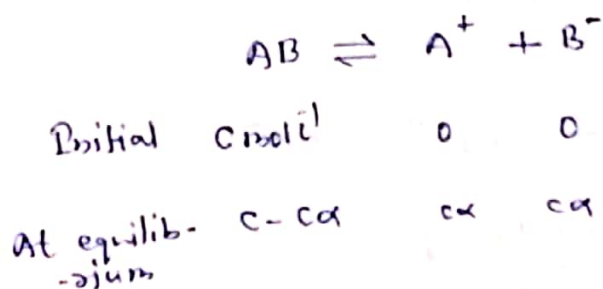


Ionic Equilibrium

Ostwald's dilution law:-

Let us consider the dissociation of an electrolyte AB. Let $C \text{ mol l}^{-1}$ be its initial concentration and α is its degree of dissociation.



Degree of dissociation (α) is defined as the fraction of an electrolyte dissociates from 1 mole of an electrolyte.

then,

$$K = \frac{[A^+][B^-]}{[AB]}$$

$$\approx K = \frac{C\alpha \times C\alpha}{C - C\alpha} = \frac{C^2 \alpha^2}{C(1-\alpha)}$$

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

(1)

The eqn is mathematical formulation of Ostwald dilution law.

where K is called dissociation constant of an electrolyte AB.

for very weak electrolytes —

$$\alpha \ll 1 \quad \& \quad 1 - \alpha = 1$$

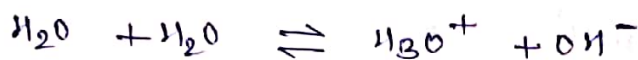
then, from eq^s - ①

$$K = c \alpha^2$$

$$\therefore \alpha = \sqrt{K/c} = \left(\frac{K}{c}\right)^{1/2}$$

Where, α is degree of dissociation of an electrolyte.

* Ionic Product of Water :-



$$K = \frac{[\text{H}_3\text{O}^+][\text{OH}^-]}{[\text{H}_2\text{O}]^2}$$

$$K \times [\text{H}_2\text{O}]^2 = [\text{H}_3\text{O}^+][\text{OH}^-]$$

Concentration of pure water is taken to be constant.

$$\therefore K_w = [\text{H}_3\text{O}^+][\text{OH}^-] \quad \left(K \times [\text{H}_2\text{O}]^2 = K_w\right)$$

Where, K_w = Ionic product of water.

K_w is constant, but it varies with temp^o. with the increase in ~~temperature~~ temperature, ionisation of water increases and thus K_w increases.

At 25°C \approx 298 K.

$$K_w = 10^{-14}$$

$$\text{So, } [\text{H}_3\text{O}^+][\text{OH}^-] = 10^{-14}$$

\Rightarrow for neutral solutions -

$$[\text{H}_3\text{O}^+] = [\text{OH}^-] = 10^{-7} \text{ mol l}^{-1}$$

for Acidic solution —

$$[H_3O^+] > [OH^-]$$

s.e. $[H_3O^+] > 10^{-7}$

∴ $10^{-6}, 10^{-5}, 10^{-4}, 10^{-3}$ -----

⇒ for alkaline solution —

$$[H_3O^+] < [OH^-]$$

$$[H_3O^+] < 10^{-7}$$

s.e. $10^{-8}, 10^{-9}, 10^{-10}$ -----

pH ⇒ Potenz of Hydrogen ion Concentration or $[H_3O^+]$
↓
Power

pH is defined as the negative logarithm of $[H_3O^+]$ in mol L⁻¹.

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

⇒ for neutral solⁿ — $[H_3O^+] = 10^{-7}$
$$pH = -\log 10^{-7} = -(-7) \log 10$$

$$= +7.$$

⇒ for Acidic solution —

$$[H_3O^+] = 10^{-6}, 10^{-5}, 10^{-4}$$

$$pH = 6, 5, 4 \text{ ----- (Acidic strength increases)}$$

⇒ for Alkaline solution —

$$[H_3O^+] = 10^{-8}, 10^{-9}, 10^{-10}$$

$$pH = 8, 9, 10 \text{ ----- (Alkalinity increases)}$$

—x—

(Dr. A. K. Gupta)