Equilibrium

① $A + B \rightleftharpoons C$ — K

② $C \rightleftharpoons A + B$ — $1/K$

③ $A \rightleftharpoons B$, $C \rightleftharpoons D$ — $K_1 \times K_2$

$A + C \rightleftharpoons B + D$

④ $A \rightleftharpoons B$, $C \rightleftharpoons D$ — K_1 / K_2

$A - C \rightleftharpoons B - D$

⑤ $K_p = K_c (RT)^{\Delta n_g}$

Eg: ① $2HI_{(g)} \rightleftharpoons H_{2(g)} + I_{2(g)}$

	$2HI$	H_2	I_2
$t=0$	a	—	—
t_{eq}	$a-x$	$x/2$	$x/2$
conc^n	$\frac{a-x}{V}$	$\frac{x}{2V}$	$\frac{x}{2V}$

(concentration)

$$K_c = \frac{[H_2][I_2]}{[HI]^2}$$

⑥ Dealing in terms of pressure.

$AB_3 \rightleftharpoons AB_2 + 1/2\ B_2$

	AB_3	AB_2	B_2
Initial	2	—	—
Peq.	$2-P$	P (partial pressure)	$P/2$

$P_T = 2 - P + P + P/2 \Rightarrow 2 + P/2$

⑦ K_c in terms of Degree of Dissociation.

$2HI \rightleftharpoons H_{2(g)} + I_{2(g)}$

	$2HI$	H_2	I_2
$t=0$	a	—	—
t_{eq}	$a-a\alpha$	$a\alpha/2$	$a\alpha/2$
conc.	$\frac{a-a\alpha}{V}$	$\frac{a\alpha}{2V}$	$\frac{a\alpha}{2V}$

$$K_c = \frac{[H_2][I_2]}{[HI]^2}$$

⑧ Reaction Quotient (Q_c).

→ Application of rxn quotient

① $Q_c = K_c$ (equilibrium)

② $Q_c > K_c$ (backward dirn)

③ $Q_c < K_c$ (forward dirn)

$$\log \frac{K_2}{K_1} = \frac{\Delta H}{2.303\ R}\left[\frac{T_2 - T_1}{T_1 T_2}\right]$$

Ionic equilibrium

① Ionic product

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

	H_2O	H^+	OH^-
$t=0$	C		
$t=eq.$	$C - C\alpha$	$C\alpha$	$C\alpha$

② Acids in pure water.

when we have to neglect water conc. ~~10^{-7} वाला नहीं~~

① 10^{-5} or ~~$>$~~ 10^{-5} — neglect 10^{-7} (water)

② 10^{-9} or ~~$<$~~ 10^{-9} — neglect conc. of Acid

③ 10^{-6} or 10^{-8} (take average)

① strong acid in pure water ② strong base in pure water } only for very strong acid/base in water

③ Weak acid in water

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

$\alpha < 0.05$ (α neglect)

$\alpha > 0.05$ (count)

a) $K_a = C\alpha^2$

b) $[H^+] = C\alpha$ — $pK_a = -\log a$

c) $[H^+] = \sqrt{K_a \cdot C}$

$pH = 1/2\ pK_a - \log C$ (acid)

$pOH = 1/2\ pK_b - \log C$ (base)

(1) Arrhenius — H^+ देता है OH⁻ देता है

(2) Brownsted-lawry — H^+ देता है / H^+ लेता है

(3) Lewis acid — e⁻ pair लेता है (Acid) / e⁻ pair देता है (Base)

Mixing of two strong acids or Mixing of two strong bases.

$$[H^+] = \frac{M_1V_1nF_1 + M_2V_2nF}{V_1 + V_2}$$

$$[H^+] = \frac{\text{Total moles}}{\text{Total Volume}}$$

Salt Hydrolysis

⇒ valid for only conjugate acid & base pair

$$K_w = K_a \times K_b$$

$$pK_w = pK_a + pK_b$$

- जब strong cation or strong anion of strong acid or base के द्वारा Hydrolysis नहीं Involve करता तो,

$K_h = ch^2$ since $K_c = c\alpha^2$

$$K_h = \frac{K_w}{K_a} \qquad h = \sqrt{\frac{K_h}{c}} \qquad pK_h = ch^2$$

(1) WiA + SiB : $pH = \frac{1}{2}(pK_w + pK_a + \log c)$

(2) SiA + WiB : $pH = \frac{1}{2}(pK_w - pK_b - \log c)$

(3) WiA + WiB : $pH = \frac{1}{2}(pK_w + pK_a - pK_b)$

Buffer soln

(1) Acidic Buffer

Weak acid + salt of WiA & strong Base

(2) Basic Buffer

Weak base + salt of WiB & Si Acid.

(1) Acidic Buffer

$$[H^+] = K_a \frac{[\text{acid}]}{[\text{salt}]}$$

(2) Basic Buffer

$$[OH^-] = K_b \frac{[\text{base}]}{[\text{salt}]}$$

solubility product # (K_{sp})

Eg $BaSO_4(s) \rightleftharpoons Ba^{2+}(aq) + SO_4^{2-}(aq)$

$$K_{eq} = \frac{[Ba^{2+}][SO_4^{2-}]}{[BaSO_4]}$$

$K_{eq} \times [BaSO_4] = [Ba^{+2}][SO_4^{2-}]$

$$K_{sp} = [Ba^{2+}][SO_4^{2-}]$$

$$K_{sp} = x^x \cdot y^y \cdot s^{x+y}$$

concept of precipitation

(1) $K_{ip} = K_{sp}$ — solute is saturated

(2) $K_{ip} < K_{sp}$ — (unsaturated)

(3) $K_{ip} > K_{sp}$ — (precipitation occurs)