# :IDEAL SOLUTION:

- A solution which obeys Rault's law over entire range of concentration at a specific temp. are known as Ideal solution.

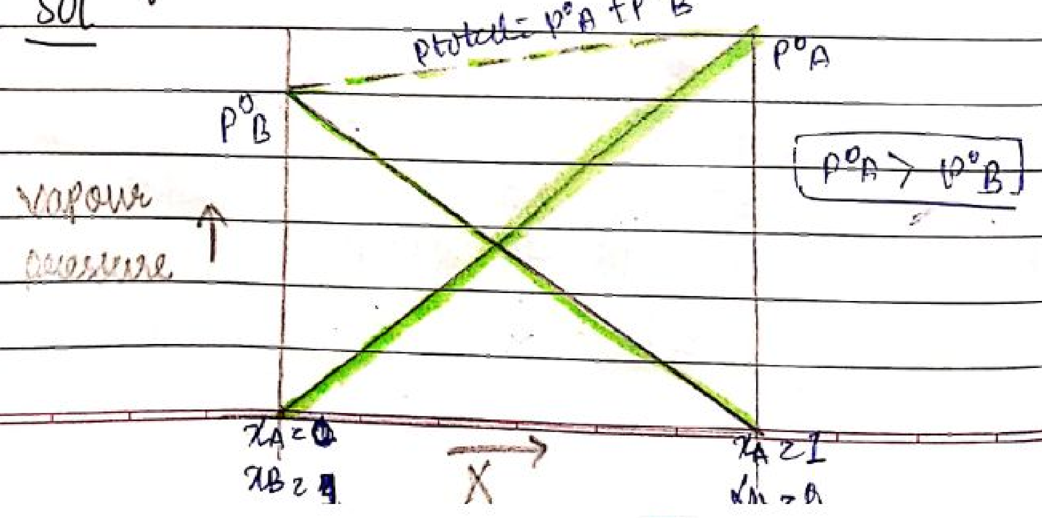
- The ideal solution have three other point /properties:

(i) $\Delta H$ mix = 0 (no heat is absorbed when compound are mixed
(ii) $\Delta V$ mix = 0 (no expansion or conc. when compound are mixed
(iii) $P_{total} = P^0_A X_A + P^0_B X_B$
(iv) A-A interaction = B-B interaction = AB interaction
(v) $\Delta G < 0$ (-ve) (Gibb's free energy)
(vi) $\Delta S > 0$ (+ve) (entropy)

★ - Liquid having similar structure and polarity are likely to form ideal solution.

Ex. Benzene - Toluene   Benzene - Phenol
Methanol - Ethanol
n-hexane - n-heptane
Chloro Benzene - Bromo Benzene

GRAPH OF IDEAL SOL$^{N}$:



$\boxed{P^0_A > P^0_B}$

# : NON-IDEAL SOLUTION :

The partial vapour pressure.

- Those solution which show deviation from Rault's law called non-ideal solution.

$\Delta H_{mix} \neq 0$ ] condition
$\Delta V_{mix} \neq 0$

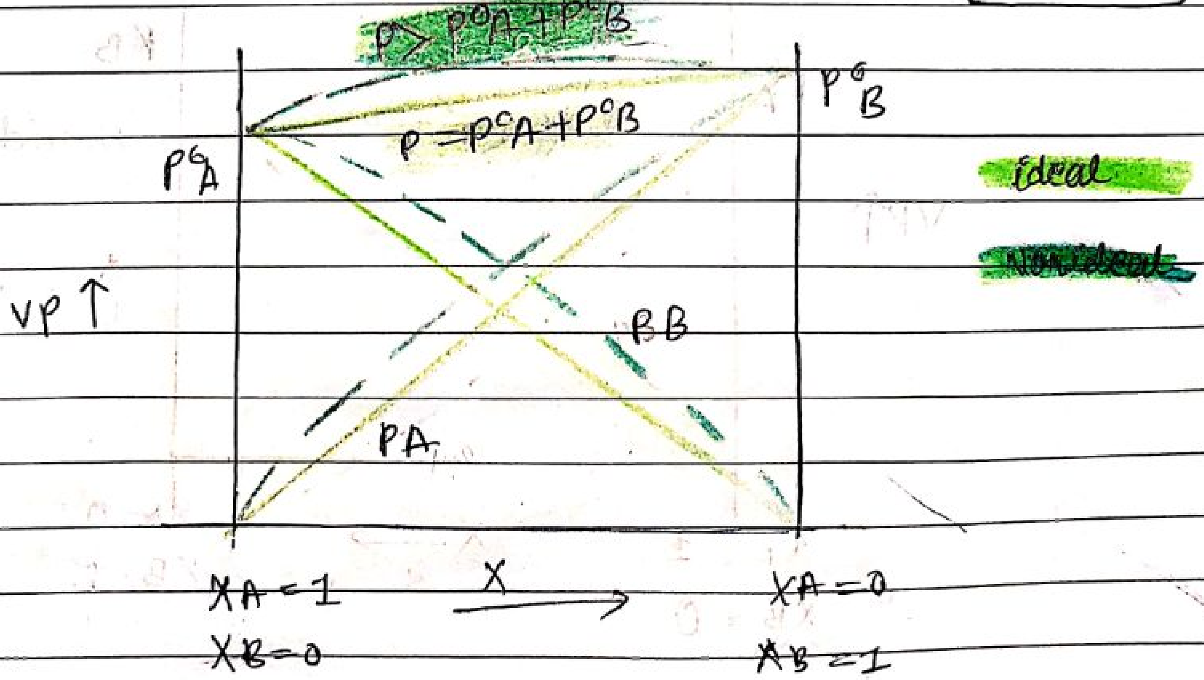
- Nonideal solⁿ can show either +ve or -ve deviation from Rault's law.

A]. $\Delta V > 0$
B]. $\Delta H > 0$ [ +VE ⇒ Endothermic process ]
C]. $P_T > P^0_A X_A + P^0_B X_B$
D]. A – A and B – B interaction interaction > A–B interaction
E]. $\Delta G < 0$ (-ve) [Gibb's free energy]
F]. $\Delta S > 0$ (+ve) [Entropy]

conditions

Graph of Nonideal solution : (+ve deviation)

CASE : 1



( [illegible] alchohol [illegible] )

## Examples of +ve deviation (weak bonding)

1] methanol + $H_2O$ $\qquad$ $CH_3OH + CCl_4$

2] methanol + $CCl_4$

3.] acetone + carbondisulphide

4.] Benzene + carbon tetrachloride

## Nonideal solution showing -ve deviation:

(Bonding is very good.)
Btwn particles

i] $\Delta V < 0$ $\qquad$ [ $\qquad$ ]

ii] $\Delta H < 0$ $\qquad$ [Exothermic = -ve]

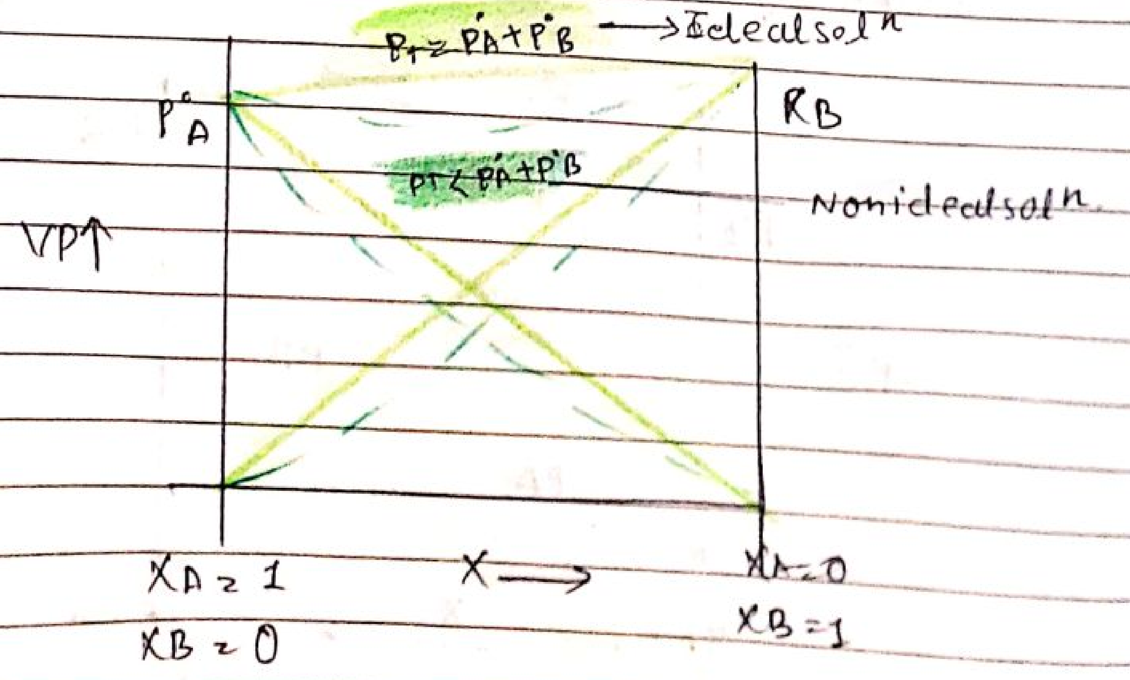
iii] $P_T < P^\circ_A X_A + P^\circ_B X_B$

iv] A-A interaction and B-B interaction $<$ A-B interaction

v] $\Delta G < 0$ $\qquad$ [$\Delta G$ = -ve]

vi] $\Delta S > 0$ $\qquad$ [$\Delta S$ = +ve]

**CASE:2** Graph of Non-ideal soln: (-ve deviation)



Examples: ( બધાં રાખે Acid-Base interaction આપે છે )

A] Nitric acid + $H_2O$

B] Chloroform + Acetone [due to hydrogen Bonding]

C] HCl + $H_2O$

D] Pyridine (Base) + Acetic acid

21-03-024

Thursday

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#Q-5. The vapour pressure of the solⁿ of 2 liquids A ($P^\circ = 80$mm) and B ($P^\circ = 120$mm) is found to be 100mm. when $X_A = 0.4$ The result shows that....

$X_A = 0.4$

$X_A + X_B = 1$

$0.4 + X_B = 1$

$X_B = 1 - 0.4$

$X_B = 0.6$

solⁿ:

$P_T = P^\circ_A X_A + P^\circ_B X_B$

$100 = 80 \times 0.4 + 120 \times 0.6$

$= 80 \times 0.4 + 120 \times 6.6$

$= 32 + 72$

$100 = 104$

$100 < 104$

$P_T < P^\circ_A X_A + P^\circ_B X_B$

$\boxed{-\text{ve deviation}}$

Answer.

#Q-6 $X_A = 0.4$ $P_T = 580$ torr

$X_B = 0.6$ $P^\circ_A = 300$ torr $P^\circ_B = 800$ torr

solⁿ

$P_T = P^\circ_A X_A + P^\circ_B X_B$

$580 = 300 \times 0.4 + 800 \times 0.6$

$580 = 120 + 480$

$580 < 600$

Negative deviation
example:- $CHCl_3 - CH_3COCH_3$

#Q.8. When KCl dissolves in water [assume endothermic dissolution]:

soln: $\Delta H = +ve$
$\Delta G = -ve$
$\Delta S = +ve$

#Q.9 The dissolving process is dissolving exothermic then :-

soln: The energy released in solvation exceeds the energy used in breaking up solute-solvent and solvent-solvent interactions.

2-3 marks Board

## : AZEOTROPES OR AZEOTROPES MIXTURE:-

- This are the binary mixture having the same composition in liquid & vapour phase and boil at constant temp.

- Liquid forming azeotropes cant saparated by fractional distillation.

- These are formed by -ve/+ve deviation of non Ideal solutions.

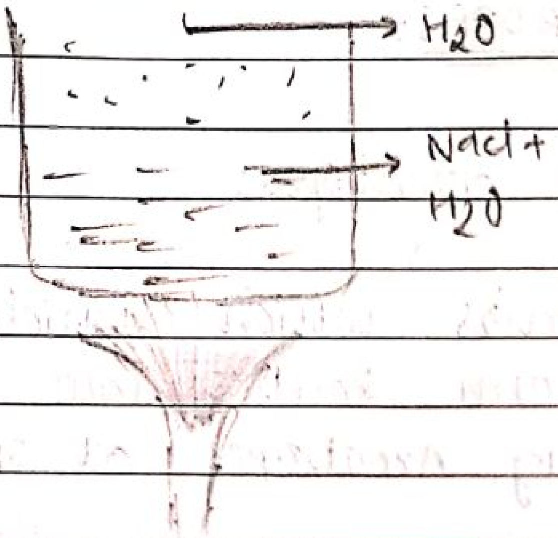
## TYPES OF AZEOTROPES:

### [A] Maximum boiling azeotropes:

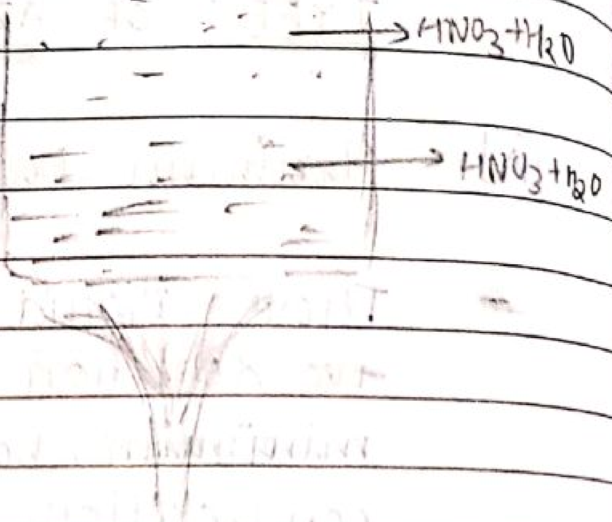
- Those liquid pairs which which show -ve deviation from Roult's law form maximum boiling Azeotropes at specific composition.
- Such azeotropes have boiling point Higher than either of 2 components
- Examples: Mixture $H_2O$ + HCl by mass (20.22%): (79.78%)

### [B] Minimum boiling azeotropes:

- Those liquid pair which shows +ve deviation from Rault's law form minimum boiling azeotropes. at specific composition.
- Such Azeotropes have B.P lower than either 2 components.
- Example: mixture of ethanol + $H_2O$ by mass (95.57%) (4.43%)



Azeotropes mixture ✗



Azeotropes mixture ✓

## :COLLIGATIVE PROPERTIES:

- Those properties which depend only upon the NO. OF SOLUTE PARTICLES [molecules, atom, ion] in a solution But not upon their nature are called colligative properties.

- Following are main colligative property:

i] Relative lowering of v. pressure
ii] elevation in B.Point ($\Delta T_b$)
iii] Depression in freezing point ($\Delta T_f$).
iv] Osmotic pressure ($\Pi$)

i] Relative lowering vapour pressure

- The addition of non-volatile solute to volile solvent during formation of solution.

- The difference in v.p of pure solvent $p^\circ A$ and solution PA represent the lowering in vapour pressure.
[$p^\circ A - PA$]

- So ratio ~~in~~ of lowering in vapour pressure to vapour pressure of pure solvent is called Relative vapour pressure.

$$\boxed{\left[\frac{p^\circ A - PA}{p^\circ A}\right]}$$

- The relative lowering in vapour pressure is ∝ mole fraction of solute in the $\text{sol}^n$ so, it is colligative property.

$$\frac{p^\circ A - PA}{p^\circ A} = X_B \text{ (solute)} \qquad \frac{3}{1+3}$$

$$\boxed{\frac{p^\circ A - PA}{p^\circ A} = \frac{n_B}{n_A + n_B}}$$

For dilute solutions

(solute) $n_B <<< n_A$

(solvent)
$n_A >>>>>> n_B$ (solute)

- $\frac{P^0_A - P_A}{P^0_A} = \frac{n_B}{n_A} = \frac{W_B \times M_A}{M_B \times W_A}$

- $\boxed{M_B = \frac{W_B}{W_A} \times M_A \times \frac{P_A}{(P^0_A - P_A)}}$

- Above expression is used to find the m.wt of unknown solute dissolve in given solvent
  ∴ $W_B$ & $W_A$ ⇒ Mass of solute & solvent Respectively
  ∴ $M_B$ & $M_A$ ⇒ ~~Mass~~ M.wt of solute & solvent respectively.

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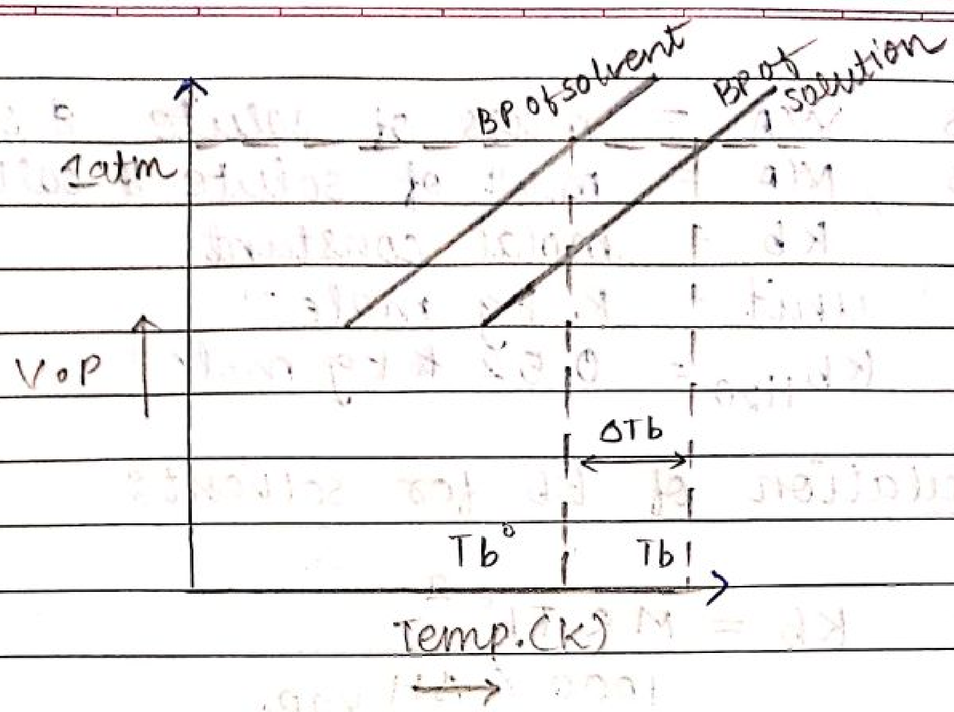
ii| Elevation in B.P :

- B.P of is temp. at which its V.P becomes equal to the atmospheric pressure

- As V.P of sol$^n$ is containing a non-valatile solute is lower than that of pure solvent so its B.P will always Higher than that of pure solvent in which the sol$^n$ is prepared.



- SO, the difference between Tb° & Tb (pure solvent) is known as elavation in B.P. [ΔTb]

Here :

$\Delta T_b = T_b - T_b^\circ$

$\Delta T_b \propto m$

$\boxed{\Delta T_b = K_b m}$

∴ Kb = molal elevation constnt or Ebulliorscopic constant.

- For a dilute solution elevation in Boiling point ∝ molal concentration of the solute in solution hence, it is colligative property.

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

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

Here: $W_B$ , $W_A$ = mass of solute & solvent
$M_B$ , $M_A$ = m.wt of solute & solvent
$K_b$ = molal constant
unit = K kg mole$^{-1}$
$K_{b_{H_2O}}$ = 0.52 K kg mole$^{-1}$

#. Calculation of Kb for solvent:

$$K_b = \frac{M R {T_b^\circ}^2}{1000 \times \Delta H_{vap.}}$$

$$K_b = \frac{R {T_b^\circ}^2}{1000 \times l_{vap.}}$$

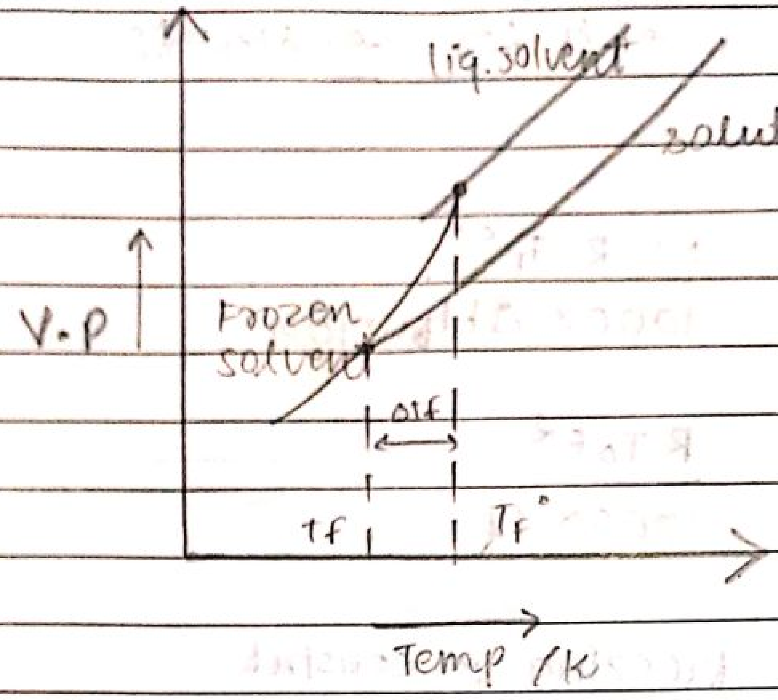
Here: M = M.wt of solvent
R = Gas constant (8.314 J/Kmol / 1.9
$T_b^\circ$ = B.P of solvent
$\Delta H_{vap.}$ = Enthalpy of vapourisation
$l_{vap.}$ = Latent heat of vapourisation

## iii Depression in Freezing point:

- Freezing point of liquid is the temp at which vapour pressure of solvent in its solid & liquid phase become equal.

- As we know that v.p of solution containing non volatile solute is lower than that of pure solvent.

- Solid form get saparated out at lower temp.



These decrease in F. point of liquid is known as Depression of F. point.

$\Delta T_f = T_f^\circ - T_f$

$\Delta T_f = K_f . m$

For dilution depression is a colligative property because ∝ molal conc. of solute

$$\Delta T_f = \frac{M_F \times W_B \times 1000}{M_B \times W_A}$$

$$M_F = \frac{K_f \times W_B \times 1000}{\Delta T_f \times W_A}$$

$K_f$ = molal depression constnt or cryoscopic constnt

unit = $K_F$ = K kg $mol^{-1}$

## #. calculation of kf for ~~constant~~ solvent:

$$KF = \frac{M \; R \; T_F^{\circ 2}}{1000 \times \Delta H_{fusion}}$$

or

$$KF = \frac{R T_0 F^2}{1000 \times lf}$$

Here:
$KF$ = freezing po. constnt
$T_0F$ = Freezing point of solvent
$lf$ = latent heat solvent
$R$ = gas constant
$M$ = Mass of solvent

## iv] Osmosis and osmotic pressure:

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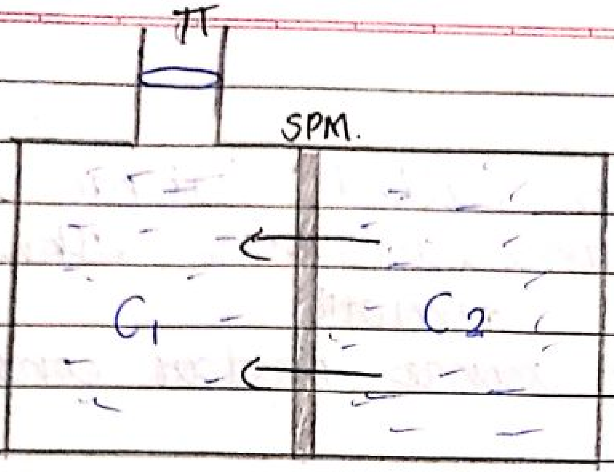
- The phenomena of spontaneous process flow of solvant molecules through semi permeable membrane from pure solvent to solution or from dilute solution to concentrated solution.

- Some natural semi permable membrane animal bladder, sell membrane etc.

(Copperferocynide)
- $Cu_2[Fe(CN_6)]$ is an artificial semi permeable which doesn't work in non-aq. solutions as it dissolves in them.



conc.

$C_1 > C_2$

High con ← low conc.
low dil$^n$ ← High dil$^n$.

Osmotic pressure: The hydrostatic pressure develops in solution which just prevents the osmosis of pure solvent into sol$^n$ through semi-permeable membrane called osmotic pressure. [OR]

$$\pi = CRT$$

$$\pi = \left[\frac{n_B}{v}\right] \times R \times T \qquad C = \text{molarity of sol}^n.$$

$$\pi = \frac{W_B \times R \times T}{M.wt_B \times v}$$

$$M.wt_B = \frac{W_B \times R \times T}{\pi \times v}$$

- In other words the pressure which must be applied to the conc. solution in order to stop osmosis process

- Osmotic pressure is colligative property it depends on no. of solute particles & not their identity.
On the basis of osmotic pressure.

a. **Isotonic $sol^n$:**

- 2 solution are called isotonic if they excert same osmotic pressure. These
- solution have same molar concentration

- 0.91% of pure Nacl is isotonic with human RBC's.

$$\pi_1 = \pi_2$$

$$C_1 \cancel{RT} = C_2 \cancel{RT} \quad [\text{At constant temp.}]$$

$$C_1 = C_2$$

$$\boxed{\frac{mole_1}{V_1} = \frac{mole_2}{V_2}}$$

b. **Hypotonic $sol^n$:**

- A $sol^n$ called hypotonic if its O.P is lower than that of $sol^n$ from which it is saparated by semi permeable membrane.

c. **Hypertonic $sol^n$:**

- A solution called hyper-tonic if its O.P. is higher than that of the $sol^n$ from which it is saparatted called hypertonic solution

d. **Plasmolysis:**

- When plant cell is take placed in hypertonic solution, the fluid from cell comes out & cell shrinks, this phenomenon called plasmolysis.

e. **Reverse osmosis:**

- When external pressure is applied on solⁿ is more than osmotic p., the solvent flows from solⁿ to the pure solvent, & which is called Reverse osmosis.

Example:

- Desalination of sea water is done by reverse osmosis.