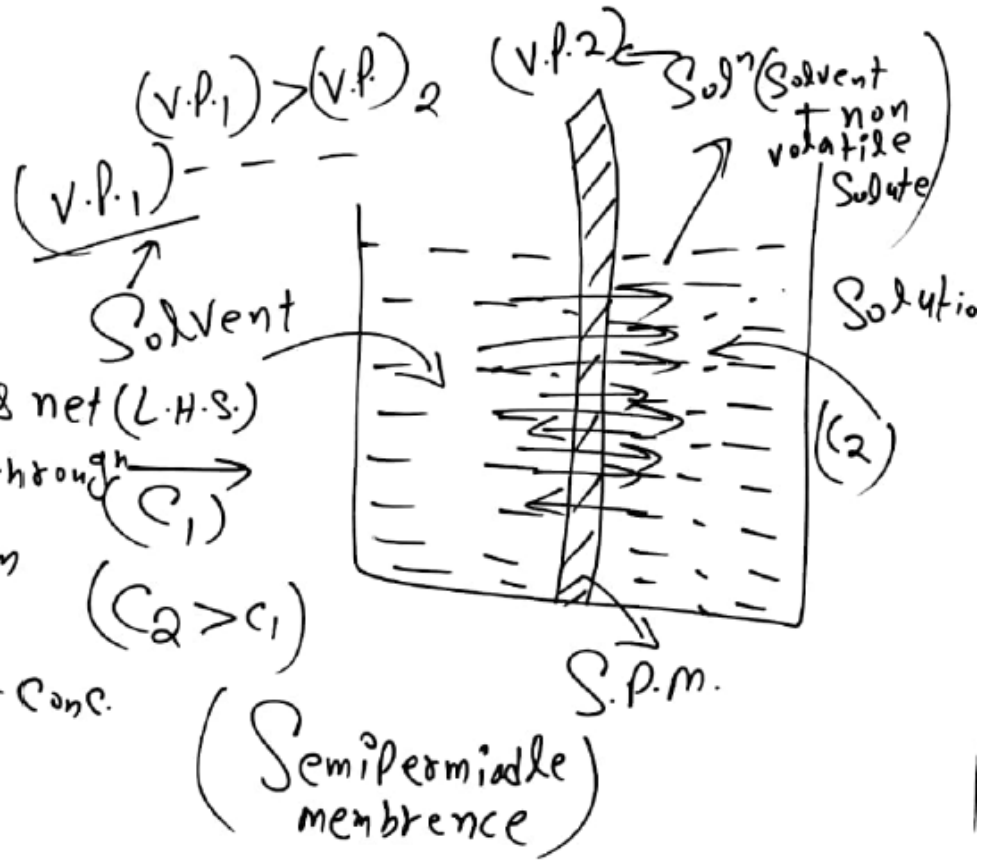


Osmotic pressure ÷

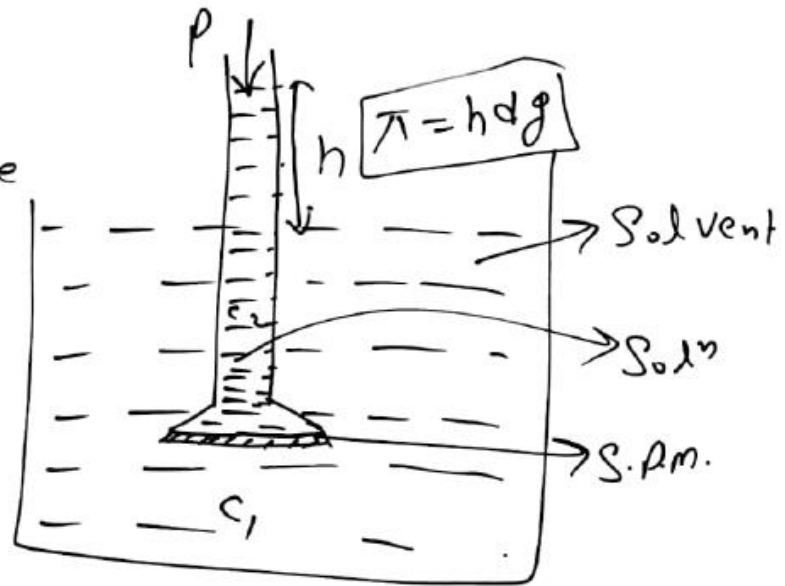
Osmosis ÷

It is defined as the spontaneous net (L.H.S.) flow of solvent molecules through a semipermeable membrane from a solvent to a solution or from lower conc. to higher conc. soln.



Osmotic pressure :-

The external pressure which must be applied on the solⁿ in order to stop the flow of solvent into solⁿ through semipermeable membrane is equal to osmotic pressure.



or

Hydrostatic pressure develops in a vertical column when solⁿ & solvent are separated by S.P.M.

Osmotic pressure = hydrostatic pressure = $h d g$

$d \rightarrow$ density
 $g \rightarrow$ acceleration due to gravity.

Where $h \rightarrow$ increase in the level of tube of unit cross section.

Vant Hoff Law for dilute Soln.

A/c to ideal gas eq. $PV = nRT$ is also followed by dilute Soln, when pressure of gas is replaced by osmotic pressure.

$$PV = nRT \rightarrow \text{ideal gas eq.}$$

$$P = \left(\frac{n}{V}\right) \cdot RT \Rightarrow \boxed{\pi = CRT}$$

$\pi \Rightarrow$ osmotic pressure of Soln in (atm)

$C = n/V \Rightarrow n \Rightarrow$ No. of mole of Solute

$V \Rightarrow$ Volume of Soln in ltr

$R \rightarrow$ gas constant. = $0.0821 \frac{\text{lit-d-atm}}{\text{K-mol}}$

$T \rightarrow$ Temp. in Kelvin.

(1) Isotonic Solutions :-

Solns having same osmotic pressure is k/a

Isotonic Soln.

Soln $\rightarrow 1 \rightarrow \pi_1$; Soln $\rightarrow 2 \rightarrow \pi_2$

Soln ① & ② are isotonic Soln.

$$\pi_1 = \pi_2$$

$$C_1 RT = C_2 RT \quad (\text{at same Temp.})$$

$$\boxed{C_1 = C_2} \Rightarrow \boxed{\frac{n_1}{V_1} = \frac{n_2}{V_2}}$$

(2) $\pi_1 > \pi_2$ or $C_1 > C_2$ hence Soln ① is hypertonic & Soln ② is hypotonic Soln.

Q.1. At 27°C Cal. o.p. of decimolar aq. soln of Urea.
 Sol. Given: $C = \frac{1}{10} \text{ m}$
 $T = 27^\circ\text{C} = 300\text{K}$
 $\pi = CAT$
 $\pi = \frac{1}{10} \times 24.6$
 $\pi = 2.46 \text{ atm.}$

$P_T \rightarrow T \rightarrow 0^\circ \text{ to } 27^\circ\text{C}$
 $\hookrightarrow 22.4 - 24.6$

Q.2. 18 gm of glucose & 6 gm of urea dissolved in 1 lt soln at 27°C
 Cal. o.p.
 Sol. $n_T = \frac{18}{180} + \frac{6}{60}$
 $n_T = 0.2 \text{ mol}$
 $\pi = \frac{0.2}{1} \times 24.6 \Rightarrow \pi = 4.92 \text{ atm.}$
 $\rightarrow 1\text{ gm Solute in } 100\text{ ml Soln.}$

Q.3. 3% Aq. Soln of glucose is isotonic with 1% aq. Soln of Non volatile Solute. Cal. m.w. of Solute.
 Sol. $\pi_1 = \pi_2 \Rightarrow C_1 AT = C_2 AT \Rightarrow C_1 = C_2$
 $\frac{3}{60} \times \frac{100}{100} = \frac{1}{\text{m.w.}} \times \frac{100}{100} \Rightarrow \text{m.w.} = 60$

Q.4. An Aq. Soln Containing 2.16×10^{-2} gm of Peptide hormone in 100ml of Soln has osmotic pressure is 2.72 mm of Hg. at 25°C. Cal molar mass of hormone.

Sol. given: $1 \text{ atm} = 760 \text{ mm of Hg}$
 $1 \text{ mm of Hg} = \frac{1}{760} \text{ atm}$

$$\pi = \frac{w}{m.w} \times \frac{1}{V(\text{lit})} \cdot RT \Rightarrow m.w. = \frac{2.16 \times 76 \times 24.4}{2.72} = 1426$$

$$\frac{2.72}{760} = \frac{2.16 \times 10^{-2}}{m.w} \times \frac{1000}{100} \times 24.4$$

Q.5. Two Soln A & B have osmotic pressure are 2.6 atm & 5.4 atm respectively. Cal. osmotic pressure of Soln prepared by mixing equal volume of A & B.

Sol. given: $\pi_A = 2.6 \text{ atm}$; Soln A $\rightarrow 1 \text{ lit}$
 $\pi_B = 5.4 \text{ atm}$; Soln B $\rightarrow 1 \text{ lit}$

as it is $V_R = 1+1 = 2 \text{ lit}$.

$$\pi_A = \frac{n_A}{V} \cdot RT$$

$$2.6 = \frac{n_A}{1} \cdot RT \Rightarrow n_A = \frac{2.6}{RT} \text{ --- (1)}$$

$$\text{as it is } n_B = \frac{5.4}{RT} \text{ --- (2)}$$

$$\pi_R = C_R RT = \frac{n_R}{V_R} \cdot RT$$

$$\pi_R = \left(\frac{2.6}{RT} + \frac{5.4}{RT} \right) \cdot \frac{1}{2} \times RT$$