

Liquid Solution

Solution :-

Homogeneous mix of two or more components.

Solution → Solute (one or more than one)

→ Solvent (only one)

(a) Component having same physical state as that of solution

(b) If there are more than one components having same physical state as that of soln, then the one which is present in excess amount (by mole) is solvent.

Liquid Solution :-

- ① Solution of liquid in liquid
- ② Solution of Solid in liquid
- ③ Solution of gas in liquid

Volatile and Non-Volatile substance :-

- Substance having tendency to form vapour and have some vapour pressure are volatile substance.

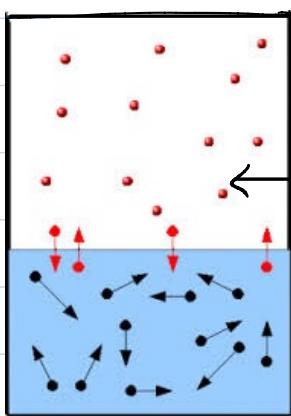
e.g.: liquids are generally volatile.

Water, alcohols, Benzene, Toluene, Acetone etc

- Substance having no tendency to form vapour are non volatile.

eg: Solids are generally non volatile
All salts and sugars, Hg etc

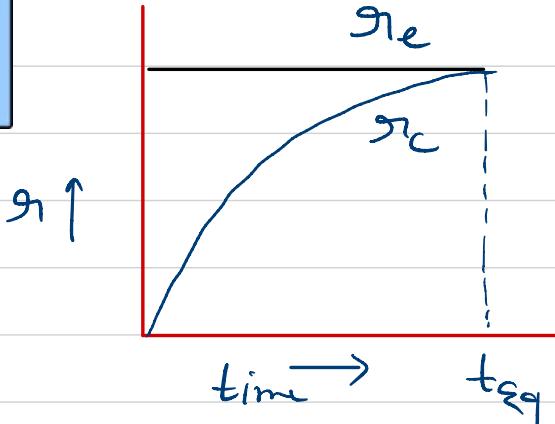
Vapour Pressure (V.P) :-



$$t=0 \quad \pi_e > \pi_c$$

$$t_{eq} \quad \pi_e = \pi_c$$

$$\text{Eq pressure} = V.P.$$



Pressure developed by vapours of volatile substance at eq. is called as Vapour Pressure



$$k_p = P_{A_{(g)}} = V.P.$$

$$\ln\left(\frac{k_{p_2}}{k_{p_1}}\right) = -\frac{\Delta H_{\text{vap}}}{R} \left[\frac{1}{T_2} - \frac{1}{T_1} \right]$$

$$= \ln\left(\frac{P_2}{P_1}\right)$$

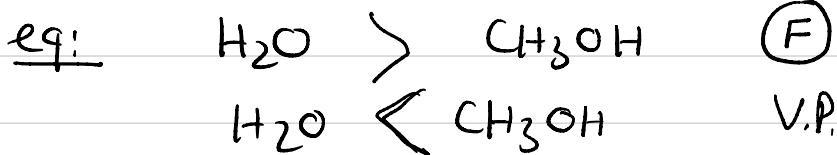
factors affecting V.P. :-

① Temp (T)

$$T \uparrow \Rightarrow V.P. \uparrow$$

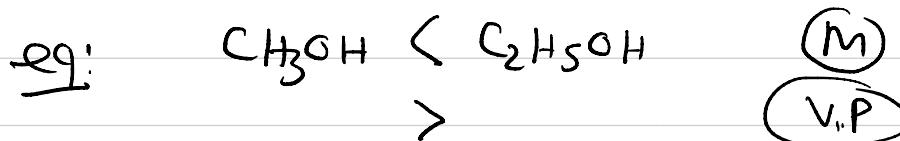
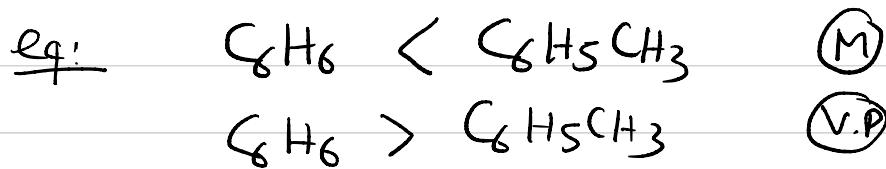
② Intermolecular forces (F) :-

$$F \uparrow \Rightarrow V.P. \downarrow$$

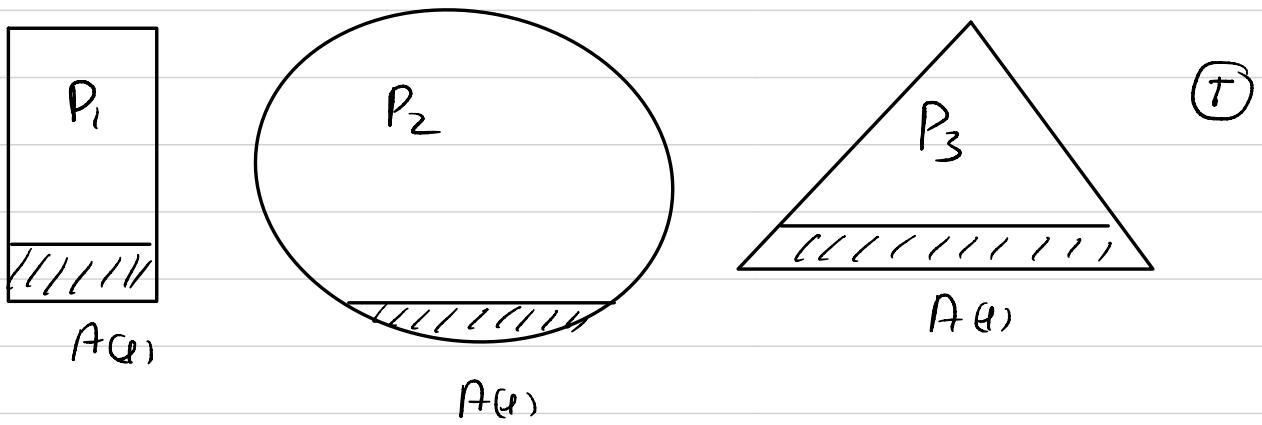


③ Molecular mass (M) :-

$$M \uparrow \Rightarrow V.P \downarrow$$



e.g.



$$P_1 = P_2 = P_3$$

Raoult's Law :- Raoult's Law is valid for ideal solution.

According to this law, V.P. of volatile substance in liquid not depend on its mole fraction and is directly proportional to it.

① Solution of liquid in liquid :-

Component	Pure	X_{liquid}	X_{vap}	V.P. in soln
	V.P.			
A	P_A°	X_A	Y_A	P_A
B	P_B°	X_B	Y_B	P_B

$$X_A \quad X_B$$

$$P_A \propto X_A$$

$$P_A = P_A^\circ X_A \quad \text{--- (I)}$$

$$P_B = P_B^\circ X_B \quad \text{--- (II)}$$

Using Dalton's Law

$$P_T = P_A + P_B \Rightarrow P_T = P_A^\circ X_A + P_B^\circ X_B$$

$$Y_A \times P_T = P_A = P_A^\circ X_A$$

$$Y_A = \frac{P_A^\circ X_A}{P_T} ; \quad X_B = 1 - Y_A$$

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	V.P.			
A	P_A°	X_A	Y_A	P_A
B	P_B°	X_B	Y_B	P_B

$$X_A \quad X_B$$

$$P_A \propto X_A$$

$$P_A = P_A^\circ X_A \quad \text{--- (I)}$$

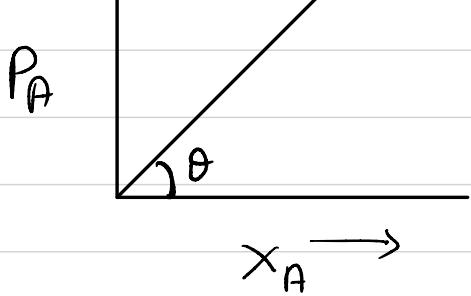
$$P_B = P_B^\circ X_B \quad \text{--- (II)}$$

Using Dalton's Law

$$P_T = P_A + P_B \Rightarrow P_T = P_A^\circ X_A + P_B^\circ X_B$$

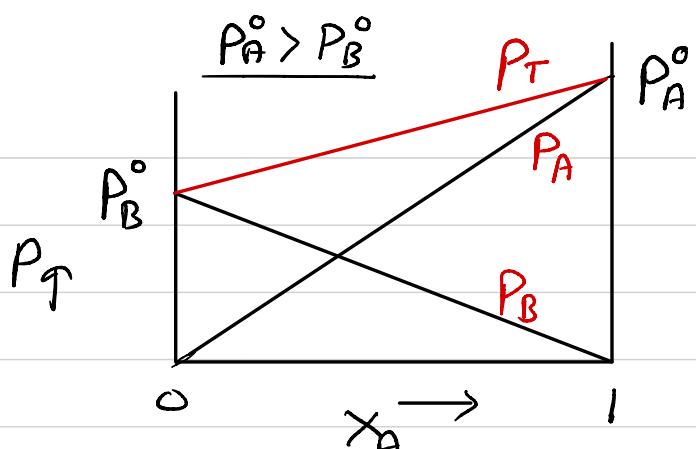
$$Y_A \times P_T = P_A = P_A^\circ X_A$$

$$Y_A = \frac{P_A^\circ X_A}{P_T} ; \quad X_B = 1 - Y_A$$



$$P_A = P_A^\circ X_A$$

$$\tan \theta = P_A^\circ$$

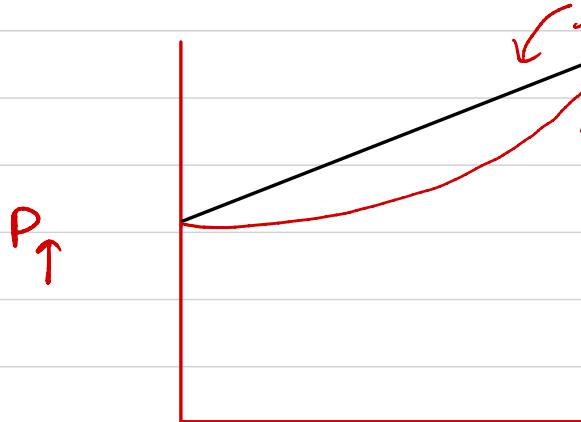


$$P_T = P_A^\circ X_A + P_B^\circ X_B$$

$$P_T = P_A^\circ X_A + P_B^\circ (1 - X_A)$$

$$P_T = P_B^\circ + (P_A^\circ - P_B^\circ) X_A$$

$$X_A = \frac{P_T - P_B^\circ}{(P_A^\circ - P_B^\circ)}$$



$$Y_A \times P_T = P_A^\circ X_A$$

$$= P_A^\circ [P_T - P_B^\circ]$$

$$Y_A \times \left(\frac{P_A^\circ - P_B^\circ}{P_A^\circ} \right) = 1 - \frac{P_B^\circ}{P_T}$$

$$\frac{P_B^\circ}{P_T} = 1 - Y_A \times \left(\frac{P_A^\circ - P_B^\circ}{P_A^\circ} \right)$$

$$\frac{P_T}{P_B^\circ} = \frac{1}{1 - Y_A \times \left(\frac{P_A^\circ - P_B^\circ}{P_A^\circ} \right)}$$

$$P_T = \frac{P_B^\circ}{1 - Y_A \times \left(\frac{P_A^\circ - P_B^\circ}{P_A^\circ} \right)}$$

$$\text{If } Y_A = 0 \Rightarrow P_T = P_B^\circ$$

$$X_A = 1 \Rightarrow P_T = P_A^\circ$$

② Solution of Solid in liquid:

Sol^m = Non volatile solid + Volatile liquid

Component	Pure V.P.	Mole fraction in liquid	V.P.	
A (Non volatile)	—	x_A	—	$\frac{P_B}{A+B}$
B (volatile)	P_B°	x_B	P_B	$x_A \quad x_B$

$$\downarrow P_B^\circ$$

$$P_B = P_B^\circ x_B$$

$$\text{Decrease in V.P.} = (P_B^\circ - P_B) = P_B^\circ (1 - x_B) = P_B^\circ x_A$$

$$\text{Relative lowering in V.P.} = \boxed{\frac{(P_B^\circ - P_B)}{P_B^\circ} = x_A}$$

$$\Rightarrow x_A \uparrow \Rightarrow \frac{\Delta P}{P_B^\circ} \uparrow$$

⇒ for very dilute solution

$$n_A + n_B \approx n_B$$

$$x_A = \frac{n_A}{n_A + n_B} \approx \left(\frac{n_A}{n_B} \right)$$

$$\boxed{\frac{P_B^\circ - P_B}{P_B^\circ} \approx \frac{n_A}{n_B}}$$

$$\Rightarrow \left[\frac{P_B^\circ - P_B}{P_B^\circ} \right] = \frac{P_B^\circ x_A}{P_B^\circ x_B} = \left(\frac{n_A}{n_B} \right)$$

Benzene and toluene forms an ideal solution. Vapour pressure of pure benzene is 100 torr while that of pure toluene is 50 torr. If mole fraction of benzene in liquid phase is $\frac{1}{3}$. Then calculate the mole fraction of benzene in vapour phase :

- (a) $\frac{2}{3}$
- (b) $\frac{1}{2}$
- (c) $\frac{2}{5}$
- (d) $\frac{1}{3}$

$$\frac{Y_B \times P_T}{Y_t \times P_T} = \frac{P_B^\circ \times X_B}{P_t^\circ \times X_t}$$

$$\frac{Y_B}{1-Y_B} = \frac{100}{50} \times \frac{\frac{1}{3}}{\frac{2}{3}} = 1$$

$$Y_B = \frac{1}{2}$$

An ideal mixture of liquids A and B with 2 moles of A and 2 moles of B has a total vapour pressure of 1 atm at a certain temperature. Another mixture with 1 mole of A and 3 moles of B has a vapour pressure greater than 1 atm. But if 4 moles of C are added to second mixture, the vapour pressure comes down to 1 atm. Vapour pressure of C, $P_C^\circ = 0.8$ atm. Calculate the vapour pressure of pure A and B :

- (a) $P_A^\circ = 1.4$ atm, $P_B^\circ = 0.7$ atm
- (b) $P_A^\circ = 1.2$ atm, $P_B^\circ = 0.6$ atm
- (c) $P_A^\circ = 1.4$ atm, $P_B^\circ = 0.6$ atm
- (d) $P_A^\circ = 0.6$ atm, $P_B^\circ = 1.4$ atm

$$1 = P_A^\circ \times \frac{1}{2} + P_B^\circ \times \frac{1}{2}$$

$$P_A^\circ + P_B^\circ = 2 \quad \text{--- (i)}$$

$$1 = P_A^\circ \times \frac{1}{8} + P_B^\circ \times \frac{3}{8} + \cancel{0.8 \times \frac{4}{8}}$$

$$0.6 \times 8 = P_A^\circ + 3P_B^\circ \quad \text{--- (ii)}$$

$$2P_B^\circ = 2.8 \Rightarrow P_B^\circ = 1.4$$

$$P_A^\circ = 0.6$$

$$550 = P_X^\circ \times \frac{1}{4} + P_Y^\circ \times \frac{3}{4} \quad \text{--- (i)}$$

$$560 = P_X^\circ \times \frac{1}{5} + P_Y^\circ \times \frac{4}{5} \quad \text{--- (ii)}$$

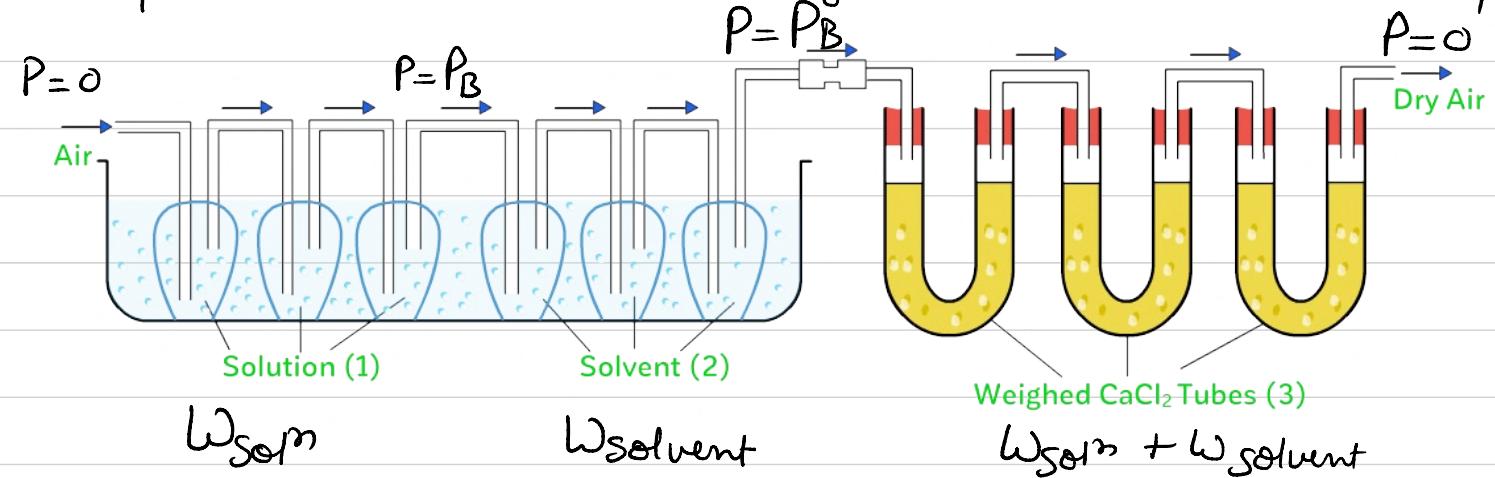
$$P_X^\circ = 400, P_Y^\circ = 600$$

Two liquids X and Y form an ideal solution. At 300 K, vapour pressure of the solution containing 1 mol of X and 3 mol of Y is 550 mmHg. At the same temperature, if 1 mol of Y is further added to this solution, vapour pressure of the solution increases by 10 mmHg. Vapour pressure (in mmHg) of X and Y in their pure states will be, respectively :

- (a) 300 and 400
- (b) 400 and 600
- (c) 500 and 600
- (d) 200 and 300

Ostwald Walker method

Experimental method to calculate relative lowering.



$$(P_B - 0) \propto \omega_{\text{Soln}} \quad \textcircled{I}$$

$$(P_B^o - P_B) \propto \omega_{\text{solvent}} \quad \textcircled{II}$$

$$(P_B^o - 0) \propto \omega_{\text{Soln}} + \omega_{\text{solvent}} \quad \textcircled{III}$$

Eqn $\textcircled{II}/\textcircled{III}$

$$\omega_{\text{Soln}} = \text{wt loss of Solution}$$

$$\omega_{\text{solvent}} = \text{wt loss of Solvent}$$

$$\left(\frac{P_B^o - P_B}{P_B^o} \right) = \frac{\omega_{\text{solvent}}}{\omega_{\text{Soln}} + \omega_{\text{solvent}}} = X_A$$

Van't hoff factor (i)

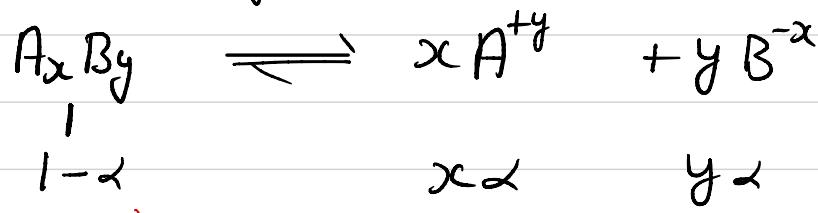
this is ratio of final No of solute particle in soln to initial no of solute particles added.

$$i = \frac{\text{Observed colligative property}}{\text{Normal or theoretical colligative property}} = \frac{(C_p)_f}{(C_p)_i}$$

$$i = \frac{\text{Normal Molar mass}}{\text{Observed molar mass}} = \left(\frac{M_i}{M_f}\right)$$

$$i = \frac{\text{Actual number of particles}}{\text{Expected number of particles}} = \left(\frac{N_f}{N_i}\right)$$

① Dissociation of Solute :-



$$i = \frac{1-\alpha + \alpha x + \alpha y}{1} \Rightarrow i = 1 - \alpha + \alpha x + \alpha y$$

$i > 1$

$$N_f > N_i$$

$$C_{pf} > C_{pi}$$

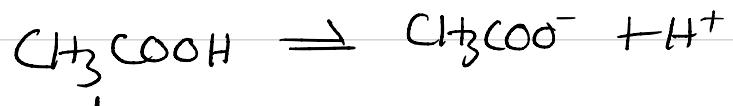
$$M_i > M_f$$

e.g. ① $\text{NaCl} \Rightarrow i = 2$

② $\text{C}_6\text{H}_{12}\text{O}_6 \Rightarrow i = 1$

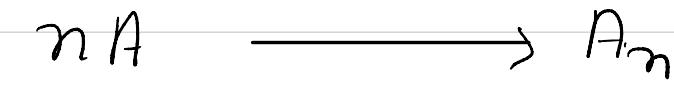
③ $\text{MgCl}_2 \Rightarrow i = 3$

④ $\text{CH}_3\text{COOH} \quad (\alpha = 0.2)$



$$i = (1 + \alpha) = 1.2$$

② Association of Solute :-



$$\begin{array}{c} | \\ (1-\alpha) \end{array} \quad \left(\frac{\alpha}{n} \right)$$

$$j = \frac{1 - \alpha + \alpha/n}{1} \Rightarrow j = (1 - \alpha + \alpha/n)$$

$$\Rightarrow j < 1$$

$$\left. \begin{array}{l} N_f < N_i \\ (C_p)_f < (C_p)_i \\ M_f > M_i \end{array} \right\}$$

e.g.: CH_3COOH in Benzene
 $(\alpha = 0.2)$



$$j = \left(1 - \frac{\alpha}{2} \right) = 0.9$$

Colligative properties:-

Properties of solution which depend on no of Solute particles are called colligative properties.

Solⁿ = Non volatile solute + Volatile liquid.

No of Solute particle ↑ → Colligative Property ↑

following properties are colligative properties -

- ① Relative lowering in V.P.
- ② Elevation in B.P. (ΔT_b)
- ③ Depression in F.P. (ΔT_f)
- ④ Osmotic pressure (Π)

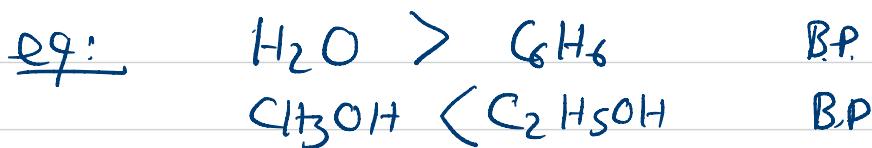
① Relative lowering in V.P. :-

$$\frac{P_B^o - P_B}{P_B^o} = X_A = \frac{i n_A}{i n_A + n_B}$$

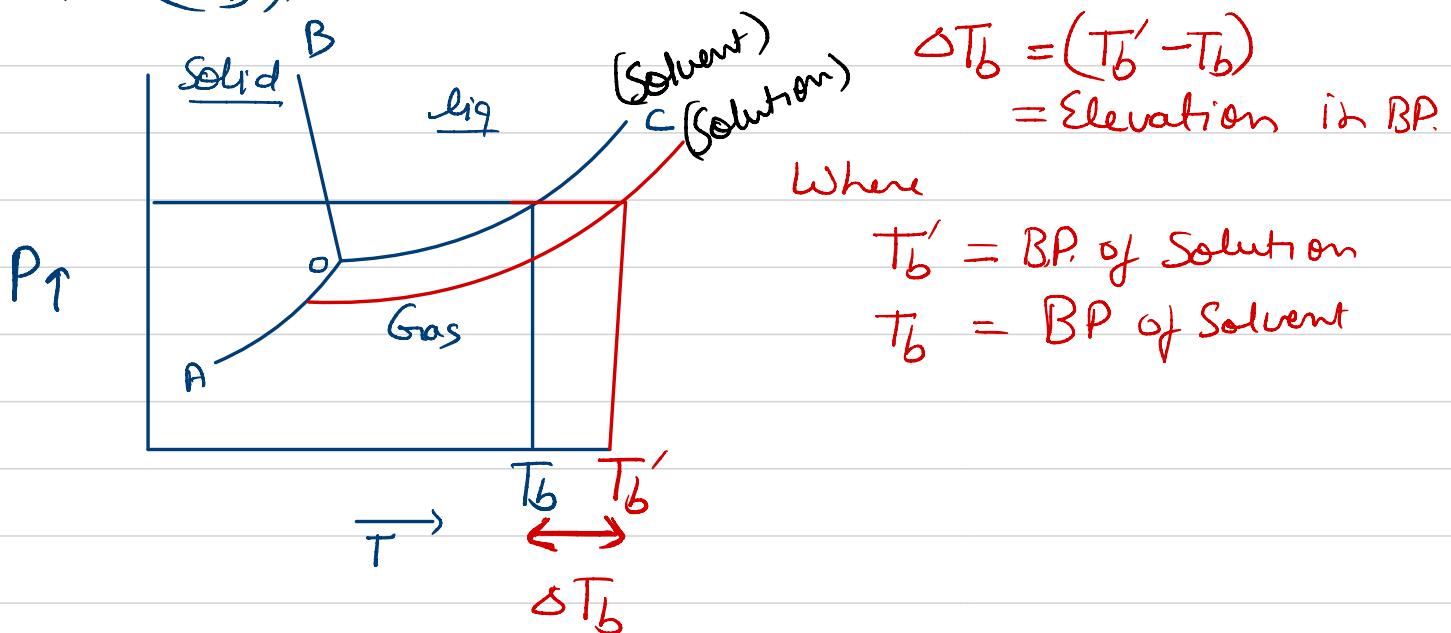
② Elevation in B.P (ΔT_b) :-

Temp at which V.P. of liquid become equal to external pressure is called as B.P. (T_b)

If external pressure is 1 atm then BP is called normal BP.



When we add a non volatile solute into volatile solvent then decrease in V.P. take place so B.P. increases. This increase in B.P. is called as elevation in B.P. (ΔT_b).



$$\Delta T_b \propto \text{No of Solute particle} \propto m$$

$$\Delta T_b \propto m$$

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

Where $m = \frac{n_A}{W_B \text{ (kg)}}$
 $= \text{molality.}$

$$\Delta T_b = k_b \cdot m$$

k_b = molal elevation cont
or

molal ebullioscopic Cont

Note:

① No of Solute particle $\uparrow \Rightarrow \Delta T_b \uparrow \Rightarrow T_b' \uparrow$

② $k_b = \frac{RT_b^2}{1000 \cdot \left(\frac{\Delta H_{\text{vap}}}{m} \right)}$

Where R = Gas cont

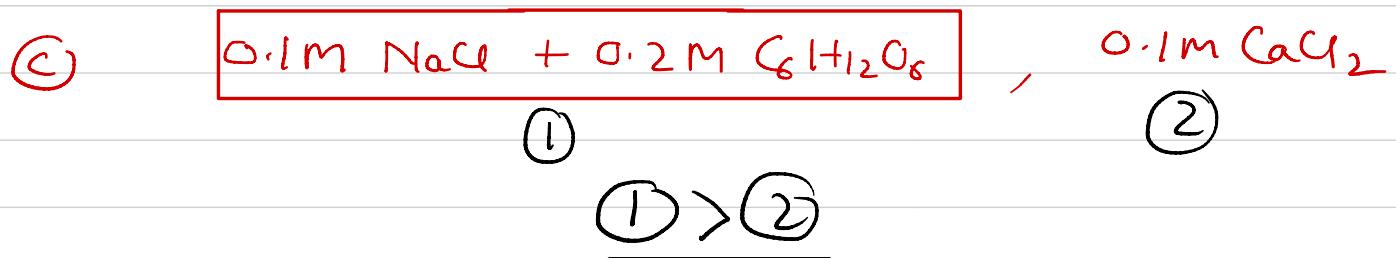
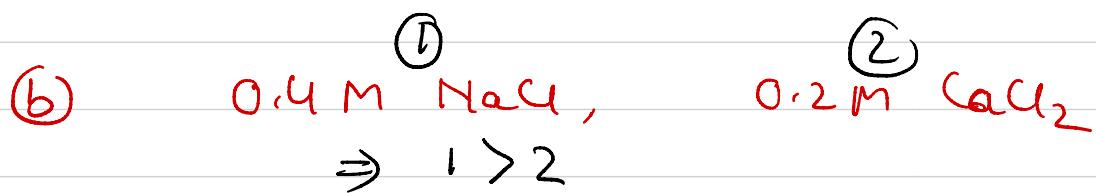
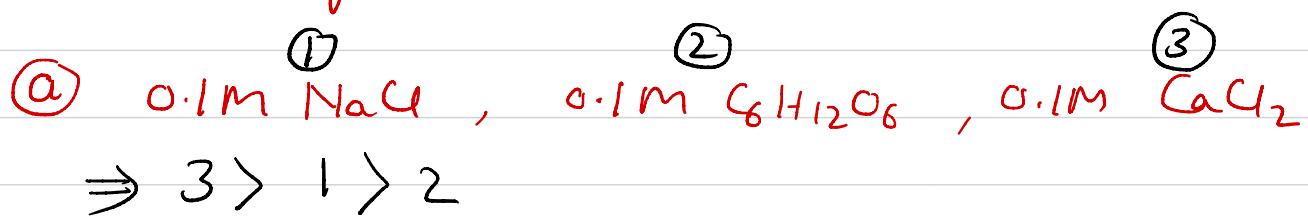
T_b = BP of Solvent

ΔH_{vap} = Enthalpy of Vapourization of Solvent

m = Molar mass of Solvent

depend on Solvent only

Ex: Write down the following solⁿ in decreasing order of their B.P.



Prob: Calculate B.P of 0.1 molal NaCl aq solⁿ

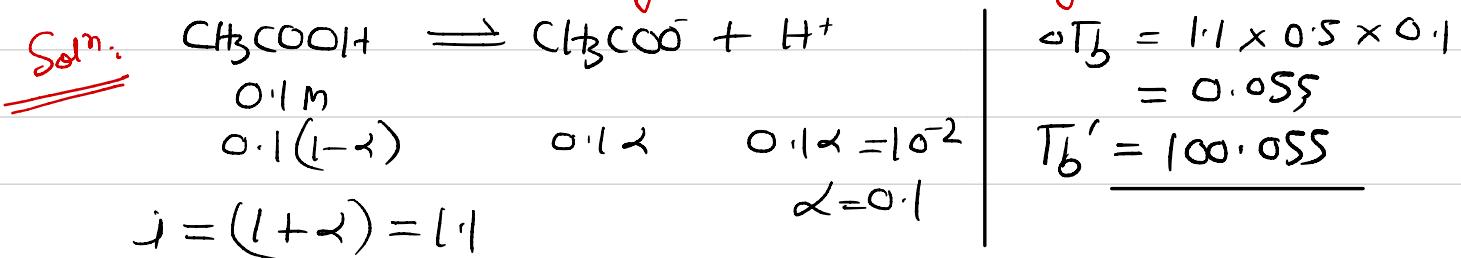
$$K_b \text{ for H}_2\text{O} = 0.5$$

$$\Delta T_b = i K_b m$$

$$T_b' - 100 = 2 \times 0.5 \times 0.1 = 0.1$$

$$\underline{T_b' = 100.1^\circ\text{C}}$$

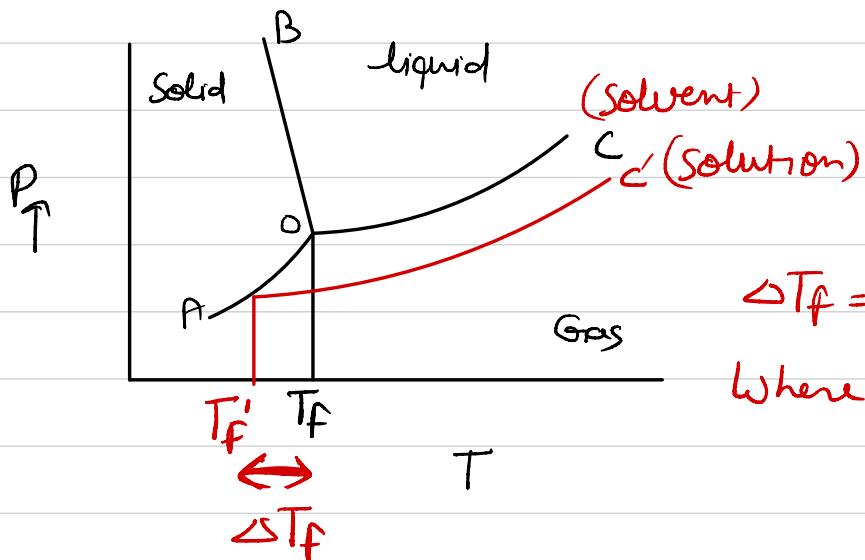
Prob: Calculate B.P of 0.1M CH₃COOH solⁿ, having pH = 2. Given K_b(H₂O) = 0.5 and assume molality and molarity to be same.



② Depression in F.P. (ΔT_f):

Temp. at which solid and liquid are in equib is called as F.P. (T_f).

Or Temp at which V.P. of solid and liq. become equal is called F.P.



$$\Delta T_f = (T_f - T_f') = \text{Depression in F.P.}$$

Where

T_f = F.P. of Solvent

T_f' = F.P. of Solution

$\Delta T_f \propto$ No. of Solute particle $\propto m$

$$\Delta T_f = k_f \cdot m$$

for dissociation / association of solute

$$\Delta T_f = i k_f \cdot m$$

Where k_f = Molal depression const
or Cryoscopic const

$$m = \text{molality} = \frac{\text{m}_A}{w_B(\text{kg})}$$

Note:

① No of solute particle \uparrow = $\Delta T_f \uparrow \Rightarrow T_f \downarrow$

②
$$K_f = \frac{RT_f^2}{1000 \frac{\Delta H_{\text{fusion}}}{M}}$$

Where R = Gas cont

T_f = F.P. of Solvent

ΔH_{fusion} = Enthalpy of fusion

M = Molar mass of Solvent.

43. How many grams of sucrose (molecular weight = 342) should be dissolved in 100 g water in order to produce a solution with a 104.76°C difference between the freezing point and the boiling point temperature? ($K_f = 1.86$, $K_b = 0.52$)

B

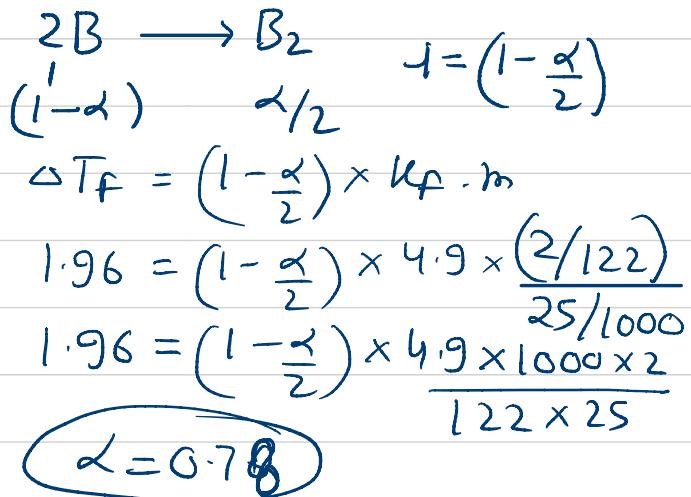
$$\frac{T_b' - 100}{(T_b' - T_f') - 100} = \frac{0.52 \times m}{(0.52 + 1.86)m}$$

$$4.76 = 2.38 \times \frac{34342}{0.1}$$

$$x = \frac{4.76 \times 0.1 \times 342}{2.38}$$

$$= 684 \text{ m}$$

- 60.** A quantity of 2 g of C_6H_5COOH dissolved in 25 g of benzene shows a depression in freezing point equal to 1.96 K. Molar depression constant for benzene is $4.9 \text{ K}\cdot\text{kg mol}^{-1}$. What is the percentage association of acid if it forms double molecules (dimer) in solution?



The relationship between osmotic pressure at 273 K when 10 g glucose (P_1), 10 g urea (P_2) and 10 g sucrose (P_3) are dissolved in 250 mL of water is :

(a) $P_1 > P_2 > P_3$ (b) $P_3 > P_1 > P_2$
~~(c) $P_2 > P_1 > P_3$~~ (d) $P_2 > P_3 > P_1$

$$\frac{10}{180}, \frac{10}{60}, \frac{10}{342}$$

$$P_2 > P_1 > P_3$$

Equal volumes of 0.4 M glucose solution at 300 K and 0.6 M fructose solution at 300 K are mixed, without change in temperature. If the osmotic pressure of glucose solution, fructose solution and the mixture are π_1 , π_2 , and π_3 , respectively, then :

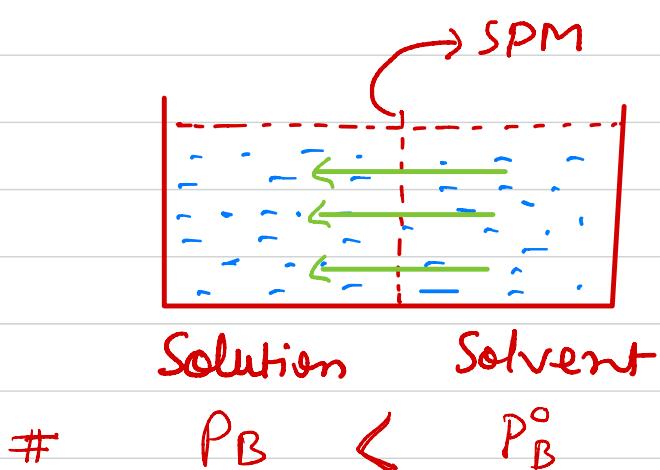
(A) $\pi_1 = \pi_2 = \pi_3$ (b) $\pi_1 < \pi_2 < \pi_3$
 (c) ~~$\pi_1 < \pi_3 < \pi_2$~~ (d) $\pi_2 < \pi_3 < \pi_1$

$$\pi_1 < \pi_2$$

$$\Rightarrow 0.2m + 0.3m = C = 0.5m$$

$$\pi_1 < \pi_3 < \pi_2$$

Osmotic pressure (π):



- ① When pure solvent is separated from soln using SPM then transfer of Solvent particle take place from pure solvent to Soln, this is called as osmosis.
- ② Min pressure applied on soln side to prevent osmosis is called as osmotic Pressure.
- ③ If more than osmotic pressure is applied on solution side then transfer of solvent particle take place in reverse direction, which is called as reverse osmosis (RO).
- ④ SPM (Semi permeable membrane) allow transfer of only solvent particle through it.

⑤ Law of Osmosis :

$$\pi \propto C \quad \text{---(I)}$$

$$\pi \propto T \quad \text{---(II)}$$

$$\pi \propto C.T.$$

$$\boxed{\pi = CRT}$$

Where

C = Molarity of Soln

R = Gas Const

T = Temp (K)

$$R = 0.0821 \text{ lit-atm / k-mol}$$

or

$$8.314 \text{ J/mol-K}$$

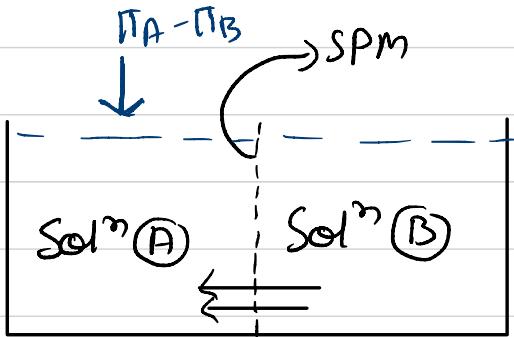
or

$$2 \text{ Cal / mol-K}$$

When solute is dissociating/associating

$$\Pi = i C R T$$

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$$C_A > C_B \text{ (given)}$$

$$P_A < P_B$$

$$\Pi_A - \Pi_B = (C_A - C_B) RT$$

$$\Pi_A > \Pi_B$$

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$$\begin{aligned} \text{Sol}^n(A) &\Rightarrow \Pi_A \\ \text{Sol}^n(B) &\Rightarrow \Pi_B \end{aligned}$$

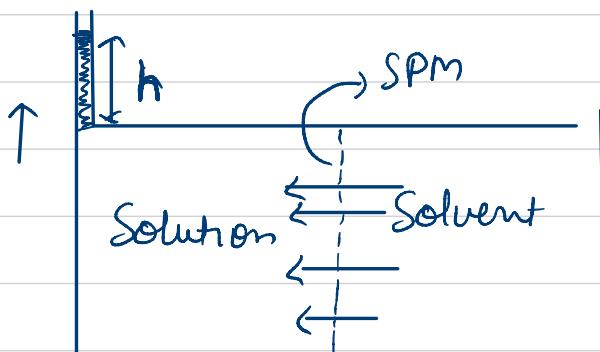
$$\text{if } \Pi_A > \Pi_B$$

$\text{Sol}^n(A)$ = hyper tonic
 $\text{Sol}^n(B)$ = hypotonic

$$\text{if } \Pi_A = \Pi_B$$

$\text{Sol}^n(A)$ and $\text{Sol}^n(B)$ are isotonic

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$$\Pi = \rho g h$$

Brom:

Calculate Osmotic Press. of a soln formed by mixing 200 ml, 60% $\frac{w}{v}$ of $C_6H_{12}O_6$ and 300 ml, 5.85% $\frac{w}{v}$ of NaCl at 300 K. (given $R = 0.08 \frac{lit\ atm}{K\ -mole}$)

$$200 \times \frac{60}{100} \times \frac{1}{180_3} \times 1 = n_{C_6H_{12}O_6} = \frac{2}{3} \text{ mole}$$

$$300 \times \frac{5.85}{100} \times \frac{1}{58.5} \times 2 = n_{NaCl} = 0.6 \text{ mole}$$

$$C = \frac{\frac{2}{3} + 0.6}{0.5} = \frac{3.8}{1.5} = \underline{\underline{2.53}}$$

$$\Pi = C RT = 2.53 \times 0.08 \times 300 \\ = \underline{\underline{60.72 \text{ atm}}}$$

Ideal and Non-Ideal Soln:

Ideal Solution:-

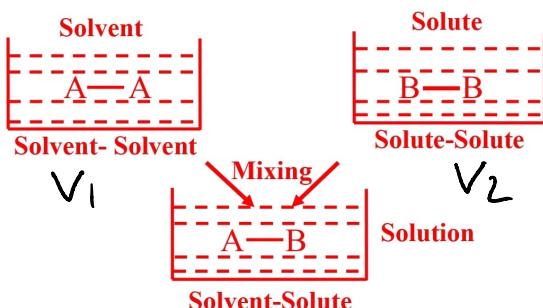
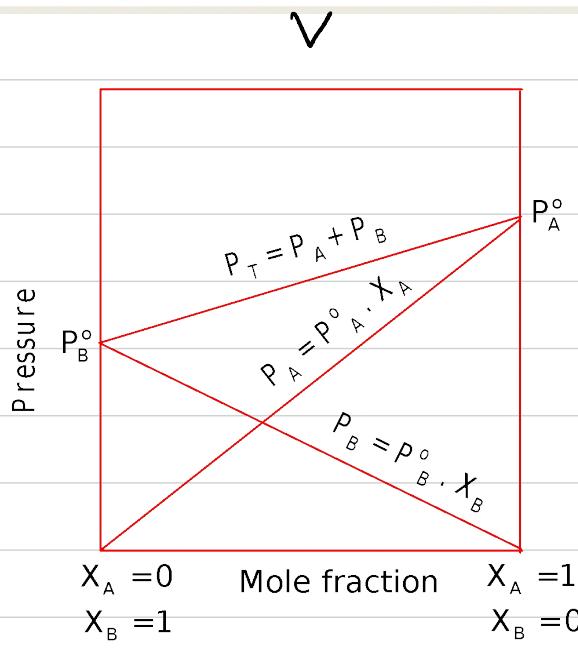


Fig.-Formation of Ideal Solution



$$\textcircled{1} \quad \Delta V_{\text{mix}} = 0$$

$$V = V_1 + V_2$$

$$\textcircled{2} \quad \Delta H_{\text{mix}} = 0$$

\textcircled{3} follow Raoult's Law

$$P_A = P_A^o \times x_A$$

$$P_B = P_B^o \times x_B$$

$$P_T = P_A^o x_A + P_B^o x_B$$

\textcircled{4} Very dilute soln behave like ideal.

\textcircled{5} Mixing of similar components produce ideal soln.

$$\textcircled{6} \quad \Delta S_{\text{mix}} = +ve$$

$$\Delta G_{\text{mix}} = \Delta H_{\text{mix}} - T \cdot \Delta S_{\text{mix}}$$

$$= -ve$$

Examples;

dilute solutions:

benzene - toluene:

n-hexane + n-heptane.

chlorobenzene

bromobenzene;

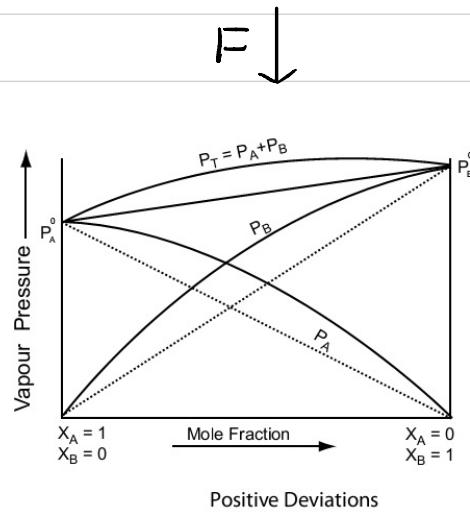
ethyl bromide + ethyl

iodide;

n-butyl chloride + n-butyl bromide.

Non-Ideal Solution:-

① Solution Showing +ve deviation :-



$$\textcircled{1} \quad \Delta V_{\text{mix}} = +\text{ve}$$

$$V > (V_1 + V_2)$$

$$\textcircled{2} \quad \Delta H_{\text{mix}} = +\text{ve}$$

$$\textcircled{3} \quad P_A > P_A^o X_A$$

$$P_B > P_B^o X_B$$

$$P_T > (P_A^o X_A + P_B^o X_B)$$

$\textcircled{4}$ mix of diff. nature showing weak interaction, show +ve deviation

$\textcircled{5}$

$$\Delta S_{\text{mix}} > 0$$

$$\Delta G = \underbrace{\Delta H_{\text{mix}}}_{+\text{ve}} - T \cdot \underbrace{\Delta S_{\text{mix}}}_{-\text{ve}}$$

$$= -\text{ve}$$

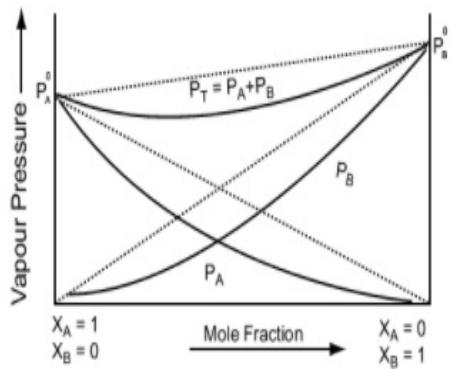
Examples:

acetone - ethanol
acetone - CS_2
water + methanol,
water + ethanol;
 CCl_4 , + toluene;
 CCl_4 + CHCl_3
acetone + benzene;
 CCl_4 + CH_3OH ;
cyclohexane - ethanol

② Solution Showing -ve deviation :-

$F \uparrow$

$$\textcircled{1} \quad \Delta V_{\text{mix}} < 0 \\ V < (V_1 + V_2)$$



$$\textcircled{2} \quad \Delta H_{\text{mix}} < 0$$

$$\textcircled{3} \quad P_A < P_A^o X_A \\ P_B < P_B^o X_B$$

$$P_T < (P_A^o X_A + P_B^o X_B)$$

④ Mixing of diff nature components showing st. interaction on chemical rxn for -ve deviation

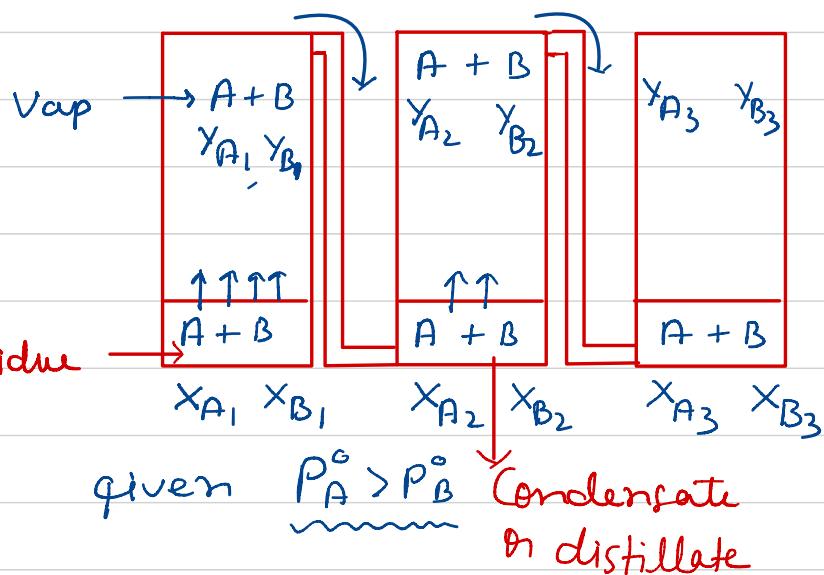
Solⁿ

$$\textcircled{5} \quad \Delta S_{\text{mix}} > 0$$

Examples:

acetone - aniline;
acetone - chloroform;
 CH_3OH - CH_3COOH
 $\text{H}_2\text{O} + \text{HNO}_3$
chloroform + diethyl ether,
water - HCl,
acetic acid + ~~pyridine~~ pyridine
chloroform - benzene.

Distillation:-



Ist $P_{T_1} = P_A^\circ X_{A_1} + P_B^\circ X_{B_1}$

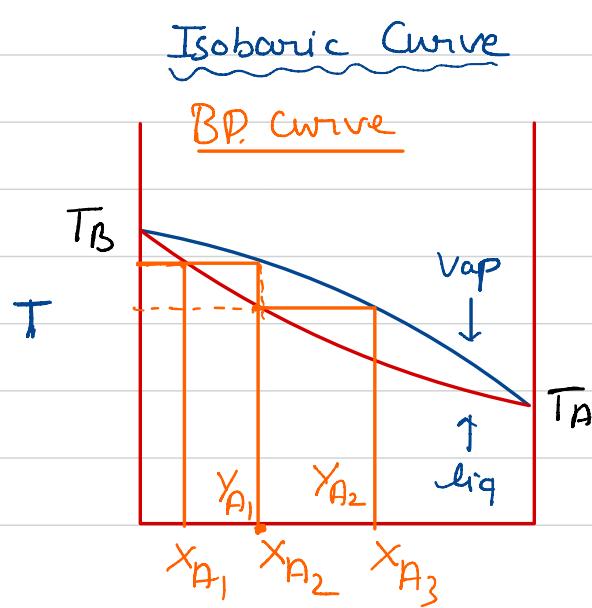
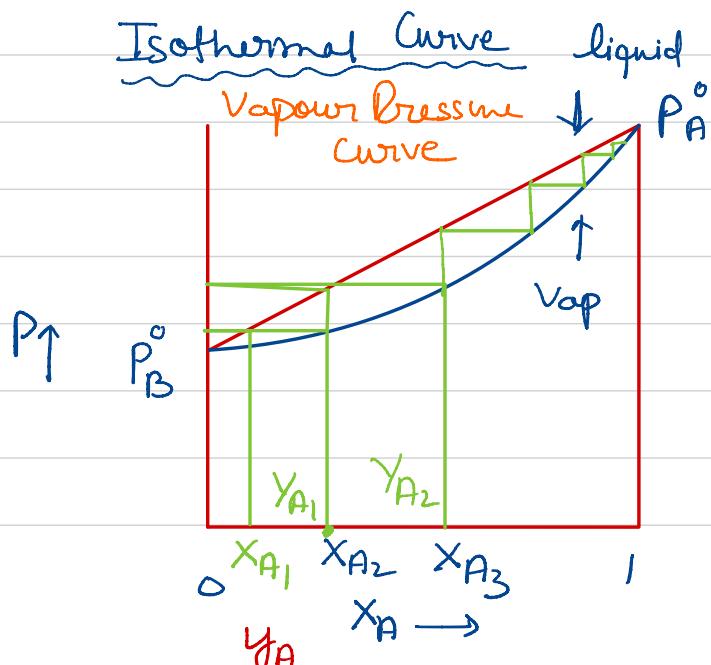
$$Y_{A_1} = \frac{P_A^\circ X_{A_1}}{P_{T_1}} : Y_{B_1} = 1 - Y_{A_1}$$

IInd $X_{A_2} = Y_{A_1}, X_{B_2} = Y_{B_1}$

$$P_{T_2} = P_A^\circ X_{A_2} + P_B^\circ X_{B_2}$$

$$Y_{A_2} = \frac{P_A^\circ X_{A_2}}{P_{T_2}} ; Y_{B_2} = 1 - Y_{A_2}$$

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Solution of gas in liquid:-

Solubility of gas in liquid can be written in X, m etc

Factors affecting solubility :-

① Effect of temperature:-



$$T \uparrow \Rightarrow \xleftarrow{Rxn}$$

At constant pressure,

$$\ln \frac{C_2}{C_1} = \frac{\Delta H_{sol}}{R} \left(\frac{1}{T_1} - \frac{1}{T_2} \right) = \frac{-\ln k_2}{k_1} \Rightarrow \text{Solubility} \downarrow$$

where C = molar concentration of gas in solution

$$K_{eq} = \frac{[A]}{P_A}$$

② Effect of pressure:-



$$P \uparrow \Rightarrow n_g \downarrow \xrightarrow{Rxn} \Rightarrow \text{Solubility} \uparrow$$

Solubility of gas in liquid follow Henry's Law at low Pressure

Henry's Law:- $P_{gas} \propto X_{gas} \Rightarrow P_{gas} = K_H X_{gas}$

Where P = Partial Press of Gas , K_H = Henry's Cont

X_{gas} = Mole fraction of gas liquid

If $P = \text{Cont}$ $\Rightarrow K_H \uparrow \Rightarrow X_{gas} \downarrow$

If $P = \text{Cont}$ $\Rightarrow T \uparrow \Rightarrow X_{gas} \downarrow \Rightarrow K_H \uparrow$

Limitations of Henry's Law :

- (1) It is valid only for ideal behaviour of gas. As none of the gas is ideal, this law may be applied at low pressure and high temperature.
- (2) It gives better result when the solubility of gas in the liquid is low.
- (3) The gas should neither dissociate nor associate in the liquid.

Nature of gases:-

⇒ Interaction force ↑ ⇒ Solubility ↑
eg: $O_2 < CO_2$

⇒ liquefaction ↑ ⇒ Solubility ↑
 T_c (Critical temp) ↑ ⇒ Solubility
 $= \left(\frac{8a}{27Rb} \right)$