

Nole concept

- ① Equivalent Mass = $\frac{\text{Nole mass}}{\text{change in oxid. no.}}$
- ② Mass % = $\frac{\text{mass of solute}}{\text{mass(g) soln}} \times 100$
- ③ Mole fraction = $(\gamma_A = \frac{n_A}{n_A+n_B})$
- ④ Volume percent (V/V) = $(\frac{\text{volume of solute}}{\text{volume of solution}} \times 100)$
- ⑤ Mass volume percent ($\frac{w}{V}$) = $(\frac{\text{mass of solute}}{\text{vol of soln}} \times 100)$
- ⑥ Molarity = $\frac{\text{moles of solute}}{\text{volume of solution}}$
- ⑦ Normality = $\frac{\text{no. of equivalents}}{\text{vol (l) soln. in lit}}$
- ⑧ Molecular formula = $(n \times \text{Empirical formula})$
- ⑨ Molality = $\frac{\text{no. of moles of solute}}{\text{Mass of solvent (in kg)}}$
- ⑩ no. of equivalents (E) = $\frac{\text{mass}}{\text{equivalent mass}}$

Structure of Atoms

- * Energy of Photon = $E = h\nu = \frac{hc}{\lambda}$
- * Photo electric effect =
$$h\nu = h\nu_0 + \frac{1}{2}mv^2$$
- * Radius of the n^{th} orbit = $\frac{an^2}{Z}$ $a = 52.9 \text{ pm}$
- * Bohr's radius of H-atom (a_0) = 0.529 \AA
- * Velocity in n^{th} orbit = $2.18 \times 10^6 \frac{Z}{n} \text{ m/sec.}$
- * Energy of H-atom in ground state = $R_H Z^2 \left[\frac{1}{n_1^2} - \frac{1}{n_2^2} \right]$
- * $I \cdot E = \frac{\Delta E}{hc} =$ De Broglie's wavelength, $\lambda = \frac{h}{mv}$, $\lambda = \frac{h}{p}$
- * Heisenberg's Uncertainty principle

$$\Delta x \cdot mv \geq \frac{h}{4\pi}$$

- * Radial nodes = $n - l - 1$
- * angular nodes = l
- * Total nodes = $(n - l - 1) + l = (n - 1)$ ✓
- * orbital angular momentum = $\sqrt{l(l+1)\hbar} / 2\pi$
- * spin angular momentum = $\left(\sqrt{s(s+1)} \frac{\hbar}{2\pi} \right)$

Gaseous State

$$\textcircled{1} \quad \frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$

\textcircled{2} Dalton's law:

$$P_{\text{total}} = P_1 + P_2 + P_3 + \dots$$

\textcircled{2} Graham's law

$$\frac{r_1}{r_2} = \sqrt{\frac{P_2}{P_1}} = \sqrt{\frac{M_2}{M_1}}$$

If 2 gases diffuse under different pressures, then

$$\frac{r_1}{r_2} = \frac{P_1}{P_2} \sqrt{\frac{M_2}{M_1}}$$

\textcircled{3} Root Mean Square Velocity

$$\sqrt{\frac{3RT}{M}} = \sqrt{\frac{3PV}{M}}$$

\textcircled{4} Average Velocity

$$\sqrt{\frac{8RT}{\pi M}}$$

\textcircled{5} Compressibility factor

$$\sqrt{\frac{2RT}{M}}$$

\textcircled{6} Vanderwaal's eq

$$\left(P + \frac{n^2 a}{V^2} \right) (V - nb) = nRT$$

(volume correction)
↳ pressure correction
(between gas molecules)

(measure of force of attraction b/w gas molecules)

\textcircled{7} Critical Pressure

$$P_c = \frac{a}{27b^2}$$

$$V_c = 3b$$

$$T_c = \frac{8a}{27Rb}$$

\textcircled{8} Boyle's Temp.

$$T_b = \frac{a}{Rb}$$

Thermodynamics

- * Intensive Variables: whose values on division remain the same.
- * Extensive Variables: whose value changes on division..
- * First law of Thermodynamics:
$$\boxed{\Delta E = q + w}$$
 - under constant press. = $\boxed{\Delta E = \Delta H}$
 - for isochoric process, $\Delta V = 0$, $P\Delta V = 0$, $\boxed{\Delta E = q}$
 - for adiabatic change, $\boxed{q = 0}$
$$W = -\Delta E = -C_V \Delta T = -C_V(T_2 - T_1)$$
$$\boxed{\Delta H = \Delta E + \Delta n g RT}$$
- * Second law of Thermodynamics
$$\eta = \frac{T_2 - T_1}{T_2} = \frac{q_2 - q_1}{q_2}$$
 (Carnot cycle)
- * Gibbs free energy $\rightarrow \boxed{G = H - TS}$
 $G \rightarrow$ Gibbs free
 $(\Delta S)_{\text{total}} > 0$, spontaneous
 $(\Delta S)_{\text{total}} < 0$, non-spontaneous
 $(\Delta S)_{\text{total}} = 0$, equilibrium

Chemical Equilibrium



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

$$K_p = \frac{[P_C]^c [P_D]^d}{[P_A]^a [P_B]^b}$$

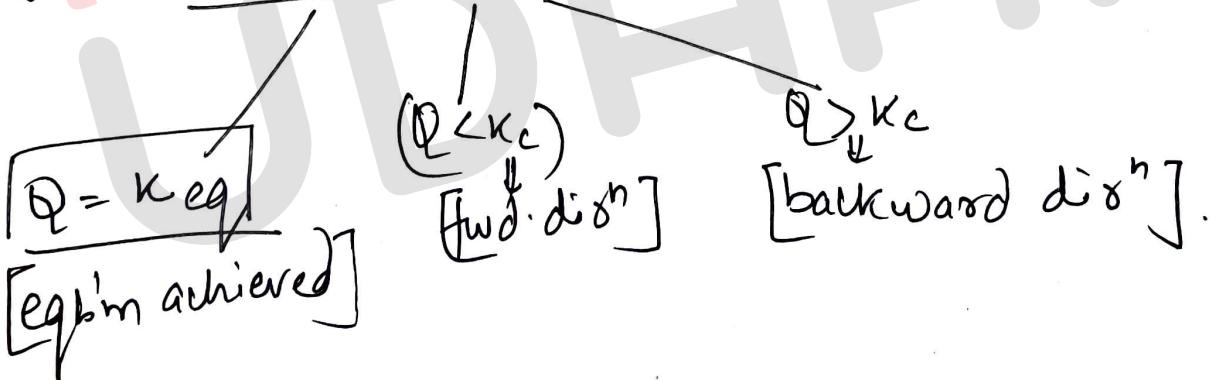
$$\boxed{K_p = K_c (RT)^{\Delta n}}$$

$$\Delta n = (c+d) - (a+b)$$

* If the equation is divided by factor 'n', the new eqⁿ. constant is n^{th} root of the previous value.

* The value of K for a given eq^{b/m} constant if the eq^{b/m} temp. does not change.

Reaction Quotient Q



Electrochemistry

① Λ_m = molar conductance, $\frac{1000 \times \text{specific conductance}}{\text{conc. (molarity)}}$

② $E_{\text{cell}} = E_{\text{cell}}^{\circ} - \frac{0.059}{n} \log \frac{[\text{Anode}]}{[\text{Cathode}]}$.

③ $E_{\text{cell}} = E_{\text{cell}}^{\circ} - \frac{0.059}{n} \log K$.

④ $E_{\text{cell}}^{\circ} = E_{\text{cathode}}^{\circ} - E_{\text{anode}}^{\circ}$

⑤ $\Delta G^{\circ} = -nF E_{\text{cell}}^{\circ}$

⑥ Cell constant (G^*) = $\frac{l}{A}$.

⑦ Conductivity = $\frac{1}{\text{Resistivity}}$
 $\kappa = \frac{1}{R} \leftarrow$

Faraday's law

(a) First law

$$W = Z i t \rightarrow Z C$$

$$Z = \frac{\text{atomic wt.}}{n \times 96500}$$

⑨ $\Delta G_1^{\circ} + \Delta G_2^{\circ} = \Delta G_3^{\circ}$,

$$E_3^{\circ} = \frac{n_1 E_1^{\circ} + n_2 E_2^{\circ}}{n_3}$$

⑩ $\kappa = \frac{K \times 1000}{C}$

⑪ $\alpha = \frac{C}{\Lambda_m^{\circ}}$

$\alpha \rightarrow$ degree of dissociation.
 $\Lambda_m^{\circ} \rightarrow$ molar conductance at any conc'.
 Λ_m° = limiting molar conductance

(b) Second law

$$\frac{\text{wt. of metal A}}{\text{wt. of metal B}} = \frac{\text{eq. wt. of A}}{\text{eq. wt. of B}}$$

Solutions

① Henry's Law [solubility of gas $\propto P$]
 $m \propto P \rightarrow P = k_h x$

② Vapour pressure
 $P_A = p_A^o x_A + p_B^o x_B \quad (x_A + x_B = 1)$

③ mole fraction of the given component in vapour phase above liquid mixture..

$$x'_A = \frac{p_A^o x_A}{p_A^o x_A + p_B^o x_B}$$

④ Deviation from Raoult's law

$$\Delta H_{mix} > 0 \\ \Delta V_{mix} > 0$$

$$(v_e) \\ \Delta H_{mix} < 0 \\ \Delta V_{mix} < 0$$

$$\Delta T_b = i K_b m \\ \Delta T_f = i K_f m \\ \Pi = i CRT$$

⑤ Colligative Properties

Relative lowering in vapour press.

$$\frac{\Delta P}{P^o} = x_1 = \frac{n_2}{n_1 + n_2} \approx \frac{n_2}{n_1}$$

Elevation in B. IP

Depression in F.P.
for dilute solution

Osmotic Pressure

$$\Delta T_f = K_f m$$

$$\Pi = CRT$$

$$\Delta T_b = K_b m$$

⑥ Vant Hoff factor (i)
 $y = \text{no. of ions or molecules due to ionisation or association}$

$$i = [1 + (y-1)x]$$

$i = 1$; when no charge
 $i > 1$; when dissociation
 $i < 1$; association

$$\frac{\text{Ionic Eq b'm}}{\alpha = \sqrt{\frac{K_a}{C}}}$$

* Solubility product (K_{sp}) $A_x B_y \rightleftharpoons (xA + yB)$

$$K_{sp} = x^y y^y (s)^{x+y}$$

AB is precipitated if $[A^+][B^-] > K_{sp}$.

* $K_w = [H_3O^+][OH^-] = 10^{-14}$ @ 298 K.

* $pK_a + pK_b = pK_w = 14$

~~$pK_w = pH + pOH = 14$~~

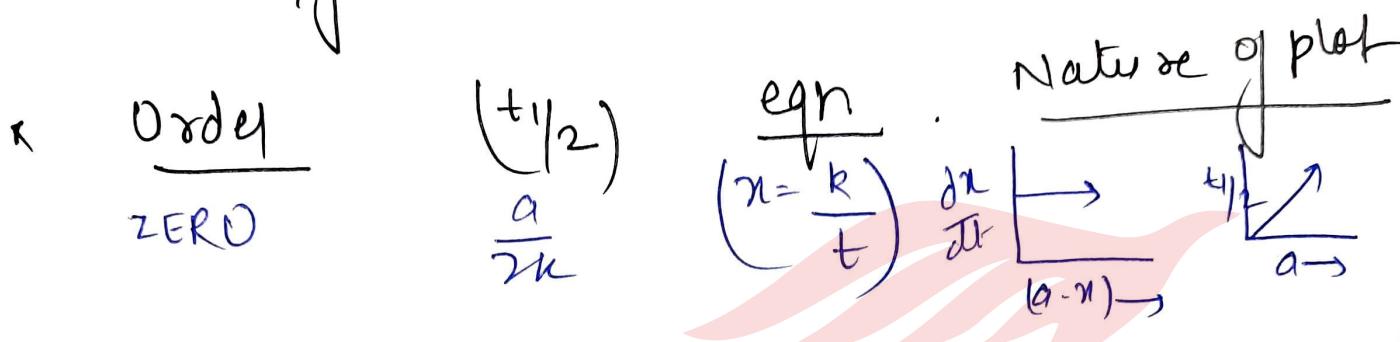
* Henderson's formula for buffer

① Acidic $pH = pK_a + \log \frac{[\text{Conjugate Base}]}{[\text{Weak Acid}]}$

② Basic $pOH = pK_b + \log \frac{[\text{Conjugate Acid}]}{[\text{Weak base}]}$

Chemical Kinetics

- * Unit of rate constant
 $\left[\text{mol}^{1-n} \text{l}^{n-1} \text{s}^{-1} \right]$ number of the reaction.
- * Rate of Rxn., $R [A]^x [B]^y$
 w.r.t, orders w.r.t A & B.



(FIRST)

$t_{1/2} = \frac{0.693}{k}$

$k = 2.303 \frac{\log(a)}{t}$

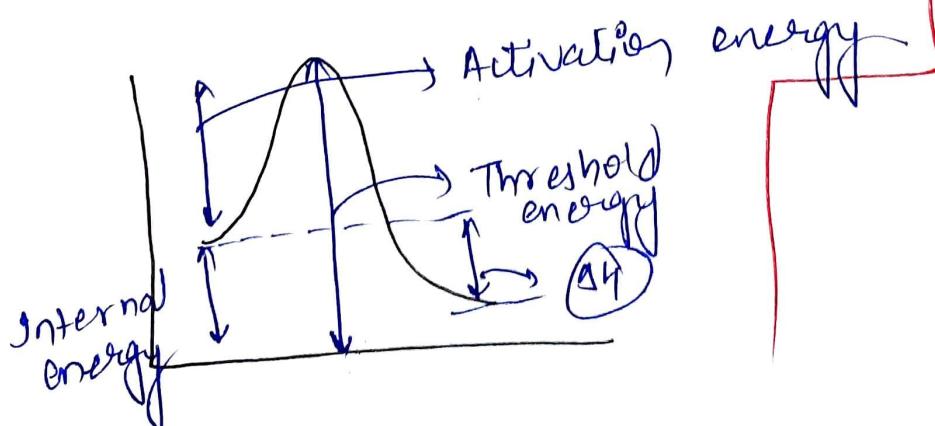


* Temperature coeff (n)

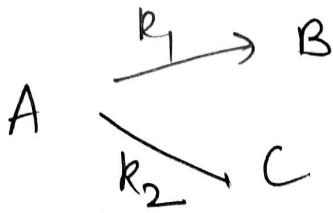
, $\frac{\text{rate const at } T + 10^\circ \text{C}}{\text{rate const at } T}$

$$\log\left(\frac{k_2}{k_1}\right) = \frac{Ea}{2.303 R} \left[\frac{1}{T_1} - \frac{1}{T_2} \right]$$

$$R = A e^{-Ea/RT}$$



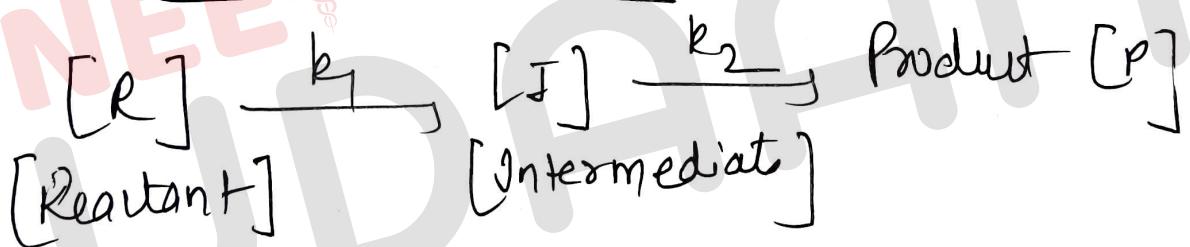
for parallel Reactions



$$(k_1 + k_2) = \frac{2.303}{t} \log \left(\frac{a_0}{a_0 - x} \right)$$

$$\therefore \frac{\text{amt. of } B \text{ at time } t}{\text{amt. of } C \text{ at time } t} = \left(\frac{k_1}{k_2} \right) \checkmark$$

Consecutive Reactions



[Concentration of I is max^m at time t]

$$t_{\max} = \frac{\ln k_2 - \ln k_1}{k_2 - k_1}$$