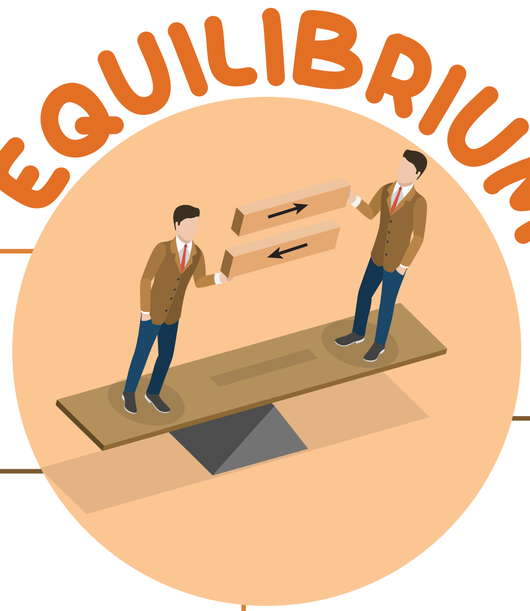
EQUILIBRIUM



Ionic Product of Water

$$2H_2O \rightleftharpoons H_3O^+ + OH^-$$

$$K_W = [H_3O^+][OH^-] = 1\times10^{-14}M^2$$

$$\therefore [OH^-] = [H^+] = 10^{-7}M @ 298\ K$$

$$pK_W = pK_a + pK_b = 7 + 7 = 14$$

Solubility Product (Ksp)

$$aA \rightleftharpoons cC + dD$$

$$Ksp = [C]^O[D]^d$$

Ostwald's Dilution Law

Applicable for weak electrlytes

$$\therefore K_c = C\alpha^2 \text{ or } \alpha = \sqrt{\left(\frac{K_c}{C}\right)}$$

$$\text{So, } \alpha = \frac{1}{\sqrt{c}} \text{ or } \propto \sqrt{v}$$

where V is the volume of solution at infinite dilution

Hydrolysis of Salts

Salts of strong base and strong acid does not undergo hydrolysis. eg. naCl, KCl

- Salt of weak base and Strong Acid

$$K_h = \frac{k_w}{K_b};\ P^H = \frac{1}{2}\left[pK_{2_a} - pK_b - \log c\right]$$

- Salt of weak Acid and weak base

$$K_h = \frac{K_w}{K_a \times K_b};\ p^H = \frac{1}{2}[pK_w - pK_a - pK_b]$$

Acids and Base

- Acids: Liberates H_2 on reacting with metals Turns blue litumus into red
- Base: Taste bitter and feel soapy Turns red litmus into blue

$$\text{Acidic} \Rightarrow [H_3O^+] > [OH^-]$$

$$\text{Basic} \Rightarrow [H_3O^+] < [OH^-]$$

$$\text{Neutral} \Rightarrow [H_3O^+] = [OH^-]$$

Direction of reaction

$Q_c > K_c$

Reaction goes from left to right

$Q_c < K_c$

Reaction goes from right to left

$Q_c = K_c$

No Net reaction occurs

Factor's of reaction

Le Chatlier's Principle

- Effect of concentration change concentration $\rightarrow$, equilibrium shift forward.
- Effect of pressure change equilibrium will shift in the direction having smaller number of moles.
- Effect of temperature change

  For exothermic $\rightarrow$ low temperature favors formation of reactants.

  For Endothermic $\rightarrow$ High temperature favors formation of products.
- Effect of inert gas $\rightarrow$ No change
- Effect of catalyst $\rightarrow$ No change

Law of chemical Equilibrium Equilibrium Law

$$aA + bB \rightleftharpoons cC + dD$$

$$K_c = \frac{[C]^C[D]^d}{[A]^a[B]^6}$$

Here K_c is equilibrium constant

Relation between equilibrium constant k_p and k_c

$$K_p = K_c(RT)^{\Delta ng}$$

Gibb'S energy

$$\Delta G = RT \ln K$$

ΔG = -ve. Spontaneous reaction

Reaction proceeds forward.

ΔG = +ve. Non Spontaneous reation

Reaction proceeds backward

ΔG = zero. equilibrium achieved

p^H Concept

$$p^H = -\log[H^+]$$

OR

$$p^H = -\log[H_3O^+]$$

for weak acid $\rightarrow$ $P^H = \frac{1}{2}(C_pK_a - \log C)$

Definition

Chemical reaction reach a state of dynamic equilibrium in which the rate of forward reaction and backward reation are same and there is No Net change in composition

Homogeneous

Reactant and Product are in Same Phase

Hetrogeneous

Reactant and Product are in different Phase

Physical Equilibrium

Equilibrium set up in a physical process like evaporation of water etc.

$(S) \rightleftharpoons (l)$

$(l) \rightleftharpoons (g)$

$(g) \rightleftharpoons (S)$

Chemical Equilibrium

Equilibrium attained in a chemical reaction

$$3H_2 + N_2 \rightleftharpoons 2NH_3$$

- Possible only in a closed system.
- Both reaction occur at same rate
- All measurable property remains constant