

CHEMISTRY

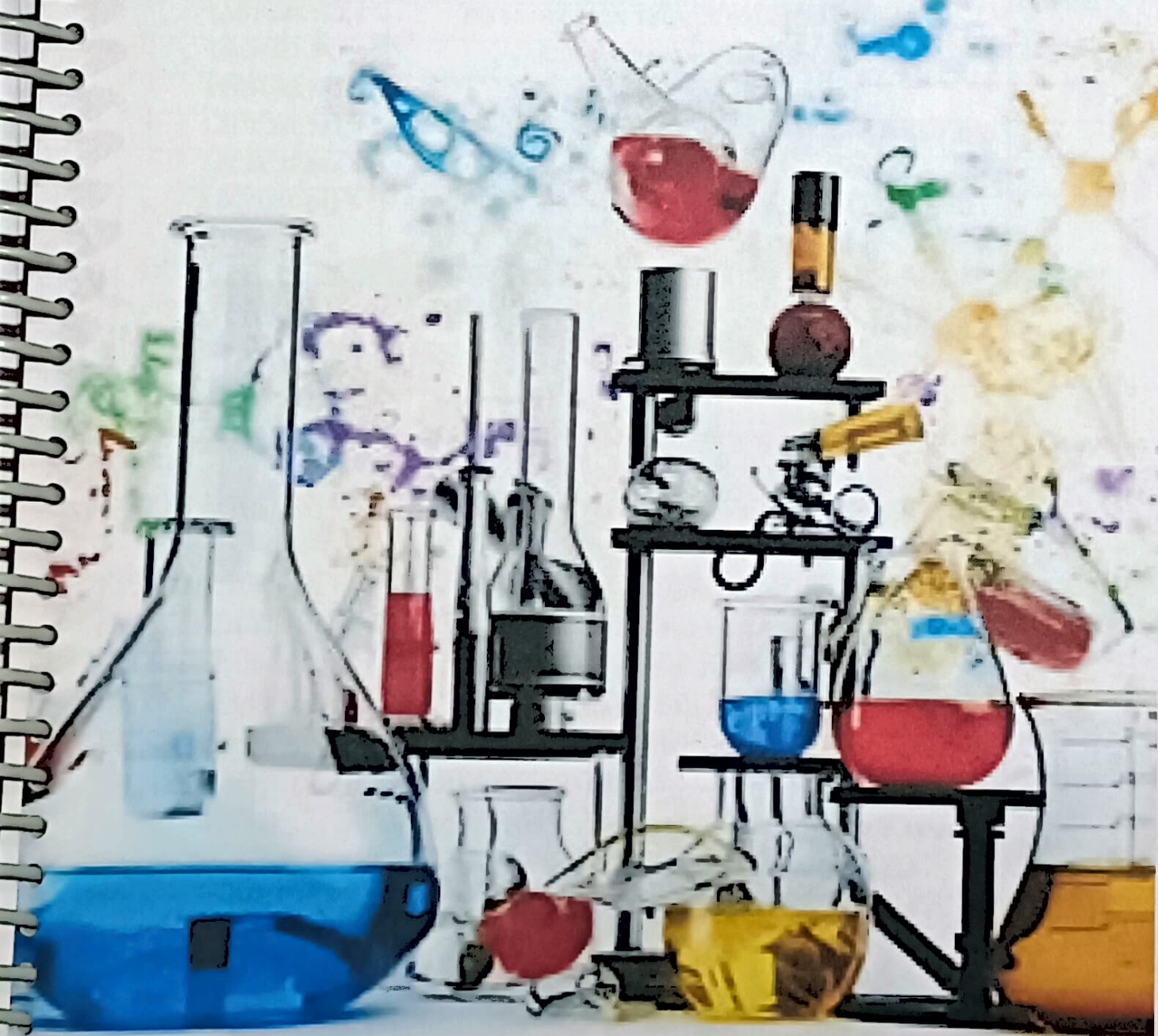
By. VICTORY ZONE
CLASSES

Name - Naman Tandi

Class - XIITH

2025 - 26

"JEE BATCH"



VICTORY ZONE CHEMISTRY CLASSES

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CHAPTER SCHEDULE

SOLUTIONS

5 APRIL 2025 TO 4 MAY 2025

S. NO	CLASS DETAIL	TOPICS DETAILS	CHECK LIST
1.	LECTURE NO. 1	INTRODUCTION TYPE OF SOLUTION THEORY	
2.	LECTURE NO. 2	EXPRESSION OF SOLUTION 25Q	
3.	LECTURE NO. 3	EXPRESSION OF SOLUTION 25Q	
4.	LECTURE NO. 4	HENRY'S LAW & ITS APPLICATIONS (LIQ+GAS SOLUTION)	
5.	LECTURE NO. 5	QUESTIONS OF HENRY'S LAW 30Q	
6.	LECTURE NO. 6	ROULT'S LAW IDEAL SOLUTION THEORY (LIQ+LIQ SOL) NONIDEAL SOLUTION, GRAPH & AZIOTROPIC MIXTURE	
7.	LECTURE NO. 7	ROULT'S LAW IDEAL SOLUTION QUESTIONS 30Q	
8.	LECTURE NO. 8	COLLIGATIVE PROPERTIES RELATIVE LOWERING IN VAPOUR PRESSURE (LIQ+LIQ SOLUTION)	
9.	LECTURE NO. 9	RELATIVE LOWERING IN VAPOUR PRESSURE 30Q	
10.	LECTURE NO. 10	ELEVATION IN BOILING POINT & DEPRESSION IN FREEZING POINT THEORY	
11.	LECTURE NO. 11	ELEVATION IN BOILING POINT & DEPRESSION IN FREEZING POINT 30Q	
12.	LECTURE NO. 12	OSMOTIC PRESSURE & APPLICATION THEORY	
13.	LECTURE NO. 13	OSMOTIC PRESSURE 20Q	
14.	LECTURE NO. 14	BOARDS PYQS DISCUSSION	
15.	LECTURE NO. 15	ABNORMAL MOLAR MASS 20Q	
16.	LECTURE NO. 16	SELF ANALYSIS PAPER IN CLASS	
17.	TEST NO. 1	3/05/2025 MCQS 30Q MM:120 (YOUR MARKS)	
18.	TEST NO. 2	4/05/2025 THEORY 16Q MM:30 (YOUR MARKS)	
19.	HOME WORK	NUMBER OF QUESTION DONE BY YOUR SELF	
20.	HOME WORK	NCERT BOOK READING & BACK QUESTIONS	

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CHAPTER = 1

03/04/2025



SOLUTIONS AND COLLIGATIVE PROP.

* Introduction

→ A solution is a homogeneous mixture of 2 or more substance which are chemically non-reacting. *

In this chapter, we only learn about binary solution.

Solution have 2 components

→ Solute :- The substance present in smaller amount in a solution is called solute.

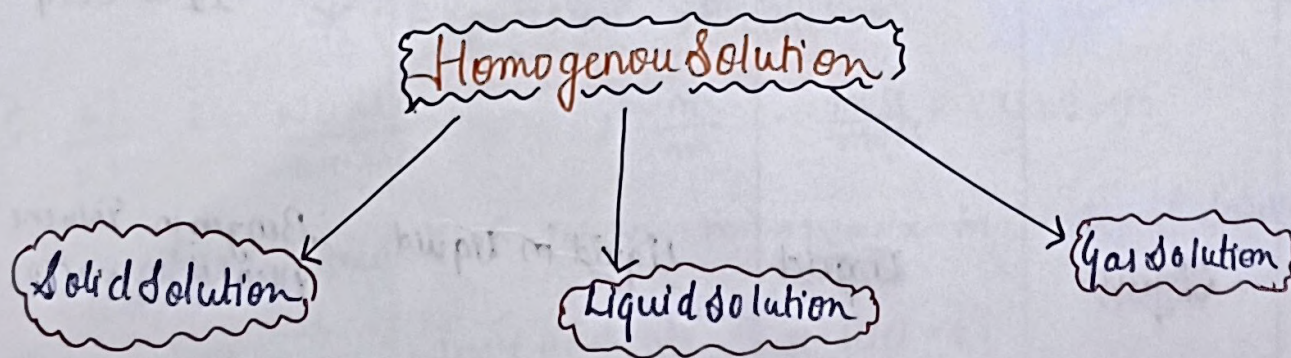
→ Solvent :- The substance present in larger amount in a solution is called solvent.

* Types of Homogenous Solution

① Solid Solution

② Liquid Solution

③ Gas Solution



S.No	Solute	Solvent	Type of Solu.	Examples
①	Solid	Solid	Solid in Solid	An alloys like brass, bronze, an alloy of copper and gold etc.
②	Liquid	Solid	Liquid in Solid	Amalgam of mercury with Na, $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$, $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$
③	Gas	Solid	Gas in Solid	Solution of H_2 in Pd, dissolved gases in minerals.
<u>LIQUID SOLUTION</u>				
④	Solid	Liquid	Solid in Liquid	Sugar solution, Salt solution, I_2 in CCl_4
⑤	Liquid	Liquid	Liquid in Liquid	Benzene in Toluene Alcohol in water
⑥	Gas	Liquid	Gas in Liquid	CO_2 in water, NH_3 in water etc.

Let us Assume, $A = \text{solute}$, $B = \text{solvent}$

$$\frac{W}{W} \% = \frac{W_A}{W_A + W_B} \times 100\%$$

$W_A = \text{solute}$
 $W_B = \text{solvent}$

(2) $\frac{\text{Volu.}}{\text{Volu.}} \% = \frac{\text{Volume}}{\text{Volume}} \%$

Defination:- Amount of substance / solute in (ml) dissolve in 100ml of solution.

$$\frac{V}{V} \% = \frac{\text{Volume of Solute}}{\text{Volume of Solution}} \times 100\%$$

Let us Assume, $A = \text{solute}$, $B = \text{solvent}$

$$\frac{V}{V} \% = \frac{V_A}{V_A + V_B} \times 100\%$$

(3) $\frac{\text{Weight}}{\text{Volume}} \%$

Defination:- Amount of solute in (g) dissolved in per 100ml of solution.

$$\frac{W}{V} \% = \frac{\text{Weight of Solute}}{\text{Volume of Solution (in ml)}} \times 100\%$$

Unit = $\frac{g}{ml}$

Used in ointment.

5 Stars Strength :- Amount of solute in (g) dissolved in per (litre) of solution
Unit :- $\frac{g}{litre}$
Used in see
 $S = \frac{W(g)}{V(l)}$

* (4) Mole fraction = $\frac{\text{अणु}}{\text{अणु}} = \frac{\text{mole}}{\text{mole}}$

It is ratio of number of moles of a particular component to the total number of moles of all the components.

$n = \text{mole}$

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

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

$$+ \frac{X_A + X_B = \frac{n_A}{n_A + n_B} + \frac{n_B}{n_A + n_B} = \frac{n_A + n_B}{n_A + n_B}$$

$$X_A + X_B = 1$$

$$X_A = \frac{n_A}{n_A + n_B} = \frac{\frac{W_A}{M_{WA}}}{\frac{W_A}{M_{WA}} + \frac{W_B}{M_{WB}}}$$

(5) Molarity / Concentration / Solubility / Active mass

Denoted By: M , C , S , $[]$

Number of moles of solute dissolved in per litre of solution

$$M = \frac{\text{mole of solute}}{\text{Volume of solution (in litre)}} = \begin{matrix} A = \text{solute} \\ B = \text{solvent} \end{matrix}$$

$$M = \frac{n_A}{V(\text{in L})}$$

$$n = \frac{W}{M_w}$$

$$M = \frac{W_A}{M_{WA} \times V(\text{in litre})}$$

$$\text{Unit} = \frac{\text{mol}}{\text{litre}} = \text{mol L}^{-1}$$

$$M = \frac{W_A \times 1000}{M_{WA} \times V(\text{in ml})}$$

⑥ Molality (m)

Number of moles of solute dissolved in 1 kg of solvent
let,

A = solute

B = solvent

$$m = \frac{\text{moles of solute}}{\text{weight of solvent in kg}}$$

$$m = \frac{n_A}{W_B \text{ (in kg)}} = \frac{W_A}{M_{wA} \times W_B \text{ (in kg)}}$$

$$m = \frac{W_A \times 1000}{M_{wA} \times W_B \text{ (in g)}}$$

* Relationship Between Molarity and Molality (Density)

let, m = molality

d = density

M = molarity

M_{wA} = Molar mass of solute.

$$\frac{1}{m} = \frac{d}{M} = \frac{M_{wA}}{1000}$$

$$m = \frac{1000 M}{M_{wA} M - 1000 d}$$

* Difference

Molarity

The ratio of moles of solute to the volume of solution in litres.

Units = M , mol Lit^{-1}

formula = $\frac{\text{moles solute}}{\text{Vol (in Litre) solution}}$

Molality

The ratio of moles of solute to the ~~volume~~ weight of solvent

Units = mol kg^{-1} , m

formula = $\frac{\text{moles solute}}{\text{weight (in kg)}}$

05/04/2025

* Mixing of Solution

Case - I

Dilution :- Mixing of solvent

Let's assume,

M_1 = Molarity of Solution (1)

M_2 = Concentration of New Solution

V_1 = Volume of Solution 1

V_2 = Volume of New Solution $V_1 + V$ } amount of solvent added

$$M_1 V_1 = M_2 V_2$$

$$M_2 = \frac{M_1 V_1}{V_1 + V} = \frac{M_1 V_1}{V_2} \quad [V_2 = V_1 + V]$$

Case - II

Two Different Concentration of Solution

Let's assume,

M_1 = concentration of solution (1)

M_2 = concentration of solution (2)

V_1 = Volume of solution (1)

V_2 = Volume of solution (2)

M = new conc.

Case - A , When Mixing of Acid + Acid or Base + Base

$$M_1 V_1 + M_2 V_2 = M$$

Case - B

Mixing of Acid + Base

Let's Assume,

M_1 = Concentration of Acid or Base

M_2 = Concentration of Base or Acid

V_1 = Volume of Acid or Base

V_2 = Volume of Base or Acid

$$M = \frac{M_1 V_1 - M_2 V_2}{V_1 + V_2}$$

$$M_1 V_1 = 90$$

$$M_2 V_2 = 110$$

Acid $\rightarrow$ H^+ release

HCl
 H_2SO_4
 HNO_3

HCOOH
 CH_2COOH

H_3PO_3
 H_2PO_2

Base $\rightarrow$ OH^- release

NaOH
 Ca(OH)_2

Al(OH)_3
 Mg(OH)_2

LiOH
 RbOH

* ⑦ Normality [N]

Denoted By "N".

Definition:- Number of gram's equivalent of solute mix in per litre of solution is called "Normality".

$$N = \frac{\text{gram equivalent of solute}}{\text{Volume of solution (in L)}}$$

$$\text{mole} = \frac{W}{MW}$$

$$\text{gram equivalent} = \frac{\text{weight}}{\text{equivalent mass}}$$

$$\left. \begin{array}{l} \text{gram} \\ \text{equivalent} = \text{mass} \\ \text{g.e.} = \end{array} \right\} = \frac{MW}{V.F.}$$

$$\text{gram equivalent} = \frac{W \times V.F.}{MW}$$

$$VF = n \text{ factor}$$

Valency factor = VF

$$N = \frac{W \times \text{Valency factor [V.F.]} }{m_w \times V (\text{in litre})}$$

Valency factor = n factor

$$N = \frac{W \times V.F. \times 1000}{m_w \times V (\text{in ml})}$$

unit - $\frac{\text{gram-equivalent}}{\text{litre}}$

→ Relationship between Molarity and Normality

$$N = \frac{W \times V.F. \times \cancel{1000}}{m_w \times V (\text{in litre})}$$

$$N = \frac{W \times 1000}{m_w \times V (\text{in ml})} \times V.F.$$

As we know that, $\text{Molarity} = \frac{W \times 1000}{m_w \times V (\text{in ml})}$

So,
$$N = \text{Molarity} \times \text{Valency factor}$$

$$\Rightarrow \{N = M \times V.F.\}$$

Mixing

Case - I

On Dilution,

$$N_1 V_1 = N_2 V_2$$

Case - II

$$(A) \Rightarrow \frac{N_1 V_1 + N_2 V_2}{V_1 + V_2} = N$$

[Acid + Acid
Base + Base]

$$(B) \Rightarrow \frac{|N_1 V_1 - N_2 V_2|}{V_1 + V_2} = N$$

$$N = \frac{w \times \text{Valency factor [V.F.]} }{m_w \times V \text{ (in litre)}}$$

Valency factor = n factor

$$N = \frac{w \times V.F. \times 1000}{m_w \times V \text{ (in ml)}}$$

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Mixing

Case - I

On Dilution,

$$N_1 V_1 = N_2 V_2$$

Case - II

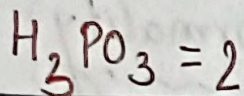
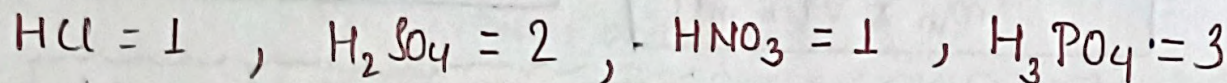
$$(A) \div \frac{N_1 V_1 + N_2 V_2}{V_1 + V_2} = N$$

[Acid + Acid
Base + Base]

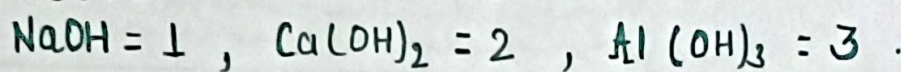
$$(B) \div \frac{|N_1 V_1 - N_2 V_2|}{V_1 + V_2} = N$$

* Valency factor (n factor) $n = \text{No. of Hydrogen atoms}$

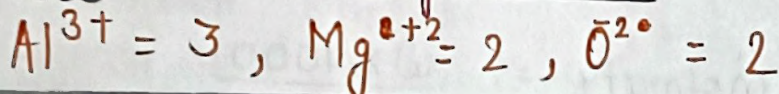
① Acid $\rightarrow$ Acidity (Capacity to give H^+ ions)
 H^+ देने की क्षमता



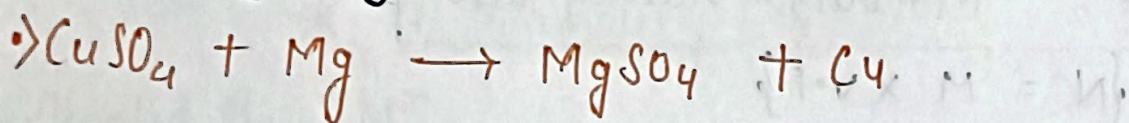
② Base $\rightarrow$ Basicity (Capacity to give OH^- ions)



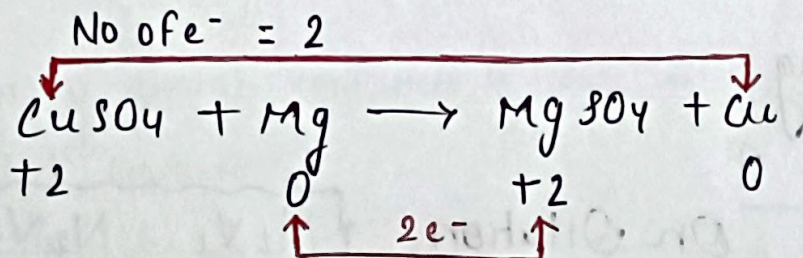
③ Ions $\rightarrow$ Charge on atoms



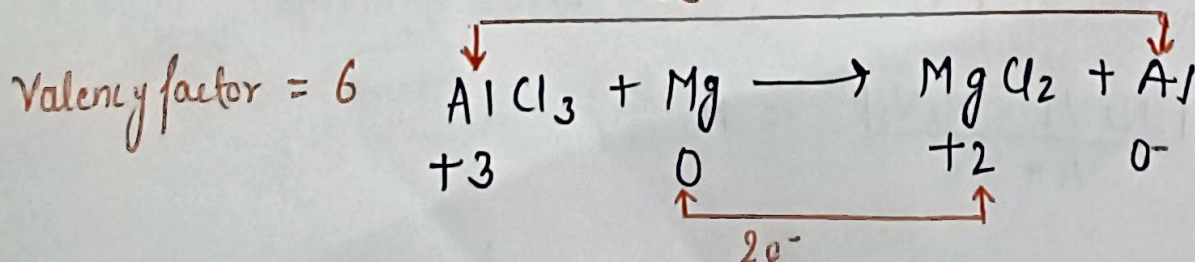
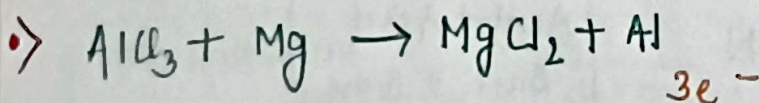
④ During any Chemical Reaction (No. of e^- transfer)



Soln

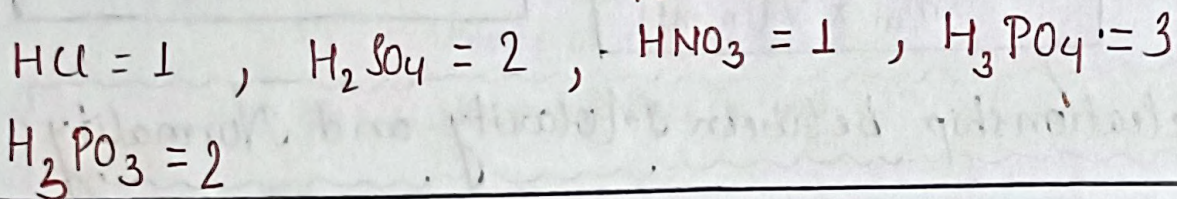


So, Valency factor = 2

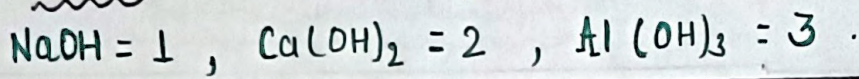


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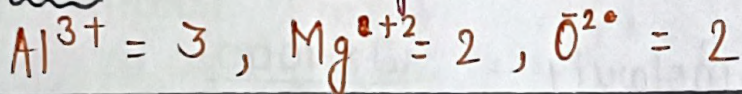
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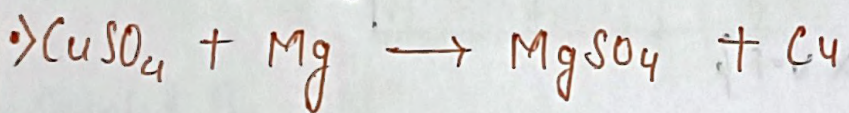
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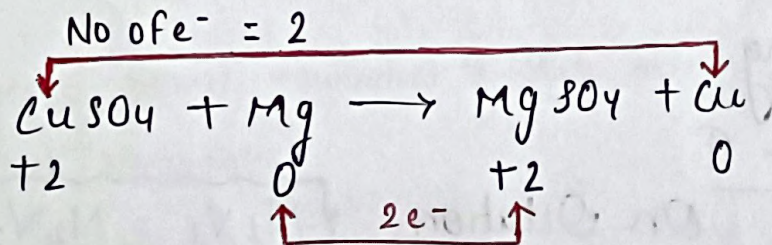
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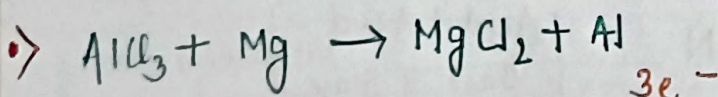
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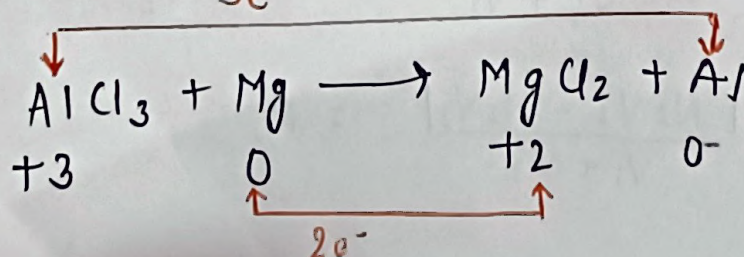
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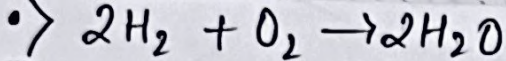


So, Valency factor = 2



Valency factor = 6





⑤ Molecule -

Oxidation Number Example - $KMnO_4$ $VF = 4$

⑥ Atom $\rightarrow$ Valency factor = Valency

Ex - $O = 2$, $Al = 3$, $N = 3$, $Ag = 1$

⑧ Parts per million (Ppm) = Only for Trace Solute.

million = 10^6

Definition - Parts of solute dissolved in parts of solution

$$100 + 10^6 =$$

[Solute + solvent = solution]

$$Ppm = \frac{\text{Parts of solute}}{\text{Parts of solution / Part of solvent}} \times 10^6$$

Note

9548

① Brass = Cu + Zn

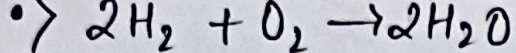
Bronze = Cu + Sn

German silver = Cu + Zn + Ni

} alloy

② The Ppm of ^{fluoride ion} ~~fluorination~~ in water prevent tooth decay upto 1 ppm while 1.5 ppm cause the tooth to become mottled [with different shape and colour]
Higher concentration of fluoride ion can be poisonous.

For example:- Sodium fluoride is use in rat poisonous.



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Note

25*

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[with different shape and colour]

For example:- Sodium fluoride is use in rat poisonous.

③ Binary Solution are a solution which have only two components 1 solute and 1 solvent.

④ $\frac{\text{mass}}{\text{mass}}\%$ used commonly in industrial application, commercial bleaching powder have 3.62 mass percentage of sodium Hypochlorite in water.

⑤ $\frac{\text{Volume}}{\text{Volume}}$ are commonly used for liquid solution.

For ex - 35% of ethylene glycol $\begin{bmatrix} \text{CH}_2 - \text{OH} \\ | \\ \text{CH}_2 - \text{OH} \end{bmatrix}$

• An antifreeze is used in cars for cooling the engine. At this concentration the antifreeze lowers the freezing point of water. to 255.4K (-17.6°C)

⑥ Ppm are used for trace amount of solution.

For example:- 1 litre of sea water, weighs 1030 g, contains about 6×10^{-3} (g) of oxygen gas, which is dissolved at such amount expression as 5.8 $\mu\text{g/lit.}$ or 5.8 ppm or 5.8 g per 10^6 g. It is also denoted by μgml^{-1} .

⑦ Mole fraction is commonly use in gases solution or liquid solution with higher vapour pressure.

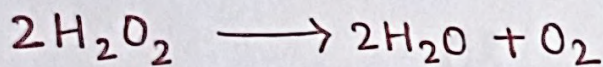
⑧ All the concentration have their merits and demerits but Volume are temperature dependent and mass doesn't depend on Temperature.

⑨ $\frac{\text{mass}}{\text{mass}} \%$, mole fraction and molality are independent of

Temperature, whereas molarity is a function of temperature. This is because Volume depends on temperature and mass does not depend on temperature

* Volume Strength of H_2O_2

Volume of oxygen at STP/NTP produced by the decomposition of H_2O_2 is called its Volume strength.



2mol
68g

2mol
36g

1mol

22.4 litre

$$1) \text{ Molarity} = \frac{\text{Volume Strength}}{11.2}$$

$$2) \text{ Normality} = \frac{\text{Volume Strength}}{5.6}$$

$$3) \text{ Normal Strength} = \frac{\text{Volume Strength} \times 17}{5.6} \left[\frac{g}{\text{litre}} \right]$$

$$4) \frac{\text{Weight}}{\text{Volume}} \% = \frac{\text{Volume Strength} \times 7}{5.6 \times 10} \left[\frac{g}{ml} \right]$$

* Liquid Solution

① Solid + Liquid

Solubility

→ The max amount of substance dissolve in a specific amount of solvent at specific temperature and pressure.

→ Solubility depends upon the nature of solute and solvent, temperature and pressure.

→ Nature → Polar → Polar solvent: - Salt + Water

→ Nonpolar → non polar solvent: - Paint + Petrol
[Turpentine oil]

A) Solubility of Solid in Liquid

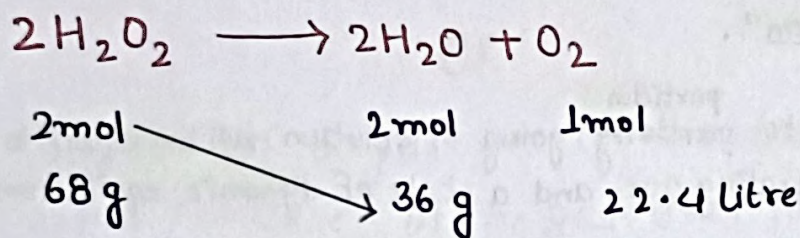
→ Every solid doesn't dissolve in given liquid.

Example:- Salt and sugar dissolve in water but not in benzene, Naphthalene and Anthracene are not dissolve in water but benzene dissolve in water

In that case "like dissolve like" that is polar substance have a intermolecular attraction between polar liquid and same as vice-versa.

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A) Solubility of Solid in Liquid

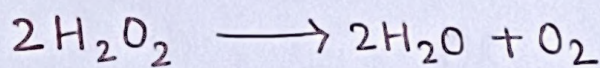
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2mol
68g

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36g

1mol

22.4 litre

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A) Solubility of Solid in Liquid

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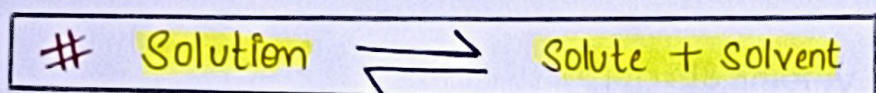
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In that case "like dissolve like" that is polar substance have a intermolecular attraction between polar liquid and same as vice-versa.

→ When a solid substance dissolves in any liquid this is called "dissolution".

→ The process in which solid is separated out from solution the process is called "crystallisation".

→ When number of solute ^{particles} going in solution will be equal to the ~~solid~~ solute particles separating out and a state of dynamic equilibrium is reached.



"The rate of ~~crystallisation~~ crystallisation is equal to rate of dissolution."

→ When a solute remains allowed to dissolve in the liquid solution at given temperature is called "UNSATURATED SOLUTION".

→ At certain stage solution does not allow to dissolve solute in liquid solution at given temperature and pressure is called "SATURATED SOLUTION".

→ The solution in which dynamic equilibrium with undissolved solute in the saturated solution and contains the maximum amount of solute dissolved in a given amount of solvent. Thus, the concentration of solute in such a solution is called "SOLUBILITY".

→ Effect of Temperature

At nearly saturated solution dissolution is an endothermic process

$\Delta H_{\text{solution}} > 0$ and the crystallisation is exothermic $\Delta H_{\text{solution}} < 0$

→ Effect of ~~temperature~~ Pressure

Pressure does not have any significant effect because solid and liquid are highly incompressible and remain unaffected by change in pressure.

SOLUBILITY OF A GAS IN A LIQUID

The Solubility of a gas in a liquid is directly proportional to the partial pressure of the gas above the surface of liquid of solution.

OR

Mole fraction of a gas in the solution is proportional to the partial pressure of the gas over the solution.

K_H maximum = Helium

* NUMERICALS * (Molarity, molality, mole fraction)

Q. 1) 10 g of NaOH mix in 15 g of water so weight by weight percent?

Sol) Given - $W_A = 10\text{ g}$ $W_B = 15\text{ g}$

$$\frac{\text{Weight}}{\text{Weight}} \% = \frac{\text{Weight of Solute} \times 100}{\text{Weight of Solution}} = \frac{10}{10+15} \times 100$$

$$\% = \frac{10}{25} \times 100 = \underline{40\%}$$

Q. 2) If $\frac{W}{W}\%$ of solution is 20% mix in ⁵⁰~~10~~ g of water

So, weight by weight percent?

Given - $\frac{W}{W}\% = 20\%$, $W_B = 50\text{ g}$
 $W_A = ?$

$$\frac{W}{W}\% = \frac{\text{Weight A}}{W_A + W_B} = 20\% = \frac{W_A}{W_A + 50}$$

$$\frac{20}{100} = \frac{W_A}{W_A + 50}$$

$$\Rightarrow \frac{1}{5} = \frac{W_A}{W_A + 50}$$

$$\Rightarrow W_A + 50 = 5W_A$$

$$50 = 4W_A$$

$$W_A = \frac{50}{4} = 12.5\text{ g of solute}$$

$$W_A = 12.5\text{ g of solute}$$

Q.3) If a solution of 24% $\frac{W}{W}$ of weight is 15g so. Calculate solute and solvent.

Given, - $W_A = ?$ $W_B = ?$ $W_A + W_B = 15g$

$$\frac{W}{W} = 24\%$$

$$\text{So, } \frac{W}{W} = \frac{W_A}{W_A + W_B}$$

$$24\% = \frac{W_A}{15}$$

$$\frac{24}{100} = \frac{W_A}{15}$$

$$24 \times 15 = 100 W_A$$

$$\text{So, } W_A + W_B = 15$$

$$\frac{360}{100} = W_A$$

$$W_B = (15 - 3.6)g$$

$$\boxed{W_A = 3.6g}$$

$$\boxed{W_B = 11.4g}$$

Q.4) 180g of glucose mix with 180g of water. What is the mole fraction of water and glucose?

$$W_A = 180g \text{ (A = glucose)}$$

$$W_B = 180g \text{ (B = water)}$$

$$X_{\text{water}} = \frac{n_{\text{water}}}{n_{\text{gluc.}} + n_{\text{water}}}$$

$$X_{\text{water}} = \frac{10}{1+10} = \frac{10}{11}$$

$$X_{\text{water}} + X_{\text{glucose}} = 1$$

$$X_{\text{glucose}} = 1 - \frac{10}{11}$$

$$X_{\text{glucose}} = \frac{11-10}{11} = \frac{1}{11}$$

$$n_{\text{glucose}} = \frac{\text{weight glue.}}{M.W_{\text{glucose}}}$$

$$n_{\text{glucose}} = \frac{180}{180} = 1 \text{ mol.}$$

$$n_{\text{water}} = \frac{180}{18} = 10 \text{ mole.}$$

$$\text{So, } X_{\text{water}} = \frac{10}{11}$$

$$X_{\text{gluc.}} = \frac{1}{11}$$

(15) 23 g of ethanol mix with 32 g of methanol. Calculate the mole fraction of ethanol and methanol?

$$W_{\text{ethanol}} = 23 \text{ g}$$

$$W_{\text{methanol}} = 32 \text{ g}$$

$$X_{\text{ethanol}} = \frac{n_{\text{ethanol}}}{n_{\text{etha.}} + n_{\text{meth.}}}$$

$$n_{\text{ethanol}} = \frac{W_{\text{ethanol}}}{M_{w \text{ ethanol}}} = \frac{23}{46} \quad \begin{array}{l} \text{C}_2\text{H}_5\text{OH} \\ M_w = 46 \text{ g} \end{array}$$

$$n_{\text{ethanol}} = 0.5 \text{ moles}$$

$$n_{\text{methanol}} = \frac{W_{\text{methanol}}}{M_{w \text{ methanol}}} = \frac{32}{32} = 1 \text{ mole} \quad \begin{array}{l} \text{CH}_3\text{OH} \\ M_w = 32 \text{ g} \end{array}$$

$$X_{\text{ethanol}} = \frac{0.5}{0.5 + 1} = \frac{5 \times 10^{-1}}{1.5} = \frac{5}{15} \times 10^{-1+1}$$

$$X_{\text{ethanol}} = \frac{1}{3}$$

$$X_{\text{ethanol}} + X_{\text{methanol}} = 1$$

$$X_{\text{methanol}} = 1 - \frac{1}{3} = \frac{2}{3}$$

Q7) What is the molarity of solution contains 5g of NaOH in 500ml of solution?

M = ?

$$M = \frac{W_A \times 1000}{V \times M_{WA}} = \frac{5 \times 1000}{500 \times 40}$$

$$\begin{cases} M_{WA} = \text{NaOH} \\ = 23 + 16 + 1 \\ = 40 \text{ g} \end{cases}$$

$$M = \frac{1000}{100 \times 40} = \frac{1}{4} = 0.25 \text{ M}$$

Q8) 0.6 M NaOH of 100 ml mix with water 500 ml what is new molarity?

$$\begin{aligned} M_1 &= 0.6 \text{ M} \\ V_1 &= 100 \text{ ml} \end{aligned}$$

$$M_2 = ?$$

$$V_2 = \cancel{100} V_1 + V_{\text{water}}$$

$$V_2 = 100 + 500$$

$$V_2 = 600 \text{ ml}$$

$$M_1 V_1 = M_2 V_2$$

$$0.6 \times 100 = M_2 \times 600$$

$$\frac{0.6 \times 100}{600} = M_2$$

$$\boxed{M_2 = 0.6 \text{ (M)}}$$

Q9) 0.1 M of HCl 10 ml + 0.3 M of NaOH 100 ml + 300 ml of H₂O. What is new concentration

$$M_1 = 0.1$$

$$V_1 = 10 \text{ ml}$$

$$V_2 = 10 + 90$$

$$V_2 = 100 \text{ ml}$$

$$M_1 V_1 = M_2 V_2$$

$$0.1 \times 10 = M_2 \times 100$$

$$M_2 = \frac{0.1 \times 10}{100}$$

$$[M_2 = \frac{1}{100} \text{ mol lit}^{-1}]$$

15/04/2025



Henry's Law

[Gas + Liquid]

According to this Law:-

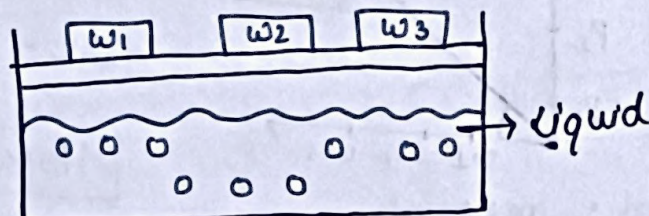
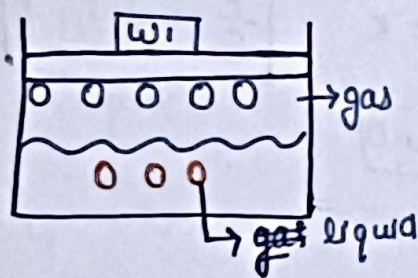
"Solubility of a gas in a liquid is directly proportional to the partial pressure of the gas above the surface of liquid or solution."

OR

"Mole fraction of a gas in the solution is proportional to the partial pressure of the gas over the solution."

OR

"The Partial pressure of gas in vapour phase is proportional to the mole fraction of the gas in the solution."



Gas + Liquid

$p \propto x$ → mole fraction of a gas / solubility

$$x = \frac{\text{mole of gas}}{\text{mole of gas} + \text{mole of water}}$$

Partial Pressure

$$p = K_H x$$

→ Henry's constant

x = mole fraction of dissolved gas

$$p = K_H x$$

Here, K_H are called Henry's constant.

Different gases have different value of K_H at same temperature.

There are some examples:-

① He - 293 K - $K_H = 144.97$ [Maximum]

② O₂ - 293 K - $K_H = 34.86$

* Some Important Points of "Henry's Law"

① Cold Drunk

Cold Drunk $\propto$ Temp $\propto \frac{1}{\text{Solubility}}$ | High Press. $\propto$ Solubility

② Aquatic Animals

Feels good in low temperature.

$$\text{Temp} \propto KH \propto \frac{1}{\text{Solubility}}$$

③ Anoxia

Blood have low oxygen level due to high altitude

High Altitude, $P (\uparrow) \propto x (\downarrow) \propto \text{Solubility} (\downarrow)$

④ Blood Bends

- Condition of scuba divers

$$P \propto x \propto \text{Solubility}$$

Oxygen level gas present

11% Helium

56.2% N_2

36.6% O_2

Partial Pressure = P
(Henry's law)

Vapour Pressure
= $(P_A) \text{ or } (P_i)$
Use Raoult's law

→ The Value of K_H depend on temperature also.

$$[K_H \propto \text{Temp}]$$

→ Unit of K_H is same of Pressure.

$$P = K_H \cdot x$$

unit same as pressure.

unitless

Note → The Solubility of gas is inversely proportional to the $[K_H]$ Henry's constant.

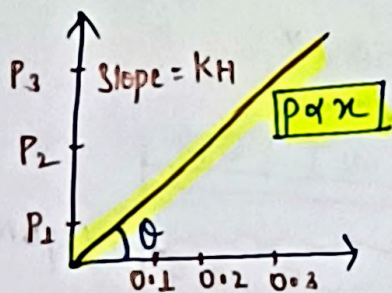
Here, it is clearly observe that, K_H of O_2 [Oxygen] are least with respect to Hydrogen and Nitrogen. That's why O_2 is more soluble in water with respect to others.

→ When temperature increases solubility decreases, Due to this reason aquatic animal are comfortable in cold water than warm water.

$$[K_H \propto \text{Temp}]$$

$$[K_H \propto \frac{1}{\text{Solubility}}]$$

Graph



Slope of graph

$$P = K_H x$$

$$\tan \theta = \frac{P}{x} = K$$

$$\frac{P}{B} = \frac{P}{x} = K_H$$

Conclusion :- Imp point

$$\hookrightarrow [K_H \propto \text{Temp} \propto \frac{1}{\text{Solubility}}]$$

Application

① To Increase the solubility of CO_2 in soft drink and beer and soda water, the bottle is sealed under high pressure and serves chilled.

② Scuba Divers must dive in high pressure under water, At this pressure all the gases dissolved in water. When the divers come towards the surface dissolved gases leads to the formation of bubble of Nitrogen in blood. This blocks capillaries and create a medical conditions called "bends" which is painful and dangerous to life.

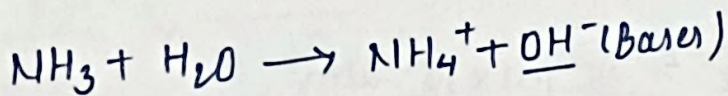
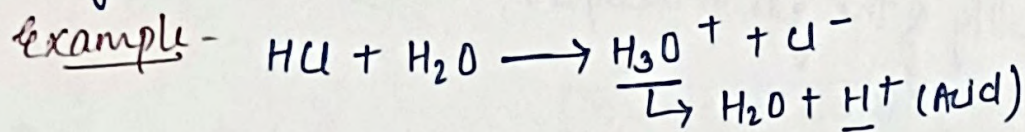
To Avoid to this situation divers mix 'He' gas in layer in Oxygen Cylinder.

$$\text{Ratio :- } 11.7\% \text{ He, } 56.2\% \text{ N}_2, 32\% \text{ O}_2$$

③ At High Altitude The Partial Pressure of Oxygen is less. so there is low concentration of Oxygen. so Peoples lives in High Altitude or Climbers.

low oxygen level in blood causes climbers weak and unable to think clearly. This medical condition are called "Anoxia".

" Note
A gas which can react with water do not obey Henry's law."



OPP-14

Q. 1 13) Henry's Law

0.2 (1) HCl

Q.3 $p \propto n$

$$\frac{P_1}{P_2} = \frac{x_1}{x_2}$$

$$\frac{1}{3} = \frac{0.5}{x_2}$$

$$x_2 = 1.5 \text{ g/L}$$

Opt (2)

0.4 pax

$$\rho = KH \gamma$$

$$\frac{p}{K_H} = x$$

Given, $P = 760 \text{ mm of Hg}$
 $k_H = 2 \times 10^5 \text{ mm of Hg}$

$$\frac{760 \text{ mm of Hg}}{2 \times 10^5 \text{ mm of Hg}} = x$$

Qpt (2)

$$x = 3.8 \times 10^{-3}$$

Q.5 (1) NH_3

Pg - 28

(Q. 42) (c) Rate at which gaseous particles are striking the solution to enter it, decreases.

(Q. 43) (d) Henry's Law

(Q. 44) (a) Solubility of the gas in the liquid

(Q. 45) $p = 0.5 \text{ atm}$

$$K_{H O_2} = 1.4 \times 10^{-3} \text{ mol lit}^{-1} = 1.4 \times 10^{-3} \text{ atm}$$

Water = 100 ml = 100 g, we know that,

$$\rho (\text{Density}) = 1 \text{ g/ml}$$

$$W = 100 \text{ g}$$

$$n_{\text{water}} = \frac{W}{M_w} = \frac{100}{18} = 5.56 \text{ moles}$$

$$P = K_H \cdot x \Rightarrow P = K_H \cdot \frac{n_{O_2}}{n_{O_2} + n_{\text{water}}}$$

$$\frac{P}{K_H} = \frac{n_{O_2}}{n_{\text{water}}} \quad [n_{O_2} \ll n_{\text{water}}]$$

$$\frac{0.5}{1.4 \times 10^{-3}} = \frac{n_{O_2}}{5.56}$$

$$\frac{0.5 \times 5.56}{1.4 \times 10^{-3}} = \frac{W_{O_2}}{M_w} = [32 \text{ [O}_2\text{]}]$$

$$W_{O_2} = \frac{0.5 \times 5.56 \times 32}{1.4 \times 10^{-3}}$$

Opt (d)

$$\boxed{W_{O_2} = 2.24 \text{ mg}}$$

NCERT Pg-8 for N_2 gas

Ex-1.4 $P = 0.987 \text{ bar}$ $K_H = 76.48 \text{ kbar}$

$$P = K_H \cdot x$$

$$\frac{P}{K_H} = x$$

$$\text{Vol} = 1 \text{ litre}$$

$$1 \text{ litre} = 1000 \text{ ml} = 1000 \text{ g}$$

$$\text{Density} = 1 \text{ g/ml}$$

$$n_{\text{water}} = \frac{w}{m_w} = \frac{1000}{18} = 55.56$$

$$n_{\text{water}} = 55.56 \text{ mol.}$$

$$\frac{P}{K_H} = \frac{n_{N_2}}{n_{N_2} + n_{\text{water}}}$$

$$n_{N_2} \ll n_{\text{water}}$$

$$\frac{P}{K_H} = \frac{n_{N_2}}{55.5}$$

$$\frac{0.987 \times 55.5}{76.48 \times 10^3} = n_{N_2}$$

$$n_{N_2} = 0.716 \text{ m mol.}$$

Pg-121 Q.15) Jee Main 2019

$$P = K_H \cdot x_{\text{gas}} \quad \text{--- (1)}$$

$$x_{\text{gas}} + x_{\text{water}} = 1$$

$$x_{\text{gas}} = 1 - x_{\text{water}}$$

Putting eq (1) value

$$P = K_H \cdot (1 - x_{\text{water}})$$

$$P = K_H - K_H x_{\text{water}}$$

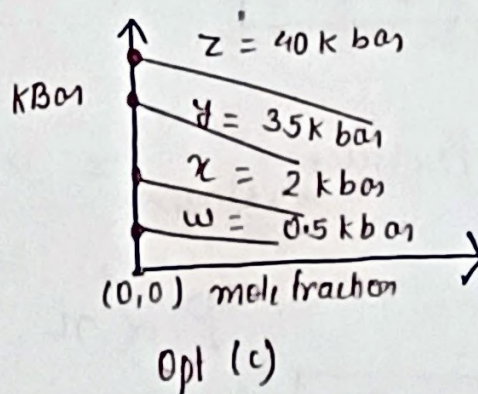
$$P = -K_H x_{\text{water}} + K_H$$

We know that,

$$y = mx + c$$

on comparing

$$m = -K_H$$



18/04/2025

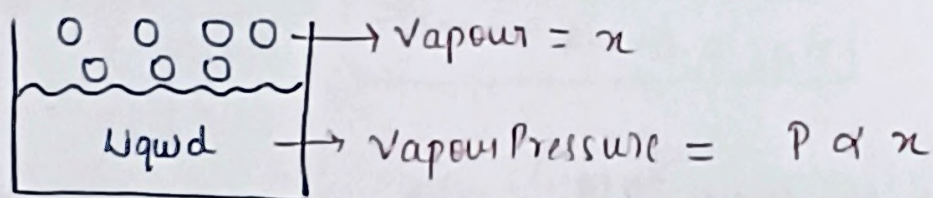
* Vapour Pressure [liq + liq solution]

Liquid solution are formed when 2 liquid mix with each other

1) Definition - "Every liquid can vapourise, this vapour have a vapour pressure when it is in close vessel."

" RAULT'S LAW "

"For a solution of volatile liquid the partial pressure of each component of the solution is directly proportional to its mole fraction present in solution."



$$\text{Vapour Pressure}_{\text{maximum}} = 760 \text{ mm of Hg} = 1 \text{ atm}$$

$$P \propto x$$

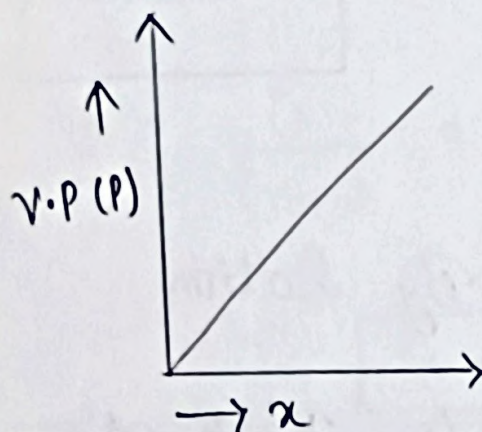
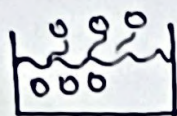
$$P = P^0 x$$

P = Vapour Pressure of liquid

x = mole fraction of vapour of that liquid.

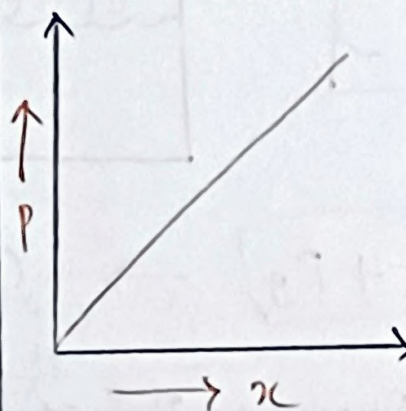
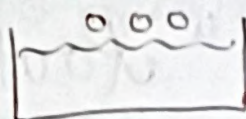
P^0 = Vapour Pressure of Pure Liquid

A
Liquid A



$$P_A = P_A^0 \times x_A$$

B
Liquid B



$$P_B = P_B^0 \times x_B$$

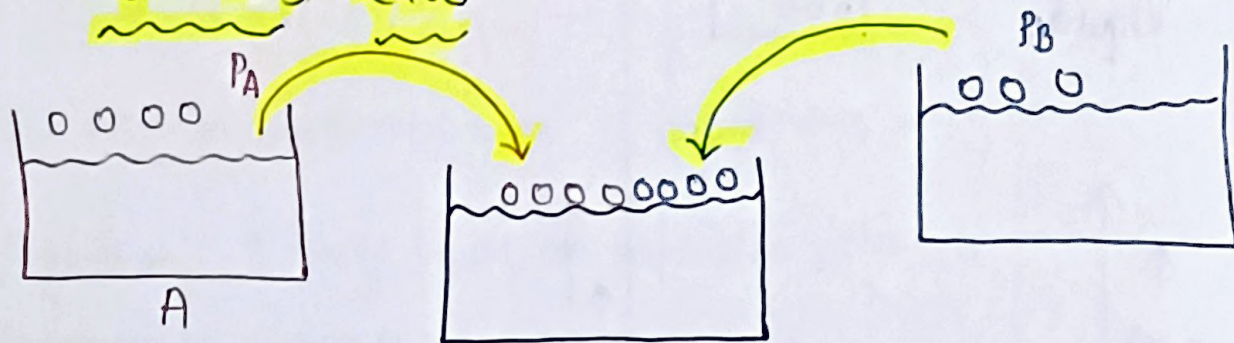
Dalton $\rightarrow$ for gas

[Rule of John Dalton]

Partial Pressure

A diagram showing three arrows labeled P_A , P_B , and P_C pointing towards a central point. To the right of this point is a rectangular box containing the equation $P_{Total} = P_A + P_B + P_C$.

"Raoult's Law"



$$P_{\text{Total}} = P_A + P_B \rightarrow \text{Given By Dalton}$$

$$P_{\text{Total}} = P_A^{\circ} x_A + P_B^{\circ} x_B \rightarrow \text{Given By Raoult's}$$

Derivation

$$P_{\text{Total}} = P_A^{\circ} x_A + P_B^{\circ} x_B$$

$$x_A + x_B = 1$$

$$x_A = 1 - x_B$$

Putting in x_A

$$P_{\text{Total}} = P_A^{\circ} (1 - x_B) + P_B^{\circ} x_B$$

$$P_{\text{Total}} = P_A^{\circ} - P_A^{\circ} x_B + P_B^{\circ} x_B$$

$$P_{\text{Total}} = P_A^{\circ} + P_B^{\circ} x_B - P_A^{\circ} x_B$$

$$P_{\text{Total}} = P_A^{\circ} + x_B (P_B^{\circ} - P_A^{\circ})$$

y_A = mole fraction of liquid solution at vapour ~~press~~ phase

$$y_A = \frac{P_A}{P_{\text{Total}}} = \frac{P_A^\circ x_A}{P_{\text{Total}}}$$

$$y_B = \frac{P_B}{P_{\text{Total}}} = \frac{P_B^\circ x_B}{P_{\text{Total}}}$$

$$y_B = 1 - y_A$$

19/04/2025

Ideal solution

A solution which obeys Raoult's law called as Ideal solution.

Imp Points

① $P_A = P_A^\circ x_A$

② $P_B = P_B^\circ x_B$

③ $P_{\text{Total}} = P_A + P_B = P_A^\circ x_A + P_B^\circ x_B$

④ $\Delta V_{\text{mix}} = 0$

⑤ $\Delta H_{\text{mix}} = 0$

⑥ Interaction between A-B are same as interaction between A-A and B-B

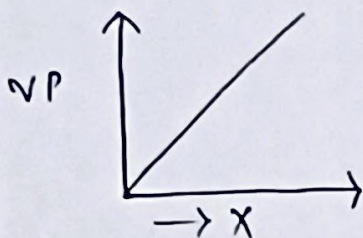
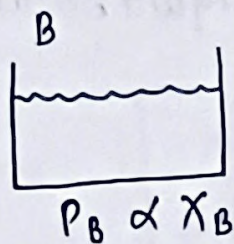
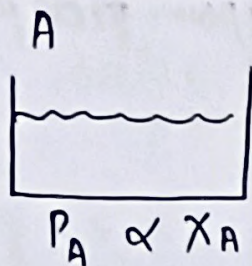
Examples :- ^{NEXT} ① Benzene + Toluene

^{NEXT} ② Bromoethane + Chloroethane

^{NEXT} ③ n hexane + n heptane

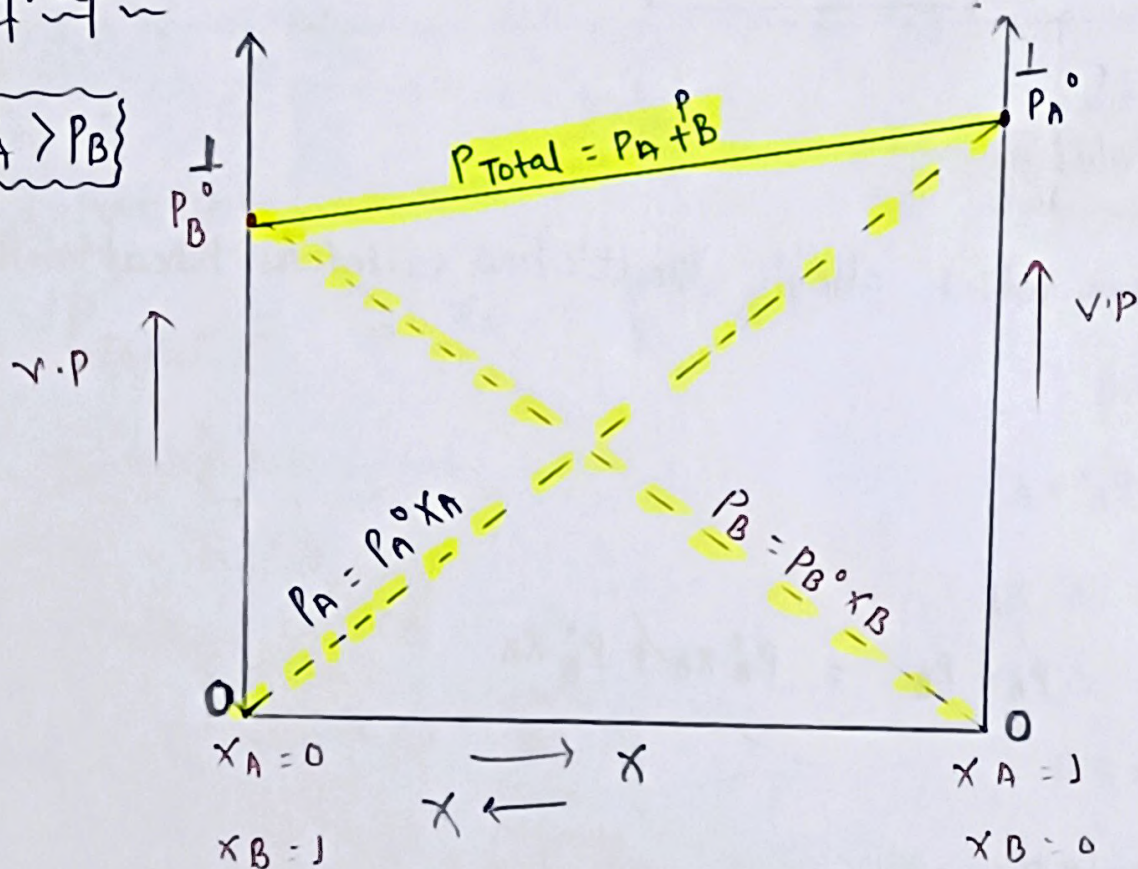
④ $\text{CCl}_4 + \text{SiCl}_4$

⑤ Chlorobenzene + Bromobenzene



Graph

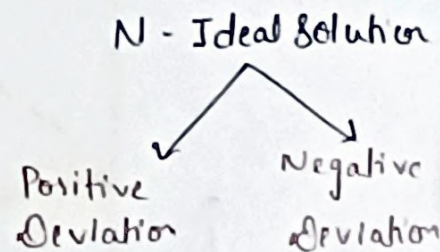
$P_A > P_B$



Graph of Ideal Solution

* Non Ideal Solution

1] Solution which doesn't obey's Raoult's law is called Non-Ideal Solution.



① Positive Deviation

$$\rightarrow P_A > P_A^\circ X_A$$

$$\rightarrow P_B > P_B^\circ X_B$$

$$\rightarrow P_{\text{Total}} > P_A^\circ X_A + P_B^\circ X_B$$

25★

$$\rightarrow \Delta V_{\text{mix}} > 0$$

$$\rightarrow \Delta H_{\text{mix}} > 0 \quad \text{Endothermic Reaction} \quad \Delta H = +ve$$

$\rightarrow$ Interaction between A-B are weaker than A-A and B-B

$$\begin{matrix} \text{A-A} \\ \text{B-B} \end{matrix} > \text{A-B}$$

Examples :-

① Ethanol + cyclohexane

② Ethanol + Water [NCERT EXAMPLES]

③ Methanol + Water

④ CCl_4 + Benzene

⑤ CCl_4 + CHCl_3

⑥ CCl_4 + Methanol

⑦ Benzene + Acetone

⑧ CS_2 + Acetone

⑨ CS_2 + Aldehyde

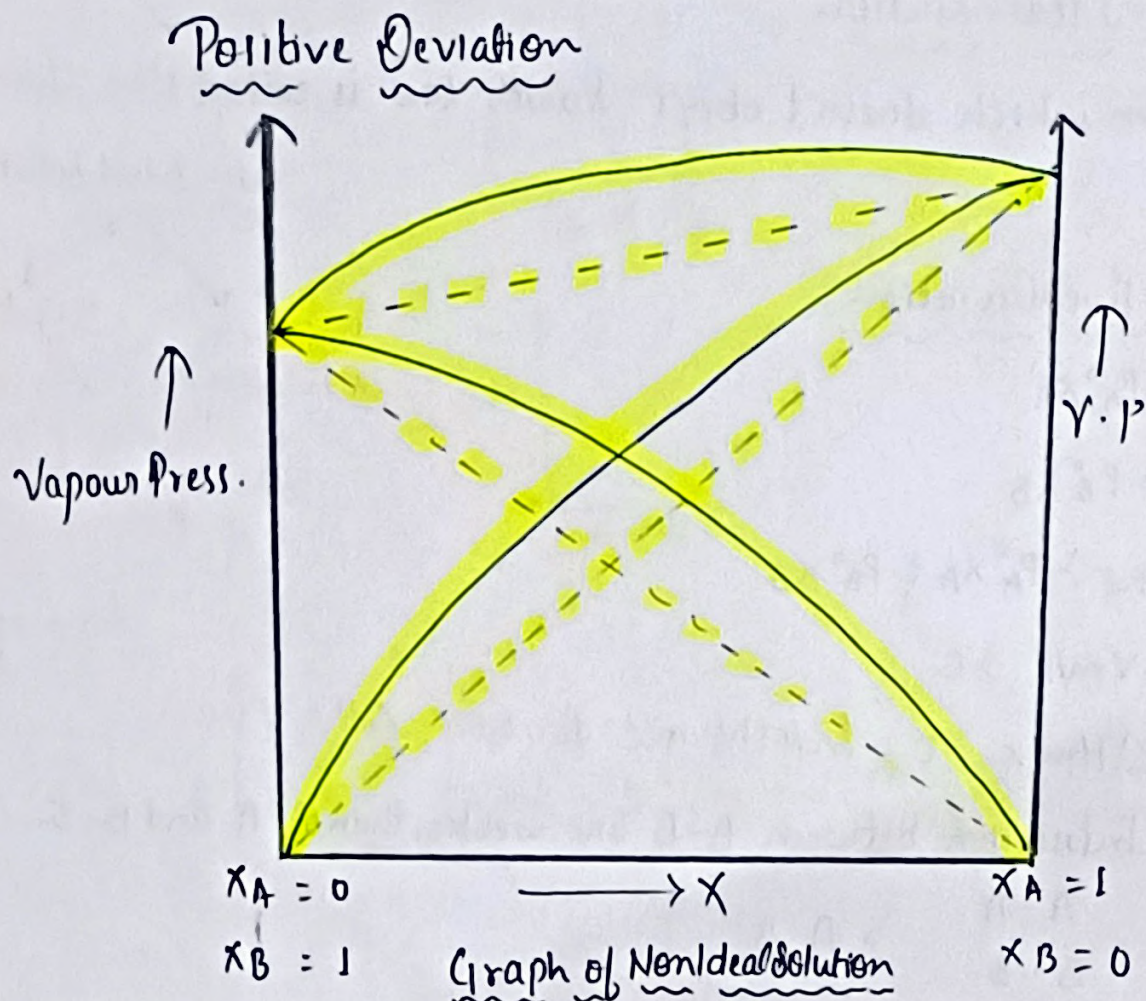
Trick To learn

① Ethanol + water
Methanol + water

② CCl_4 + Methanol
 CCl_4 + Benzene

③ Benzene + Acetone
 CS_2 + Acetone

④ CS_2 + Aldehyde
 CCl_4 + CHCl_3
Ethanol + Cyclohexane



② Negative Deviation

$$\rightarrow P_A < P_A^\circ X_A$$

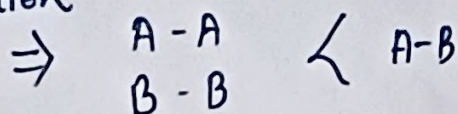
$$\rightarrow P_B < P_B^\circ X_B$$

$$\rightarrow P_{\text{Total}} < P_A^\circ X_A + P_B^\circ X_B$$

$$\rightarrow \Delta H_{\text{mix}} < 0 \quad \text{Exothermic Reaction } \Delta H = -ve$$

$$\rightarrow \Delta V_{\text{mix}} < 0$$

$\rightarrow$ Interaction between A-B are stronger than A-A and B-B interaction



Examples

① HCl + water

② HNO_3 + water

③ H_2SO_4 + water

④ Phenol + Aniline

{ NCERT EXAMPLES }

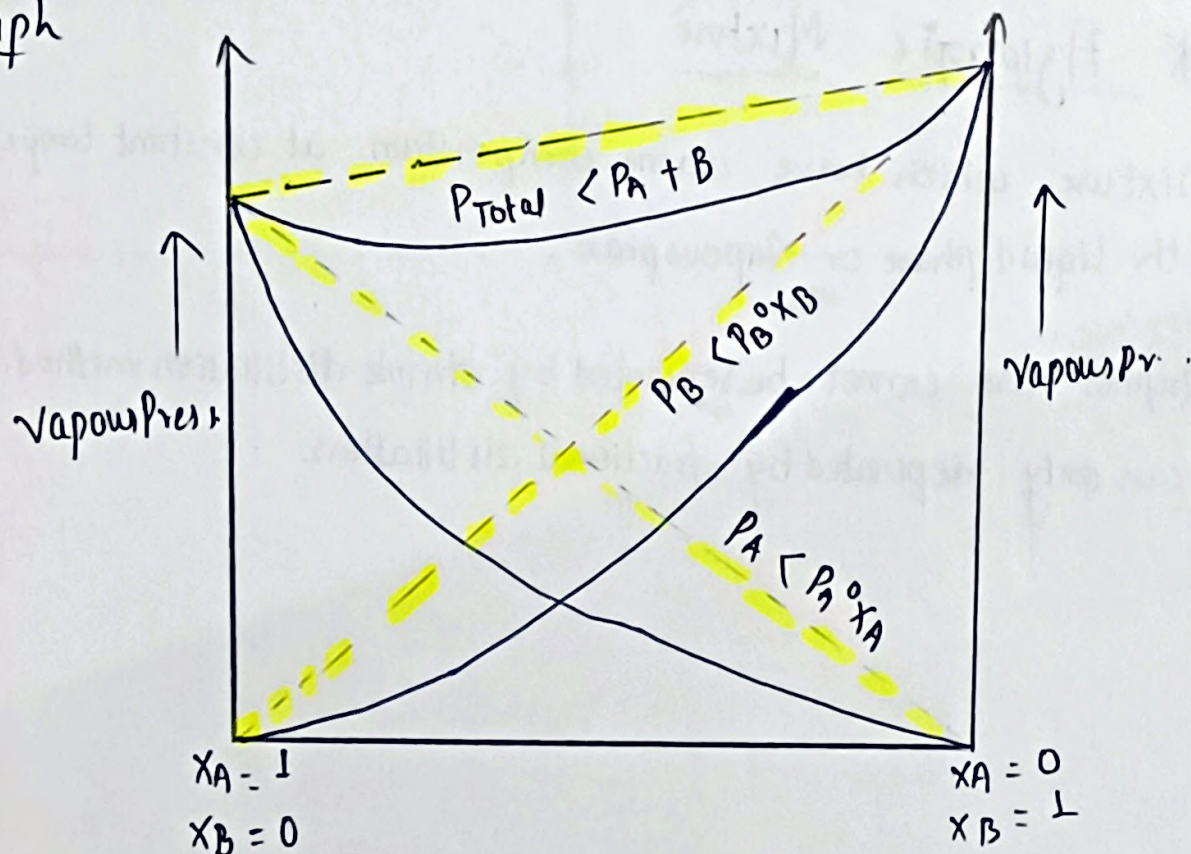
⑤ Chloroform + Acetone

⑥ Chloroform + Benzene

⑦ Chloroform + Nitric Acid

⑧ Aniline + Acetone

Graph



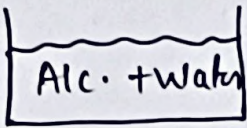
Graph of Negative Deviation

Note for Ideal and Non Ideal solution,

$\Delta S = +ve \rightarrow$ change in Entropy

$\Delta G = -ve \rightarrow$ change in Gibbs free Energy

Note Extra knowledge

 Vapour pressure $\rightarrow$ more
 $\rightarrow$ So, Vapour mole fraction is more

$\rightarrow$ This Law is called "Konowaloff's" Rule.

* Azotropic Mixture

A mixture which have same composition at constant temperature in both liquid phase or vapour phase.

Azotropes are cannot be separated by simple distillation method. They can only separated by fractional distillation.

Minimum Boiling

Azotropes

→ Water Boiling Point :- less

→ Examples- $C_2H_5OH + H_2O$

95% + 5%

At $65^\circ C$

→ High Positive Deviation they all are minimum boiling azeotropes.

Maximum Boiling

Azotropes

→ Boiling point of water → maximum

→ Ex- $HNO_3 + H_2O$

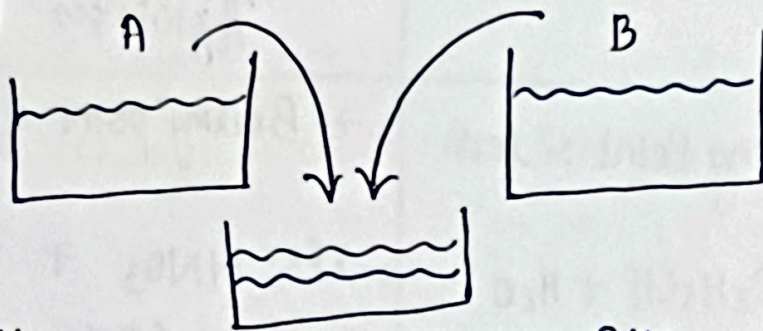
68% 32%

At $393.5 K$

→ High Negative deviation they all are maximum boiling azeotropes

22/04/2025 Pg - 15

Indext Ques 8
Soln



$$P_A^{\circ} = 450 \text{ mm of Hg}$$

$$P_B^{\circ} = 700 \text{ mm of Hg}$$

$$P_{\text{Total}} = 600 \text{ mm of Hg}$$

$$P_{\text{Total}} = P_A^{\circ} X_A + P_B^{\circ} X_B$$

$$X_A = 1 - X_B$$

$$P_{\text{Total}} = P_A^{\circ} + (P_B^{\circ} - P_A^{\circ}) X_B$$

$$600 = 450 + (700 - 450) X_B$$

$$600 - 450 = 250 X_B$$

$$\frac{150}{250} = X_B$$

$$X_B = 0.6$$

$$X_A = 0.4$$

$$y_B = \frac{P_B^{\circ} X_B}{P_{\text{Total}}} = \frac{700 \times 0.6}{600} = \frac{7 \times 6}{6 \times 10}$$

$$y_B = 0.7$$

$$y_A = 0.3$$

OPP - 05 Pg - 15

	A	B
Qw. 1) weight	40 g	20 g
molar mass	20 g	40 g
number of moles	2 mol	0.5 mol

$$X_A = \frac{n_A}{n_A + n_B} = \frac{2}{2 + 0.5} = \frac{2}{2.5} = \frac{20}{25} = 0.8$$

$$X_A = 0.8 \quad X_B = 0.2 \quad \text{Given} = P_A^\circ = 70 \quad P_B^\circ = 50$$

$$P_{\text{Total}} = P_A^\circ X_A + P_B^\circ X_B$$

$$P_{\text{Total}} = 70 \times 0.8 + 50 \times 0.2$$

$$P_{\text{Total}} = 56 + 10$$

$$[P_{\text{Total}} = 66 \text{ mm of Hg}]$$

Qw. 5) pentane Hexane

↓
Solution = Ideal = follow Raoult's law

$$\text{Given, } n_p = 1 \quad P_p^\circ = 440$$

$$n_h = 4 \quad P_{h_x}^\circ = 120$$

$$X_{\text{pentane}} = \frac{n_{\text{pentane}}}{n_{\text{pentane}} + n_{\text{hexane}}} = \frac{1}{1+4} = \frac{1}{5} = 0.2$$

$$\boxed{X_p = 0.2 \quad X_{h_x} = 0.8}$$

$$P_{\text{Total}} = P_p^\circ X_p + P_{h_x}^\circ X_{h_x}$$

$$P_{\text{Total}} = 440 \times 0.2 + 120 \times 0.8$$

$$= 88 + 96$$

$$= 184 \text{ mm of Hg}$$

$$y_{\text{pentane}} = \frac{P_p^\circ X_p}{P_{\text{Total}}} = \frac{88}{184} =$$

$$\boxed{y_p = 0.478}$$

24/04/2025

COLLIGATIVE PROPERTIES

The Property depend on number of solute Particles irrespective of their nature relative to the total number of particles present in the solution, Such Properties are called Colligative Properties.

→ There are four types of Colligative Properties -

→ Relative Lowering in Vapour Pressure.

→ Elevation in Boiling Point

→ Depression in Freezing Point

→ Osmotic Pressure.

→ Function of Colligative Property :-

Determination of molar mass of solute.

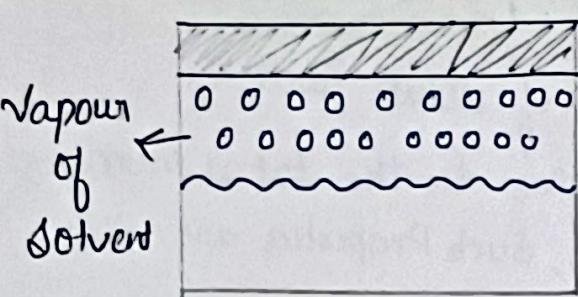
* Relative Lowering in Vapour Pressure

When we mix non-volatile and non-electrolyte solute in any Volatile Solvent the Vapour Pressure decreases.
"Doesn't depend on nature of solute particles"

This is due to :-

"Decreases in the Surface Area of Solvent Surface."
So the layers are not available for solvent to vapourise.

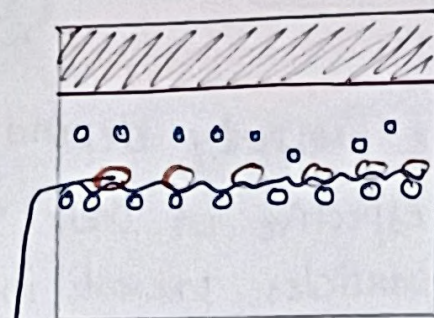
This causes "Lowering in Vapour Pressure".



$$P_A = P_A^\circ X_A$$

$$P_{\text{Total}} = P_A + P_B$$

$$P_{\text{Total}} = P_A^\circ X_A$$



Non Volatile and
Non electrolyte
solute

$$P_B = P_B^\circ X_B = 0$$

$$P_B = 0$$

$P_A = P_A^\circ X_A$, A = Solvent and B = Solute

$$X_A = 1 - X_B$$

$$P_A = P_A^\circ (1 - X_B)$$

$$P_A = P_A^\circ - P_A^\circ X_B$$

$$P_A^\circ - P_A = P_A^\circ X_B$$

$$\Delta P = P_A^\circ X_B$$

$$\frac{\Delta P}{P_A^\circ} = X_B$$

X_B = Mole fraction of B

ΔP = Relative lowering
in vapour pressure.

$$\frac{\Delta P}{P_A^\circ} = \frac{n_B}{n_A + n_B}$$

If the solution are very very dilute
 $n_A \gg n_B$

$$\frac{\Delta P}{P_A^\circ} = \frac{n_B}{n_A}$$

We know that, $n = \frac{w}{M_w}$

$$\frac{\Delta P}{P_A^0} = \frac{W_B \times M_{WA}}{M_{WB} \times W_A}$$

$$M_{WB} = \frac{W_B \times M_{WA} \times P_A^0}{\Delta P \times W_A}$$

Let, P_A^0 Vapour Pressure of Pure Solvent

P_A Vapour Pressure of solution

$\Delta P = P_A^0 - P_A =$ Lowering in Vapour Pressure

$M_{WB} =$ molar mass of solute

$M_{WA} =$ molar mass of solvent

$W_A =$ Weight of solvent

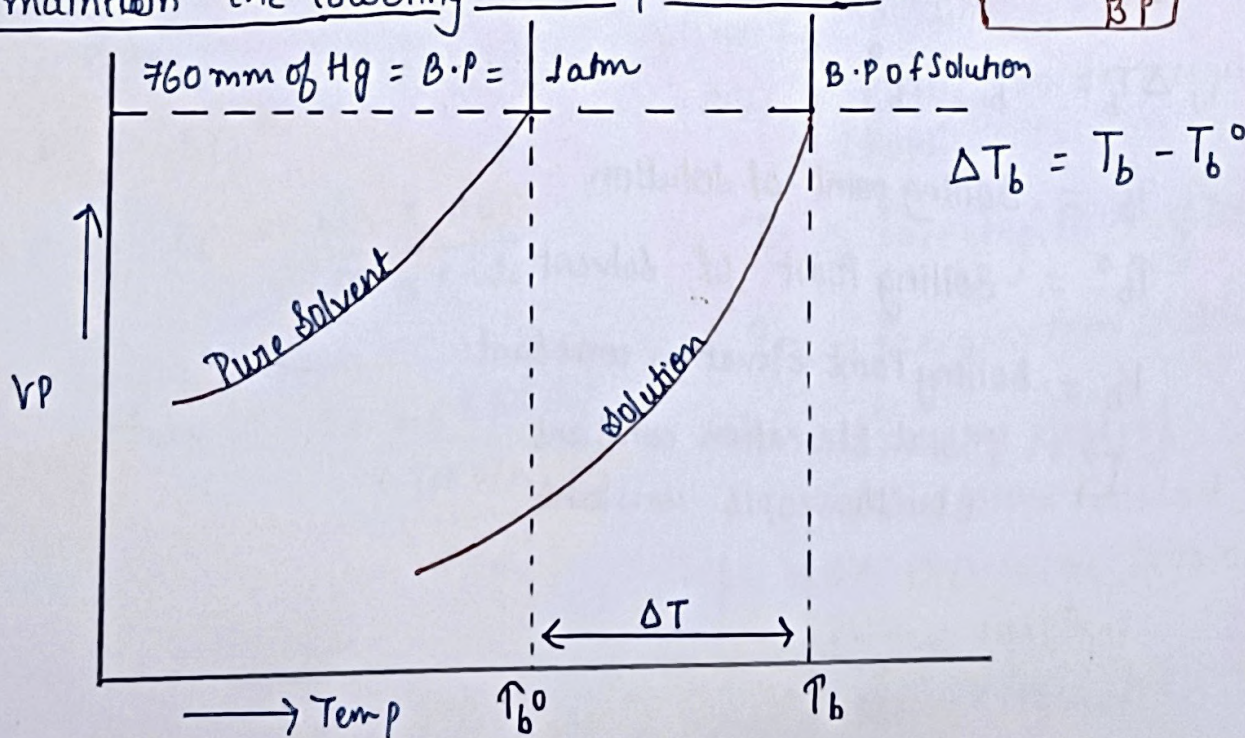
$W_B =$ Weight of solute.

* Elevation in Boiling Point

When we mix Solid non volatile substance in volatile Solvent Vapour Pressure Decreases.

When Vapour Pressure Decreases irrespective the boiling point increase to maintain the lowering in Vapour Pressure.

$$VP \propto \frac{1}{BP}$$



$$\Delta T_b = T_b - T_b^0 \quad \Delta T_b \propto m$$

$$\Delta T_b = K_b \cdot m$$

A = Solvent B = Solute.

$$\Delta T_b = \frac{K_b \times w_B \times 1000}{M_{wB} \times w_A}$$

or

$$M_{wB} = \frac{K_b \times w_B \times 1000}{\Delta T_b \times w_A}$$

Let, M_{wB} = molar mass of solute

w_B = weight of solute

w_A = weight of solvent

$$\Delta T_b = T_b - T_b^0$$

T_b = Boiling point of solution

T_b^0 = Boiling point of solvent

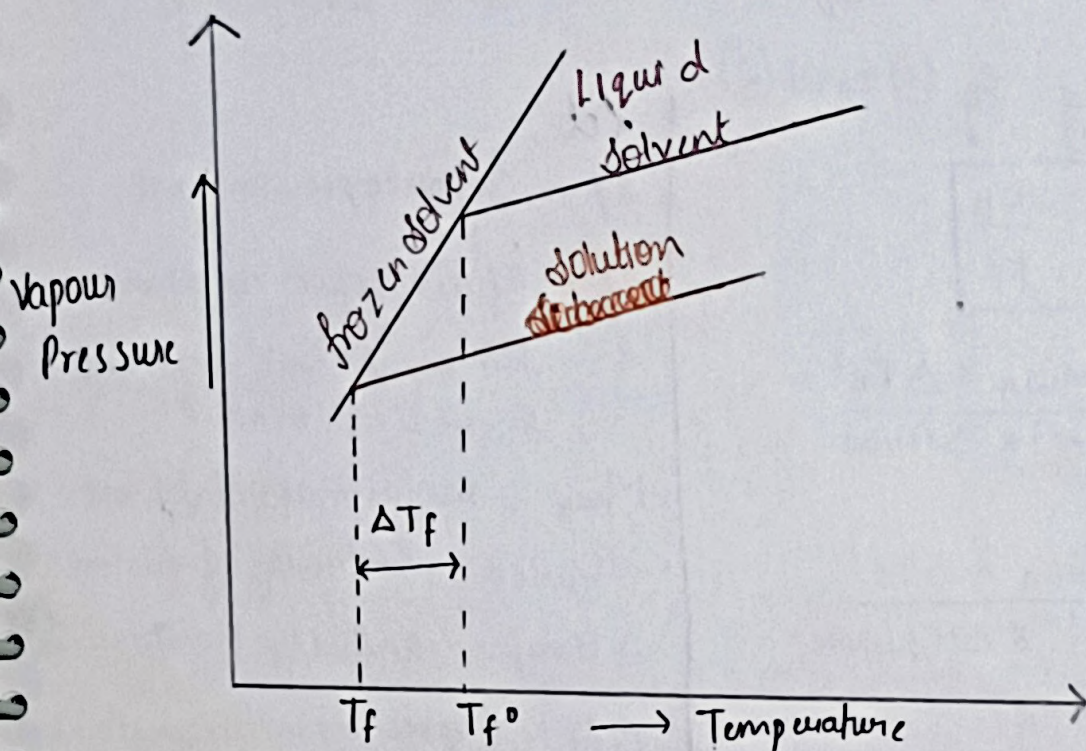
K_b = Boiling Point Elevation constant

↳ = Molal Elevation constant

↳ = Ebullioscopic constant

$$K_b \text{ of water} = 0.52 \text{ K kg mol}^{-1}$$

* Depression in Freezing Point



$VP \propto FP$

When we add non-volatile non electrolyte solute then the Vapour Pressure decreases. Due to Vapour Pressure decreases freezing point decreases. to create vapour pressure gap.

$$\Delta T_f = T_f^0 - T_f$$

$$\Delta T_f \propto m$$

$$\Delta T_f = K_f m$$

$$\Delta T = K_f \times \frac{W_B \times 1000}{M_{WB} \times W_A}$$

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

Let, W_A = weight of solvent

W_B = weight of solute

M_{WB} = molar mass of solute

ΔT_f = Depression in freezing point

T_f^0 = Freezing Point of solvent

T_f = Freezing Point of solution

K_f = Freezing point of Depression constant
 ↳ molar Depression constant
 ↳ Cryoscopic constant

$$K_f \text{ of water} = 1.86 \text{ K Kg mol}^{-1}$$

26/04/2025 Relationship between $K_b, K_f, \Delta T_b, \Delta T_f$

$$\Delta T_b = K_b \cdot m - \text{Eq (1)}$$

$$\Delta T_f = K_f \cdot m - \text{Eq (2)}$$

Dividing Eq (1) and (2)

$$\boxed{\frac{\Delta T_b}{\Delta T_f} = \frac{K_b}{K_f}}$$

$$K_b = \frac{R \times M_{WA} \times \Delta T_b^2}{1000 \times \Delta H_{\text{vap}}}$$

$$K_f = \frac{R \times M_{WA} \times \Delta T_f^2}{1000 \times \Delta H_{\text{fusion}}}$$

Let,

K_f = Cryoscopic constant

K_b = Ebullioscopic constant

R = Universal Gas Constant

$\hookrightarrow 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$

M_{WA} = molar mass of solvent

ΔH_{fusion} = enthalpy of fusion

ΔH_{vap} = enthalpy of vaporisation

ΔT_f = Depression in freezing point

ΔT_b = Elevation in boiling point

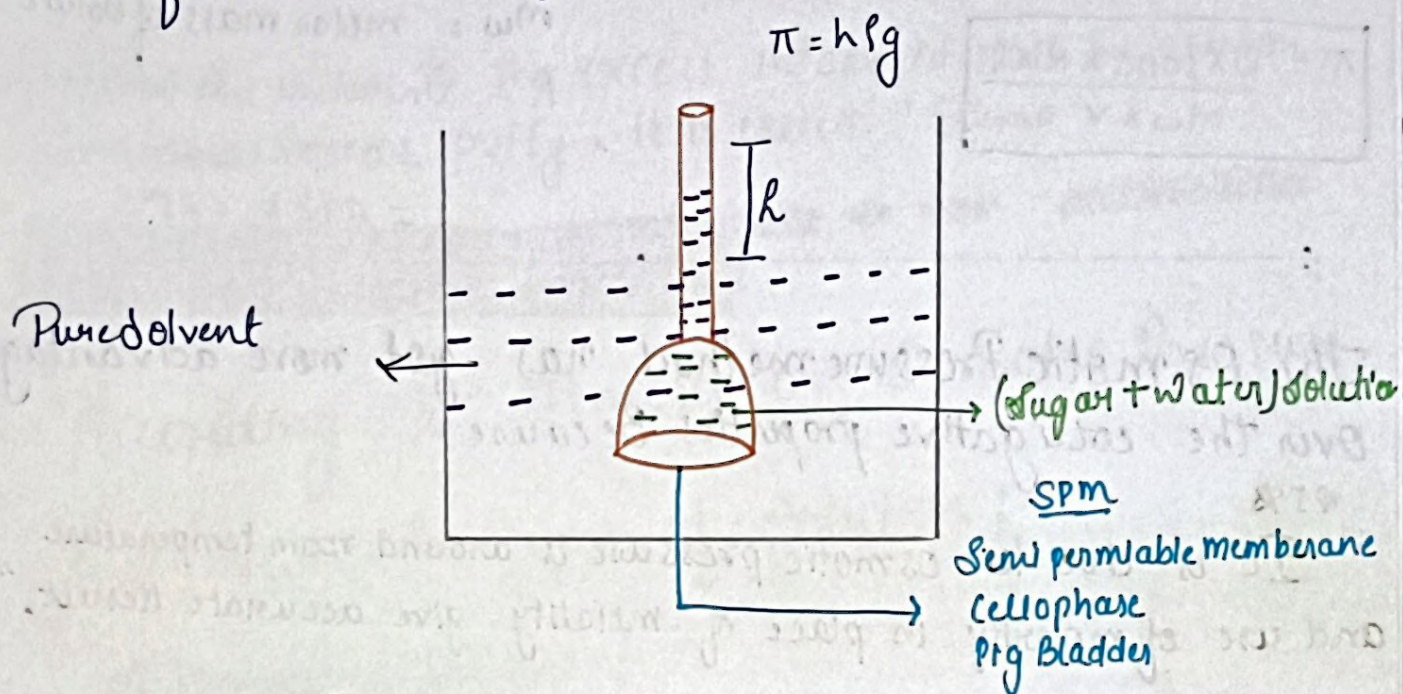
* De-icing Agent

Common salt (NaCl) or calcium chloride is scattered on the road to melt ice in cold countries, Due to Depression in Freezing Point

Where NaCl and CaCl_2 , NaCl is more cheaper and their molar mass are half of CaCl_2 so it is lesser needed, in lesser quantity.

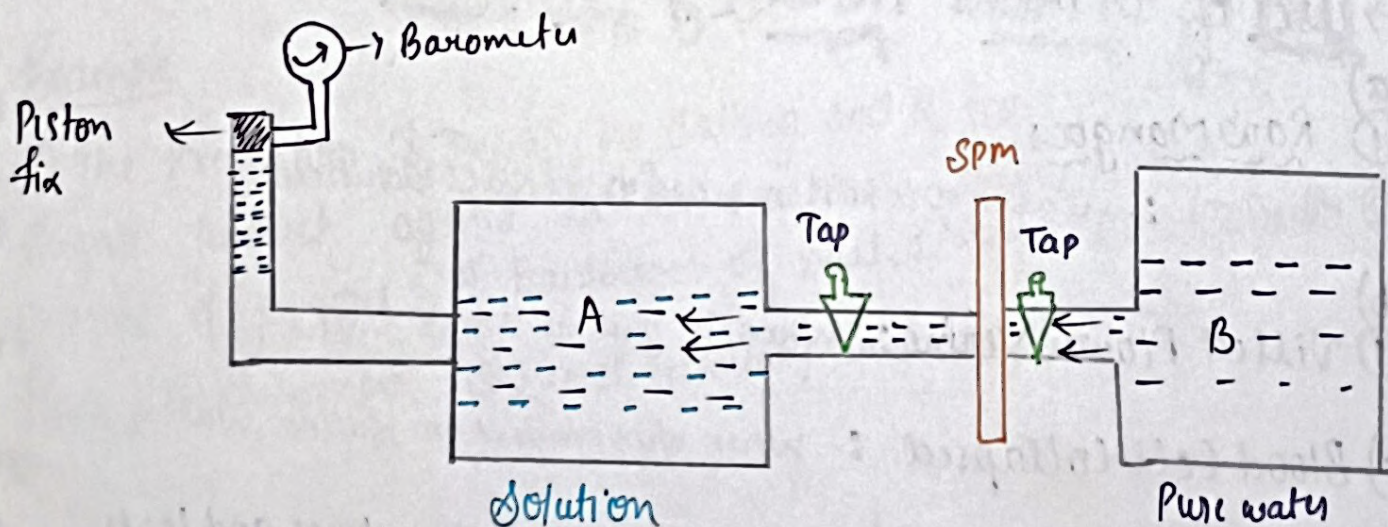
* Osmosis

Flow of Solvent Through SPM [Semi Permeable Membrane]



* Osmotic Pressure

The Opposite pressure to just stop the process of osmosis.



$\pi \propto \text{Concentration/Molarity}$

$\pi = \text{Osmotic Pressure}$

$$\pi = CRT$$

$$\pi = \frac{W \times 1000 \times R \times T}{M_w \times V}$$

$W = \text{Weight of solute}$

$M_w = \text{molar mass of solute}$

$R = \text{Universal Gas Constant}$

$$= 0.0821 \text{ Latm mol}^{-1}$$

$$= 298 \text{ K} = 25^\circ \text{C}$$

The Osmotic Pressure method has got more advantage over the colligative properties because

Q58

"It is due to osmotic pressure is around room temperature and use of molarity in place of molality give accurate Result."

This Method is used for determine molar mass of protein, Polymers, macromolecules etc.

→ uses of osmosis in Biological Process

a)

① Raw Mangoes

② Shruvel :- When pickled in brine (NaCl solution)

b)

① Wilted Flower revive :- When it put in fresh water,

c) Blood Cell Collapsed :- When suspended in Saline water.

d) Plant Root Absorb water and sent top of the trees and leaves by the process of osmosis.

e) Osmosis helps in plant growth and germination of seeds.

f) RBC's burst :- When placed in water, Due to Endosmosis

g) Uses of Salts and Sugars in Jam and Pickles :- act as preservative, It prevent of bacteria and fungi, that dead bodies swell up under water due to endosmosis

h) Edema Due to the excess intake of salt by a person, the tissues become puffy. It is called "Edema".

It is due to retention of water due to ~~end~~ in the tissue to the intercellular space.

→ According to Osmosis or Osmotic Pressure

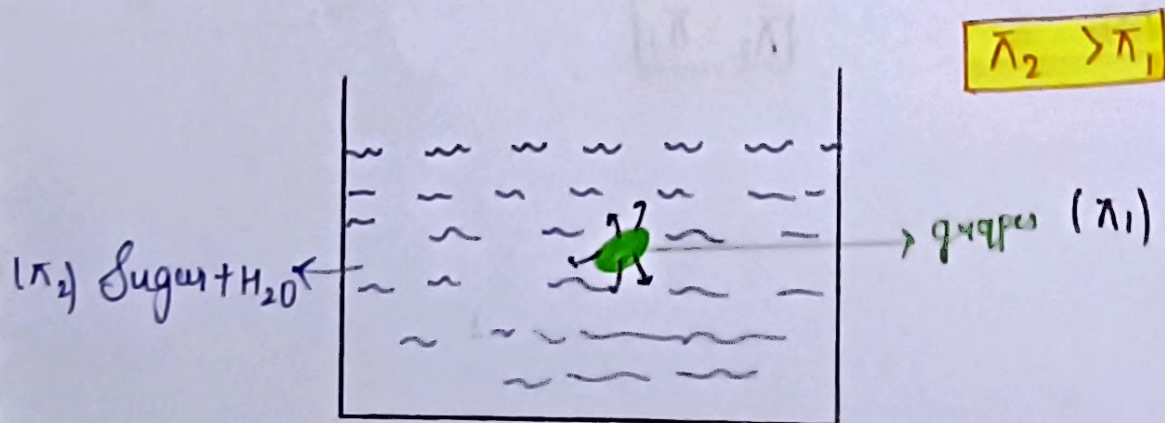
There are 3 types of solution :-

a) Hypertonic Solution :-

A solution in which osmotic pressure (π_2) are more than the osmotic pressure of given solution (π_1) .

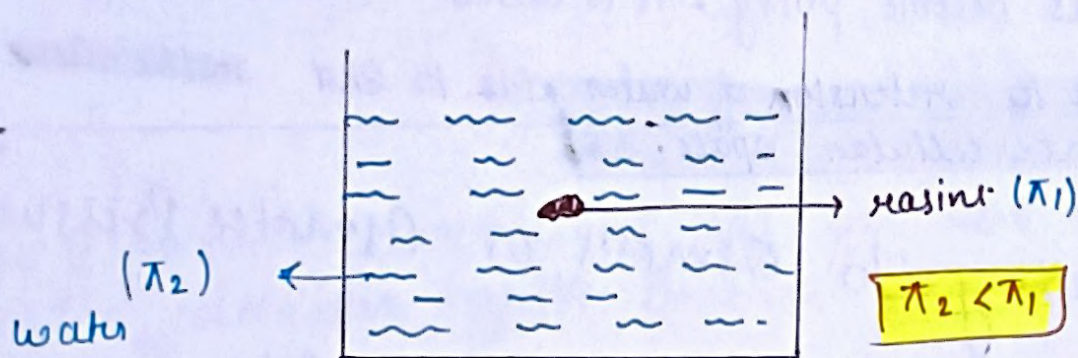
Example

① The Prevention of meat by salting and of fruit by adding sugar, protect against bacterial action. Through this process of osmosis. A bacterium of salted meat or candied fruit, loses water shrivel (shrink) and dies.



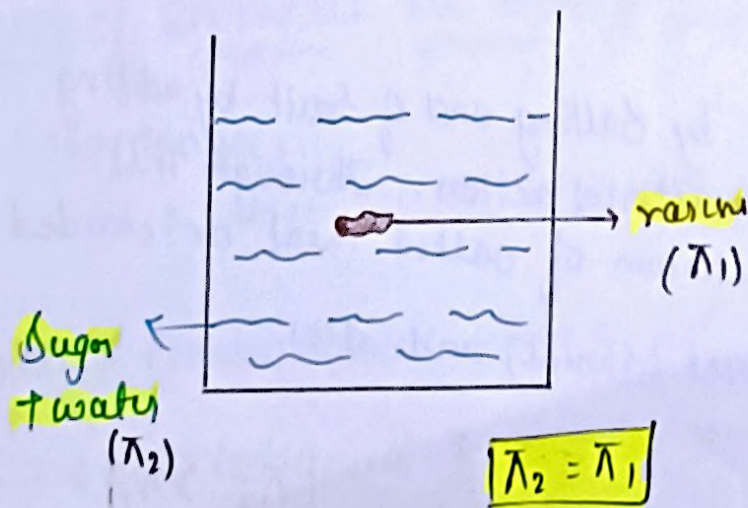
b) Hypotonic Solution

A solution in which osmotic pressure is less than the osmotic pressure of given solution.



c) Isotonic Solution

A solution in which osmotic pressure is equal to given solution.



Blood concentration is 0.9% $\frac{V}{V}$

Only for Isotonic solution

$$\pi_1 = \pi_2$$

$$C_1 R T_1 = C_2 R T_2 \quad [R = R]$$

$$C_1 T_1 = C_2 T_2$$

$$\text{So, } T_1 = T_2$$

$$C_1 T_1 = C_2 T_1$$

$$\boxed{C_1 = C_2}$$

$$\frac{w_1 \times 1000}{m_{w_1} \times V_1} = \frac{w_2 \times 1000}{m_{w_2} \times V_2}$$

$$\boxed{\frac{w_1}{w_2} = \frac{m_{w_1} \times V_1}{m_{w_2} \times V_2}}$$

Let,

w_1 = weight of solute in 1st solution

w_2 = weight of 2nd solution

m_{w_1} = molar mass of 1st solution

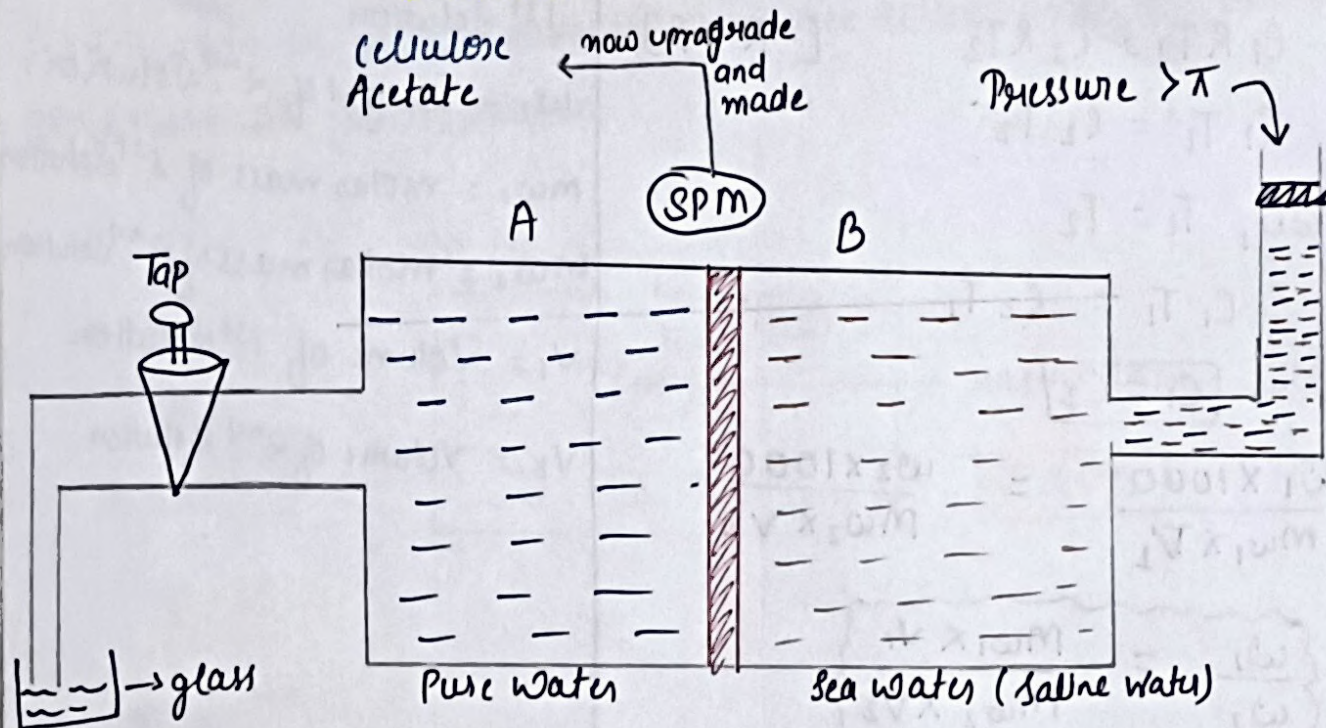
m_{w_2} = molar mass of 2nd solution

V_1 = Volume of 1st solution

V_2 = Volume of 2nd solution

29/04/2025

Reverse Osmosis [RO]



The Direction of Osmosis can be reversed if the pressure larger than the osmotic pressure is applied to the solution side.

That's now, The Pure Solvent is flow out of the solution through Semi Permeable Membrane. This process is called RO.

1) This process is also called De-salination of Salt Water.

2) We cannot use normal (SPM) in this process because SPM can be burst so we can use cellulose acetate as SPM.

Van't Hoff factor / Abnormal molar mass

All the colligative properties are for non-volatile and non-electrolyte, For electrolyte molecules are separated into many ions and colligative properties are depend upon number of molecules so colligative properties are wrong.

We have use correction factor in each of colligative property. This correction factor are called Van't Hoff factor.

It is denoted by $[i]$.

Correction factor

i = Van't Hoff factor

$$i^o = \frac{\text{Normal molar mass}}{\text{Abnormal molar mass}}$$

$$i^o = \frac{\text{Observed colligative property}}{\text{Calculated colligative property}}$$

$$i^o = \frac{\text{Total number of mole after association / dissociation}}{\text{Total number of mole before association / dissociation}}$$

Van't Hoff factor are of Two types

Association

25*

like - Acetic acid

form Dimer in aquatic phase
Due to Hydrogen Bond.

Dissociation

like NaCl ionized
in H_2O .

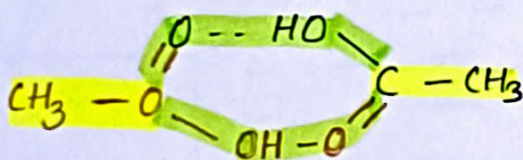
(i) for Association

→ value less than 1

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



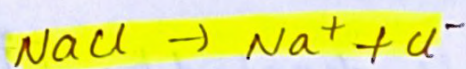
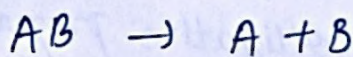
→ Example - Acetic Acid



i for Dissociation

→ value more than 1

$$i = 1 + (n-1)\alpha$$



→ Use this correction factor in all the colligative Properties

① Relative in lowering in Vapour Pressure

$$\frac{\Delta P}{P^0} = i \times X_B = i \times \frac{n_B}{n_A + n_B}$$

② Elevation in Boiling Point

$$\Delta T_b = i \cdot K_b \cdot m$$

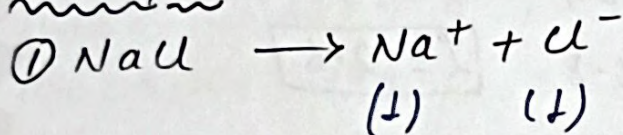
③ Depression in Freezing point

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

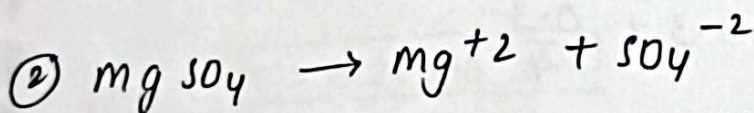
④ Osmotic Pressure

$$\pi = (RT) i$$

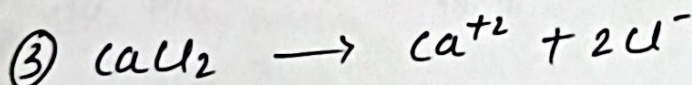
Examples -



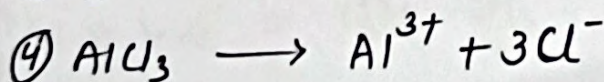
$$i = 2$$



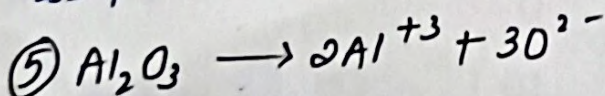
$$i = 2$$



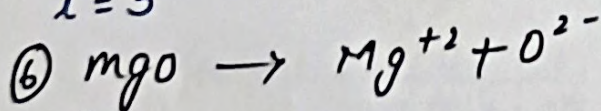
$$i = 3$$



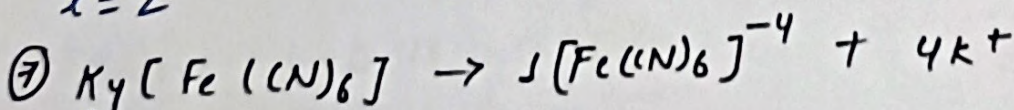
$$i = 4$$



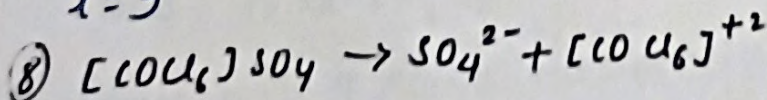
$$i = 5$$



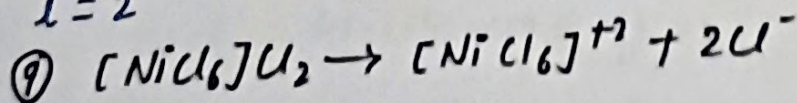
$$i = 2$$



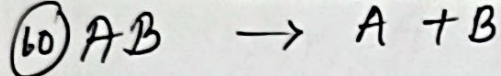
$$i = 5$$



$$i = 2$$



$$i = 3$$



$$\alpha = 40\% = 0.4$$

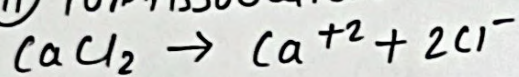
$$i = ? \quad n = 2$$

$$i = 1 + (n-1)\alpha$$

$$i = 1 + (2-1) 0.4$$

$$\boxed{i = 1.4}$$

(11) for Dissociation



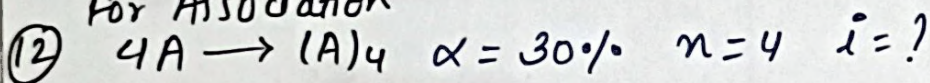
$$\alpha = 80\% = 0.8 \quad i = ? \quad n = 3$$

$$i = 1 + (n-1)\alpha$$

$$i = 1 + (3-1) 0.8$$

$$\boxed{i = 2.6}$$

for Association

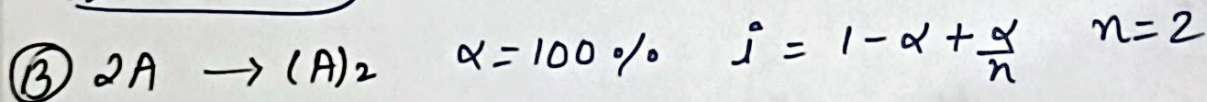


$$i = 1 + \alpha + \frac{\alpha}{n}$$

$$i = 1 - 0.3 + \frac{0.3}{4}$$

$$i = 0.7 + 0.075$$

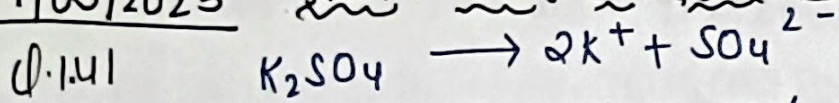
$$\boxed{i = 0.775}$$



$$i = 1 - 1 + \frac{1}{2}$$

$$\boxed{i = \frac{1}{2}}$$

1/05/2025 NCERT VERY IMP QUESTIONS



$i = n = 3$ completely dissolved $\alpha = 100\%$

$$\pi = i CRT$$

$$\pi = i \times \frac{w}{m_w \times V} \times RT$$

given = $w = 25 \times 10^{-3} g$, $V = 2 \text{ litre}$, $T = 25^\circ C = 273 + 25 = 298 K$

$$m_w = K_2SO_4 = 174 g$$

$$\pi = \frac{3 \times 25 \times 10^{-3} \times 0.0821 \times 298}{174 \times 2} = 5.27 \times 10^{-3} \text{ atm}$$

$$\boxed{\pi = 5.27 \times 10^{-3} \text{ atm}}$$

1.38) $m_w = \text{Benzene} = C_6H_6 = 12 \times 6 + 1 \times 6 = 78 g$

$$w_B = 80 g$$

$$m_w \text{ Toluene} = C_6H_5-CH_3 = 92 g \quad w_T = 100 g$$

$$P^\circ_{\text{Benzene}} = 50.71 \text{ mm of Hg} \quad P^\circ_{\text{Toluene}} = 32.06 \text{ mm of Hg}$$

$$n_{\text{Benzene}} = \frac{80}{78} = 1.02 \quad n_{\text{Toluene}} = \frac{100}{92}$$

$$X_{\text{Benzene}} = \frac{1.02}{1.02 + 1.08} = 0.48$$

$$X_{\text{Toluene}} = 1 - 0.48 = \underline{\underline{0.52}}$$

$$P_{\text{Total}} = P_A^\circ X_A + P_B^\circ X_B$$

$$P_{\text{Total}} = 50.71 \times 0.48 + 32.06 \times 0.52$$

$$P_{\text{Total}} = 41.124 \text{ mm of Hg}$$

$$y_{\text{Benzene}} = \frac{P^\circ_{\text{Benzene}} \cdot X_{\text{Benzene}}}{P_{\text{Total}}} = \frac{50.71 \times 0.48}{41.124} = 0.6$$

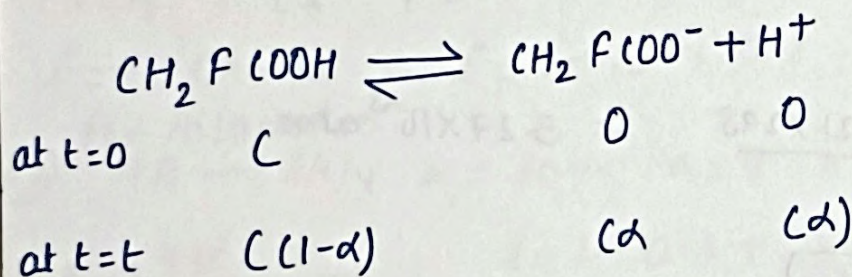
$$y_{\text{Toluene}} = 0.4$$

1.33) Dissociation constant = K_a

Degree of dissociation = α

Correction factor = i

Vant Hoff factor = i



$K_a = \frac{C\alpha \cdot C\alpha}{C(1-\alpha)}$

Given, $W_A = 19.5 \text{ g}$ $M_w = \text{CH}_2\text{FCOOH} = 78 \text{ g}$

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

$1^\circ\text{C} = i \times 1.86 \times \frac{W \times 1000}{m_w \times W} = \frac{78 \times 500}{1.86 \times 19.5 \times 1000}$

$i = 1.0753$

$K_a = \frac{C\alpha^2}{1-\alpha}$

$i = 1 + (n-1)\alpha$

$1.0753 = 1 + (2-1)\alpha$

$1.0753 - 1 = \alpha$

$\alpha = 0.0753$

$K_a = C\alpha^2$

$1 \gg \alpha$
 $[C = 0.5 \text{ m}]$

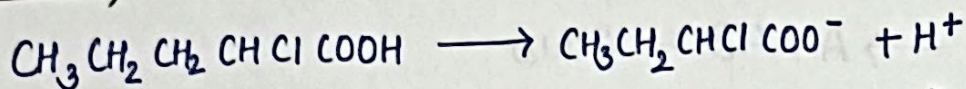
$K_a = 0.5 \times (0.075)^2$

$K_a = 3.07 \times 10^{-3}$

$C = \frac{W \times 1000}{m_w \times V} = \frac{19.5 \times 1000}{78 \times 500}$

$C = 0.5 \text{ m}$

$$\underline{1.32)} \quad K_a = 1.4 \times 10^{-3}$$



$$K_a = \frac{C\alpha^2}{1-\alpha} \quad 1 \gg \alpha$$

$$K_a = C\alpha^2$$

$$\alpha = \sqrt{\frac{K_a}{C}} = \sqrt{\frac{1.4 \times 10^{-3}}{0.326}}$$

$$\boxed{\alpha = 0.0625}$$

$$M = \frac{w \times 1000}{m_w \times V}$$

$$= \frac{10 \times 1000}{122.5 \times 250}$$

$$m \approx M = 0.326$$

$$\Delta T_f = i \times K_f \times m$$

$$= 1.065 \times 1.86 \times 0.326$$

$$\Delta T_f = 0.65 \text{ K}$$

$$i = 1 + (n-1)\alpha$$

$$i = 1 + (2-1) \times 0.065$$

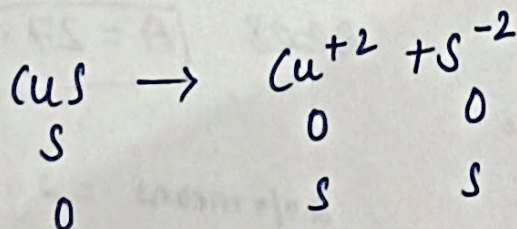
$$i = 1 + 0.065 = 1.065$$

$$\boxed{i = 1.065}$$

1.27))

at t=0

at t=t



$$\boxed{K_{sp} = S^2} \quad S = \text{molarity}$$

$$6 \times 10^{-16} = S^2$$

$$S = \sqrt{6 \times 10^{-16}}$$

$$\boxed{S = 2.45 \times 10^{-8}}$$

1.22

$$\pi = CRT$$

$$\pi_1 = 4.98 = \frac{w_1 \times 1000}{m_{w_1} \times V_1} \quad \text{--- (1)}$$

$$\pi_2 = 1.52 = \frac{w_2 \times 1000}{m_{w_2} \times V_2} \quad \text{--- (2)}$$

$$V = ? \quad m = ? \quad \pi = CRT$$

Divide (1) and (2)

$$\frac{4.98}{1.52} = \frac{36}{w_2}$$

$$w_2 = \frac{36 \times 1.52}{4.98}$$

$$\boxed{w_2 = 10.48 \text{ g}}$$