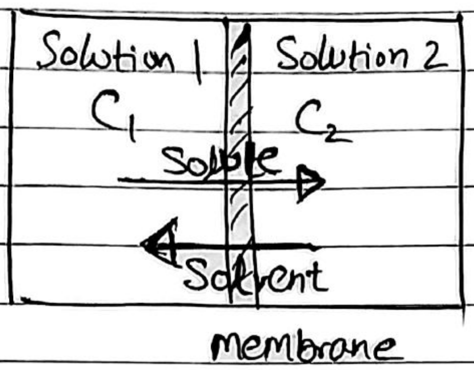
Class 12 Chapter 1: Solutions
Lecture 07
⇓

Osmotic Pressure (OP):-

Osmosis

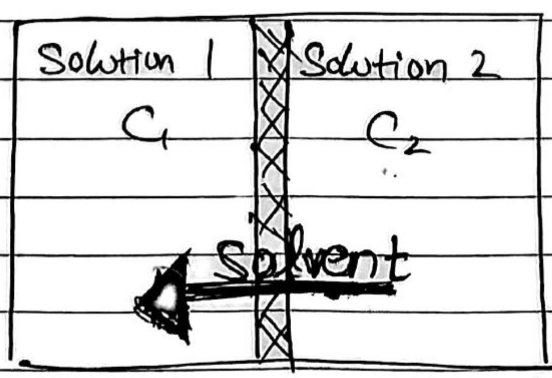
Diffusion:
movement of a substance from it's higher Concentration to its lower Concentration



$(C_1 > C_2)$

Solute (excess): C_1 ⇒ movement $C_1 \longrightarrow C_2$
Solvent (excess): C_2 ⇒ movement $C_2 \longrightarrow C_1$
movenent will Continue untill Concentration is same

Osmosis



$(C_1 > C_2)$

*** Semi Permeable Membrane (SPM)
(Do not allow solute particles to pass through, Only solvent particles can pass)

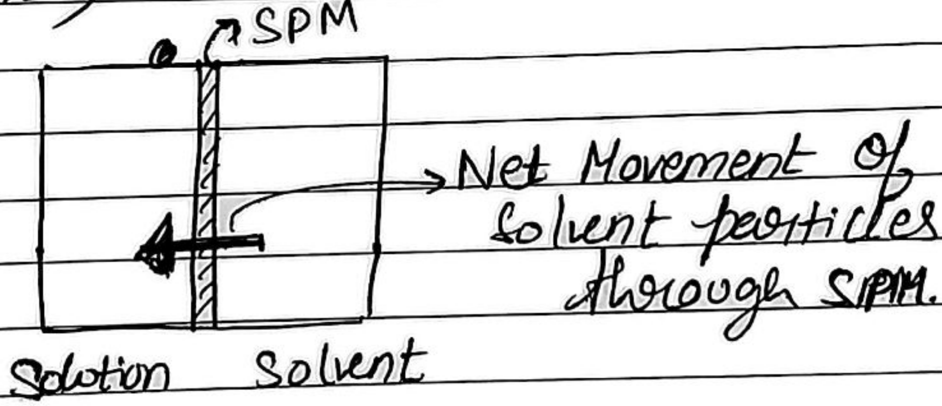
Semi Permeable Membrane: (SPM)

(i) Can be of animal membrane or artificial membrane such as that of Copper Ferrocyanide $Cu_2[Fe(CN)_6]$ or cellophane

(ii) These membranes have very small pores which can allow small solvent particles to pass through but not large solute molecules

(iii) The net flow of Solvent particle from it's higher concentration to it's lower Concentration through a semi permeable Membrane is called Osmosis.

(Note: Movement of solvent particles is from both sides but we are talking about net movement).



Solvent net movement from higher Concentration of Solvent to lower Concentration of solvent.

Osmotic Pressure (OP) $\longrightarrow \pi$

The movement of solvent molecules from solvent to solution side by applying extra pressure from solution side.

⇒ The extra pressure applied over solution side to prevent OSMOSIS is called Osmotic Pressure (π)

$\pi \propto M$ (Molarity of Solution)

$\pi \propto T$ ($T \rightarrow$ Temp in Kelvin)

$$\boxed{\pi = MRT}$$

→ R is solution constant whose value is equal to Gas Constant = 0.0821 atm L / mol K

$$\left(M = \frac{\text{no of moles of solute}}{\text{Volume of Solution (in L)}} \right)$$

Types of Solutions

① Isotonic : $\pi_1 = \pi_2$ Solutions having same OP (if Temp is same, M is also same)

② Hypotonic : Hypo → less Osmoptic Pressure

③ Hypertonic : Hyper → More osmotic Pressure.

Shrink → loss of fluid (Hypo) Swell → gain of fluid (Hyper)

Q1) Calculate the Osmotic Pressure of 5% (w/v) solution of Cane Sugar ($C_{12}H_{22}O_{11}$) at 15°C.

a) 2.8 atm b) 3.4 atm c) 4.2 atm d) 6.0 atm.

Solution: 5% ⇒ 5g Cane sugar in 100mL sol.

$T = 273 + 15$
$= 288$

$C_{12}H_{22}O_{11}$
Molar Mass $= 342$

$\Pi = MRT$

$= \frac{\text{no of moles}}{\text{vol of sol (in L)}} \times 0.0821 \times 288$

$= \frac{5}{342 \times 0.1} \times 0.0821 \times 288$

≈ 3.4 atm

Q2) 200 cm^3 of an aqueous solution contains 1.26g of a polymer. The Osmotic pressure of this solution at 300K is 2.6×10^{-3} atm. Find Molar Mass of polymer

a) 50,000 g/mole b) 60,000 g/mole c) 70,000 g/mole d) 80,000 g/mole

Solution

Let Molar Mass of polymer be x

$\Pi = MRT$

$2.6 \times 10^{-3} = \frac{1.26}{x \times 0.2} \times 0.0821 \times 300$

$x \approx 60,000$

Q3) A 5% solution of cane sugar is isotonic with 0.877% solution of urea. Calculate the Molecular Mass of urea, if the Molar Mass of cane sugar is 342.

Solution:

$$\pi_1 = \pi_2$$

$$M_1 \cancel{RT} = M_2 \cancel{RT}$$

$$\frac{\text{no of moles of Cane sugar}}{\text{vol of sol (in L)}} = \frac{\text{no of moles of urea}}{\text{vol of solution (in L)}}$$

$$\Rightarrow \frac{5}{342 \times 0.\cancel{1}} = \frac{0.87}{x \times \cancel{0.1}}$$

$$\Rightarrow x = \frac{0.87 \times 342}{5}$$

$$\Rightarrow x \approx 60 \text{ g/mol.}$$