solutions

solutions are homogeneous mixtures of two or more components.

↳ Binary soln → Two components
↳ Tertiary soln → 3 components.
↳ Polymaly soln → more components.

solute → less amount
solvent → large amount.

[Table 2.1 : Types of solutions]

mass percentage (w/w)

mass % of a component = $\frac{\text{mass of comp}}{\text{mass of soln}} \times 100$

Volume percentage (v/v)

Vol % of a component = $\frac{\text{vol of compo}}{\text{vol of soln}} \times 100$

mass by Volume % (w/v)

$= \frac{\text{mass of component}}{\text{vol}^n \text{ of soln}} \times 100$

mole fraction (X)

- unitless quantity
- mole fraction of soln = 1

$$\chi_A = \frac{n_A}{n_A + n_B}$$

$$\chi_B = \frac{n_B}{n_A + n_B}$$

Q. Find mole fraction of 90g H_2O & 40g NaOH.

$n_A = \frac{90}{18} = 5$ moles

$n_B = \frac{40}{40} = 1$ mol

mole of fraction of $H_2O = \frac{5}{5+1} = \frac{5}{6}$

mole fraction of NaOH $= \frac{1}{6} = \frac{1}{6}$.

Q. In a Binary soln $\chi_A = 0.65$, $\chi_B = ?$ mole fraction of soln = ?

Ans. $\chi_A + \chi_B = 1$.

$0.65 + \chi_B = 1$.

$\boxed{\chi_B = 0.35}$

Molarity (M)

$= \frac{\text{moles of solute}}{\text{litres of solution}}$

$$M = \frac{w}{m} \times \frac{1000}{V(ml)}$$

where,
w = given mass
m = molar mass
V(ml) = vol^n of soln in ml

Ques calculate molarity of 4g NaOH in 250 ml solution.

$M = \frac{w_B}{m_B} \times \frac{1000}{V(ml)} = \frac{4}{40} \times \frac{1000}{250}$

$\boxed{M = 0.4 \text{ Molar}}$

$\boxed{M_1V_1 = M_2V_2}$

Molality (m)

$= \frac{\text{moles of solute}}{\text{Solvent (in kg)}}$

$$m = \frac{w_B}{m_B} \times \frac{1000}{w_A(g)}$$

Ques calculate molality of 49g H_2SO_4 in 500g water?

Ans

$m = \frac{w_B}{m_B} \times \frac{1000}{w_A(g)} = \frac{49}{98} \times \frac{1000}{500}$

$\boxed{m = 1 \text{ molal}}$

Molarity	molality
• moles of solute dissolved in 1 litre of solution.	• moles of solute dissolved in 1 kg of solvent.
• symbol is M	• symbol is m.
• Formula is mole/litre	• mole/kg
• Affected by change in Temp.	• Do not get affected by the change in Temp.

Relation bet^n M & m

$$M = \frac{md}{1 + m M_B \text{ (in kg)}}$$

where,
M → molarity, d → density
m → molality, M_B → molar mass in kg

SOLUBILITY

↓
Dissolution or miscibility

" at particular temp, maximum amount of solute in grams is dissolved in particular quantity of solvent so that solution becomes saturated."

Solubility of solid in liquid

- **Temperature** –

endothermic process

↳ Temp. increases, solubility of solid in liquid ~~decreases~~ increases.

exothermic process

↳ Temp. increases, solubility of solid in liquid decreases.

Like dissolve like

↳ Polar dissolves Polar
Eg: HCl + NaOH

↳ Non-Polar dissolve non-Polar.
Eg: Benzene + Toluene

↳ Polar don't dissolve in Non Polar.
Eg: H_2O + Oil

Solubility of gases in liquid

- **Temperature**

↳ when gases dissolved in liquid, this is an exothermic process
Now, Temp ↑
∴ solubility ↓

- **Pressure** [Henry law]

" Acc. to Henry's law, mass of gas dissolved is directly proportional to Pressure of gas."

In terms of solubility,

$$m = K_H P$$

Now, Acc. to Dalton's modifications,

$$P \propto \chi_B$$

$$P = K_H \chi_B \leftarrow \text{mole fraction (solubility)}$$

↑ Henry's constant.

About Henry's constant :-

- $K_H \propto$ Temp $\propto \frac{1}{\text{solubility}}$
- It has different values for different gases at same temp. That means it is a ~~nature of~~ function of nature of gases.
- SI unit → K bar (Kilobar)

Applications –

- To increase the solubility of CO_2 in soft drinks and soda water, the water bottle is sealed with High Pressure.
- On the sea level, Pressure ↑, conc^n of Nitrogen ↑ which causes **bends** → To avoid this → air is diluted with Helium.
- At high altitudes, Partial Pressure of oxygen is very low → **Anoxia**

Ideal	Non-Ideal
• which obay's Raoult's law $P_A = P^\circ_A \chi_A$ $P_B = P^\circ_B \chi_B$	• which don't obey Raoult's law $P_A \neq P^\circ_A \chi_A$ $P_B \neq P^\circ_B \chi_B$
• Interaction of A-B is same as interaction of A-A & B-B.	• Interaction of A-B is not same as interaction of A-A & B-B
• $\Delta V = 0$ (volume)	• $\Delta V \neq 0$
• $\Delta H = 0$	• $\Delta H \neq 0$.

Physics wallah Nice Sir

P W N S

+ve weak -ve strong.

+ve Deviation

↳ F.OA → weak

↳ $P_A > P^\circ_A \chi_A$

$P_B > P^\circ_B \chi_B$

↳ $\Delta V = +ve$

↳ $\Delta H \uparrow\uparrow$ (Heat absorbed)

eg: $H_2SO_4 + H_2O$

$HNO_3 + H_2O$

-ve Deviation

↳ F.OA → strong.

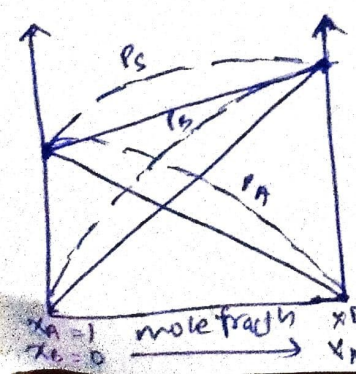
↳ $P_A < P^\circ_A \chi_A$

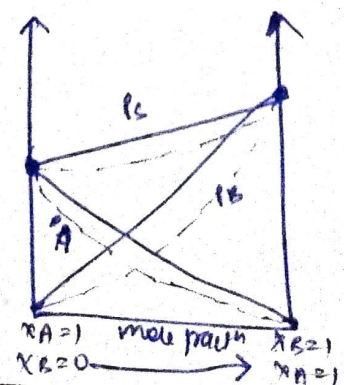
$P_B < P^\circ_B \chi_B$

↳ $\Delta V = -ve$

↳ $\Delta H \downarrow\downarrow$ (Heat evolved)

eg: $CH_3-\overset{O}{\overset{\|}{C}}-CH_3 + CHCl_3$





Azeotropes { Constant Boiling Mixture }

↳ such type of mixtures having fixed composition and constant boiling point called azeotropes

eg: Rectified spirit (ethanol + H_2O : 95% : 5%)

↳ when liq & vapour comp. is same

Maximum Boiling Azeotropes

↳ shown by positive deviation mixture.

Minimum Boiling Azeotropes

↳ shown by negative deviation mixture.

Colligative Properties

"Those properties which depends upon no. of moles of solute but not depends upon the nature of solute."

→ Osmotic Pressure

"It is the particular pressure which is applied at the higher concentration side to prevent osmosis through semi-permeable membrane."

$P \propto C$ [molar conc.] —— (i)

$P \propto T$ [Temp.] —— (ii)

From eq (i) & (ii)

$P \propto CT$

$P = RCT$

R = gas constant.

$\therefore P = \frac{n}{V} \times R \times T$ [C = molar conc^n]

$\boxed{PV = nRT}$

High concentration ← osmosis — Low concentration

high concentration — reverse osmosis → low concentration

Abnormal Molar mass.

Whenever solute particles undergoes association or dissociation, calculated molar mass comes different from expected molar mass.

→ Van't Hoff Factor (i)

"It is the ratio of experimental colligative property ~~or~~ to the theoretical colligative property."

or.

"It is the ratio of theoretical value of molecular mass to the experimental value of molecular mass"

$$i = \frac{\text{Theoretical molecular mass}}{\text{Observed molecular mass}}$$

- $i > 1$ → dissociation
- $i = 1$ → No asso. or diss.
- $i < 1$ → association

Case - 1

For non - electrolyte

$i = 1$

eg: urea (NH_2CONH_2)
glucose ($C_6H_{12}O_6$)

Case - 2 [For electrolyte]

(a) For dissociation of electrolyte ($i > 1$)

$$\alpha = \frac{i-1}{n-1}$$

(b) For ~~dis~~ association of electrolyte ($i < 1$)

$$\alpha = \frac{i-1}{\frac{1}{n}-1}$$