- Solubility of gas in liquid : (Henry's law)

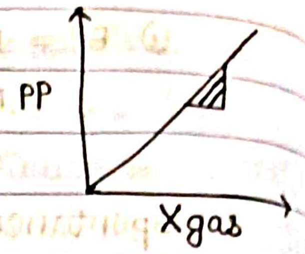
$X_{gas} = \dfrac{n_{gas}}{n_{gas} + n_{H_2O}}$

② $K_H \propto \dfrac{1}{\text{solubility}}$

P.P ∝ solubility

P.P ∝ mole Fraction of gas

$PP = K_H X_{gas}$

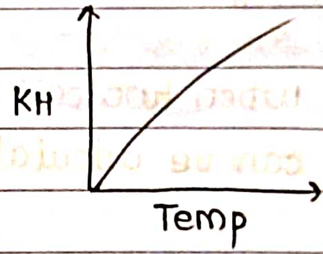


K_H = Henry's constant of gas

Depends on nature of gas

③ slope = K_H = $\tan\theta$

① $K_H \propto$ Temp



- Factors affecting solubility of Gas :

① Nature of gas : Order of solubility

$SO_3 > SO_2 > CH_4 > NH_3 > HCl > O_2 / N_2 > H_2 > He$

② Nature of solvent ∝ Dielectric constant ∝ Polarity

③ Temp $\propto \dfrac{1}{\text{solubility}}$

④ $P.P = K_H$ solubility

PP ∝ solubility

- Limitations of Henry's law :

① P = low T = low

② Gas dissolved in liq

③ Ideal gas Behaviour

④ V.V small amount of gas solubile in liq

- Solubility of Liquid in Liquid :

① Evaporation : liquid → vapour

② Condensation : Vapour → liquid

$r_{eva} = r_{cond}$ (at equilibrium state)

③ At equilibrium pressure exerted by vapours on the surface area of liquid when both liquid and vapour Both are at equilibrium

↓

Vapour pressure → Depends only on the Temperature

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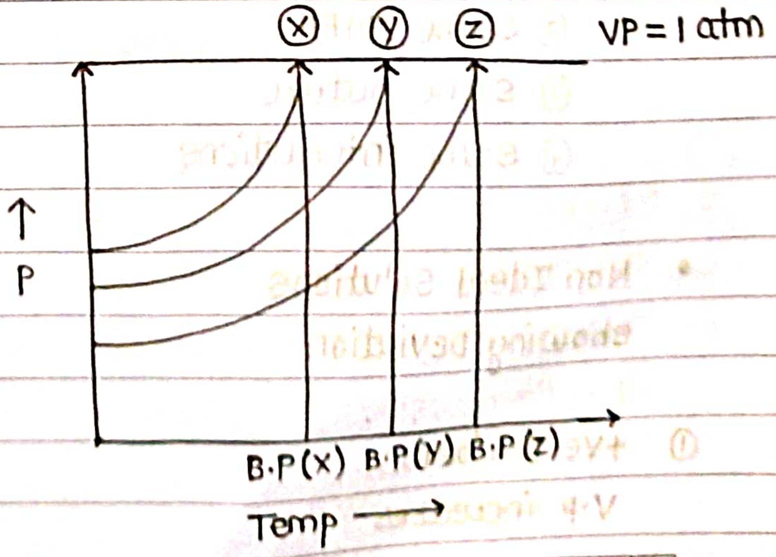
- Imp points of vapour pressure :

1. In closed vessel.
2. V.P ∝ Temp
3. Depends on Temp and nature of liquid .
4. Open vessel → evoporation
   closed vessel → Both evoporation and condensation
5. Temp ∝ K.E
   $K.E = \frac{3}{2} nRT$
6. At Higher altitude
   P = low
   B.P (H_2O) < 100°C
7. In pressure cooker → cooking time For Food → B.P (H_2O) ↑
   Reduced
8. During eva/ conden → no. of molecules on the surface area always constant.
9. B.P — Temp at which V.P of liq = 1 atm
   $B.P \propto \frac{1}{V.P}$

H_2O — 100°C
CH_3OCH_3 — 38°C
C_6H_6 — 65°C
C_2H_5OH — 85°C
$C_6H_5NH_2$ — 225°C

Low BP — High VP — Volatile liquid
High BP — Low VP — Non - Volatile liquid

1. BP order
   Z > Y > X
2. VP order
   Z < Y < X

- 

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- Mixing of two volatile liquids (Roults Law 1)

- Vapour state

$P_A = Y_A TP$

$P_B = Y_B TP$

- Liquid state

$P_A = X_A P_A^0$

$P_B = X_B P_B^0$

- Daltons law of PP

TP sum of the PP

$TP = P_A + P_B$

$TP = X_A P_A^0 + X_B P_B^0$

P_A — partial pressure of A

P_B — partial pressure of B

P_A^0 — V.P of pure liquid A

P_B^0 — V.P of pure liquid B

X_A — MF of A in liquid state

X_B — MF of B in liquid state

Y_A — MF of A in vap. state

Y_B — MF of B in vap. state

Total M.F = 1

$X_A + X_B = 1$

- Ideal Solutions:

The solution which obeys Raoutts law exactly over entire range of concenterations is called Ideal Solution

$\boxed{A-A}$ $\boxed{B-B}$ $\xrightarrow{\text{mixed}}$ $\boxed{A-B}$

Ⓐ Ⓑ AB solution (Ideal solution)

A and B liq should have

1. same FG
2. same IMFA
3. same nature
4. same interactions

1. $A-A = B-B = A-B$
2. $P_A = X_A P_A^0$
   $P_B = X_B P_B^0$
3. $TP = P_A + P_B$
4. $\Delta V\ mix = 0$
5. $\Delta H\ mix = 0$

- Non Ideal Solutions showing Deviation

① +ve Deviation

V.P increases

② −ve Deviation

V.P Decreases

① A-A and B-B strong
A-B - weak

② $P_A > X_A P_A^o$
$P_B > X_B P_B^o$
$T_P > P_A + P_B$

③ $\Delta H_{mix} > 0$ — endothermic

④ $\Delta V_{mix} > 0$ — Volume increases

ex: $CH_3COCH_3 + C_2H_5OH$
CH_3COCH_3 + ether
$CCl_4 + CH_3OH$
$H_2O + CH_3OH$
$CH_3COCH_3 + CS_2$

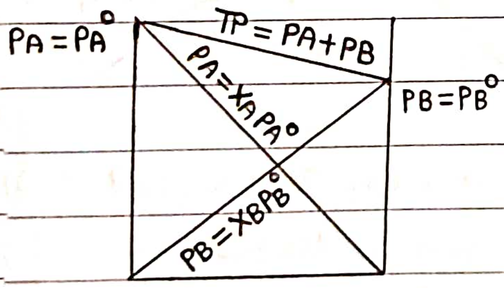
① A-A and B-B weak
A-B - strong

② $P_A < X_A P_A^o$
$P_B < P_B^o X_B$
$T_P < P_A + P_B$

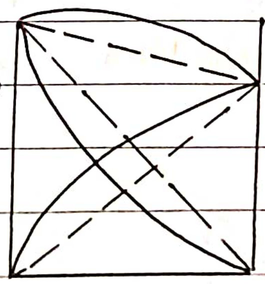
③ $\Delta H_{mix} < 0$ — exothermic

④ $\Delta V_{mix} < 0$ — volume decreases

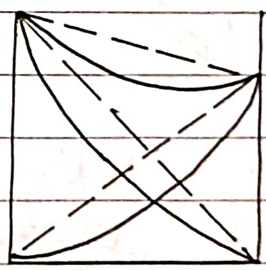
ex: $H_2O + CH_3COOH$
$H_2O + HCl$
$CH_3OH + CH_3COOH$
$CHCl_3 + CH_3COCH_3$
$CHCl_3 + C_6H_6$
$C_6H_5NH_2 + CH_3COCH_3$



$X_A = 1$ $X_B = 1$
$X_B = 0$ $X_A = 0$



+ve Deviation
V.P Increases



-ve Deviation
V.P Decreases

$X_A + X_B = 1$

- Azeotropic mixture :

A mixture of 2 or more components can boils at same temp and can't seperated by distillation process called Azeotropic mixture

- Note:

① Non-Ideal solution give azeotropic mixture.
② After mixing V.P of both liquids inc or decr than pure liquids
③ After mixing BP of both liquids inc or decr than pure liquids
④ Means BP of Azeotropic mixture $\longrightarrow$ Greater or lesser than BP of pure liquids
⑤ B.P of both liquids same $\longrightarrow$ At this BP composition of Both liquid phase and vapour phase are same.

- Colligative properties:

Properties depends on. No. of solute particles But not nature of solute is called colligative properties.

⓪ Relative lowering of V.P :

On addition of Non volatile solids solute, V.P of solvent decreases called Lowering of vapour pressure.

a) $LVP = P^s - P^o$ (P^s = Vapour. P of solution / P^o = Vapour P of solvent)

b) $RLVP = \frac{LVP}{P^o} = \frac{P^o - P^s}{P^o}$ (Value Increases)

c) $RLVP = X_{solute}$ —— According to Raults law

d) $\frac{P^o - P^s}{P^o} = \frac{n}{N}$ —— Find P^o / P^s / LVP / RLVP

e) $\frac{P^o - P^s}{P^o} = \frac{wt}{m.wt} \times \frac{M.wt}{Wt}$ —— Find M.wt of solute

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f) $\frac{p^o - p^s}{p^o} = m \times \frac{M \cdot wt}{1000}$ m - molallty

- Elevation of BP (ΔT_b)

On addition of Non volatile solute, V.P of solvent decreases so BP of solution increases called elevation of B.P

$T_{bs} > T_b^o$

① $\Delta T_b = T_b^s - T_b^o$ (T_b^s = B.P of solution / T_b^o = B.P of pure solvent)

② $\Delta T_b = K_b m$ K_b = Ebullioscopic / molal elevation / B.P of elevation constant

→ Elevation of Bp at conc of soln 1 molal

③ $T_b^s - T_b^o = K_b \times \frac{wt}{mwt} \times \frac{1000}{Mwt}$

- Depression of Freezing point (ΔT_f):

On addition of Non volatile solute V.P of solution decreases so FP of solution decreases called Depression of FP.

$T_f^o > T_f^s$

① $\Delta T_f = T_f^o - T_f^s$ — (T_f^o = FP of solvent / T_f^s = FP of solution)

② $\Delta T_f = K_f m$ K_f — cryoscopic / F.P depression constant

③ $\Delta T_f = K_f \times \frac{wt}{mwt} \times \frac{1000}{Wg}$.

- Osmotic pressure:

- Moving of solvent molecules High conc ⟶ Low conc through semi-permeable membrane called osmosis.

- The external pressure applied on the piston to stop the osmosis called osmotic pressure.

① $\pi = CST$ C = conc. = molarity $= n \times \frac{1}{V_L} = \frac{wt}{mwt} \times \frac{1}{V_L} = \frac{wt}{mwt} \times \frac{1000}{V_{ml}}$

$S = R = 0.0821 = \frac{1}{12}$

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② Two solutions mixed $\pi_{RS} = \pi_1 + \pi_2$

$= C_1ST_1 + C_2ST_2$

$= C_1ST + C_2ST$

$= (C_1+C_2)\, ST$

③ A and B two solutions

a. $OP(A) < OP(B)$ —— A is hypotonic than B

b. $OP(A) = OP(B)$ —— A is isotonic than B

c. $OP(A) > OP(B)$ —— A is hypertonic than B

- A and B are isotonic solution

$\boxed{\pi_A = \pi_B}$

$C_1ST_1 = C_2ST_2$

$T_1 = T_2$

$\downarrow$

$\boxed{C_1 = C_2}$ $\rightarrow$ $\dfrac{n_1 \times 1}{V_1 L} = \dfrac{n_2 \times 1}{V_2 L}$

$V_1 = V_2$

$\downarrow$

$\boxed{n_1 = n_2}$ $\rightarrow$ $\dfrac{w_1}{m.wt_1} = \dfrac{w_2}{m wt_2}$

$K_b(H_2O) = 0.52$

- Formulae: $K_f(H_2O) = 1.86$

① $RLVP = i\, X_{solute}$

② $\Delta T_b = i\, K_b m$

③ $\Delta T_f = i\, K_f m$

④ $\pi = i\, CST$

(i) No. of solute particles (i)

(ii) Amount of solute

(iii) No. of moles of solute (X_{solute})

(iv) Conc. of solution (C)

(v) C·i

$\underline{RLVP / LVP / BP / \Delta T_b / \Delta T_f / \pi} \propto (i)\ (ii)\ (iii)\ (iv)\ (v)$

FP / VP

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- According to Roults law :

① Dilute ⟶ $\frac{P^o - P_s}{P^o} = \frac{wt}{mwt} \times \frac{M \cdot wt}{Wt}$ — P^o/ LVP

② conc — P^s/ RLVP

⟶ $\frac{P^o - P^s}{P_s} = \frac{wt}{mwt} \times \frac{M \cdot wt}{Wt}$ — m·wt of solute

- A and B are isotonic solution ⟶ $\frac{wt_1}{mwt_1} \times \frac{1000}{V_1} = \frac{wt_2}{mwt_2} \times \frac{1000}{V_2}$

- Roult's law : RLVP = Xsolute

$\frac{LVP}{P_o}$ = Xsolute

- Abnormal Mwt – VantHoff Factor (i)

i = No. of solute particles ⟶ For Dissociation — $i > 1$

For Association — $i < 1$

For glucose, sucrose, Fructose, Non volatile solutes, Non electrolytic solutes ⟵ For diss/Associ — $i = 1$

Association

① For degree of dissociation (α) of solute = $\frac{l-1}{n-1}$

② For degree of association (α) of solute = $\frac{l-1}{\frac{1}{n}-1}$

$2A \longrightarrow A_2$	$i = 1/2$
$3A \longrightarrow A_3$	$i = 1/3$
$4A \longrightarrow A_4$	$i = 1/4$

n = no. of particles asso/ disso when $\alpha = 100\%$

l = no. of particles asso/ disso when $\alpha = 100\%$ or $\alpha \neq 100\%$

- Relation b/w normal and abnormal wt :

① $i = \dfrac{\text{No. of particles asso/diss}}{\text{No. of particles taken}}$

②

$i = \dfrac{\text{Normal wt}}{\text{Abnormal wt}}$ Abnormal wt $= \dfrac{\text{Normal weight}}{i}$