

CLASS-12 BOARDS

FORMULA SHEET

By - Bharat Panchal Sir...

Bharat Panchal Sir  Chemistry Guruji 2.0

To help in our Journey

YOU CAN DONATE



SOLUTIONS

$$\text{Mass Percentage } (\omega/w)\% = \frac{\omega_2}{\omega_1 + \omega_2} \times 100$$

$$\text{Volume Percentage } (V/V)\% = \frac{V_2}{V_1 + V_2} \times 100$$

$$\text{Mass by Volume Percentage } (\omega/v) = \frac{\omega_2}{V \text{ (cm}^3 \text{ ml)}} \times 100$$

Mass fraction

$$x_1 = \frac{\omega_1}{\omega_1 + \omega_2} \quad \text{or} \quad x_2 = \frac{\omega_2}{\omega_1 + \omega_2}$$

$$\text{Parts per million (ppm)} = \frac{\omega_2}{\omega_1 + \omega_2} \times 10^6$$

$$\text{Molarity (M)} = \frac{\omega_B \times 1000}{M_B \times V(\text{ml})} \quad \text{Unit = mol/litre}$$

$$\text{Molality (m)} = \frac{\omega_B \times 1000}{M_B \times W_A(\text{g})} \quad \text{Unit = moles/kg}$$

↳ molarity is inversely proportional to temperature

Mole Fraction (x)

$$x_A = \frac{n_A}{n_A + n_B} \quad x_B = \frac{n_B}{n_A + n_B}$$

$x_A + x_B = 1$ mole fraction is a unitless quantity

Henry Law

$b = K_H x_B$ partial pressure of gas

↳ mole fraction of solute

RAOULT'S LAW

$$p_A \propto x_A$$

$$p_A = b'_A \times x_A$$

$$p_B \propto x_B$$

$$p_B = b'_B \times x_B$$

for Volatile Solute

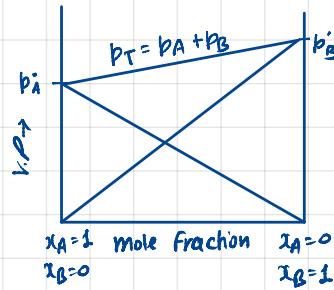
$$p_T = p_A + p_B$$

for Non-Volatile Solute

$$p_T = p_A + p_B \\ = b'_A \times x_A$$

IDEAL SOLUTION

Interaction of A-B are equal to interaction of A-A and B-B



$$\Delta V_{\text{mix}} = 0$$

$$\Delta H_{\text{mix}} = 0$$

e.g. n-Hexane + n-Heptan

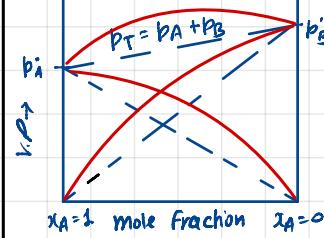
NON-IDEAL SOLUTION

Positive Deviation

A-B interaction are weaker than A-A and B-B interaction

$$\Delta V_{\text{mix}} = +ve$$

$$\Delta H_{\text{mix}} = +ve$$



Form minimum boiling Azeotropes

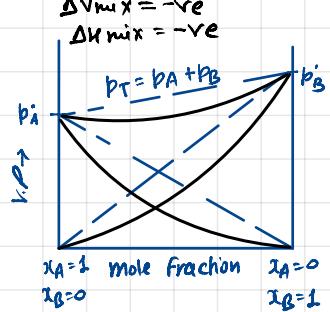
e.g. Acetone + Ethanol

Negative Deviation

A-B interaction are stronger than A-A and B-B interaction

$$\Delta V_{\text{mix}} = -ve$$

$$\Delta H_{\text{mix}} = -ve$$



Form maximum boiling Azeotropes

e.g. acetone + chloroform

Colligative Properties

depends on number of solute
Relative lowering of V.P. $\Rightarrow \frac{b'_A - b_S}{b'_A} = x_B \quad \text{or} \quad i x_B$

Elevation in Boiling Point $\Rightarrow \Delta T_b = K_b m \quad \text{or} \quad i K_b m$

Depression in freezing Point $\Rightarrow \Delta T_f = K_f m \quad \text{or} \quad i K_f m$

Osmotic Pressure $\Rightarrow \Pi = CRT \quad \text{or} \quad \frac{n}{V} RT \quad \text{or} \quad i \frac{x_n}{V} RRT$

Unit of K_b and $K_f = \text{K g mol}^{-1}$

$$\Delta T_b = T_b - T'_b$$

$$\Delta T_f = T'_f - T_f$$

$$\Delta T_b = K_b \times \frac{W_B}{M_B} \times \frac{1000}{W_A(g)}$$

$$\Delta T_f = K_f \times \frac{W_B}{M_B} \times \frac{1000}{W_A(g)}$$

ΔT_b \rightarrow Elevation in B.Pt

ΔT_f \rightarrow Depression in F.pt

T_b \rightarrow B.Pt of solution

T_b' \rightarrow B.Pt of pure solvent

T_f' \rightarrow F.pt of pure solvent

T_f \rightarrow F.pt of solution

K_b \rightarrow molal elevation constant

K_f \rightarrow molal depression constant

Vant Hoff factor (i)

= $\frac{\text{Normal Molecular Mass}}{\text{Observed Molecular Mass}}$

$$i > 1$$

solute undergoes dissociation

$$i < 1$$

solute undergoes association

$$i = 1$$

no association no dissociation

$$\alpha_{\text{dissociation}} = \frac{i-1}{n-1} \quad \alpha_{\text{association}} = \frac{i-1}{\frac{1}{n}-1}$$

Electrochemistry

Cell - which convert one form of energy into another form of energy

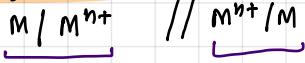
Electrochemical Cell

Chemical → electrical

Electrolytic Cell

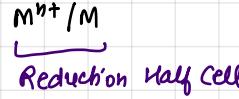
electrical → chemical

Representation of a Cell

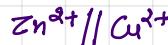


Oxidation Half Cell

Two solution separation



Reduction Half Cell



NERNST EQUATION



$$E_{cell} = E^{\circ}_{cell} - \frac{0.0591}{n} \log \frac{1}{[M^{n+}]}$$

$$E_{cell} = E^{\circ}_{cell} - \frac{0.0591}{n} \log \frac{[Ox]}{[Red]} \text{ at } 298K$$

At Equilibrium $E_{cell} = 0$

$$E^{\circ}_{cell} = \frac{0.0591}{n} \log K_c \text{ at } 298K$$

Gibbs free Energy

$$\Delta G^{\circ} = -nF E^{\circ}_{cell}$$

$$\Delta G^{\circ} = -2.303 RT \log K_c$$

Chemistry Guruji 2.0

CONDUCTIVITY OF IONIC SOLUTIONS

Conductance (G) = $\frac{1}{R} = \frac{I}{V} = \frac{A}{l} = K \frac{A}{l}$ Unit = ohm⁻¹
 → increases on dilution as larger no. of ions are produced

Specific Conductance [CONDUCTIVITY]

$K = \frac{1}{l}$ or $G \times \frac{l}{A}$ or $G \times A^{-1}$ Unit = ohm⁻¹ cm⁻¹ or S cm⁻¹

→ decrease on dilution as number of ions per cm³ decrease

MOLAR CONDUCTIVITY

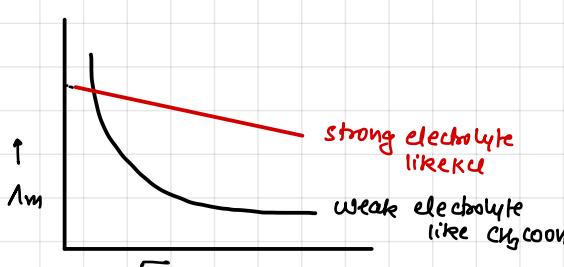
$$\Lambda_m = K \times V \text{ or } K \times \frac{1000}{M} \text{ Unit = } \Omega^{-1} \text{ cm}^2 \text{ mol}^{-1} \text{ or } S \text{ m}^2 \text{ mol}^{-1}$$

→ Increase with dilution due to large increase in V .

Limiting Molar Conductivity (Λ_m° or Λ_m^{∞})

when concentration of electrolyte approaches zero

→ Variation of molar conductivity with concentration



Debye-Hückel Equation
 $\Lambda_m = \Lambda_m^{\circ} - A\sqrt{C}$

Λ_m = Molar conductivity at V dilution

C = concentration

A = constant which depends upon

Plot of Λ_m and against \sqrt{C} is a straight line with intercept equal to Λ_m° and slope equal to $-A$.

For weak electrolyte, on dilution very large increase in conductance
 For strong electrolyte, on dilution only a small increase in conductance

Kohlrausch's Law

$$\Lambda_m^{\circ} \text{ Electrolyte} = \Lambda_m^{\circ} \text{ Cation} + \Lambda_m^{\circ} \text{ Anion}$$

→ degree of dissociation

$$\alpha = \frac{\Lambda_m}{\Lambda_m^{\circ}} \quad [\text{Molar conductivity at concentration } c] \\ \Lambda_m^{\circ} \quad [\text{Molar conductivity at infinite dilution}]$$

$$\rightarrow \text{Dissociation Constant (K}_c) = \frac{c\alpha^2}{1-\alpha}$$

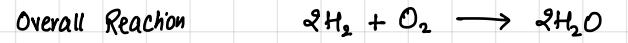
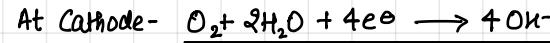
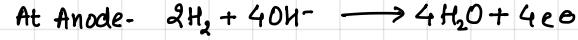
Faraday's First Law

$$w = z \times I \times t = \frac{\text{Molar Mass}}{n \times F} \times I \times t$$

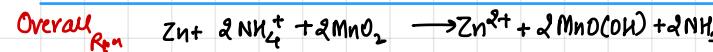
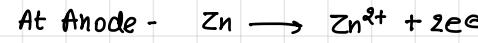
Faraday's Second Law

$$\frac{w_1}{w_2} = \frac{E_1}{E_2} \quad [\text{where } E \text{ is equivalent weight}]$$

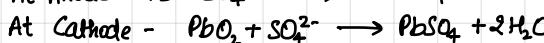
Fuel Cell



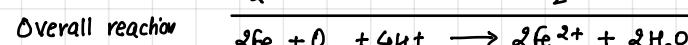
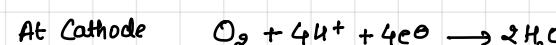
Dry Cell



Lead-Storage Battery -



Corrosion of iron...



Formula of rust - $Fe_2O_3 \cdot xH_2O$

CHEMICAL KINETICS

$R \rightarrow P$

Rate of Reaction

$$-\frac{\Delta [R]}{\Delta t} = +\frac{\Delta [P]}{\Delta t}$$

UNIT OF RATE mol L⁻¹ sec⁻¹ or mol L⁻¹ min⁻¹

Average rate

change in concentration at large time interval

$R \rightarrow P$

$$-\frac{\Delta [R]}{\Delta t} = +\frac{\Delta [P]}{\Delta t}$$

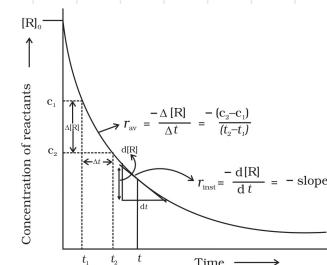
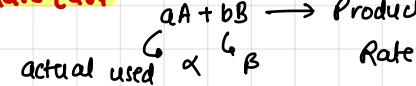


Fig. 4.1: Instantaneous and average rate of a reaction

Rate Law -



actual used $\propto A^a B^b$

rate constant or specific reaction rate ↑

Rate of Reaction = $K[A]^{\alpha} [B]^{\beta}$

Order = $\alpha + \beta$

Half life $t_{1/2} \propto \frac{1}{k^{n-1}}$; where n is order of rxn

Zero Order

$$\text{rate} = k[A]^0$$

$$[A]_t = -kt + [A]_0$$

$$t = \frac{R_o - R}{k}$$

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

Unit of $K = \text{mol L}^{-1} \text{s}^{-1}$

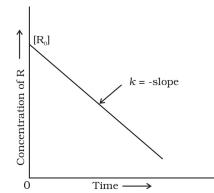


Fig. 4.3: Variation in the concentration vs time plot for a zero order reaction

First Order

$$\text{Rate} = k[A]^1$$

$$\ln [A]_t = -kt + \ln [A]_0$$

$$t = \frac{-\ln 2.303}{k} \log \frac{R_o}{R_t}$$

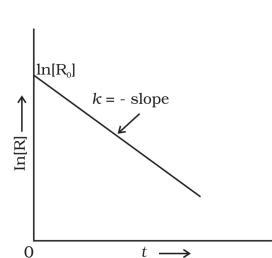


Fig. 4.4: A plot between $\ln[R]$ and t for a first order reaction

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

Unit of $K = \text{sec}^{-1}$

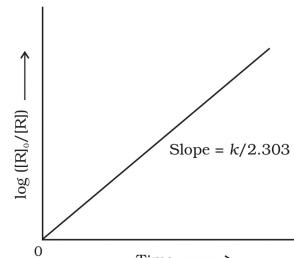
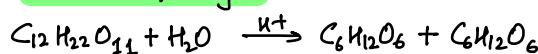


Fig. 4.5: Plot of $\log [R]_0/[R]$ vs time for a first order reaction

PSEUDO FIRST ORDER -

Those reaction which are not truly of first order but under certain conditions becomes of first order

Inversion of sugar



$$\text{Rate} = k[C_{12}H_{22}O_{11}]$$

Arrhenius Equation

$$K = Ae^{-E_a/RT}$$

$$\log K = \log A - \frac{E_a}{2.303 RT}$$

where $K = \text{Rate constant}$

$A = \text{Pre-exponential factor}$

$E_a = \text{Activation Energy}$ $T = \text{Temp}$

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

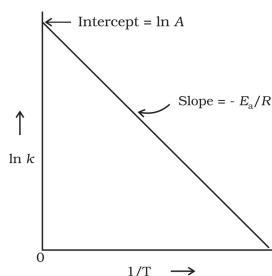
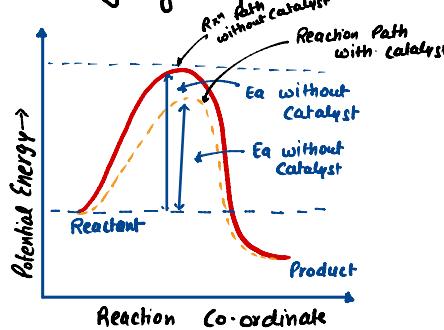


Fig. 4.10: A plot between $\ln k$ and $1/T$

Role of Catalyst: a chemical substance which alters the rate of reaction without undergoing any chemical change



COLLISION THEORY

The number of collision b/w the reacting molecules taking place per second per unit volume is known as Collision frequency

$$\text{rate} = P Z_{AB} e^{-E_a/RT}$$

$P + P$ called the probability or steric factor Z_{AB} = Collision Frequency for reactant A & B.