value of POH can be calculated and vice-versa

$pH = 14 - POH$

$POH = 14 - pH$

Q. 4. In an aqueous solution $[H^+] = 10^{-3}$ g/lit; calculate pH and POH value

Ans. $[H^+] = 10^{-3}$ g ion/lit

$pH = - \log [H^+] = - \log_{10^{-3}} = 3$

or $\{pH = \log \frac{1}{H^+} = \log \frac{1}{10^{-3}} = \log^3 = 3\}$

$[H^+] [OH^-] = 10^{-14}$

$OH^- = \frac{10^{-14}}{[H]^+} = \frac{10^{-14}}{10^{-3}} = 10^{-14} \times 10^3 = 10^{-11}$

$\therefore$ POH of solution will be 11

$pH + POH = 3 + 11 = 14$

Q. 5. $[H_3O^+]$ conc. of a 0.05 solution of HCl is 0.05 M. What is pH of this solution.

Ans. $pH = - \log (5 \times 10^{-2}) = - \log_{10^{-2}} - \log 5$

$= 2 - 0.70 = 1.30$