

Colligative Properties of Solution →

↳ Properties which depend only on concⁿ of solute (not on nature of solute) are known as Colligative Properties.

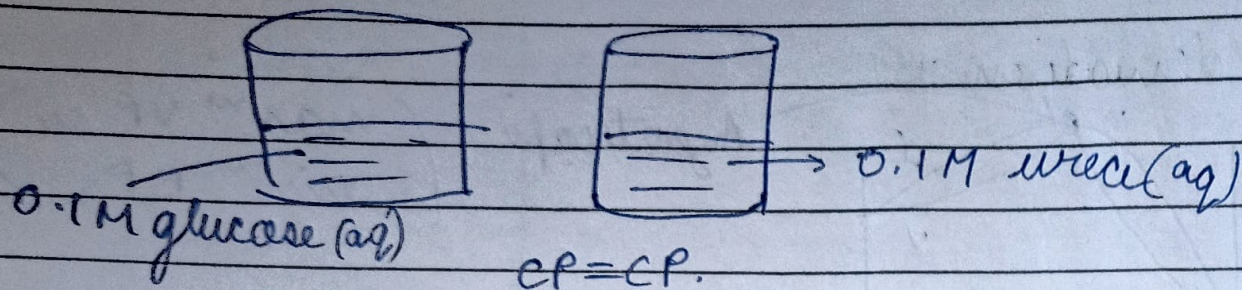
CP of solⁿ —

RLVP

ΔT_b → elevation in B.P

ΔT_f → depression in F.P.

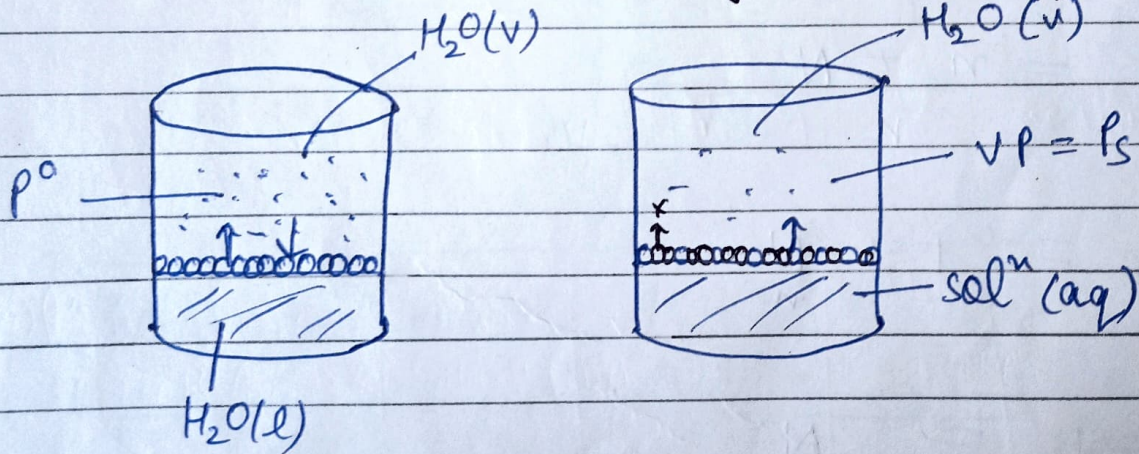
π → osmotic pressure.



Note: Properties of solⁿ which depend on nature of solute also are known as constitutional properties like colour, taste, conductance, etc.

Colligative Properties

1 Relative lowering in VP of solⁿ (RLVP) -



Vapour pressure of solⁿ having non-volatile solute is always less than the VP of pure solvent at same temp. is known as
↳ VP of solⁿ. $[p^0 > P_s]$

$$\text{LVP of sol}^m = P^\circ - P_s$$

$$\text{RLVP of sol}^m = \frac{P^\circ - P_s}{P^\circ}$$

For sol^m, total VP = $P_A^\circ X_A + P_B^\circ X_B \rightarrow 0$.

$$P_s = P^\circ X_{\text{solvent}}$$

Solute $\Rightarrow B$
(non volatile)

$$P_s = P^\circ (1 - X_{\text{solute}})$$

$$1 - \frac{P_s}{P^\circ} = X_{\text{solute}}$$

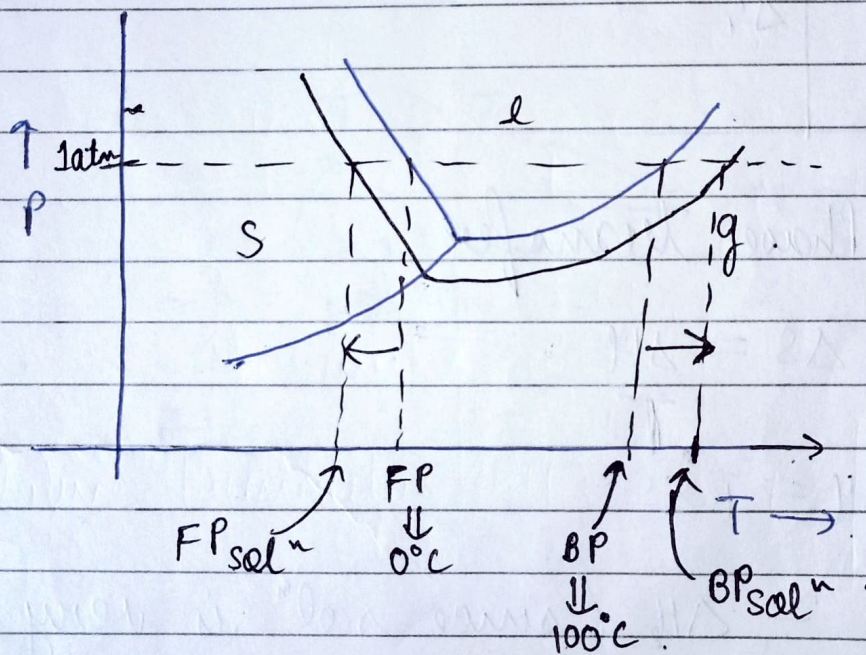
$$\boxed{\frac{P^\circ - P_s}{P^\circ} = X_{\text{solute}} = \frac{n}{n + N}}$$

2; 3

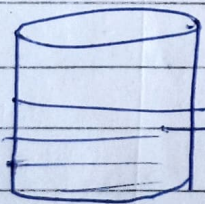
Elevation in B.P. or Depression in F.P. of solⁿ :- ΔT_b
Depression in ΔT_f

$$\Delta T_b = BP_{sol^n} - BP_{solvent}$$

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



— ⇒ Pure H₂O
— ⇒ aq solⁿ



NaCl(aq) solⁿ
BP > 100°C
FP < 0°C

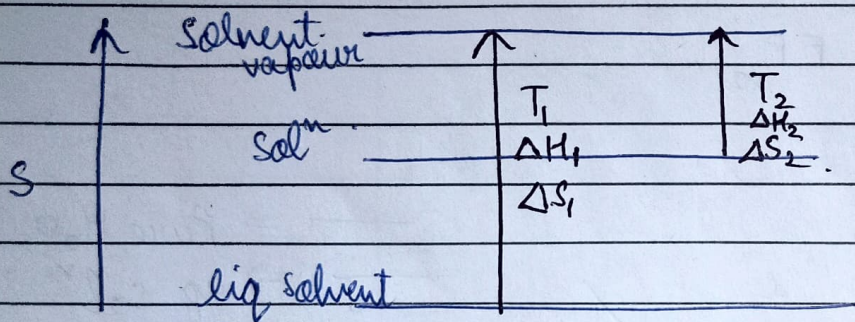
Explanation of ΔT_b & ΔT_f by Entropy:

Entropy \Rightarrow Pure solvent $<$ solⁿ.

On heating a solⁿ
 $\text{solvent (l)} \rightleftharpoons \text{solvent (vap)}$

On cooling a solⁿ
 $\text{solvent (l)} \rightleftharpoons \text{solvent (solid)}$

$\Delta T_b = ?$



For Phase transfer

$$\Delta S = \frac{\Delta H}{T}$$

$$\Delta H = T \Delta S$$

$\Delta H_1 \approx \Delta H_2$ (since solⁿ is very dilute)

$$T_1 \Delta S_1 \approx T_2 \Delta S_2$$

$$\Delta S_1 > \Delta S_2$$

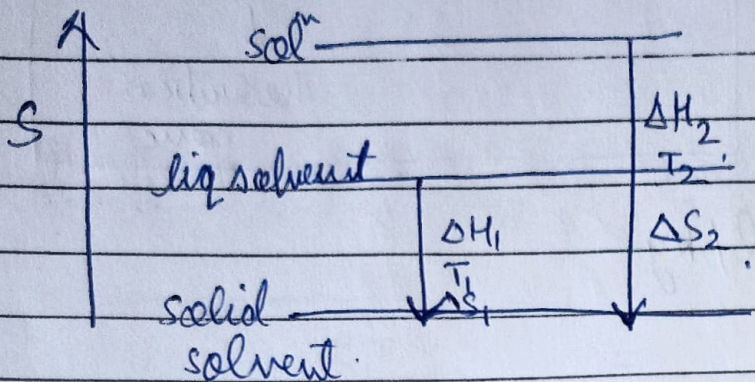
$$T_1 < T_2$$

\nearrow BP of pure solvent \leftarrow BP of solⁿ

$$\Delta T = T_2 - T_1$$

$$\Delta T_f = ?$$

For Phase Transfer



$$\Delta S = \frac{\Delta H}{T}$$

$$\Delta H = T \Delta S$$

$\Delta H_1 \approx \Delta H_2$ (since solⁿ is very dilute)

$$T_1 \Delta S_1 \approx T_2 \Delta S_2$$

$$\Delta S_1 < \Delta S_2$$

$T_1 > T_2$
 ↑ FP of pure solvent ↓ FP of solⁿ

$$\Delta T_f = T_1 - T_2$$

K_f = molal depression constant or
cryoscopic constant.

Unit of K_f = $K \text{ kg/mol}$.

K_f depends on solvent (not on solute)

$$K_f = \frac{RT^2}{1000 L_{\text{fusion}}} = \frac{RT^2}{1000 \frac{\Delta H_{\text{fusion}}}{\text{M.M of solvent}}}$$

T = FP of solvent

L_f = latent heat of fusion of 1g solvent

ΔH_f = " " " " 1 mol solvent