GROUP - A (Physical)

From,
Dr. A. K. Gupta
(chemistry)
L.S. College, Muz

Ionic equillibria

Ostwald's dilution law:-

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

	AB	$\rightleftharpoons A^+$	$+ B^-$
Initial	C molL^{-1}	0	0
At equilibrium	$C - C\alpha$	$C\alpha$	$C\alpha$

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

then,

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

or

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

$$\boxed{K = \frac{C\alpha^2}{(1-\alpha)}} \quad \text{—— (1)}$$

This eqn is mathematical formulation of Ostwald dilution law.

where K is called dissociation constant of an electrolyte AB.

for very weak Electrolytes —

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

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then, from eq^s — ①

$$K = C\alpha^2$$

$$\text{or} \quad \alpha = \sqrt{K/C} = (K/C)^{1/2}$$

Where, α is degree of dissociation of an electrolyte.

* Ionic Product of Water :-

$$H_2O + H_2O \rightleftharpoons H_3O^+ + OH^-$$

$$K = \frac{[H_3O^+][OH^-]}{[H_2O]^2}$$

$$K \times [H_2O]^2 = [H_3O^+][OH^-]$$

Concentration of pure water is taken to be Constant.

$$\therefore \quad K_w = [H_3O^+][OH^-] \qquad (K \times [H_2O]^2 = K_w)$$

Where, K_w = Ionic product of water.

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

At 25°C or 298 K.

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

$$\text{So,} \quad [H_3O^+][OH^-] = 10^{-14}$$

⇒ for neutral solution —

$$[H_3O^+] = [OH^-] = 10^{-7} \text{ mol } L^{-1}.$$

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For Acidic Solution —

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

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

$\therefore 10^{-6}, 10^{-5}, 10^{-4}, 10^{-3}$ ....

⇒ for alkaline solution —

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

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

i.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 ...... (Acidic Strength increases)

⇒ For Alkaline solution —

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

pH = 8, 9, 10 .... (Alkalinity increases.

—x—

(Dr. A. K. Gupta)

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