# 10+2 PCM NOTES

BY

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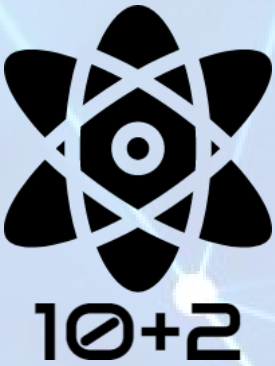
(PDF version handwritten notes of Maths, Physics and Chemistry for 10+2 competitive exams like JEE Main, WBJEE, NEST, IISER Entrance Exam, CUCET, AIPMT, JIPMER, EAMCET etc.)



# Dilute Solution & Colligative Properties.



* Concentration Units:

1. Molarity: Number of moles of solute present for one litre of the solution. (M).

2. Molality: Number of moles of the solute present in 1000 g of the solvent. (m)

3. Normality: Number of equivalents of ~~solvent~~ solute present in one litre of the solution. (N).

4. Formality: Number of gram-formula weights of the solute per litre of the solution. (F).

* Dilute Solution or Ideal Solution: Formed by dissolving such a small amount of the non-volatile solute in the solvent that there is no absorption or evolution of heat.

$P_{solution} \propto x_{solvent}$

$\Rightarrow P_{solution} = P_{solvent} \cdot x_{solvent}$. [Raoult's Law].

* Vapour Pressure Lowering: Addition of solute particles lowers vapour pressure of the solvent.

lowering in VP of solvent $\propto$ mole fraction of solute

$$p^0 - p \propto \frac{n_1}{n_1 + n_2}.$$

$$p^0 - p = p^0 \frac{n_1}{n_1 + n_2}.$$

$$\frac{p^0 - p}{p^0} = \frac{n_1}{n_1 + n_2} \approx \frac{n_1}{n_2}$$

$$= \frac{W_1 \times M_2}{M_1 * W_2}.$$

$p^0 \rightarrow$ VP of pure solvent

$p \rightarrow$ VP of solvent in presence of solute.

$n_1 \rightarrow$ solute moles

* Raoult's Law in binary Solution:

$P_A = x_A \cdot P_A^0$ ; $P_B = x_B \cdot P_B^0$

$p = x_A P_A^0 + x_B P_B^0 = x_A P_A^0 + (1 - x_A) P_B^0$.

$p = P_B^0 + x_A (P_A^0 - P_B^0)$.

* ppm:

Parts per million =

$$\frac{\text{No. of parts of the component}}{\text{Total no. of parts of all components of the solution}} \times 10^6.$$

* mass %, ppm, mole fraction, molality are independent of temperature, whereas molarity is a function of temperature.

* polar solute dissolves in polar solvents, non-polar solute in non-polar solvents. (like dissolves like).

* Solubility of solid in liquid -

a) Effect of temperature:

Solute + solvent $\rightleftharpoons$ solution

If $\Delta H_{sol} > 0$, solubility increases with temp.

If $\Delta H_{sol} < 0$, solubility decreases with temp.

b) Effect of pressure: no effect.

* Solubility of gas in liquid:

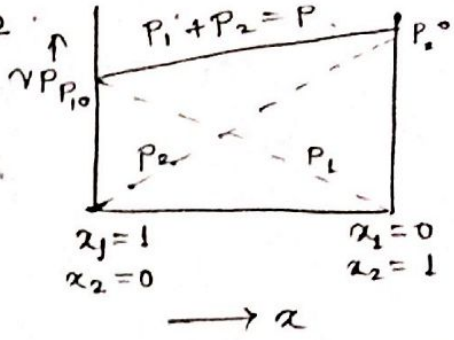
a) Effect of temp: solubility decreases with increase in temp.

b) Effect of pressure: increases with pressure.

$p = K_H \cdot x$ (Henry's law)

C. * Vapour Pressure of Liquid-Liquid Solution:

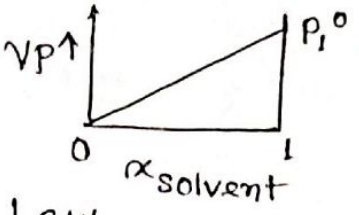
$$P_{total} = P_1^0 + (P_2^0 - P_1^0)\, x_2$$




* Raoult's Law → a special case of Henry's Law.

* for solid-liquid solution (solid non-volatile)

$$P_1 \propto x_1 \Rightarrow P_1 = x_1 P_1^0.$$

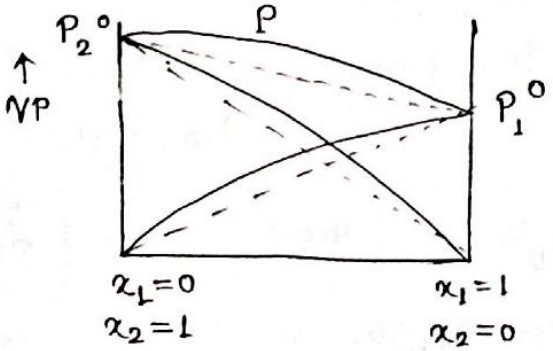



* Ideal Soln: Obeys Raoult's Law over the entire range of concentration. $\Delta H_{mix} = 0$, $\Delta V_{mix} = 0$.

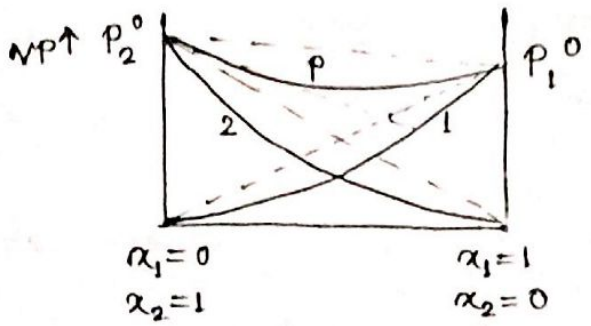
(n-hexane – n-pentane, bromoethane-chloroethane, benzene-toluene).

* Non-Ideal Soln: Doesn't obey Raoult's Law.

• Positive Deviation: A-B interactions are weaker than those between the solute-solute and solvent-solvent. Molecules of A (or B) will find it easier to escape if than in pure state. (ethanol – acetone, carbon disulphide – acetone).



• Negative Deviation: The A-A, B-B interactions are weaker than A-B interactions. (phenol - aniline, chloroform - acetone)




* Azeotropes: Some liquids on mixing form azeotropes which are binary mixtures having the same composition in liquid & vapour phase and boil at a constant temp.

• minimum boiling azeotrope: solutions showing large positive deviation form them (ethanol - water).

• maximum boiling azeotrope: solutions showing large negative deviation form them ($HNO_3$ - water)

* Elevation of boiling point: Liquid boils at the temp. when vp equals the atmospheric pressure. Presence of non-volatile solute decreases vp. Hence, temperature is needed to make the vp = atm. pressure at bp.

$T_b - T_b^0 \propto m$ | molal concentration of solute → m

$\Rightarrow \Delta T_b = K_b m$

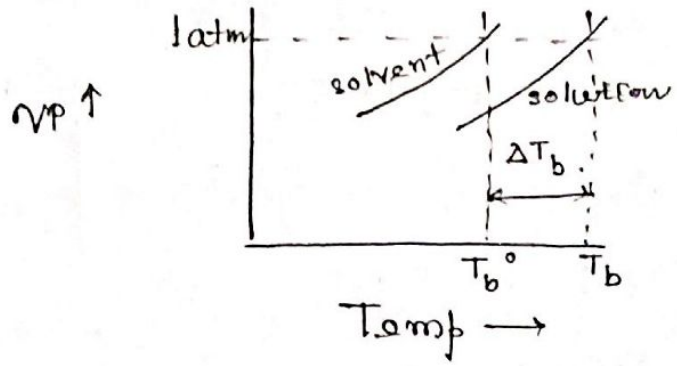
$K_b$ → Boiling Point Elevation constant / Molal Elevation constant (Ebullioscopic Constant).

C.

Here, $m = \dfrac{1000 \times W_2}{M_2 \times W_1}$.

$W_1$ gram solvent
$W_2$ gram solute.
$m = \dfrac{W_2/M_2}{W_1/1000}$.

$$\boxed{\Delta T_b = K_b \frac{1000 \times W_2}{M_2 \times W_1}}$$




* Depression of freezing Point: freezing point is the temp. at which the vp of the substance in its liquid phase is equal to the solid phase's vp. freezing point decreases as the vp of the solvent is lower in the presence of non-volatile solute.

$$T_f - T_f^\circ \propto m \quad \Rightarrow \Delta T_f = K_f m.$$

$K_f \rightarrow$ freezing point depression constant/ Molal Depression Constant/ Cryoscopic Cons.

$$\boxed{\Delta T_f = K_f \frac{1000 \times W_2}{M_2 \times W_1}}$$

- $K_f = \dfrac{R \times M_1 \times T_f^2}{1000 \times \Delta H_{fusion}} = \dfrac{RT_f^2}{1000 l_f}$

$K_b = \dfrac{R \times M_1 \times T_b^2}{1000 \times \Delta H_{vaporisation}} = \dfrac{RT_b^2}{1000 l_v}$

$M_1 \rightarrow$ molar mass of solvent
$R \rightarrow$ gas constant.
$l_v, l_f \rightarrow$ latent heat of vap. & fusion.

* Osmosis: Flow of solvent through semi-permeable membrane (SPM).

- Pressure that just stops the flow of solvent is called osmotic pressure.
- Solvent always flows from lower to higher concentration.

$\pi$ (osm. pressure) $= CRT$.

c → molarity of solution.
$n_2$ → moles of solute.

$$\pi = \frac{n_2}{V} RT$$

$$\Rightarrow \pi V = \frac{W_2}{M_2} RT$$

$$\Rightarrow M_2 = \frac{W_2 RT}{\pi V}$$ ✓

- Two solutions having same osmotic pressure at a temp. are called isotonic solutions. No osmosis occurs.
- Osmotic pressure of fluid inside blood cell is equivalent to that of 0.9% (mass/vol) sodium chloride solution, called normal saline solution.
- Hypertonic – Hypotonic Solution.

* Reverse Osmosis: Pressure larger than the osmotic pressure applied to the soln side.

- Water Purification
- Desalination Plants.

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* Van't Hoff factor:

$$i = \frac{\text{Observed Colligative Property}}{\text{Calculated Colligative Property.}}$$

$$= \frac{\text{Total no. of moles of particles after association/dissociation}}{\text{No. of moles of particles before association/dissociation}}$$

* Inclusion of i in eqn for colligative properties:

$$\frac{P_1^0 - P_1}{P_1^0} = i \frac{n_2}{n_1} \quad \text{(lowering of Vp).}$$

$$\Delta T_b = i K_b m \quad \text{(Elevation of bp)}$$

$$\Delta T_f = i K_f m \quad \text{(Depression of fp).}$$

$$\pi = i \frac{n_2 RT}{V} \quad \text{(osmotic pressure).}$$

* For ideal binary soln, if the components' mole fractions are $x_A$ & $x_B$' in the vapour, then

$$\frac{1}{P} = \frac{x_A'}{P_A^0} + \frac{x_B'}{P_B^0}.$$