2nd Sem (Honours)

Colligative Properties

· Depression of Freezing point.

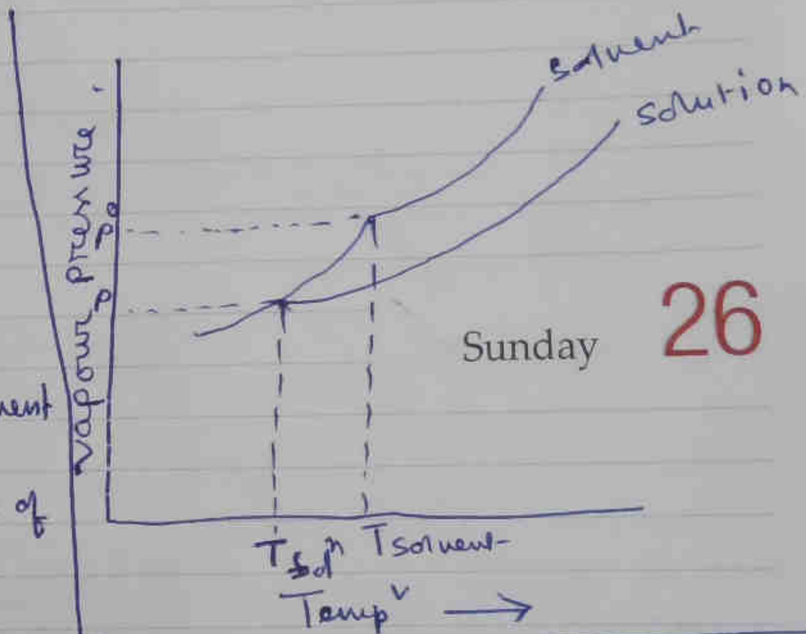
Freezing point depression is the decrease of the freezing point of a solvent on the addition of a non-volatile Solute. Examples : Salt in water,

$\Delta T_f = T_{solvent} - T_{sol^n}$

ΔT_f = Depression in freezing point.

$T_{solvent}$ = Freezing Point of the solvent

$T_{solution}$ = Freezing point of the solution.



For a solution containing non volatile solute

$$\Delta T_f \propto m$$

Where "m" is the molality of the solution.

$$\Delta T_f = K_f m$$

K_f = Cryoscopic constant, or molal freezing Point constant. For water $K_f = 1.86 \, K.kg \, mol^{-1}$

$$\left[\text{molality} = \frac{\text{mole of solute}}{\text{Kg of the solvent}} \right]$$

If W_2 is the mass of the solute in gm.

M_2 = Molar mass of the solute.

W_1 = wt of the solvent in gm.

$$m = \frac{\frac{W_2}{M_2}}{\frac{W_1}{1000}}$$

$$= \frac{W_2 \times 1000}{M_2 \times W_1}$$

Thus

$$\Delta T_f = k_f m$$

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

From this we can determine the molecular mass M_2 of the solute.

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

Colligative properties

4

Osmotic pressure.

Osmotic pressure is the minimum pressure that would have to be applied to pure solvent to prevent it from passing into a given solution by osmosis. (through a semi permeable membrane)

Derivation of vant Hoff equation for osmotic pressure of a solution.

(i) According to vant Hoff Boyles law

$$\pi \propto \frac{1}{V} \rightarrow (1)$$

Where π is the osmotic pressure Sunday 2
V is the volume of the solution

(ii) According vant Hoff Charles law.

$$\pi \propto T \rightarrow (2) \quad T = temp^r$$

combining eq^n (1) & (2)

$$\pi \propto \frac{T}{V} \quad \text{or} \quad \pi V \propto T$$

$$\pi V = RT \quad [R = consta$$

$R = 0.082$ L atmos mol^{-1} K^{-1}

$R = 8.314$ J mol^{-1} K^{-1}

For n mole of solute

$$\pi V = nRT$$