PARISHRAM

2026

CHEMISTRY

Lecture 01

Bharat Mata Ki Jai ♡

SOLUTIONS

[Types of Solutions]

BY – PRIYA-PUTRA-SUNIL

TOPICS TO BE COVERED

(i) Introduction to Solution

(ii) Classification of Solution

Types of Solutions


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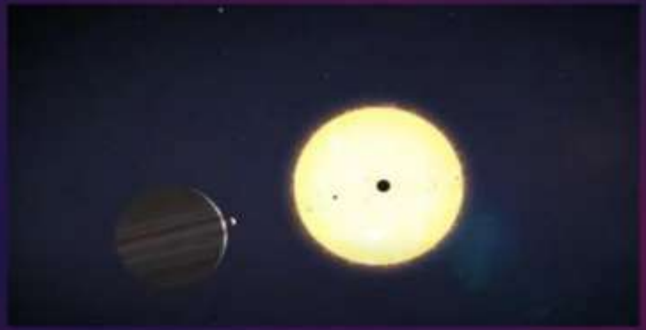
× NORMAL LIVE CLASS

✓ MOVIE LIKE LIVE CLASS

A SUNIL BHAIYA CREATIONS

LIVE EXPERIMENTS

3D ANIMATIONS AND SIMULATIONS



ANIMATED VIDEOS AND SONGS FOR REVISION

SCIENCE MOVIES

CLASS CONTENT FLOW AND RULES

Concepts to be taught today **(Topics to Be Covered)**

Teaching & Question practice **(Let's Practice, Give a Thought, Beat Your Brains Out** and **PYQs' Wallah)**

Live Experiments & Revision **(A Sunil Bhaiya Creations)**

Homework **(Concept Polish)**

Tips to increase study efficiency **(Efficiency Hacks)**

Gyaan to make you a better human being **(Insaniyat Ka Gyaan)**

CLASS CONTENT FLOW AND RULES

I

Samaj mein aaye toh likhna hai

Aye Bhaiya❤️ – *Another way to say 'YES'*

II

Nahi samaj mein aaye toh likhna hai

It's not difficult, I can do it.

III

Sabki izzat kare aur spam na kare!

An arduous decision of blocking you will be taken!

CLASS CONTENT FLOW AND RULES

Aap akele nahi hai. Apke sath padhenge **Hasmukhlal** aur **Simaila**

CBSE CLASS 12 PHYSICAL CHEMISTRY

S. No.	Title	Marks	
1	Solutions	7	
2	Electrochemistry	9	23
3	Chemical Kinetics	7	
4	d -and f -Block Elements	7	BKT Sir
5	Coordination Compounds	7	
6	Haloalkanes and Haloarenes	6	
7	Alcohols, Phenols and Ethers	6	
8	Aldehydes, Ketones and Carboxylic Acids	8	Shourya ma'am
9	Amines	6	
10	Biomolecules	7	
	Total	**70**	

SAMAJ AAYA TOH LIKH DO.

AYE BHAIYA

INTRODUCTION TO $\boxed{\text{SOLUTION}}$

(घोल)

WHAT IS A SOLUTION?

uniform composition (एक समान)

elements

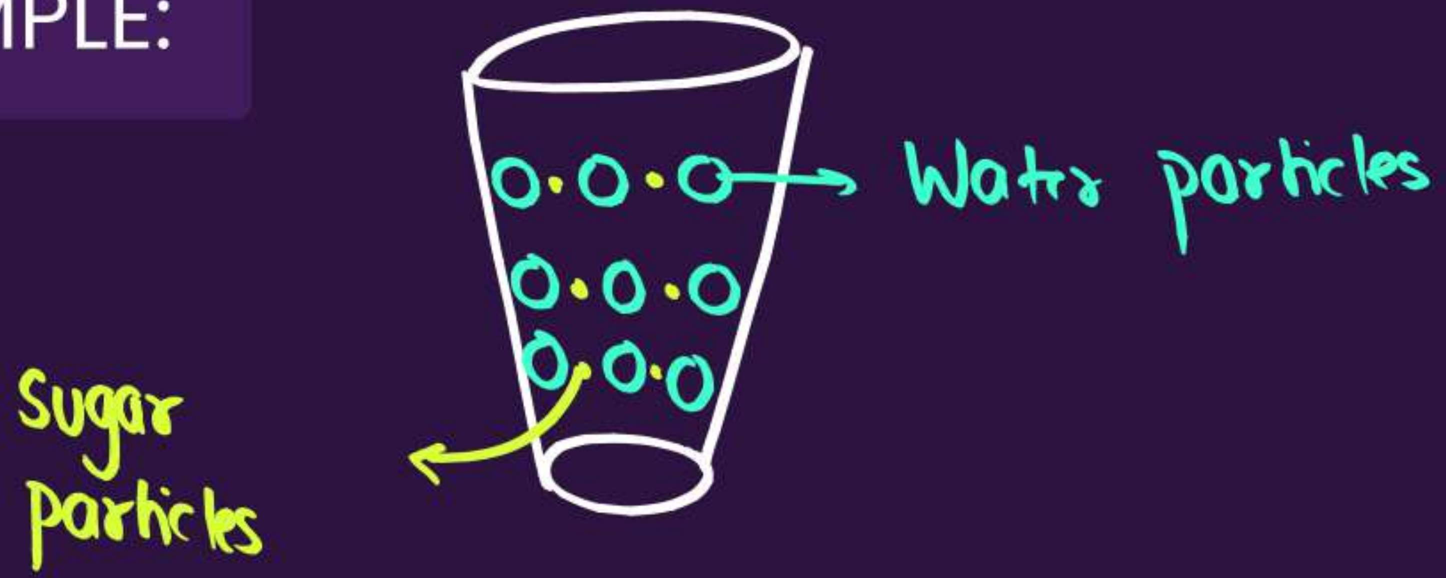
compounds

I II

It is a homogeneous mixture of two or more pure substances combined physically in any proportion by mass.

III IV

EXAMPLE:



COMPONENTS OF A SOLUTION

SOLUTE

- It is dissolved into solvent.
- Present in lesser quantity than solvent.

SOLVENT

- Solute is dissolved into it.
- Present in larger quantity than solute.

SAMAJ AAYA TOH LIKH DO.

AYE BHAIYA

CLASSIFICATION OF SOLUTION

'अलग अलग प्रकार के solution'

CLASSIFICATION OF SOLUTION

I ON THE BASIS OF WATER AS SOLVENT

Yes

No

AQUEOUS SOLUTION ✓

NON AQUEOUS SOLUTION ✓

EXAMPLES

Solute Solvent

Salt in water

Sugar in water

Solute Solvent (C_2H_5OH)

$\boxed{\text{Iodine dissolved in ethanol}}$

Iodine dissolved in chloroform

$(CHCl_3)$

Tincture of iodine

LET’S PRACTICE

QUESTION

Which among the following is an example of a non-aqueous solution?

(A) Cold drink → water (solvent) & carbon dioxide, sugar, flavouring agents (solute)

(B) Salt dissolved in water (solvent)

(C) Sugar dissolved in water (solvent)

Aqueous Soltn

(D) Sulphur dissolved in carbon disulphide

solvent other than water

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AYE BHAIYA

CLASSIFICATION OF SOLUTION

COMPONENTS OF A SOLUTION

II ON THE BASIS OF NUMBER OF ~~SOLUTE ADDED~~

Types of Solution	Number of Components	General Composition	Example
Binary	2	1 Solute + 1 Solvent	**Salt** in **water**
Ternary	3	2 Solutes + 1 Solvent	**Salt** and **sugar** in **water**
Quaternary	4	3 Solutes + 1 Solvent	**Glucose, sodium chloride** and **potassium chloride** in **water** → ORS

GIVE A THOUGHT

SUNIL SIKANJI CENTRE

While making sikanji, Hasmukhlal and Simaila observed me. Hasmukhlal says it is a ternary solution while Simaila says it is a quaternary solution. Who is right?

A. 

B. 

Water + Sugar + Salt + Lemon juice
(solvent) ← Solute →

SAMAJ AAYA TOH LIKH DO.

AYE BHAIYA ✓

CLASSIFICATION OF SOLUTION

ON THE BASIS OF RELATIVE CONCENTRATION OF SOLUTE AND SOLVENT

dil.

DILUTE SOLUTION

Contains lesser solute particles in a given amount of solvent as compared to concentrated solution.

conc.

CONCENTRATED SOLUTION

Contains more solute particles in a given amount of solvent as compared to diluted solution.

CLASSIFICATION OF SOLUTION

ON THE BASIS OF RELATIVE CONCENTRATION OF SOLUTE AND SOLVENT

EXAMPLE

B is concentrated with respect to A which is diluted.

Cup	Solute	Solvent	Solution Type
A	5 g sugar	100 mL water	Dilute (light sweetness)
B	20 g sugar	100 mL water	Concentrated (very sweet)
C	5 g sugar	500 mL water	

Compare A & C. Which is dilute & which is conc.?

$\boxed{A \rightarrow \text{conc.}}$ $\boxed{C \rightarrow \text{dil.}}$

SAMAJ AAYA TOH
LIKH DO.

AYE BHAIYA ✓

CLASSIFICATION OF SOLUTION

ON THE BASIS OF 'AMOUNT OF SOLUTE' ADDED

I SATURATED SOLUTION

II UNSATURATED SOLUTION

III SUPER SATURATED SOLUTION

Let's understand each one of them one by one.

CLASSIFICATION OF SOLUTION

ON THE BASIS OF AMOUNT OF SOLUTE ADDED

(i) **Saturated Solution:** A solution in which maximum amount of solute is dissolved in a solvent at a particular temperature.

Example: At 20 °C, maximum 31 gram of potassium nitrate ~~can be~~ is dissolved in 100 g of water.

GIVE A THOUGHT

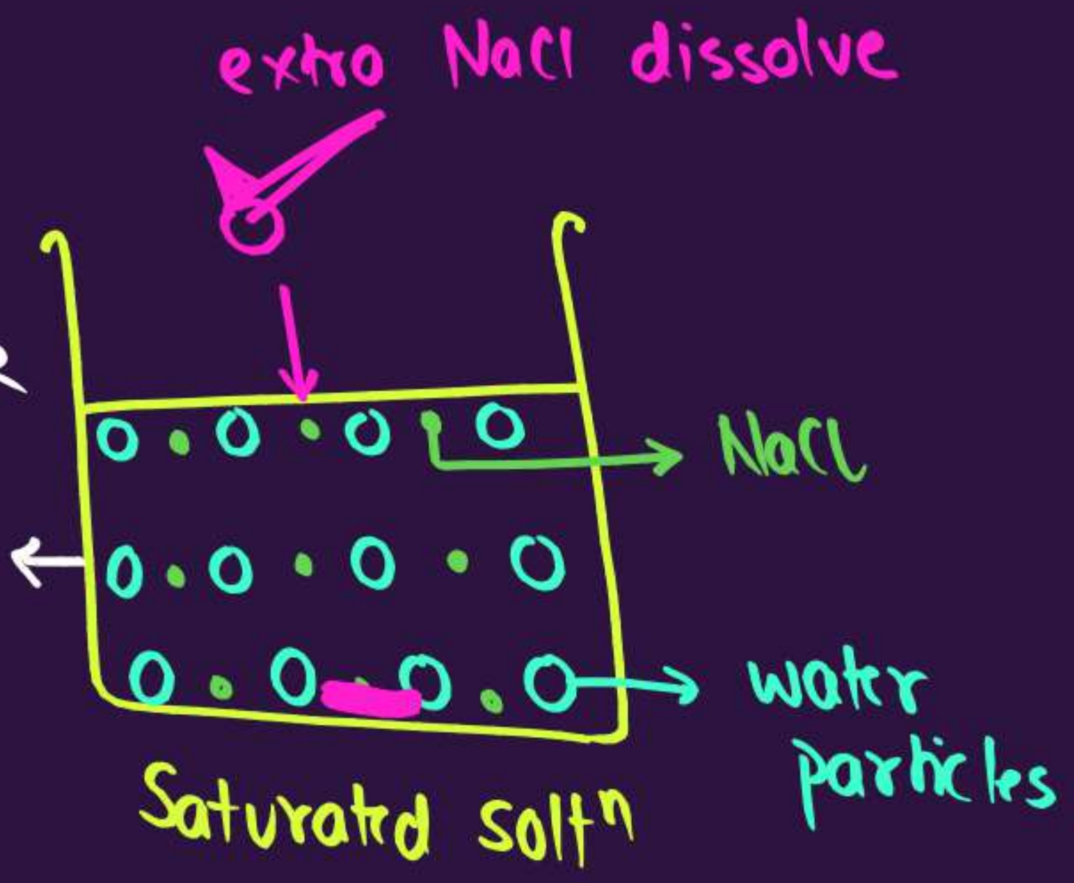
What if you try to dissolve more solid solute in a saturated solution without increasing temperature?

Kya yeh possible hai?

(A) Yes

(B) No

जितना extra namak ghola woh ghul jaega par pahle se jo dissolved hai woh bahar aa jaega.



GIVE A THOUGHT

What if you try to dissolve more solid solute in a saturated solution without increasing temperature?

If we will (try to dissolve more solid solute in a saturated solution without increasing temperature) the [solid solute will dissolve but the originally dissolved solute will come out of the solution.]

Hence, the maximum solid solute that will be dissolved will remain the same.

GIVE A THOUGHT

What if you try to dissolve more solid solute in a saturated solution without increasing temperature?

Now, understand this through Bollywood movie 'Hera-Pheri'

CLASSIFICATION OF SOLUTION

ON THE BASIS OF AMOUNT OF SOLUTE ADDED

(ii) **Unsaturated Solution:** Contains lesser solute dissolved than the maximum limit that can be dissolved in a solvent at a given temperature.

Example: At 20 °C, 20 gram of potassium nitrate is dissolved in 100 g of water.

'11 gram more can be dissolved to make it saturated'

CLASSIFICATION OF SOLUTION

ON THE BASIS OF AMOUNT OF SOLUTE ADDED

ex: HONEY

(iii) Super Saturated Solution: Contains more than the maximum amount of solute in a solvent at a given temperature.

[at temp. (T), max^m x g solute is dissolved in y gram solvent]

Saturated Soln

Temp. (T) (↑) to T' & additional x' g solute is dissolved

at temp. (T'), $(x+x')$ g of solute is dissolved in y g solvent

Temp. again (↓) to (T), $(x+x')$ g is dissolved in y g solvent

Super Saturated soln

SAMAJ AAYA TOH LIKH DO.

AYE BHAIYA

CLASSIFICATION OF SOLUTION

ON THE BASIS OF PHYSICAL STATE OF SOLUTE AND SOLVENT

Absorption of H_2 in palladium

	SOLUTE	SOLVENT	
I *Solid Solutions*	Gas	Solid	Solution of hydrogen (g) in palladium (s)
	Liquid	Solid	Amalgam of mercury (l) with sodium (s)
	Solid	Solid	Copper dissolved in gold (s)
			OR (s) Silver

(I) Copper/Silver in gold, mercury in sodium] → alloys (homogeneous mixtures)

(II) amalgam: alloy of any metal with mercury.

CLASSIFICATION OF SOLUTION

ON THE BASIS OF PHYSICAL STATE OF SOLUTE AND SOLVENT

	SOLUTE	SOLVENT	
II *Liquid Solutions*	Gas	Liquid	Oxygen (g) dissolved in water (l)
	Liquid	Liquid	Ethanol (l) dissolved in water (l)
	Solid	Liquid	Glucose (s) dissolved in water (l)

CLASSIFICATION OF SOLUTION

ON THE BASIS OF PHYSICAL STATE OF SOLUTE AND SOLVENT

Nitrogen is 78.08% in air & hence it is present in largest quantity in air so, it is considered as solvent.

	SOLUTE	SOLVENT	
III *Gaseous Solutions*	Gas	Gas	Mixture of oxygen (g) and nitrogen (g) gases
	Liquid	Gas	Chloroform (l) mixed with nitrogen gas (g)
	Solid	Gas	Camphor (s) in nitrogen gas (g)

PYQS' WALLAH

CBSE PYQ

Name the solvent and solute in the solution "Ethanol dissolved in water."

- Ethanol → solute
- water → solvent
- Liquid-in-liquid solution

CBSE PYQ

Which of the following is an example of a $\underbrace{\text{solid solution}}_{\text{Solid solvent}}$?

(A) Oxygen dissolved in $\underbrace{\text{water}}_{\text{solvent}}$ (l)

(B) Chloroform mixed with nitrogen gas (g)

(C) Copper dissolved in $\underbrace{\text{gold}}_{\text{Solvent}}$ (s)

(D) Mixture of oxygen and nitrogen gases (g)

CONCEPT POLISH – HOMEWORK

CBSE PYQ

(A)

ASSERTION: Amalgam of mercury with sodium is a solid solution.

REASON: In a solid solution, both solute and solvent are in the solid state. (R)

A. Both A and R are true, and R is the correct explanation of A

B. Both A and R are true, but R is not the correct explanation of A

C. A is true, but R is false

D. A is false, but R is true

SAMAJ AAYA TOH LIKH DO.

AYE BHAIYA

EFFICIENCY HACKS BY SUNIL BHAIYA

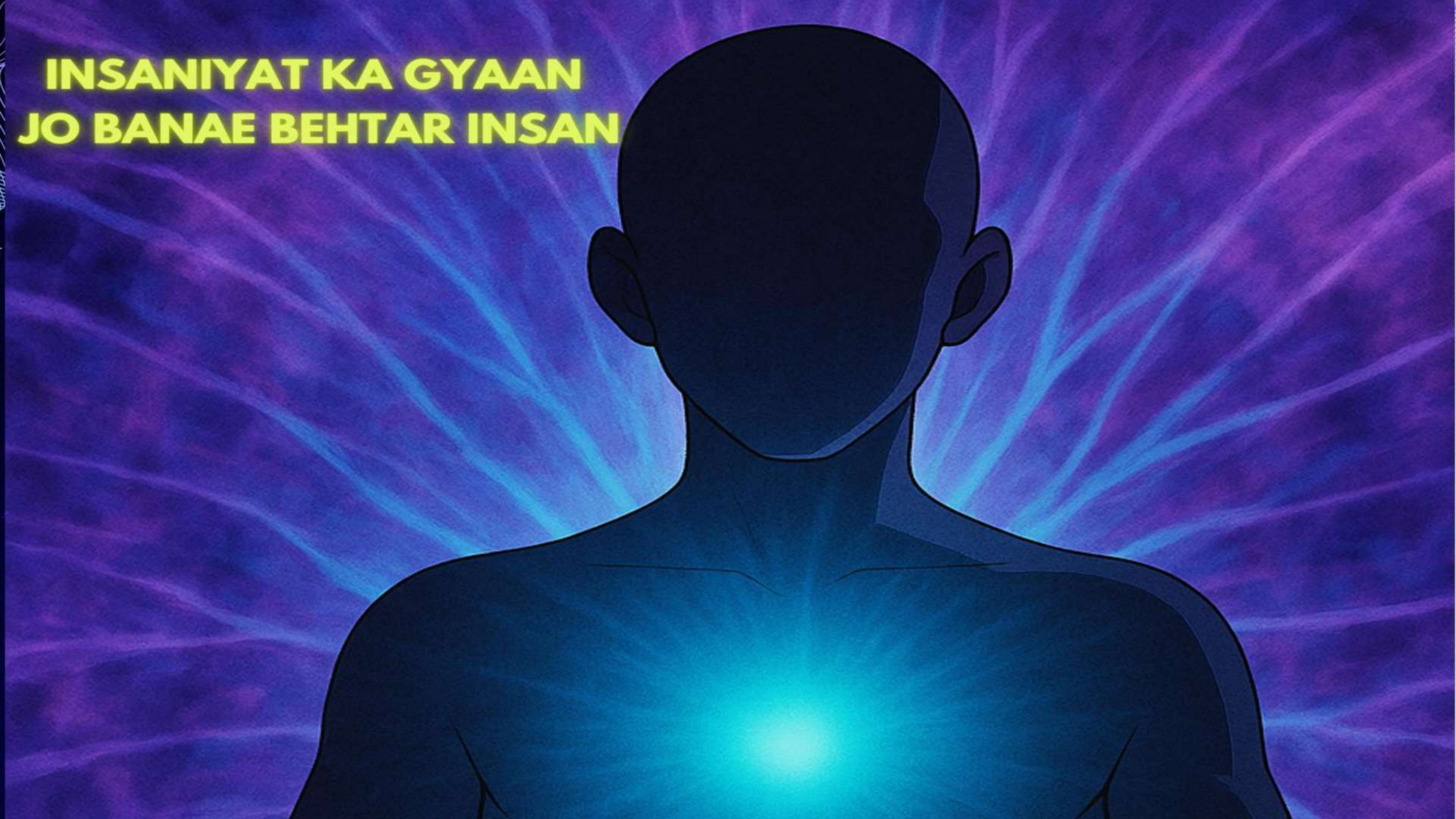
Tips to Avoid Sleep While Studying!

(i) Don’t feel too comfortable while studying.

(ii) Stay hydrated while studying.

(iii) Read aloud, walk and write more.

(iv) Talk proper sleep of 6-8 hours.


INSANIYAT KA GYAAN
JO BANAE BEHTAR INSAN

SUNIL BHAIYA IS ALWAYS THERE FOR YOU.
#sbsathhai
#pwsathhai

Thank You

PARISHRAM

2026

CHEMISTRY

Bharat Mata Ki Jai ♡

Lecture 02

SOLUTIONS

Concentration Terms – Part I

BY – PRIYA-PUTRA-SUNIL

TOPICS TO BE COVERED

Concentration Terms - Part I

(i) Concentration of a Solution and Ways to Express It

(ii) Relative Concentration Units – Percentage Concentration

(iii) Dilute Concentration Units

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CONCEPT POLISH – HOMEWORK DISCUSSION

CBSE PYQ

liquid

solid

ASSERTION: Amalgam of mercury with sodium is a solid solution. (✓)

REASON: In a solid solution, both solute and solvent are in the solid state. 'Statement'

(X)

A. Both A and R are true, and R is the correct explanation of A

B. Both A and R are true, but R is not the correct explanation of A

C. A is true, but R is false ✓

D. A is false, but R is true

CONCENTRATION OF A SOLUTION AND WAYS TO EXPRESS IT

INTRODUCTION TO CONCENTRATION

solution किस किस cheej से बना है

- The composition of a solution can be described by expressing its concentration.

- The concentration of a solution can be expressed qualitatively like the solution is dilute (i.e., relatively very small quantity of solute) or it is concentrated (i.e., relatively very large quantity of solute).

- But this can lead to a lot of confusion and thus the need for a quantitative description of the solution, i.e. in the form of an exact number or a ratio.

QUANTITATIVE WAYS TO EXPRESS CONCENTRATION

- Relative Concentration Units – Percentage Concentration
- Dilute Concentration Units
- Concentration Units Based on Mole → Next Class

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Percentage
per 100

$\% = \frac{\text{Your marks}}{\text{Total marks}} \times 100\% = \frac{\cancel{450}^{90}}{\cancel{500}} \times \cancel{100}\% = 90\%$

450 number 500 में से थे
तो 90 —॥— 100 में से होंगे

'CONCEPT'

450 marks ⟶ 500 marks
'x' ⟶ 100 marks

$x \times 5\cancel{00} = 450 \times 1\cancel{00}$

$x = 90$

RELATIVE CONCENTRATION UNITS – PERCENTAGE CONCENTRATION

RELATIVE CONCENTRATION UNITS – PERCENTAGE CONCENTRATION

Concentrations are often expressed in terms of relative units (e.g. percentages) with three different types of percentage concentrations commonly used:

I Mass Percent

II Volume Percent

III Mass/Volume Percent

RELATIVE CONCENTRATION UNITS – PERCENTAGE CONCENTRATION

Denoted By

C-I

(i) Mass Percent (W/W%): It is defined as the ratio of the mass of solute that is present in a solution relative to the mass of solution, as a whole.

C-II

$$\text{Mass \%} = \frac{\text{mass of solute } (g)}{\text{mass of solution } (g)} \times 100\% \quad \textbf{OR} \quad \text{Mass \%} = \frac{\text{mass of solute}}{\text{mass of (solute + solvent)}} \times 100\%$$

C-III

water is solvent

Example: Aqueous solution of H_2SO_4 is 49% by mass means → 49 g of H_2SO_4 is present in 100 g soltⁿ

mass of water = mass of soltⁿ − mass of H_2SO_4
= 51 g

LET'S DECODE NCERT

Meaning: 10 g of glucose (solute) is dissolved in 90 g of water (solvent) to form 100 g solution.

I

For example, (if a solution is described by 10% glucose in water by mass, it means that 10 g of glucose is dissolved in 90 g of water resulting in a 100 g solution). Concentration described by mass percentage is commonly used in industrial chemical applications. For example, commercial bleaching solution contains 3.62 mass percentage of sodium hypochlorite in water. II

Meaning: 3.62 g of NaClO (solute) is dissolved in 96.38 g of water (solvent) to form 100 g solution.

LET'S PRACTICE

QUESTION

SOLUTE SOLVENT

After dissolving $\boxed{15\text{ g common salt}}$ in water, the solution weighs $\boxed{125\text{ g}}$. What will be the mass by mass percentage/mass percent of the solution?

A 11%

B 12%

C 13%

D 15%

'FORMULA'

$$\text{Mass \%} = \frac{\text{mass of solute}}{\text{mass of solution}} \times 100\%$$

$$= \frac{\cancel{15}^{3}\,\cancel{g}}{\cancel{125}_{\cancel{5}}\,\cancel{g}} \times \cancel{100}^{4}\,\%$$

$$= 12\,\% \Longrightarrow$$ 12 g common salt is present in 100 g soltn

'CONCEPT'

$15\text{ g} \longrightarrow 125\text{ g soltn}$

$'x' \longrightarrow 100\text{ g soltn}$

$$x \times \cancel{125}_{\cancel{5}} = \cancel{15}_{3} \times \cancel{100}_{4}$$

$$\boxed{x = 12\text{ g}}$$

NCERT Intext 1.1

2 7 5

Calculate the mass percentage of benzene (C_6H_6) and carbon tetrachloride (CCl_4) if 22 g of benzene is dissolved in 122 g of carbon tetrachloride.

'solvent' Solute

'formula'

$$\text{Mass \%} = \frac{\text{mass of solute}}{\text{mass of solution}} \times 100\%$$

mass % of benzene $= \frac{22\,g}{(22\,g + 122\,g)} \times 100\%$

$= \frac{\cancel{22}^{11}}{\cancel{144}\ \cancel{72}\ \cancel{36}\ 18} \times \cancel{100}^{\cancel{50}\ 25}\% = \frac{11 \times 25}{18} = \frac{275}{18}\%$

$\approx \frac{270}{18}\%$

$\boxed{\approx 15\%}$

→ 15 g of benzene is present in 100 g solution

(ii) mass of $CCl_4 \approx 100 - 15 \approx 85\,g$

⇓

85% by mass

CONCEPT

mass % of benzene

22 g benzene ⟶ 144 g solt^n

'x' ⟶ 100 g solt^n

$$x \times 144 = 22 \times 100$$

$$x = \frac{22 \times 100}{144} = \frac{275}{18} \approx \frac{270}{18} \approx 15 \text{ g}$$

$\Downarrow$

15 % by mass

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RELATIVE CONCENTRATION UNITS – PERCENTAGE CONCENTRATION

Denoted by

C-I

(ii) Volume Percent (V/V%): It is defined as the ratio of the volume of solute that is present in a solution, relative to the volume of the solution, as a whole.

C-II

$$\text{Volume \%} = \frac{\text{volume of solute} \ (\text{mL})}{\text{volume of solution} \ (\text{mL})} \times 100\% \quad \textbf{OR} \quad \text{Volume \%} = \frac{\text{volume of solute}}{\text{volume of (solute + solvent)}} \times 100\%$$

C-III

water is solvent

Example: Aqueous solution of ethanol is 49% by volume means 49 mL of ethanol is present in 100 mL $soln^{n}$

Volume of water = 100 - 49 = 51 mL

LET'S DECODE NCERT

Meaning: 10 mL of ethanol (solute) is dissolved in 90 mL of water (solvent) to form 100 mL solution.

For example, 10% ethanol solution in water means that 10 mL of ethanol is dissolved in water such that the total volume of the solution is 100 mL. Solutions containing liquids are commonly expressed in this unit. For example, a 35% (*v*/*v*) solution of ethylene glycol, 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).

Meaning: 35 mL of $C_2H_6O_2$ (solute) is dissolved in 65 mL of water (solvent) to form 100 mL solution.

LET'S PRACTICE

QUESTION

solute solvent

100 mL of alcohol is dissolved in 400 mL of water. Identify the volume % of the solution from the given options.

(A) 18%

(B) 22%

(C) 20%

(D) 23%

Formula

$$\text{Volume \%} = \frac{\text{volume of solute}}{\text{volume of solution}} \times 100\%$$

$$= \frac{100 \text{ mL}}{500 \text{ mL}} \times 100\%$$

$$= \frac{\cancel{100}^{20}}{\cancel{500}} \times 1\cancel{00}\%$$

$= 20\%$ → 20 mL of alcohol is present in 100 mL soltn

Concept

100 mL alcohol ⟶ 500 mL soltn

'x' ⟶ 100 mL soltn

$100 \times 1\cancel{00} = x \times 5\cancel{00}$

$x = 20$ mL

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LIKH DO.

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RELATIVE CONCENTRATION UNITS – PERCENTAGE CONCENTRATION

Denoted by

C-I

(iii) Mass by Volume Percent (W/V%): It is defined as ratio of the mass of solute that is present in a solution, relative to the volume of the solution, as a whole.

C-II

$$\text{Mass/Volume \%} = \frac{\text{mass of solute}}{\text{volume of solution}} \times 100\%$$

g

mL

OR

$$\text{Mass/Volume \%} = \frac{\text{mass of solute}}{\text{volume of (solute + solvent)}} \times 100\%$$

C-III

water is solvent

Example: Aqueous solution of ethanol is 18% by mass-by-volume means 18 g of ethanol is present in 100 mL soltn

LET'S PRACTICE

QUESTION

How many litres of 5.0% (w/v) glucose solution would you take to obtain 75 g glucose?

mili

'FORMULA'

$$\text{Mass/Volume \%} = \frac{\text{mass of solute}}{\text{volume of solution}} \times 100\%$$

'CONCEPT'

↓

'Homework'

A. 3000 mL

B. 1500 mL

C. 2000 mL

D. 2500 mL

$$5\% = \frac{75\ g}{'x'} \times 100\%$$

$$\cancel{5}x = \overset{15}{\cancel{75}} \times 100$$

$$\boxed{x = 1500}$$

SAMAJ AAYA TOH
LIKH DO.

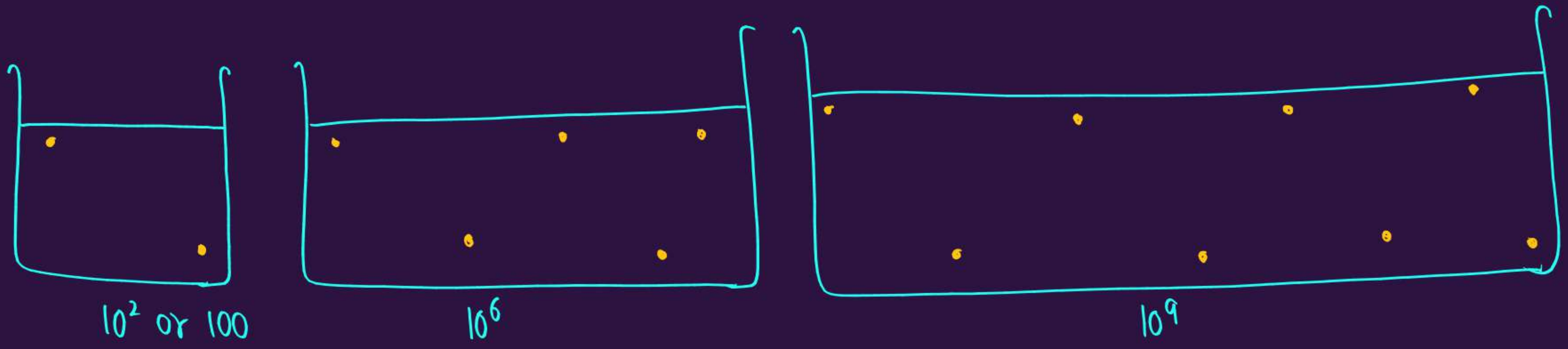
AYE BHAIYA

DILUTE CONCENTRATION UNITS

DILUTE CONCENTRATION UNITS

Sometimes when solutions are too dilute and instead of using really low percentage concentrations such as 0.00001% or 0.000000001%, they are expressed in parts per million or parts per billion.

10^9 10^6



DILUTE CONCENTRATION UNITS

parts per 100

(i) Mass % = $\dfrac{\text{mass of solute}}{\text{mass of solution}} \times 100\%$

(ii) $\text{ppm} = \dfrac{\text{mass of solute}}{\text{mass of solution}} \times \boxed{1,000,000}$

(parts per million)

(iii) $\text{ppb} = \dfrac{\text{mass of solute}}{\text{mass of solution}} \times \boxed{1,000,000,000}$

(Parts per billion)

Meaning of:

(a) 10 % mass-by-mass soln → 10 g of solute is dissolved in 100 g solution

(b) 10 ppm → 10 g of solute is dissolved in 10^6 g solution

(b) 10 ppb → 10 g of solute is dissolved in 10^9 g solution

LET'S PRACTICE

NCERT EXERCISE 1.9

A sample of drinking water was found to be severely contaminated with chloroform, $CHCl_3$, supposed to be carcinogenic in nature. The level of contamination was 15 ppm (by mass).

(i) Express this in $\boxed{\text{per cent by mass}}$

15 g is dissolved in 10^6 g soln

Cancer causing

'FORMULA'

$$\text{mass \%} = \frac{\text{mass of solute}}{\text{mass of soln}} \times 100\%$$

$$= \frac{15\ \cancel{g}}{10^{\cancel{6}}\ \cancel{g}} \times \cancel{100}\%$$

$$= \frac{15}{10^4}\% = \boxed{15 \times 10^{-4}\ \%}$$

15×10^{-4} g is dissolved in 100 g soln

'CONCEPT'

15 g of $CHCl_3$ is dissolved in $\longrightarrow$ 10^6 g soln

'x' $\longrightarrow$ 100 g soln

$\Rightarrow x \times 10^6 = 10^2 \times 15$

$\Rightarrow x = \frac{15 \times 10^{\cancel{2}}}{10^{\cancel{6}4}} = 15 \times 10^{-4}$ g $\longrightarrow$ 15×10^{-4} %

SAMAJ AAYA TOH LIKH DO.

AYE BHAIYA

CONCEPT POLISH - HOMEWORK

NCERT THEORY

The concentration of pollutants in atmosphere is often expressed in terms of _____ or _____.

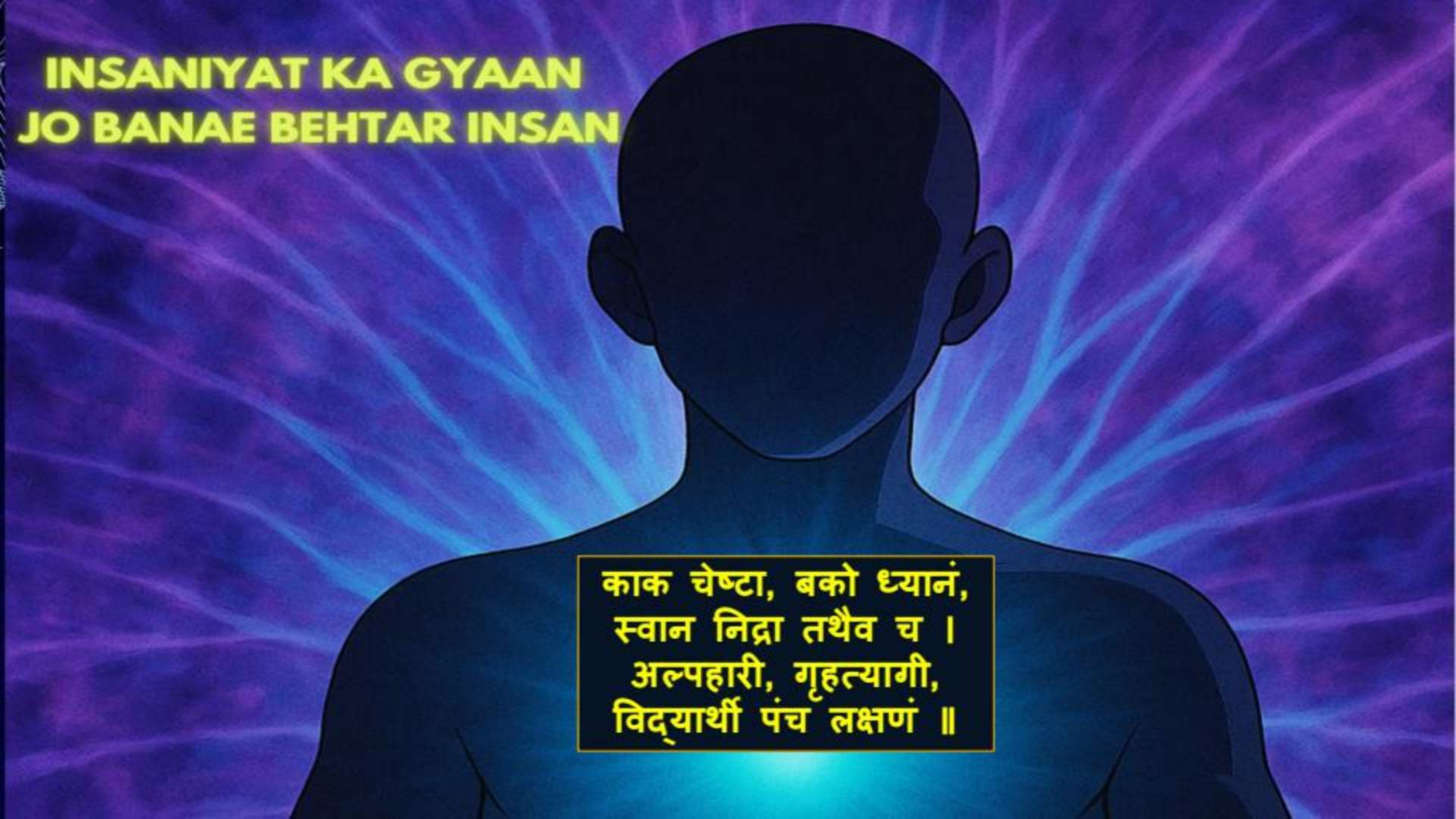
NCERT EXERCISE 1.7

A solution is obtained by mixing 300 g of 25% solution and 400 g of 40% solution by mass. Calculate the mass percentage of the resulting solution.

EFFICIENCY HACKS BY SUNIL BHAIYA

Healthy Supper Options for Students Studying During Evening

(i) Cowpea Chaat
(ii) Sweet potato and spinach cu
(iii) Cornflakes with milk
(iv) Brown bread with butter and turmeric milk
(v) Turmeric milk with roasted chana


INSANIYAT KA GYAAN
JO BANAE BEHTAR INSAN
काक चेष्टा, बको ध्यानं,
स्वान निद्रा तथैव च ।
अल्पहारी, गृहत्यागी,
विद्यार्थी पंच लक्षणं ॥

SUNIL BHAIYA IS ALWAYS THERE FOR YOU.

#sbsathhai

#pwsathhai

Thank You

PARISHRAM

2026

CHEMISTRY

Bharat Mata Ki Jai♡

Lecture 03

SOLUTIONS

Concentration Terms – Part II

BY – PRIYA-PUTRA-SUNIL

TOPICS TO BE COVERED

(i) Concentration Units Based on Mole

Concentration Terms - Part II

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CONCEPT POLISH – HOMEWORK DISCUSSION

NCERT THEORY

The concentration of pollutants in $\boxed{\text{water}}$ ✓ or $\boxed{\text{atmosphere}}$ ✓ is often expressed in terms of $\frac{\mu g}{mL}$ ___ or ppm ___.

NCERT EXERCISE 1.7

A solution is obtained by mixing 300 g of 25% solution and 400 g of 40% solution by mass. Calculate the mass percentage of the resulting solution.

I II

$$\frac{160 + 75}{235}$$

FORMULA → Mass % = $\dfrac{\text{mass of solute}}{\text{mass of solution}} \times 100\%$

Soltⁿ I

$$25\% = \frac{x}{300\,g} \times 100\%$$

$$\boxed{75\,g = x}$$

Soltⁿ II

$$40\% = \frac{y}{400\,g} \times 100\%$$

$$\boxed{y = 160\,g}$$

Soltⁿ III → Resultant Soltⁿ

$$\text{mass}\,\% = \frac{(75 + 160)}{(300 + 400)} \times 100\%$$

$$= \frac{235}{700} \times 100\%$$

$$= \boxed{33.57\,\%}$$

NCERT EXERCISE 1.7

A solution is obtained by mixing 300 g of 25% solution (I) and 400 g of 40% solution by mass (II). Calculate the mass percentage of the resulting solution.

CONCEPT

Solt^n I

25 g is dissolved in → 100 g solt^n

'x' → 300 g solt^n

$\boxed{x = 75\ g}$ ✓

40 g is dissolved in → 100 g solt^n

'y' → 400 g solt^n

$\boxed{y = 160\ g}$ ✓

Solt^n III

Mass %

235 g is dissolved in → 700 g solt^n

'z' → 100 g solt^n

$z \times 700 = 235 \times 100$

$$\boxed{z = \frac{235 \times 100}{700} = 33.57\ g}$$

33.57 %

SAMAJ AAYA TOH
LIKH DO.

AYE BHAIYA

CONCENTRATION UNITS BASED ON MOLE

QUANTITATIVE WAYS TO EXPRESS CONCENTRATION

- Relative Concentration Units – Percentage Concentration (✓)
- Dilute Concentration Units (✓)
- Concentration Units Based on Mole → 'Today's Class'

CONCEPT RECAP

ex: 1 mole of C = 6.02×10^{23} atoms of C = 12 g
1 mole of O_2 = 6.02×10^{23} molecules of O_2 = 32 g

Concept Approach

MOLAR MASS

1 mole atoms/molecules /formula units	=	6.02×10^{23} atoms/molecules/ formula units	=	Gram atomic/Gram molecular/Gram formula unit mass

1 mole of NaCl = 6.02×10^{23} formula units of NaCl = 58.5 g

Formula Approach

$$\text{Number of moles (n)} = \frac{\text{Given mass (g)}}{\text{Molar mass (g/mol)}}$$

$$\text{Number of moles (n)} = \frac{\text{Number of particles}}{6.022 \times 10^{23}}$$

Avogadro No.

C-II

$\frac{1}{4}$ → $\left[\frac{\text{part}}{\text{whole}}\right]$ → fraction

C-I

MOLE FRACTION (χ)

→ (chi but pronounced as 'kai')

- C-III It is the ratio of number of moles of a particular component to the total number of moles of the solution.

$$\text{Mole fraction of a component} = \frac{\text{Number of moles of the component}}{\text{Total number of moles of all the components}} \begin{matrix} \rightarrow \text{mol} \\ \rightarrow \text{mol} \end{matrix} = \frac{\cancel{\text{mol}}}{\cancel{\text{mol}}}$$

- It is a $\boxed{\textbf{unitless quantity.}}$

LET'S PRACTICE

QUESTION

A solution contains 1.5 moles of glucose ($C_6H_{12}O_6$) and 4.5 moles of water. What is the mole fraction of each component?

A .225, .75

B .25, .75

C .225, .775

D .25, .745

$$X_{glucose} = \frac{1.5}{1.5+4.5} = \frac{15}{6\times10} = \frac{\cancel{15}}{\cancel{60}} = \frac{1}{4} = .25$$

$$X_{water} = \frac{4.5}{1.5+4.5} = \frac{45}{6\times10} = \frac{\cancel{45}^{3}}{\cancel{60}_{4}} = \frac{3}{4} = .75$$

**

$$\boxed{X_{solution} = X_{glucose} + X_{water} = .25 + .75 = 1}$$

QUESTION

1 molecule of $CH_3OH = 12 + 4 + 16 = \underline{32\,u}$

— " — $H_2O = 2 + 16 = \underline{18\,u}$

What are the mole fractions of methanol (CH_3OH) and water (H_2O) in a solution prepared by dissolving 64 g of methanol in 108 g of water?

(A) .225, .75

(B) .25, .75

(C) .225, .775

(D) .25, .745

Concept Approach

1 mole of $CH_3OH = 32\,g$

'x' $= 64\,g$

$\boxed{x = 2 \text{ mole}}$

1 mole of $H_2O = 18\,g$

'y' $= 108\,g$

$y = \dfrac{\cancel{108}\ \cancel{36}\ 6}{\cancel{18}\ \cancel{6}} \Rightarrow \boxed{y = 6 \text{ mole}}$

$X_{methanol} = \dfrac{2}{(2+6)} = \dfrac{\cancel{2}}{\cancel{8}} = \dfrac{1}{4} = .25$

$X_{water} = \dfrac{6}{(2+6)} = \dfrac{\cancel{6}\,3}{\cancel{8}\,4} = \dfrac{3}{4} = .75$

QUESTION

What are the mole fractions of methanol (CH_3OH) and water (H_2O) in a solution prepared by dissolving 64 g of methanol in 108 g of water?

(A) .225, .75

(B) .25, .75

(C) .225, .775

(D) .25, .745

Formula Approach

$$\text{Number of moles (n)} = \frac{\text{Given mass (g)}}{\text{Molar mass (g/mol)}}$$

$$n_{CH_3OH} = \frac{\cancel{64}^{2}\ \cancel{g}}{\cancel{32}\ \cancel{g}} = 2 \text{ moles}$$

$$n_{H_2O} = \frac{\cancel{108}\ \cancel{g}}{\cancel{18}\ \cancel{g}} = 6 \text{ moles}$$

$$X_{CH_3OH} = \frac{2}{(2+6)} = \frac{2}{8} = \frac{1}{4} = .25$$

$$X_{H_2O} = \frac{\cancel{6}}{\cancel{8}} = \frac{3}{4} = .75$$

NCERT Solved Example 1.1

$C_2H_6O_2 = 24 + 6 + 32 = \underline{62}$

aye bhaiya

Calculate the mole fraction of ethylene glycol ($C_2H_6O_2$) in a solution containing 20% of $C_2H_6O_2$ by mass.

$\rightarrow$ 20 g $C_2H_6O_2$ is dissolved in $\rightarrow$ 100 g soln

$\downarrow$

'80 g water'

$\downarrow$

FORMULA

$n_{C_2H_6O_2} = \frac{\cancel{20}^{10}}{\cancel{62}_{31}} = \frac{10}{31} = .32$

$n_{H_2O} = \frac{\cancel{80}^{40}}{\cancel{18}_{9}} = 4.44$

$x_{C_2H_6O_2} = \frac{.32}{.32 + 4.44} = \frac{.32}{4.76}$

$= \frac{32 \times \cancel{10}}{4.76 \times \cancel{10}}$

$= \frac{\cancel{32}\ \cancel{16}\ 8}{\cancel{476}\ \cancel{238}} = \boxed{\frac{8}{119}}$

$x_{H_2O} = 1 - \frac{8}{119} = \frac{119 - 8}{119} = \boxed{\frac{111}{119}}$

SAMAJ AAYA TOH
LIKH DO.

AYE BHAIYA

MOLARITY (M)

C-I

C-II

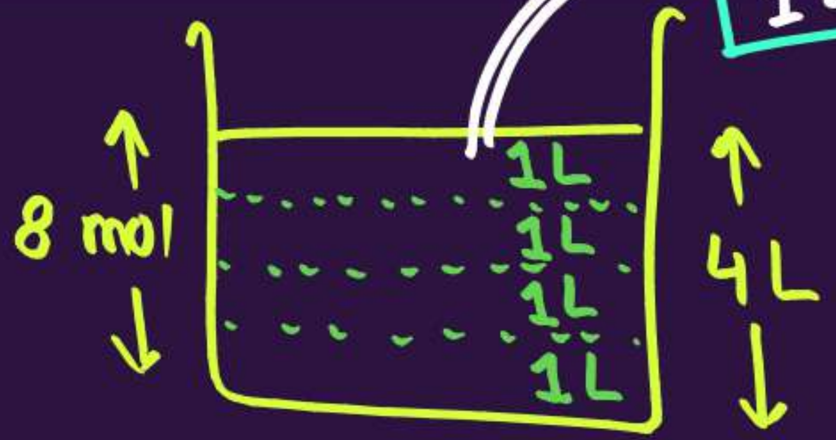
- It is the number of moles of solute in each litre or 1 L of solution.

$$\text{Molarity (M)} = \frac{\text{No. of moles of solute}}{\text{Volume of solution in litres}} \begin{matrix} \rightarrow \text{mol} \\ \rightarrow \text{L} \end{matrix}$$

- Its unit is $\boxed{\textbf{mol/L.}}$

'PHEEL'

Molarity (M): ?
Solute: 8 mol
Solution: 4 L



$\boxed{\frac{2\ \text{mol}}{1\ \text{L}} = 2\ \text{M soln}}$

amount of substance (n)
↓ S.I. unit
mole (mol)

MOLARITY (M)

- It is the number of moles of solute in each litre or 1 L of solution.

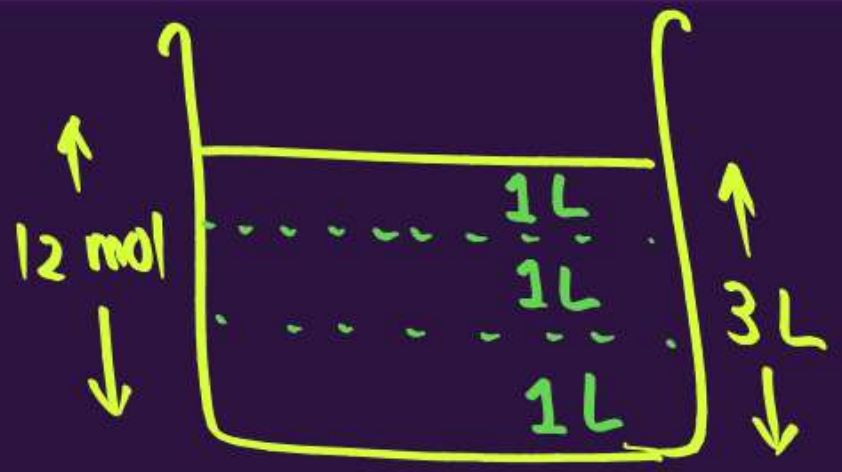
$$\text{Molarity (M)} = \frac{\text{No. of moles of solute}}{\text{Volume of solution in litres}}$$

- Its unit is **mol/L.**

$4\,M = \frac{4\text{ mol}}{1\text{ L}}$

'PHEEL'

Molarity (M): 4 M ✓
Solute: ? 12 mol
Solution: 3 L



1 L solt^n → 4 mol
3 L solt^n → 'x'

$\boxed{x = 12\text{ mol}}$

MOLARITY (M)

- It is the number of moles of solute in each litre or 1 L of solution.

$$\text{Molarity (M)} = \frac{\text{No. of moles of solute}}{\text{Volume of solution in litres}}$$

- Its unit is **mol/L.**

$3M = \frac{3 \text{ mol}}{1 L}$

'PHEEL'

Molarity (M): 3 M
Solute: 15 mol
Solution: ?

In 1 L → 3 mol
'x' → 15 mol

$x \times 3 = 15$

$\boxed{x = 5}$

LET'S PRACTICE

QUESTION

'solute'

$NaOH \rightarrow 23 + 16 + 1 = 40\,u$

Calculate the molarity of NaOH in the solution prepared by dissolving its 4 g in enough water to form 250 mL of the solution.

$$\text{Molarity (M)} = \frac{\text{No. of moles of solute}}{\text{Volume of solution in litres}}$$

(i) no. of moles of NaOH (solute)

$$n_{NaOH} = \frac{\cancel{4}\,g}{\cancel{40}\,g/mol} = \frac{1}{10} = .1$$

$\hookrightarrow \frac{1}{10}$ mol

(ii) $1\ mL = 10^{-3}\ L$

$250\ mL = 'x'$

$$x = 250 \times 10^{-3} = \frac{250}{1000} = .250\ L$$

$\hookrightarrow \frac{250}{1000}\ L$

(iii)
$$M = \frac{\frac{1}{10}}{\frac{250}{1000}} = \frac{1}{1\cancel{0}} \times \frac{10\cancel{0}\cancel{0}}{25\cancel{0}}$$

$$= \frac{10}{25} = .4\ M \text{ or } .4\ \frac{mol}{L}$$

QUESTION

Calculate the molarity of NaOH in the solution prepared by dissolving its 4 g in enough water to form 250 mL of the solution.

solute

$$\boxed{M = \frac{mol}{L}}$$

'CONCEPT'

(I) 1 mole of NaOH = 40 g

x = 4 g

$x \times 40 = 4$

$$\boxed{x = \frac{4}{40} = \frac{1}{10}}$$

(II) 250 mL $\rightarrow$ $\boxed{\frac{250}{1000} L}$

(III) $\frac{1}{10}$ mol is dissolved in $\longrightarrow$ $\frac{250}{1000}$ L solt^n

'x' $\longrightarrow$ 1 L solt^n

$x \times \frac{250}{1000} = \frac{1}{10}$

$x = \frac{100\cancel{0}}{25\cancel{0} \times \cancel{10}} = \frac{10}{25}$

.4 M

SAMAJ AAYA TOH LIKH DO.

AYE BHAIYA ✓

MOLALITY (m) C-I

C-II

- It is the number of moles of solute in each kilogram of solvent.

$$\text{Molality (m)} = \frac{\text{No. of moles of solute}}{\text{Mass of solvent in kg}}$$ or dissolved in 1 kg solvent

- Its unit it $\boxed{\text{mol/kg.}}$

DIFFERENCE BETWEEN MOLARITY AND MOLALITY

$$111\text{ g of } CaCl_2 = 1 \text{ mole of } CaCl_2$$

1 molar solt^n of $CaCl_2$
(M)

↓

1 mole of $CaCl_2$ is dissolved in 1 L solt^n

↓

111 g $CaCl_2$ is firstly dissolved in small amount of H_2O ⟶ Now, put water into this solt^n till volume becomes 1 L.

1 molal solt^n of $CaCl_2$
(m)

↓

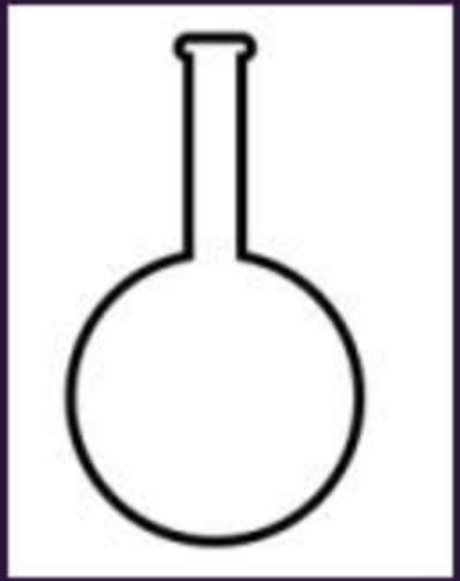
1 mole of $CaCl_2$ is dissolved in 1 kg water (solvent)

↓

111 g of $CaCl_2$ is dissolved in 1 kg H_2O

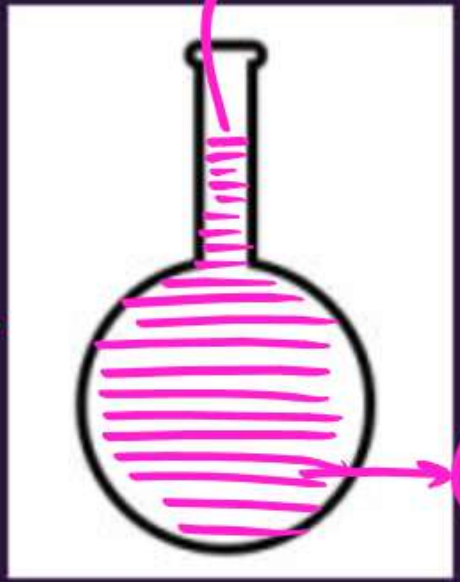
WHAT'S THE POINT OF MOLALITY (m)?

→ Volume of solⁿ = 1 L



T(↓), Volume of solⁿ (↓)

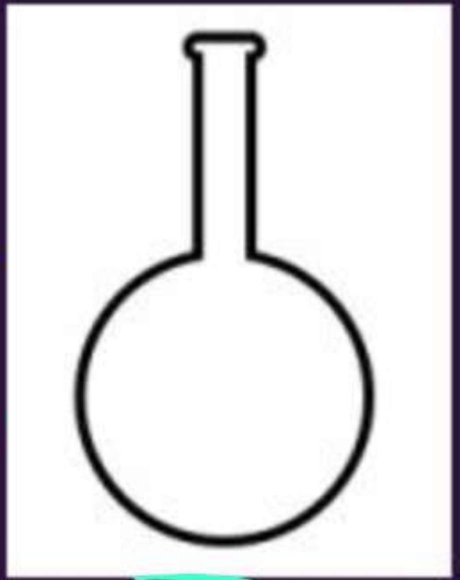
[Water contracts on cooling]



(solvent is H_2O)

T(↑), Volume of solⁿ (↑)

(water expands on heating)

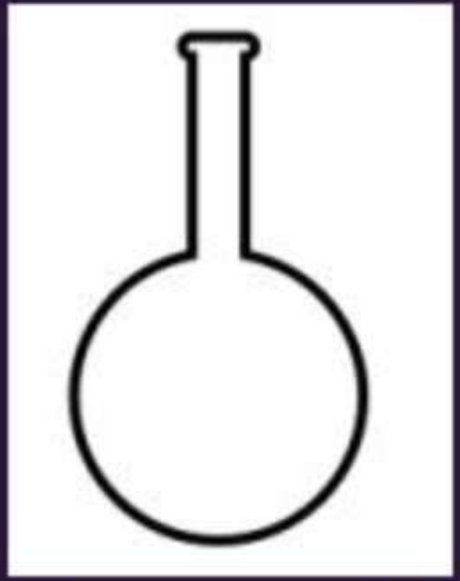


4 °C	60 °C	98 °C
1 mol/.974 L = 1.027 M	1 mol/1.00 L = 1.00 M	1 mol/1.025 L = .976 M

Molarity (M) depends on temp.

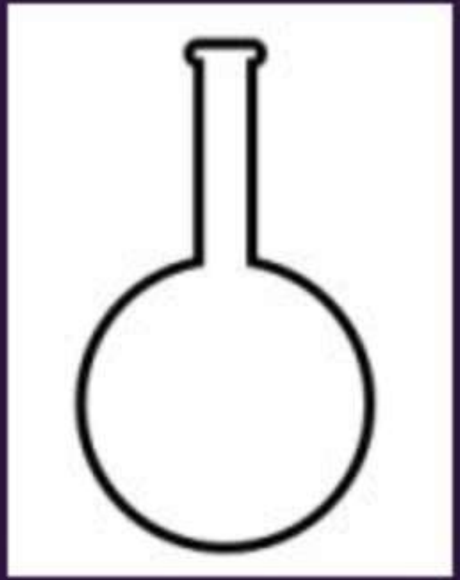
WHAT'S THE POINT OF MOLALITY (m)?

molality (m) doesn't depend on temp.



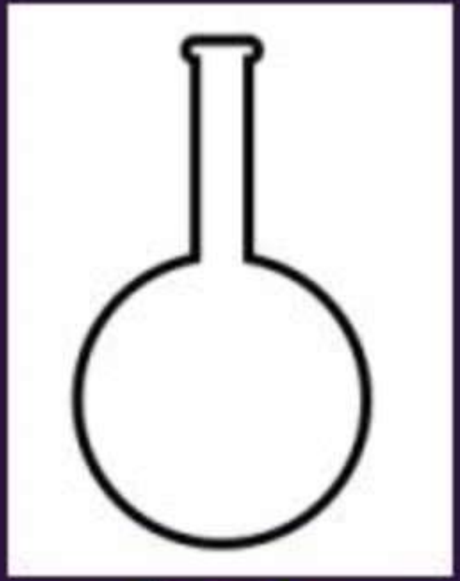
4 °C

1 mol/1 kg H_2O



60 °C

1 mol/1 kg H_2O



98 °C

1 mol/1 kg H_2O

1 molal solution

LET'S PRACTICE

SAMAJ AAYA TOH LIKH DO.

AYE BHAIYA ✓

CONCEPT POLISH - HOMEWORK

NCERT Solved Example 1.3

Calculate molality of 2.5 g of ethanoic acid (CH_3COOH) in 75 g of benzene.

NCERT Solved Example 1.2

Calculate the molarity of a solution containing 5 g of NaOH in 450 mL solution.

NCERT Intext 1.4

Calculate the mass of urea (NH_2CONH_2) required in making 2.5 kg of 0.25 molal aqueous solution.

NCERT Intext 1.3

Calculate the molarity of each of the following solutions:

(a) 30 g of $Co(NO_3)_2 . 6H_2O$ in 4.3 L of solution

(b) 30 mL of 0.5 M H_2SO_4 diluted to 500 mL.

NCERT EXERCISE 1.4

Concentrated nitric acid used in laboratory work is 68% nitric acid by mass in aqueous solution. What should be the molarity of such a sample of the acid if the density of the solution is 1.504 g mL^{-1}?

SAMAJ AAYA TOH
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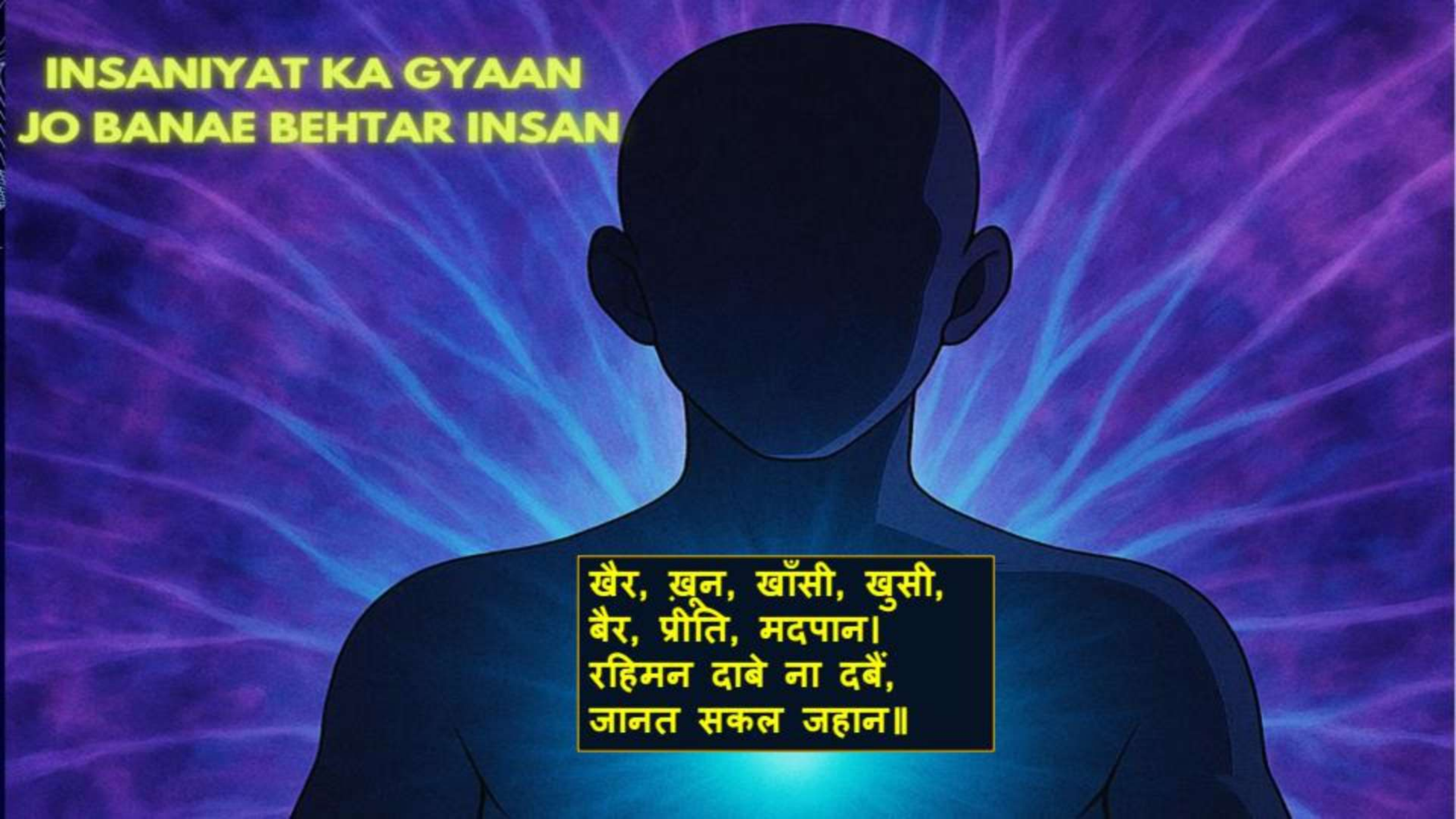
EFFICIENCY HACKS BY SUNIL BHAIYA


INSANIYAT KA GYAAN
JO BANAE BEHTAR INSAN
खैर, ख़ून, खाँसी, खुसी,
बैर, प्रीति, मदपान।
रहिमन दाबे ना दबैं,
जानत सकल जहान॥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SUNIL BHAIYA IS ALWAYS THERE FOR YOU.

#sbsathhai

#pwsathhai

Thank You

PARISHRAM

2026

CHEMISTRY

Bharat Mata Ki Jai ♡

Lecture 04

SOLUTIONS

Solubility of Solids and Liquids in Gases

BY – PRIYA-PUTRA-SUNIL

TOPICS TO BE COVERED

Numerical Practice

(i) Solubility of Solids and Gases in Liquids (✓)

Numerical Practice and Solubility
of Solids and
Gases in Liquids - Part I


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CONCEPT POLISH – HOMEWORK DISCUSSION

NCERT Solved Example 1.2

Calculate the molarity of a solution containing 5 g of NaOH in 450 mL solution.

solute

$23 + 16 + 1 = 40 \frac{g}{mol}$

Formula Approach

'for exams'

$$\text{Molarity (M)} = \frac{\text{No. of moles of solute}}{\text{Volume of solution in litres}}$$

(i) no. of moles of NaOH (n) $= \frac{\text{given mass}}{\text{molar mass}}$

$= \frac{5\,g}{40\,\frac{g}{mol}}$

$\boxed{n = \frac{1}{8}\ mol}$

(ii) $1\ mL = 10^{-3}\ L$

$450\ mL = 'x'$

$\boxed{x = \frac{450}{1000}\ L}$

(iii) $M = \frac{\frac{1}{8}}{\frac{450}{1000}} = \frac{1}{\cancel{8}_{2}} \times \frac{\cancel{1000}^{\cancel{20}\ 5}}{\cancel{450}_{9}}$

$= \frac{5}{18} = .27\ M$

OR $.27\ \frac{mol}{L}$

NCERT Solved Example 1.2

Calculate the molarity of a solution containing 5 g of NaOH in 450 mL solution.

Concept Approach

(i) 1 mole of $NaOH = 40\,g$

'x' mole $= 5\,g$

$$\boxed{x = \frac{5}{40} = \frac{1}{8}\ \text{mol}}$$

(ii) $450\ mL \rightarrow \frac{450}{1000}\ L$

(iii) $\frac{1}{8}$ mol is dissolved in $\longrightarrow \frac{450}{1000}\ L$

'x' $\rightarrow 1\ L$

$$x = \frac{8 \times 1000}{450} = \frac{5}{18} = .27\ M$$

NCERT Solved Example 1.3

Calculate molality of 2.5 g of ethanoic acid (CH_3COOH) in 75 g of benzene.

→ solute

→ solvent

$24 + 4 + 32 = 60\ \frac{g}{mol}$

Formula Approach

$$\text{Molality (m)} = \frac{\text{No. of moles of solute}}{\text{Mass of solvent in kg}}$$

(i) no. of moles of CH_3COOH $(n) = \frac{\text{given mass}}{\text{molar mass}}$

$= \frac{2.5\ g}{60\ \frac{g}{mol}}$

$= \frac{25}{60 \times 10}$ mol

$$\boxed{n = \frac{1}{24}\ \text{mol}}$$

(ii) 1 kg = 1000 g

'x' = 75 g

$$\boxed{x = \frac{75}{1000}\ \text{kg}}$$

(iii) $m = \frac{\frac{1}{24}}{\frac{75}{1000}} = \frac{1}{24} \times \frac{1000}{75}$

$= \frac{5}{9} = \boxed{.55\ m}$ or $\boxed{.55\ \frac{mol}{kg}}$

NCERT Solved Example 1.3

Calculate molality of 2.5 g of ethanoic acid (CH_3COOH) in 75 g of benzene.

Concept Approach

(i) 1 mole of CH_3COOH = 60 g

'x' mole = 2.5 g

$$\boxed{x = \frac{2.5}{60 \times 10} = \frac{1}{24} \text{ mol}}$$

(ii) 75 g → $\frac{75}{1000}$ kg solvent

(iii) $\frac{1}{24}$ mol of CH_3COOH is dissolved in → $\frac{75}{1000}$ kg

'x' → 1 kg

$x = \frac{1000 \times 24}{75} = .55$ m

or

$.55 \frac{\text{mol}}{\text{kg}}$

SAMAJ AAYA TOH
LIKH DO.

AYE BHAIYA

NCERT Intext 1.3

$Co(NO_3)_2.6H_2O \rightarrow 59 + 2(14+48) + 6(2\times1+16)$
$\rightarrow 291$ g/mol

Calculate the molarity of each of the following solutions:

(a) 30 g of $Co(NO_3)_2.\ 6H_2O$ in 4.3 L of solution

(b) 30 mL of 0.5 M H_2SO_4 diluted to 500 mL.

Formula Approach

$$\text{Molarity (M)} = \frac{\text{No. of moles of solute}}{\text{Volume of solution in litres}}$$

(i) no. of moles of $Co(NO_3)_2.6H_2O\ (n) = \dfrac{30\,g}{291\,\frac{g}{mol}}$

$$\boxed{n = \frac{30}{291}\ \text{mol}}$$

(ii) $M = \dfrac{\frac{30}{291}}{\frac{4.3}{1}} = \dfrac{30}{291} \times \dfrac{1}{4.3}$

$\approx \dfrac{\cancel{30}^{1}}{\cancel{300}_{10} \times 4} \approx \dfrac{1}{40} \approx .025\ M$

NCERT Intext 1.3

Calculate the molarity of each of the following solutions:

(a) 30 g of $Co(NO_3)_2 \cdot 6H_2O$ in 4.3 L of solution

(b) 30 mL of 0.5 M H_2SO_4 diluted to 500 mL.

Concept Approach

(i) 1 mole of $Co(NO_3)_2 \cdot 6H_2O = 291$ g

'x' mole $= 30$ g

$$\boxed{x = \frac{30}{291} \text{ mol}}$$

(ii) $\frac{30}{291}$ mol is dissolved in $\longrightarrow$ 4.3 L

'x' $\longrightarrow$ 1 L

$$x = \frac{30}{291} \times \frac{1}{4.3} \approx .025 \text{ M}$$

NCERT Intext 1.3

Calculate the molarity of each of the following solutions:

(a) 30 g of $Co(NO_3)_2 \cdot 6H_2O$ in 4.3 L of solution

(b) 30 mL of 0.5 M H_2SO_4 diluted to 500 mL.

$M_1 = .5\ M$ $\quad$ $M_2 = ?$

$V_1 = 30\ mL$ $\quad$ $V_2 = 500\ mL$

$= \frac{30}{1000}\ L$ $\quad$ $= \frac{500}{1000}\ L$

$M_1 = \frac{n}{V_1} \xrightarrow{\text{dilution}} M_2 = \frac{n}{V_2}$

$\boxed{n = M_1V_1}$ - (1) $\quad$ $\boxed{n = M_2V_2}$ - (2)

from (1) & (2)

$\boxed{M_1V_1 = M_2V_2}$

$\Leftarrow \frac{5}{1\cancel{0}} \times \frac{3\cancel{0}}{\cancel{1000}} = M_2 \times \frac{500}{\cancel{1000}}$

$\cancel{15}^{3} = M_2 \times 5\cancel{00}^{100}$

$\boxed{.03\ M \Leftarrow \frac{3}{100} = M_2}$

SAMAJ AAYA TOH
LIKH DO.

AYE BHAIYA

NCERT Intext 1.4

'solute'

$\overset{2}{28} + 4 + 12 + 16$

$\boxed{60\ g/mol} \rightarrow \boxed{\frac{60}{1000}\ \frac{kg}{mol}}$

Calculate the mass of urea (NH_2CONH_2) required in making 2.5 kg of 0.25 molal aqueous solution.

Formula Approach

$$\text{Molality (m)} = \frac{\text{No. of moles of solute}}{\text{Mass of solvent in kg}}$$

Mass of solution = 2.5 kg

'x' kg solute

(2.5 - x) kg solvent

(i) no. of moles of urea (n) = $\frac{x \times 1000}{60}$ mol

(ii) $.25 = \dfrac{\frac{x \times 1000}{60}}{\frac{(2.5-x)}{1}}$

$.25 = \frac{x \times 1000}{60} \times \frac{1}{(2.5-x)}$

$\frac{\cancel{.25}}{\cancel{100}} \times \overset{15}{\cancel{60}} \times (2.5 - x) = 1000x$

$\overset{3}{\cancel{15}}(2.5 - x) = \overset{200}{\cancel{1000}}x$

$\Rightarrow 7.5 - 3x = 200x$

$\Rightarrow 7.5 = 203x$

$\Rightarrow \boxed{\frac{7.5}{203}\ kg = x}$

in 'g'

$\frac{7500}{203} \approx \frac{75\cancel{00}}{2\cancel{00}} \approx \boxed{37.5\ g}$

NCERT Intext 1.4

Calculate the mass of urea (NH_2CONH_2) required in making 2.5 kg of 0.25 molal aqueous solution.

Concept Approach

$= .25 = \frac{g.m.}{m.m.} \Rightarrow g.m. = .25 \times 60 = \underline{15\ g}$

(i) .25 molal soltⁿ → .25 mol of urea is dissolved in 1 kg or 1000 g solvent

(ii)

SOLUTION	SOLUTE	SOLVENT
1015 g	15 g	1000 g
2.5 kg → 2500 g	'x'	

(iii) 15 g is dissolved in → 1015 g

'x' → 2500 g

$x = \frac{7500}{203} \approx \frac{7500}{200} \approx 37.5\ g$

NCERT EXERCISE 1.4

Concentrated nitric acid used in laboratory work is 68% nitric acid by mass in aqueous solution. What should be the molarity of such a sample of the acid if the density of the solution is 1.504 g mL^{-1}?

Volume of $soln^n \rightarrow \boxed{1 L = 1000 mL}$

(i) Density of $soln^n = \dfrac{\text{Mass of } soln^n}{\text{Volume of } soln^n}$

$\Rightarrow \dfrac{1.504 \text{ g}}{\cancel{1000}\ \cancel{mL}} \times \cancel{1000}\ \cancel{mL}$ = mass of $soln^n$

$\Rightarrow \boxed{1504 \text{ g} = \text{mass of } soln^n}$

(ii) 68 g HNO_3 is present in $\rightarrow$ 100 g $soln^n$

'x' $\rightarrow$ 1504 g $soln^n$

$x \times 100 = 68 \times 1504$

$\boxed{x = \dfrac{68 \times 1504}{100} \text{ g}}$

'given mass'

NCERT EXERCISE 1.4

$HNO_3 = 1 + 14 + 48 = \underline{\underline{63}}\ \frac{g}{mol}$

Concentrated nitric acid used in laboratory work is 68% nitric acid by mass in aqueous solution. What should be the molarity of such a sample of the acid if the density of the solution is 1.504 g mL^{-1}?

(iii) $\text{no. of moles (n)} = \dfrac{\frac{68 \times 1504}{100}\ \cancel{g}}{63\ \frac{\cancel{g}}{mol}} = \dfrac{68 \times 1504}{100 \times 63}$

(iv) $M = \dfrac{\text{no. of moles of solute}}{\text{volume of sol}^n \text{ in L}} = \dfrac{68 \times 1504}{100 \times 63} \approx \dfrac{\cancel{68}^{34} \times \cancel{1504}^{\cancel{752}\ 47}}{100 \times \cancel{64}_{\cancel{32}\ \cancel{16}}} \approx \underline{15.98}\ M$

'1L'

SAMAJ AAYA TOH LIKH DO.

AYE BHAIYA

SOLUBILITY OF SOLIDS AND GASES IN LIQUIDS

SOLUBILITY

Solubility is the maximum amount of solute that can dissolve in a given amount of solvent at a given temperature.

ex: $90^\circ C$, a maximum of 36 g of NaCl can be dissolved in 100 g H_2O

↓

$\boxed{\text{Solubility of NaCl in } H_2O \text{ at } 90^\circ C}$

GIVE A THOUGHT

The concentration of a solute in a saturated solution is called its solubility.

A. Yes

B. No

GIVE A THOUGHT

The concentration of a solute in a saturated solution is called its solubility.

A. Yes

B. No

Yes! another definition

Solubility is the maximum amount of solute that can dissolve in 100 g of solvent at a given temperature to form a saturated solution.

(s) → solid
(l) → liquid

SOLUBILITY OF SOLIDS IN LIQUIDS

'solute' 'solvent'

- We put NaCl (s) in water (l), will it dissolve. (YES or NO)
- We put NaCl (s) in benzene (l), will it dissolve. (YES or NO)
- We put naphthalene (s) in water (l), will it dissolve. (YES or NO)
- We put naphthalene (s) in benzene (l), will it dissolve. (YES or NO)

Are you confused about why this is happening?

SOLUBILITY OF SOLIDS IN LIQUIDS

Polar → Having poles, i.e. charges (+ve & -ve charges)

- The reason behind this is the intermolecular interactions. If the interactions are similar between the solid solute and liquid solvent then only the solute will dissolve into the solvent. This principle is also called **like-dissolve-like.**

Solute	Solvent	Type of Solute	Type of Solvent	Solubility	Intermolecular Force
NaCl	Water	Polar	Polar	✅ Soluble	Ion-dipole interaction
Naphthalene	Benzene	Non-polar	Non-polar	✅ Soluble	London dispersion forces (Van der Waals)

- So, the first factor that affects solubility of 'solids in liquids' is '**Nature of Solute and Solvent**'.

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AYE BHAIYA ✓

SOLUBILITY OF SOLIDS IN LIQUIDS

- When a solid solute is added to the solvent, it dissolves and its concentration increases in solution. This process is known as dissolution.

- It is reverse of dissolution where dissolved solid solute particles gets separated from the solution. This process is known as crystallisation.

- When a saturated solution is formed then, if more solute is added without changing temp., Rate of __dissolution______ = Rate of __crystallisation______

GIVE A THOUGHT

Is the below statement true if the solution is a saturated solution?

$$\text{Undissolved solid} \rightleftharpoons \text{Dissolved solute}$$

A. Yes

B. No

GIVE A THOUGHT

Is the below statement true if the solution is a saturated solution?

$$\text{Undissolved solid} \underset{\text{Crystallisation}}{\overset{\text{Dissolution}}{\rightleftharpoons}} \text{Dissolved solute}$$ ← [Without changing temp.]

A. Yes
B. No

Yes!
There is a dynamic equilibrium between undissolved solid and dissolved solute. in a saturated soln.

CONCEPT RECAP

Le Chatelier's Principle

- When a system at equilibrium is disturbed by a change in temperature, pressure, or concentration of reactants or products etc. the system will shift in such a way as to counteract the disturbance and restore a new equilibrium.

Change in Enthalpy (ΔH)

- The heat absorbed/released by the system at constant pressure is actually measured by measuring changes in the enthalpy.

$\Delta H \rightarrow +ve$ or $\Delta H > 0 \rightarrow$ ENDOTHERMIC

$\Delta H \rightarrow -ve$ or $\Delta H < 0 \rightarrow$ EXOTHERMIC

SOLUBILITY OF SOLIDS IN LIQUIDS

(ii) Effect of Temperature

The solubility of a solid in a liquid is significantly affected by temperature changes.

- According to Le Chatelier's Principle, if the dissolution of a solid in liquid is endothermic **($\Delta H > 0$)**, the solubility of the solid-in-liquid increases with the rise in temperature.

ENDOTHERMIC DISSOLUTION OF SOLUTE

- For Example: $$\text{Undissolved solute} + \text{Heat} \rightleftharpoons \text{Dissolved solute}$$

If heat is added (temperature is increased), equilibrium will shift towards the forward direction to absorb the heat and reduce the temperature. This increases the solubility of solid in liquid.

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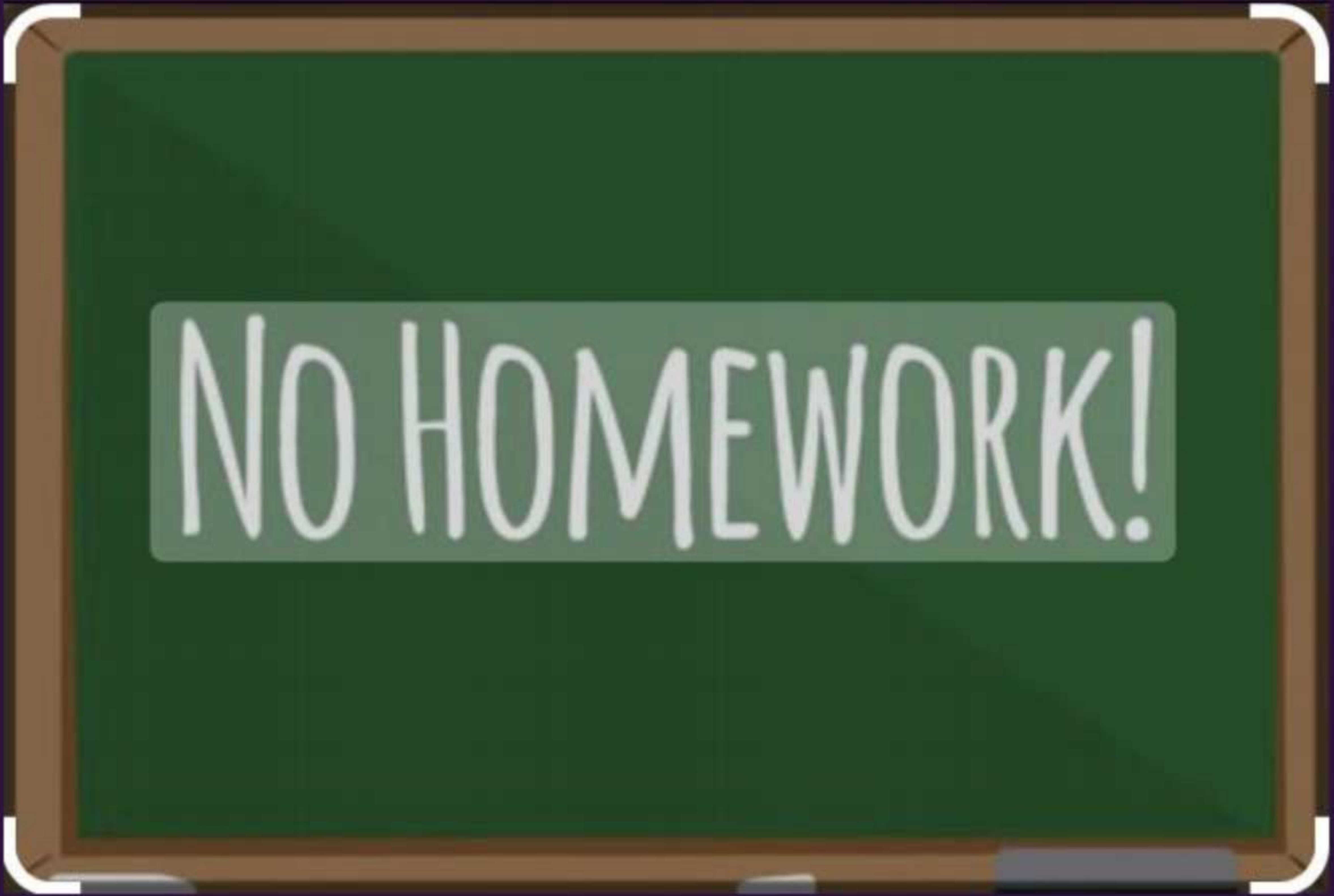
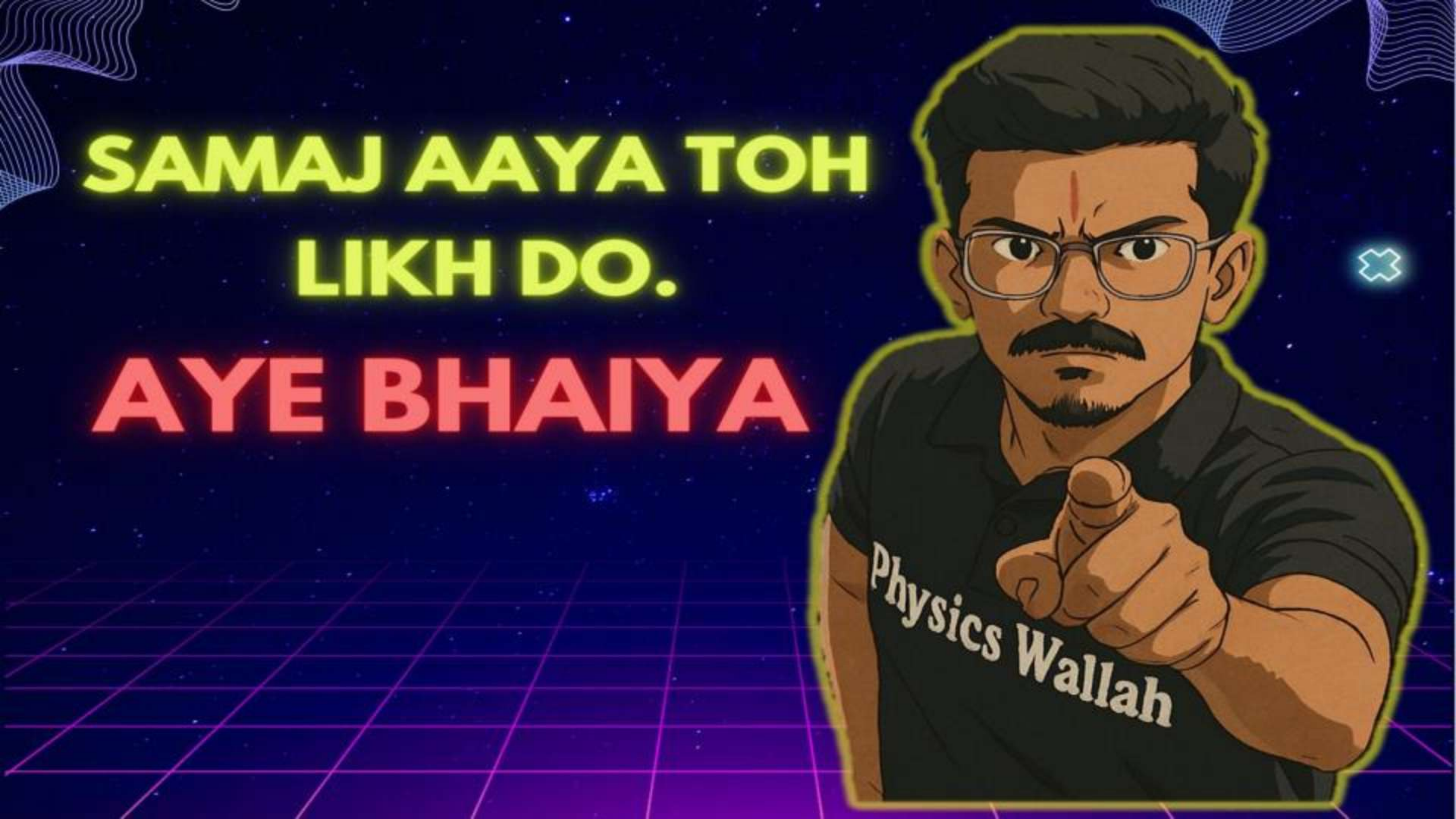
CONCEPT POLISH – HOMEWORK


NO HOMEWORK!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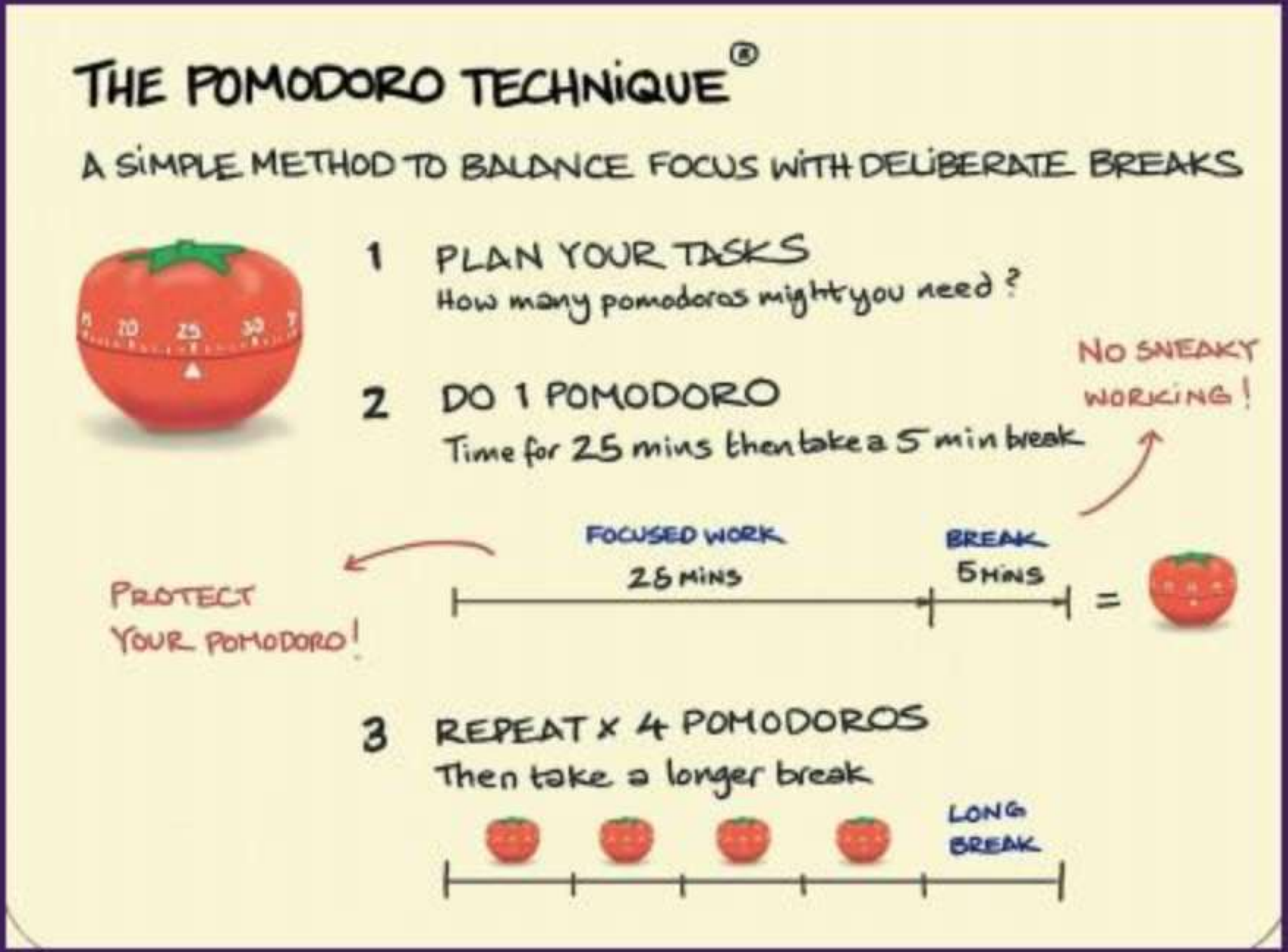

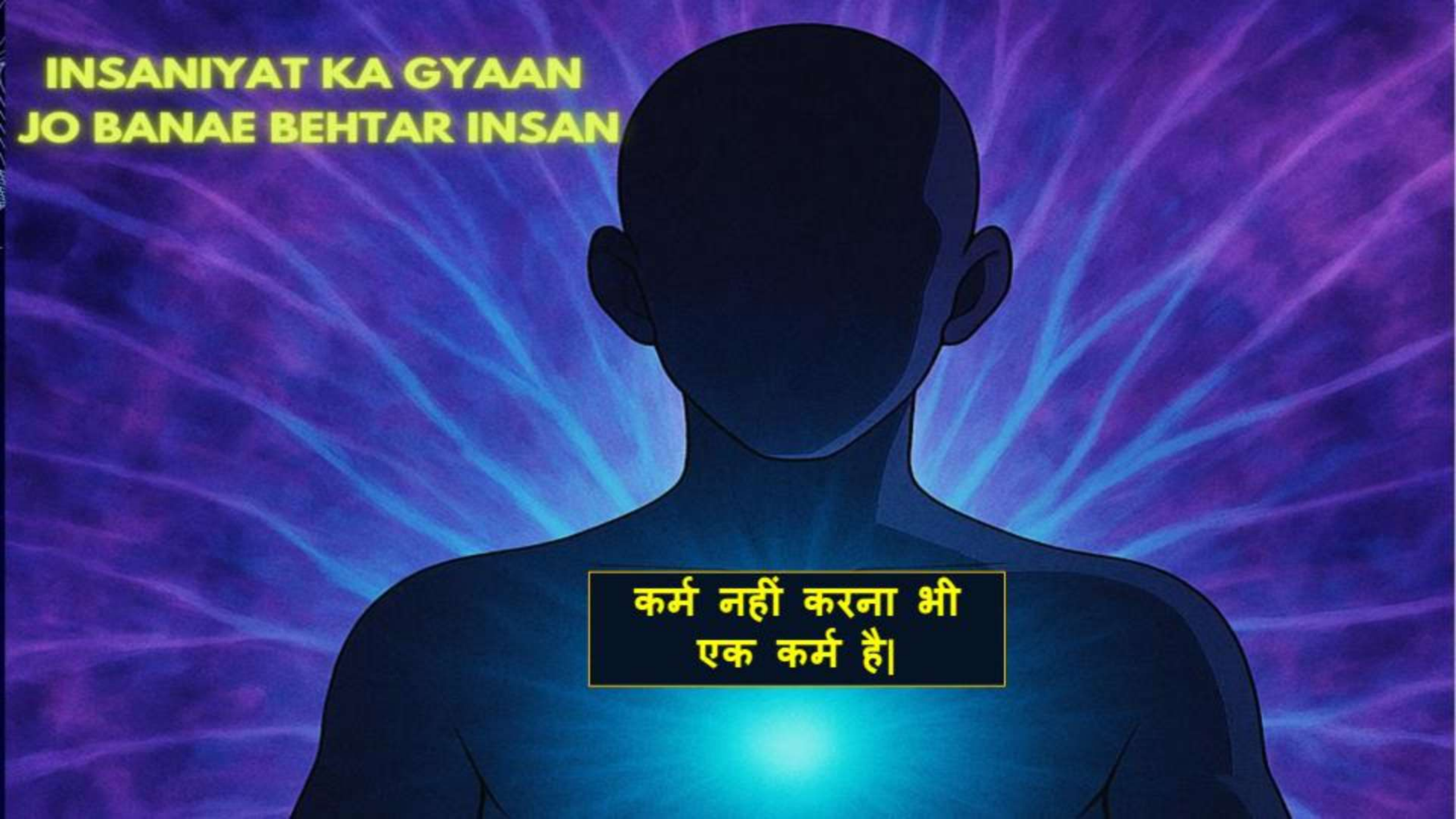
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JO BANAE BEHTAR INSAN
कर्म नहीं करना भी
एक कर्म है|


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Thank You

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2026

CHEMISTRY

Bharat Mata Ki Jai ♡

Lecture 05

SOLUTIONS

Solubility of Solids and Liquids in Gases – Part II
Henry's Law, Its Applications and Limitations

BY – PRIYA-PUTRA-SUNIL

TOPICS TO BE COVERED

(i) Solubility of Solids and Gases in Liquids – Part II

(ii) Henry's Law, Its Applications and Limitations


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SOLUBILITY OF SOLIDS AND GASES IN LIQUIDS – PART II

CONCEPT RECAP

If we have a saturated solution and without changing temperature we are adding more solid solute to the solution then there exists a dynamic equilibrium as:

$$\text{Undissolved solid} \rightleftharpoons \text{Dissolved solute}$$

SOLUBILITY OF SOLIDS IN LIQUIDS

(ii) Effect of Temperature

The solubility of a solid in a liquid is significantly affected by temperature changes.

- According to Le Chatelier's Principle, if the dissolution of a solid in liquid is exothermic **($\Delta H < 0$)**, the solubility of the solid-in-liquid decreases with the rise in temperature.
- For Example: $\text{Undissolved solute} \rightleftharpoons \text{Dissolved solute} + \text{Heat}$

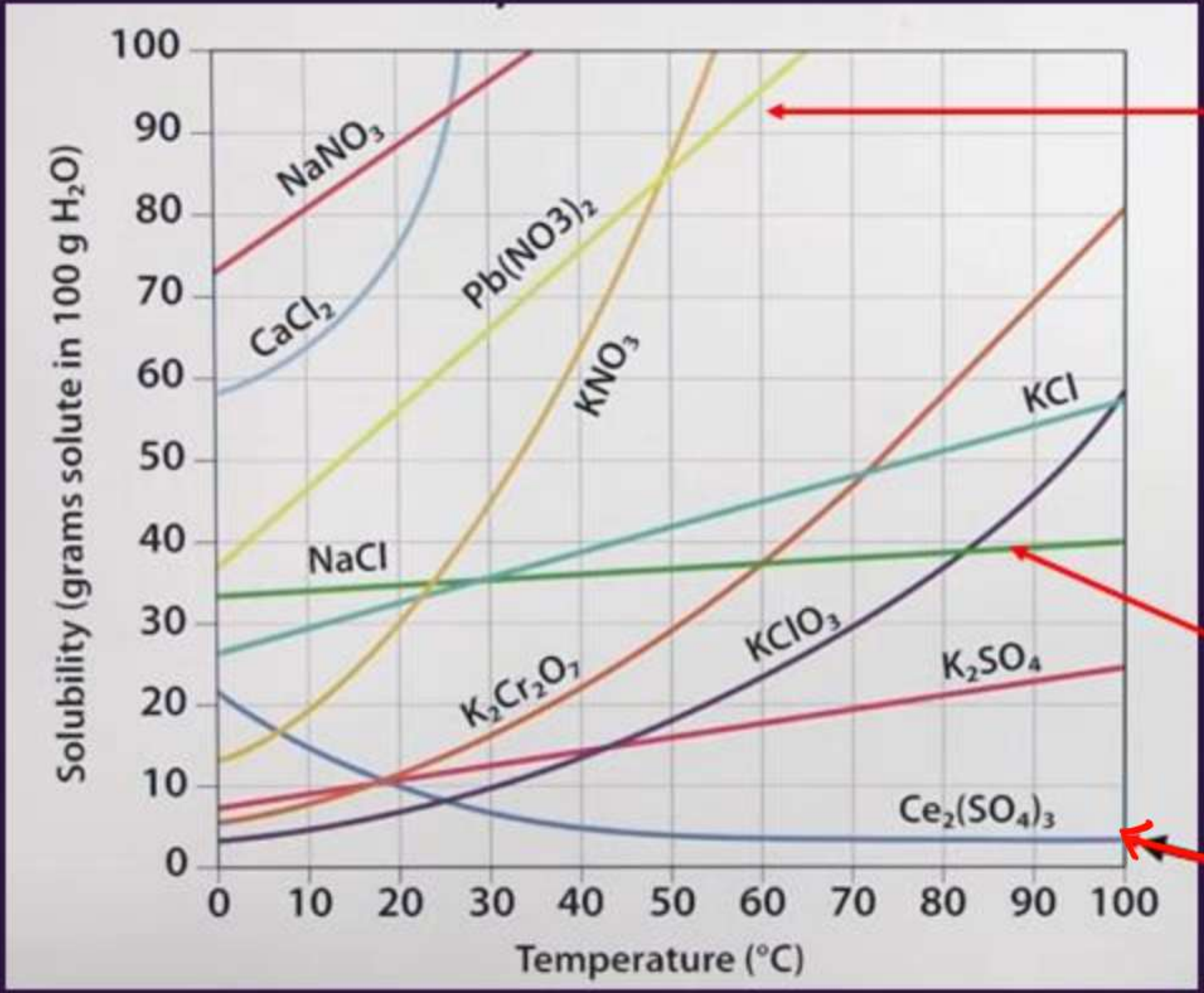
If heat is added (temperature is increased), equilibrium will shift towards the backward direction to absorb the heat and reduce the temperature. This decreases the solubility of solid in liquid.

IMPORTANT TO REMEMBER

(i) If the dissolution of a solid-in-liquid is endothermic, increasing temperature of a saturated solution and now adding more solid solute to this saturated solution will make the solid solute dissolve as the solubility increases.

(ii) If the dissolution of a solid-in-liquid is exothermic, increasing temperature of a saturated solution and now adding more solid solute to this saturated solution will decrease the solubility of solid solute.

SOLUBILITY OF SOLIDS IN LIQUIDS



Solubility increases with an increase in temperature

'Endothermic dissolution'

'baht kam'

(Solubility negligibly changes with an increase in temperature)

Exothermic dissolution

Solubility decreases with an increase in temperature

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AYE BHAIYA ✓

LET’S PRACTICE

QUESTION

The solubility of a solid in a liquid generally increases with:

A) Decrease in temperature (for endothermic solutes)

B) Increase in temperature (for endothermic solutes)

C) Increase in pressure

D) Decrease in surface area

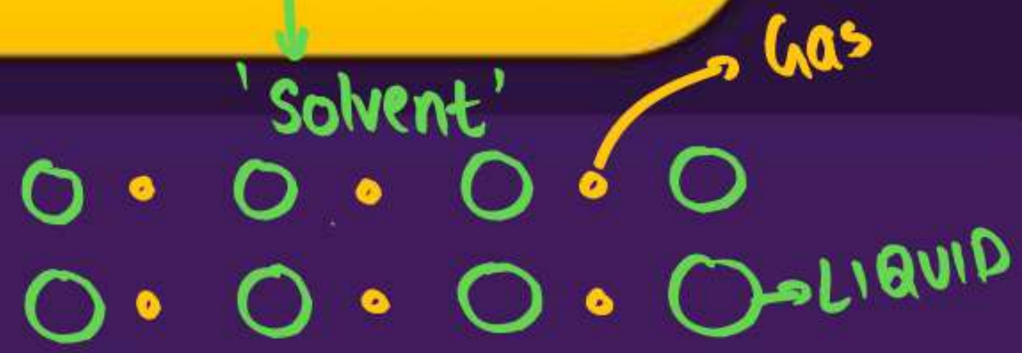
SOLUBILITY OF SOLIDS IN LIQUIDS

(iii) Effect of Pressure

Pressure does not have any significant effect on solubility of solids in liquids. It is so because solids and liquids are highly incompressible and practically remain unaffected by changes in pressure.

SOLUBILITY OF GASES IN LIQUIDS

'Solute' 'Solvent'



(i) Effect of Temperature

- When a 'gas' dissolves in a 'liquid':

(i) Gas molecules slow down, lose their kinetic energy and move into a more ordered liquid phase.

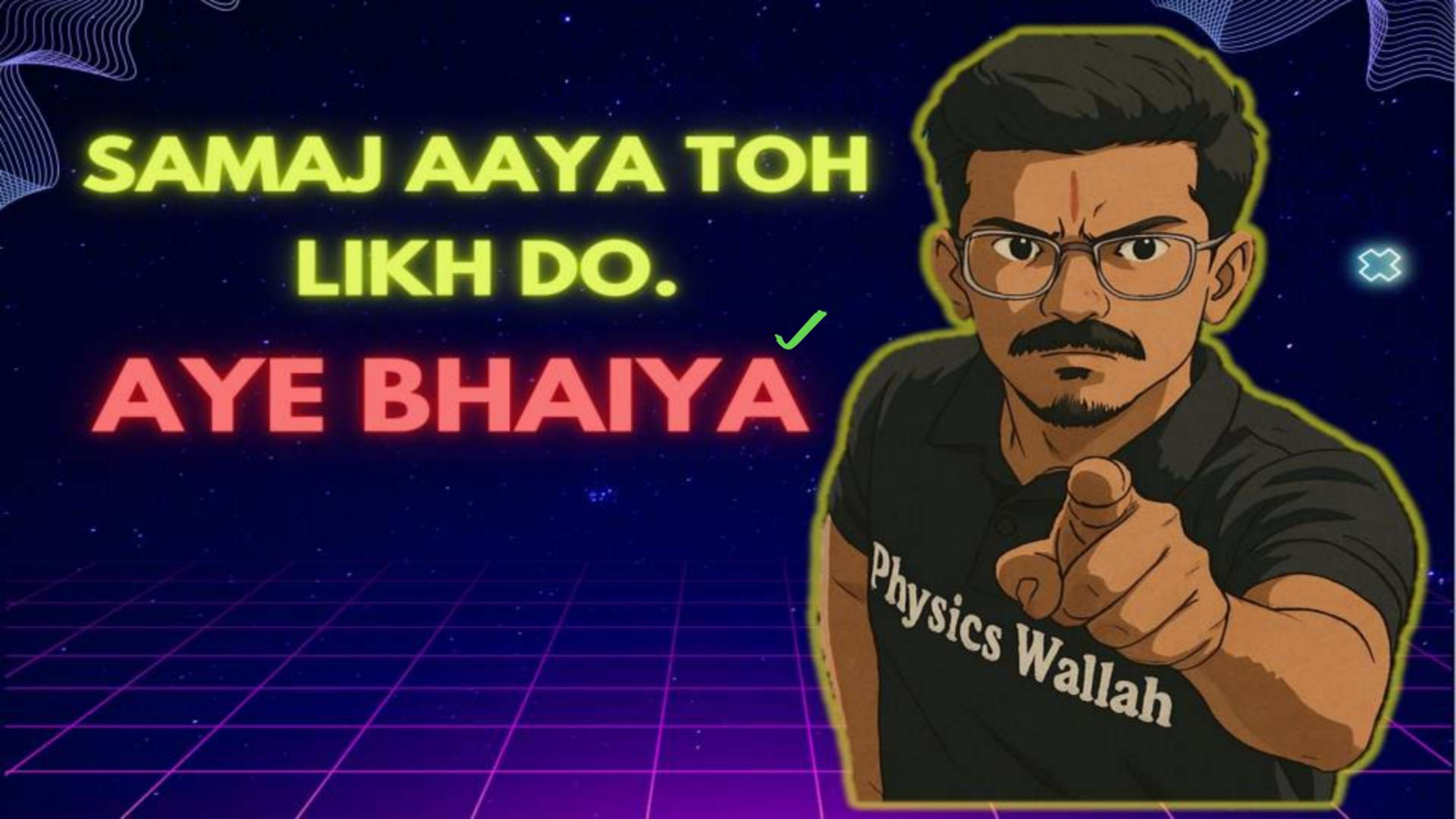
(ii) [The lost kinetic energy is released in the form of heat. This is similar to condensation of vapour into a liquid.]

(iii) So, it is an [exothermic dissolution].

generally

- According to Le Chatelier's Principle, if the dissolution of a gas in liquid is exothermic **($\Delta H < 0$)**, the solubility of the gas-in-liquid decreases with the rise in temperature.

$$\text{Gas (above liquid)} \rightleftharpoons \text{Gas dissolved in liquid} + \text{Heat}$$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LET'S PRACTICE

QUESTION

Dissolution of a gas in liquid is usually:

(A) Endothermic

(B) Exothermic

(C) Thermoneutral

(D) Cannot be predicted

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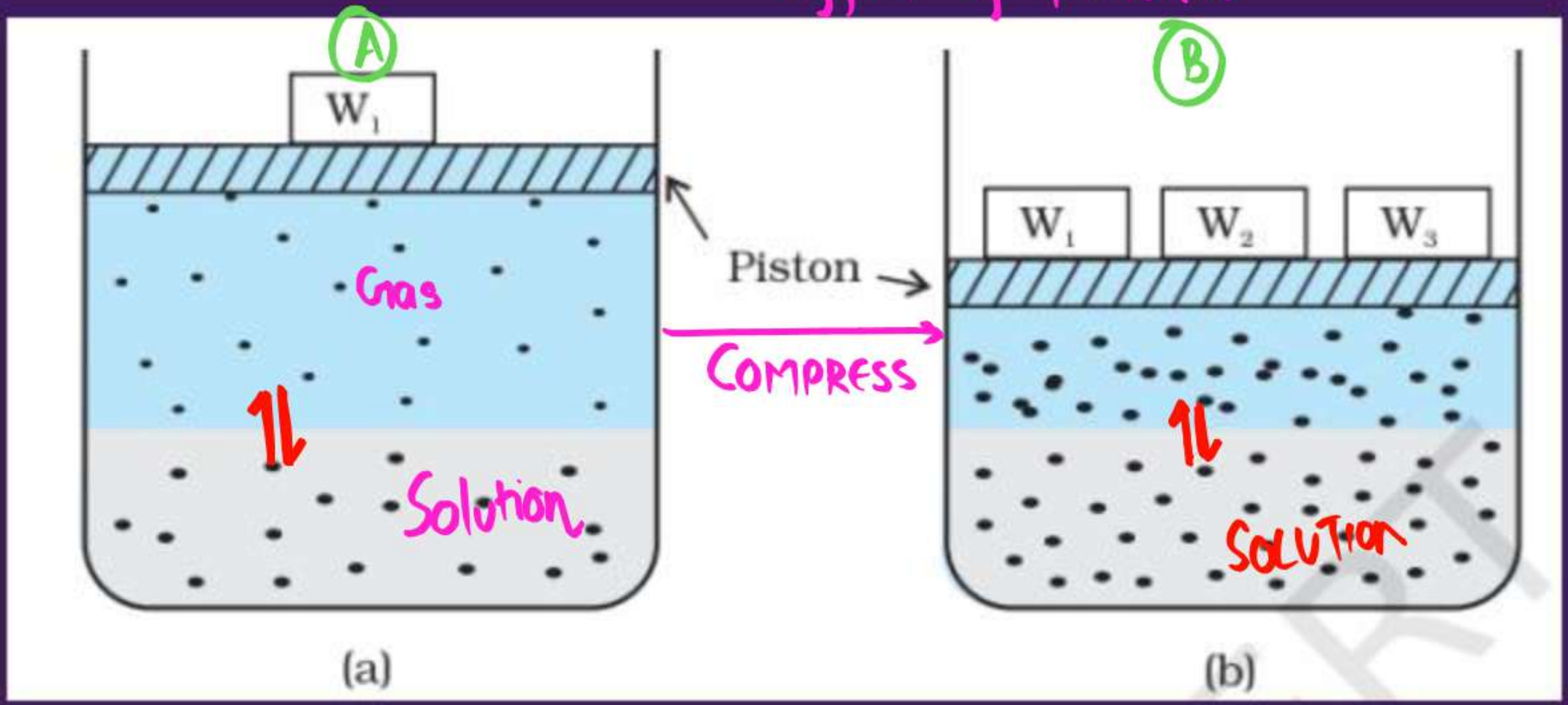
HENRY'S LAW, ITS APPLICATIONS AND LIMITATIONS

SOLUBILITY OF GASES IN LIQUIDS

'Effect of Pressure'



Pressure of gas above the solution $\boxed{\text{increases}}$ so the solubility of gas also increases till it reaches new equilibrium.

from A to B

we have compressed the gas

occupied volume by gas (↓)

no. of gas particles striking on solt^n has (↑)

PRESSURE OF GAS ON SOLT^n (↑)

HENRY'S LAW

[partial pressure becomes imp.] → individual gas ka pressure

- According to Henry, at a constant temperature the solubility of a gas in a liquid is directly proportional to the pressure of the gas present above the surface of liquid or solution.

(I)

Solubility of gas (S) in liquid ∝ Pressure of gas above solt^n / Liquid (P)

$\Rightarrow S \propto P \Rightarrow \boxed{S = K_H P}$ $K_H \rightarrow$ Henry's constant

- If we express it in partial pressure of gas and mole fraction of a gas in the solution as a measure of its solubility, then it can be said that the (at constant temp.) mole fraction of gas in the solution is proportional to the partial pressure of the gas over the solution.

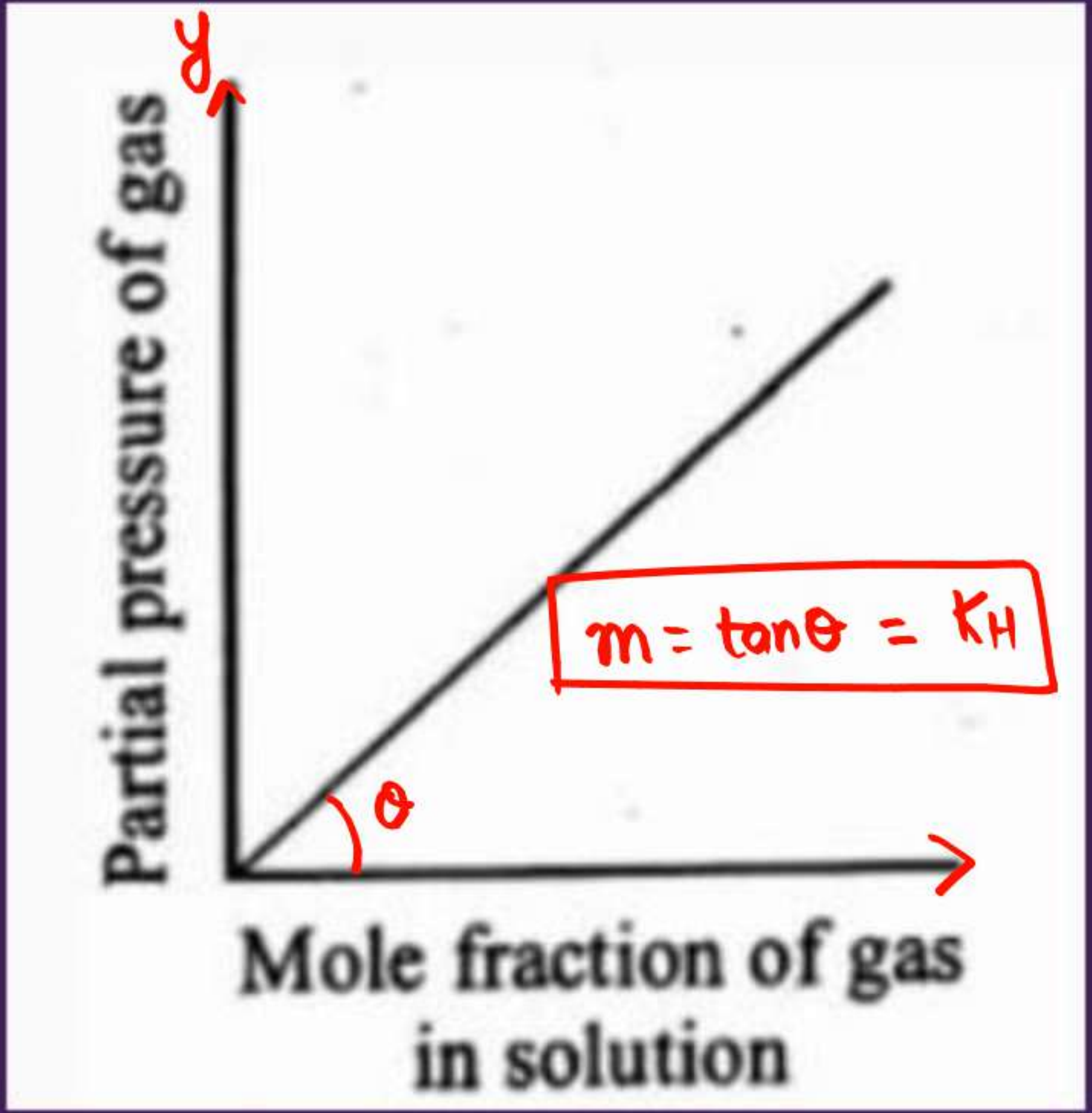
(II)

$\Rightarrow P_{gas} \propto X$

$\Rightarrow \boxed{P_{gas} = K_H X}$

$K_H \rightarrow$ Henry's Constant

GRAPH OF HENRY'S LAW



$p_{gas} = K_H \, x$

$$\boxed{y = m x}$$

m → Slope

GIVE A THOUGHT

$\boxed{p = K_H x}$

Higher the value of K_H at a given pressure, the lower is the solubility of the gas.

A. Yes

B. No

$$\frac{p}{K_{H_1}} = x_1 \qquad \frac{p}{K_{H_2}} = x_2 \qquad K_{H_1} > K_{H_2}$$

$$\boxed{x_1 < x_2}$$

LET'S DECODE NCERT

Gas	Temperature/K	K_H /kbar
He	293	144.97
H_2	293	69.16
N_2	$\boxed{293}$	76.48
N_2	$\boxed{303}$	88.84
O_2	$\boxed{293}$	34.86
O_2	$\boxed{303}$	46.82

T(↑) K_H(↑)

T(↑) K_H(↑)

- K_H values for both N_2 and O_2 increase with increase of temperature indicating that [the solubility of gases decrease with an increase in temperature.]

Cold H_2O → more gases dissolved

Hot H_2O → less gases dissolved

- (It is due to this reason that aquatic species are more comfortable in cold waters rather than in warm waters.)

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AYE BHAIYA

LET'S PRACTICE

NCERT EXEMPLAR Q.NO. 18

The value of Henry's constant K_H is ______________.

(A) greater for gases with higher solubility.

(B) greater for gases with lower solubility.

(C) Constant for all gases

(D) not related to the solubility of gases.

$$\frac{p_{gas}}{K_H} = x$$

x → mole fraction of gas

Solubility of gas-in-liquid

$K_H (\uparrow), x (\downarrow)$

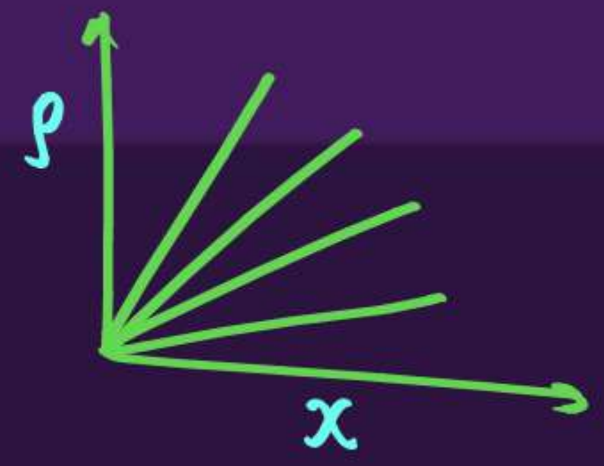
$K_H (\downarrow), x (\uparrow)$

NCERT EXEMPLAR Q. NO. 40

What is the significance of Henry's Law constant K_H?

Henry's law constant (K_H) is significant because:

- Specifically, a $\boxed{\text{higher } K_H \text{ value}}$ at a given pressure indicates lower solubility of the gas in the liquid.
- If temperature increases value of K_H increases which means solubility of gas decreases.
- This constant allows for comparing the relative solubilities of different gases in the same solvent.



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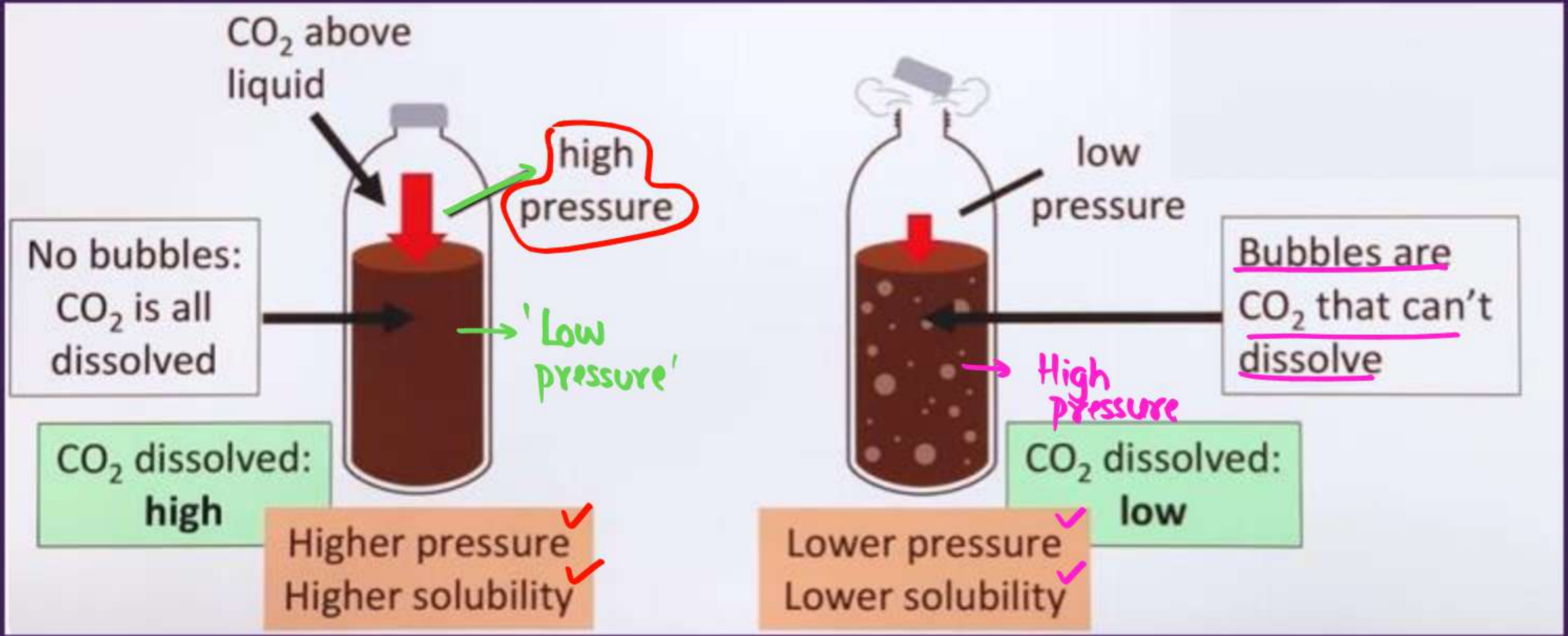
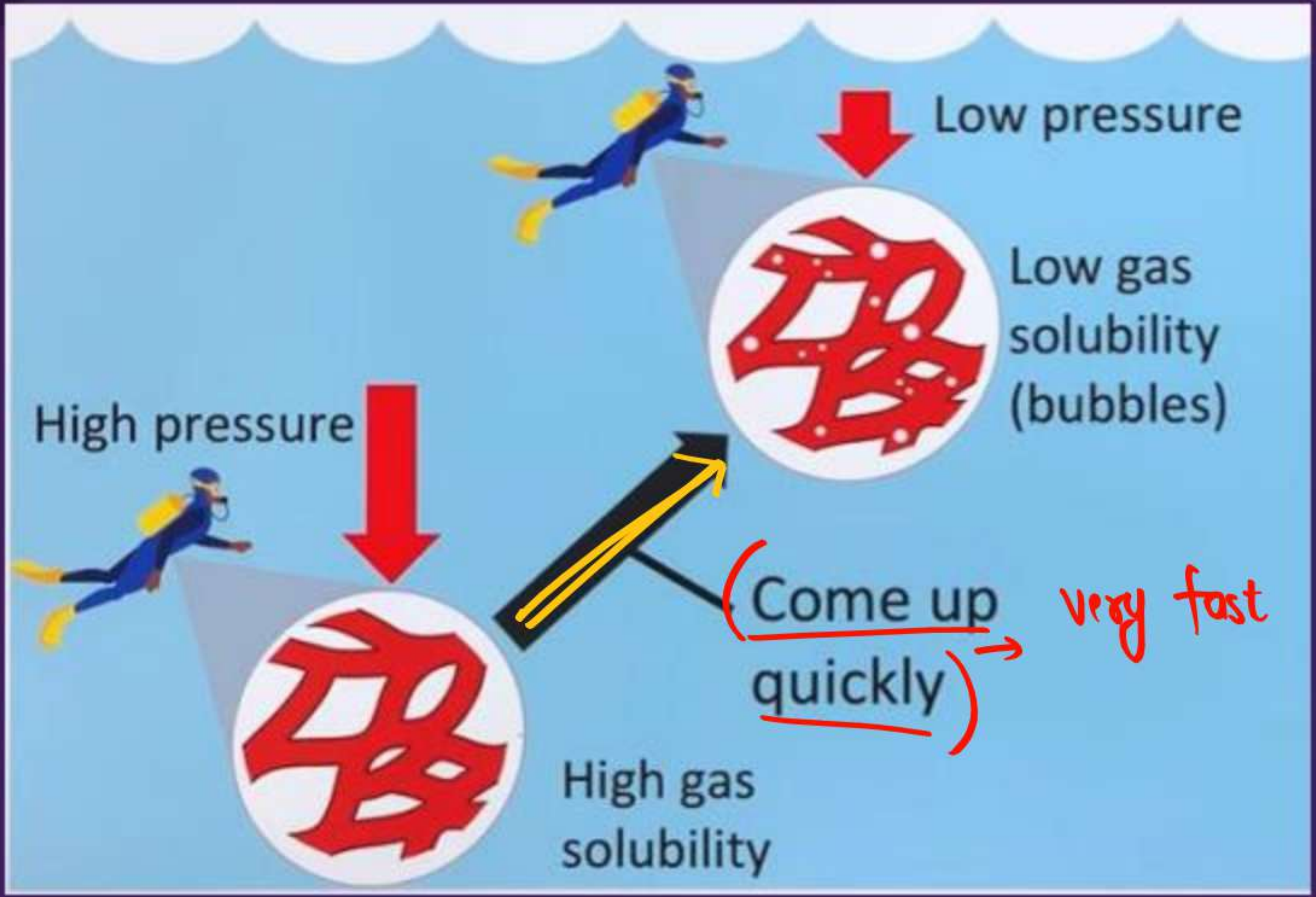
APPLICATIONS OF HENRY'S LAW



(i) To increase the solubility of CO_2 in soft drinks and soda water, the bottle is sealed under high pressure.

APPLICATIONS OF HENRY'S LAW



(ii) 'SCUBA DIVING'

- Underwater, high pressure increases the solubility of gases (like nitrogen) in the blood.
- When divers come up quickly, pressure drops, and nitrogen comes out as bubbles in blood — causing decompression sickness which is also called bends (painful and dangerous).

Solution to ignore 'Bends'

(i) Come-up very slowly so that pressure drops slowly. This ensures that gases dissolved in blood won't come out in form of bubbles.

(ii) NCERT mentioned (Search & write)

APPLICATIONS OF HENRY'S LAW

(iii) At high altitudes the partial pressure of oxygen is less than that at the ground level. This leads to low concentrations of oxygen in the blood and tissues of people living at high altitudes or climbers.

Low blood oxygen causes climbers to become weak and unable to think clearly, symptoms of a condition known as hypoxia.

anoxia mentioned in NCERT (wrong)

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CONCEPT POLISH - HOMEWORK

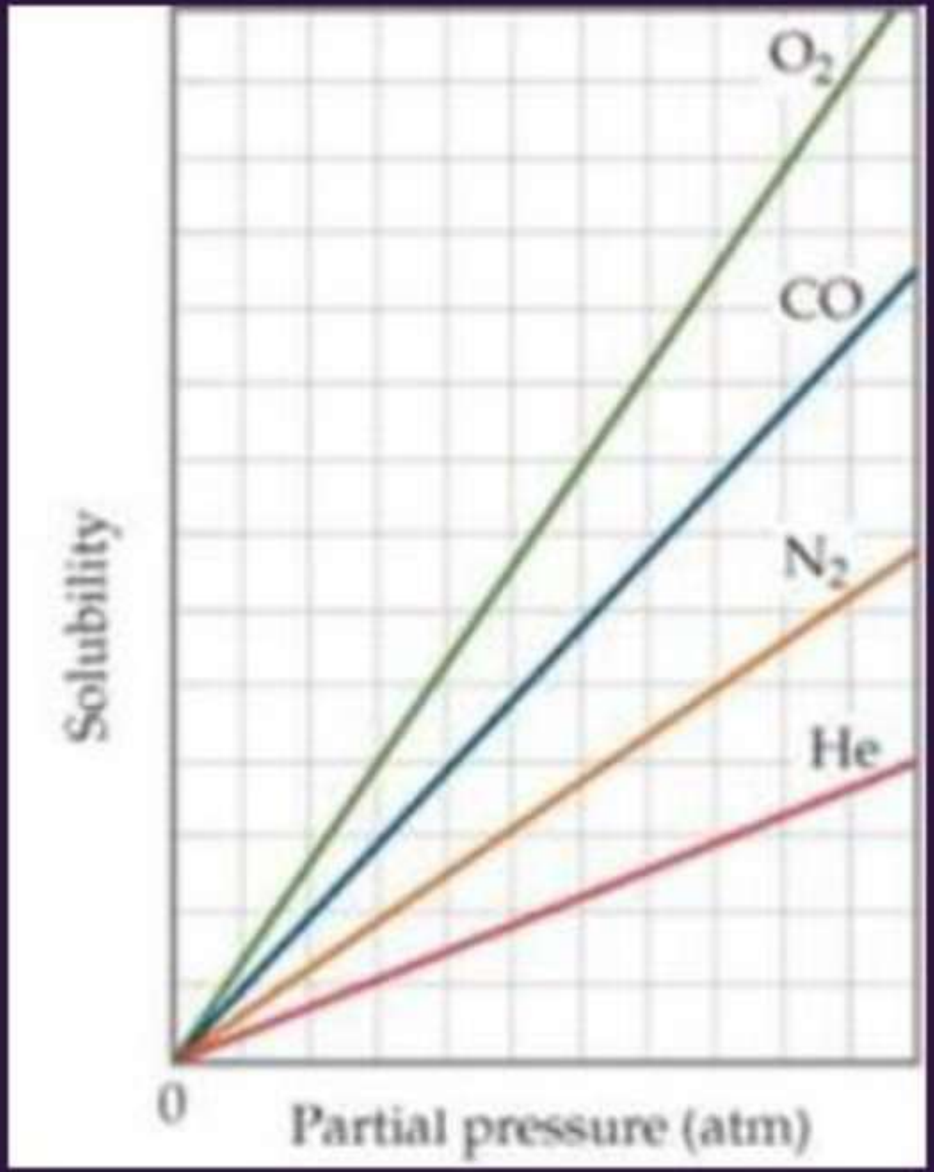
(1) Unit of K_H.

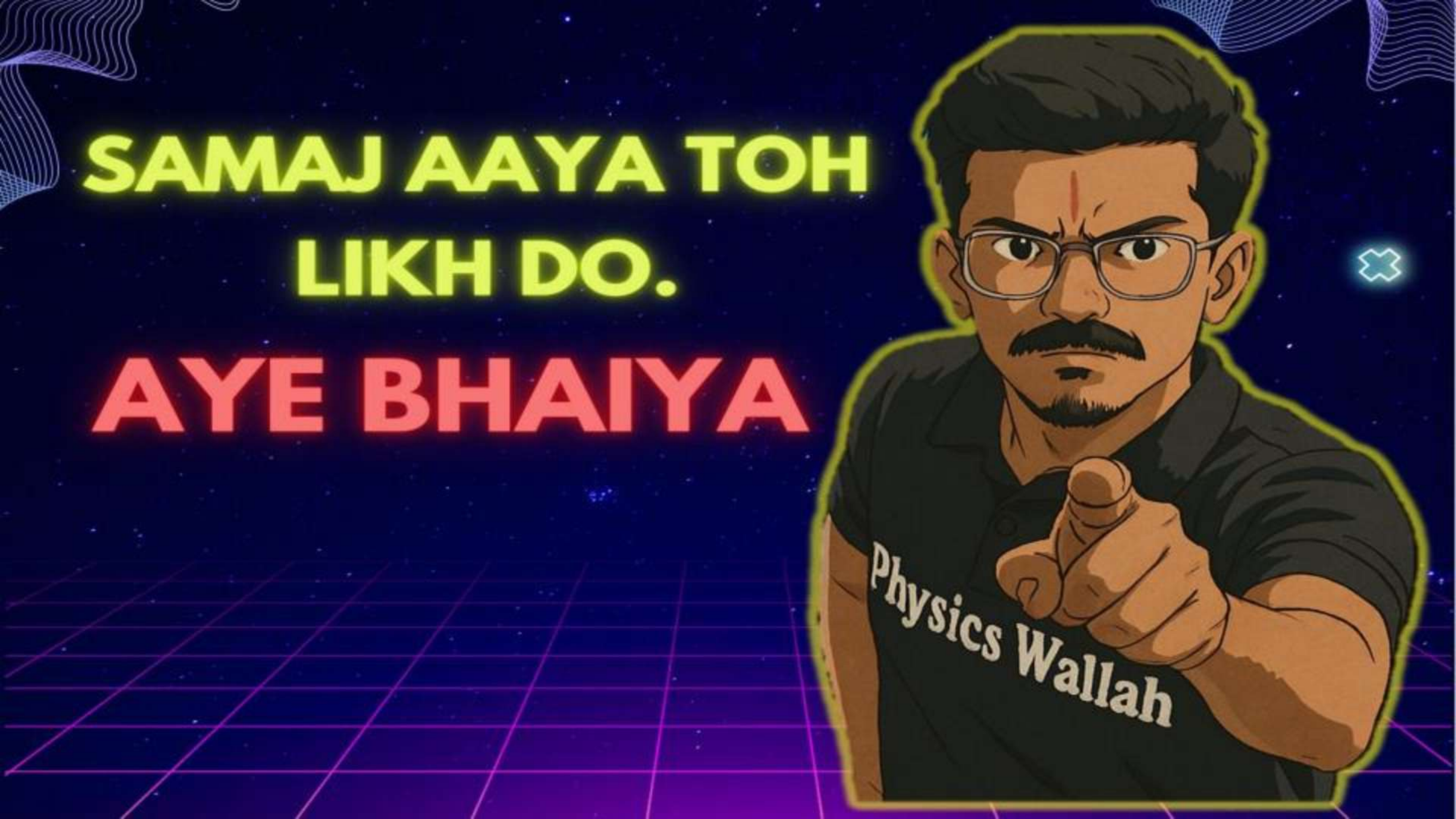
QUESTION

If N_2 gas is bubbled through water at 293 K, how many millimoles of N_2 gas would dissolve in 1 litre of water? Assume that N_2 exerts a partial pressure of 0.987 bar. Given that Henry's law constant for N_2 at 293 K is 76.48 kbar.

QUESTION

Which gas will have higher solubility in the liquid at the same pressure?

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Books for Board Preparation

✓

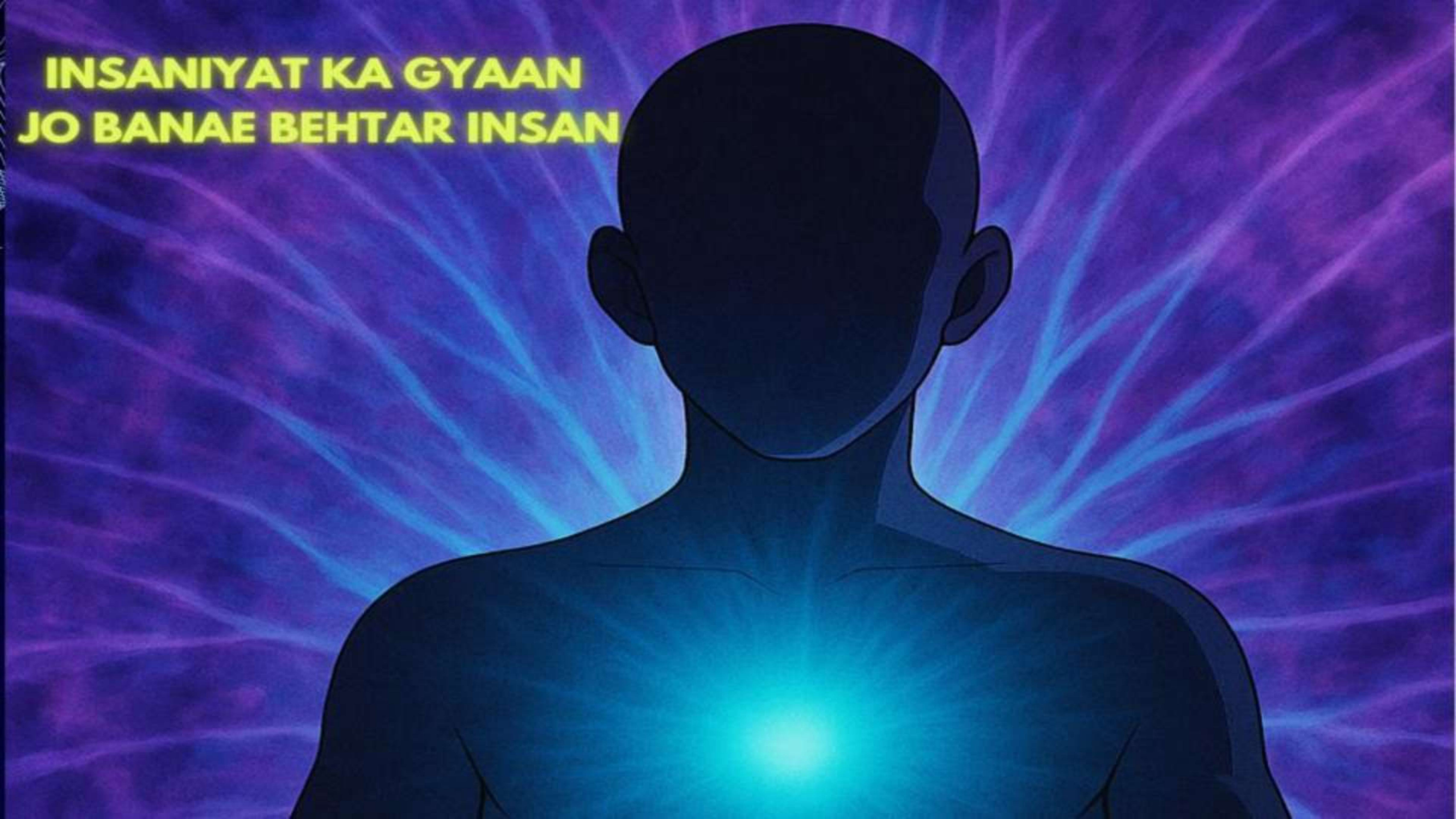
NCERT Theory

NCERT Intext + Exercise +

Solved Examples

✓

NCERT Exemplar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Thank You

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2026

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CHEMISTRY

Lecture 06

SOLUTIONS

Doubts, PYQs', Vapour Pressure and Factors Affecting It

BY – PRIYA-PUTRA-SUNIL

TOPICS TO BE COVERED

(i) Doubts

(ii) Homework Discussion

(iii) CBSE Previous Year Questions

(iv) Vapour Pressure and Factors Affecting It


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DOUBTS

Research at your own using AI

DOUBT

Bhaiya jb solid dissolve hoga liquid mein toh temperature badhane pr kb solubility bdhegi aur kb ghategi?

(i) Ab jis solid ko hum saturated solution mein dissolve karwa rahe hai who heat absorb krke dissolve hota hai, i.e. endothermic dissolution ($\Delta H > 0$), toh iski solubility temperature badhane par bdhegi as per Le Chatelier's principle.

$$\text{Undissolved solute} + \text{Heat} \rightleftharpoons \text{Dissolved solute}$$

(ii) Ab jis solid ko hum saturated solution mein dissolve karwa rahe hai woh heat release krke dissolve hota hai, i.e. exothermic dissolution ($\Delta H < 0$), toh iski solubility temperature badhane par ghategi as per Le Chatelier's principle.

$$\text{Undissolved solute} \rightleftharpoons \text{Dissolved solute} + \text{Heat}$$

DOUBT

Bhaiya gas dissolution in liquid temperature badhane pr kyun ghat jaata hai?

Ab jis gas ko hum saturated solution of gas-in-liquid mein dissolve karwa rahe hai woh heat release krke dissolve hota hai, i.e. exothermic dissolution ($\Delta H < 0$), toh gas ki solubility temperature badhane par ghategi as per Le Chatelier's principle.

dynamic equilibrium in a saturated soln of gas-in-liquid →

$$\text{Gas (above liquid)} \rightleftharpoons \text{Gas dissolved in liquid} + \text{Heat}$$

DOUBT

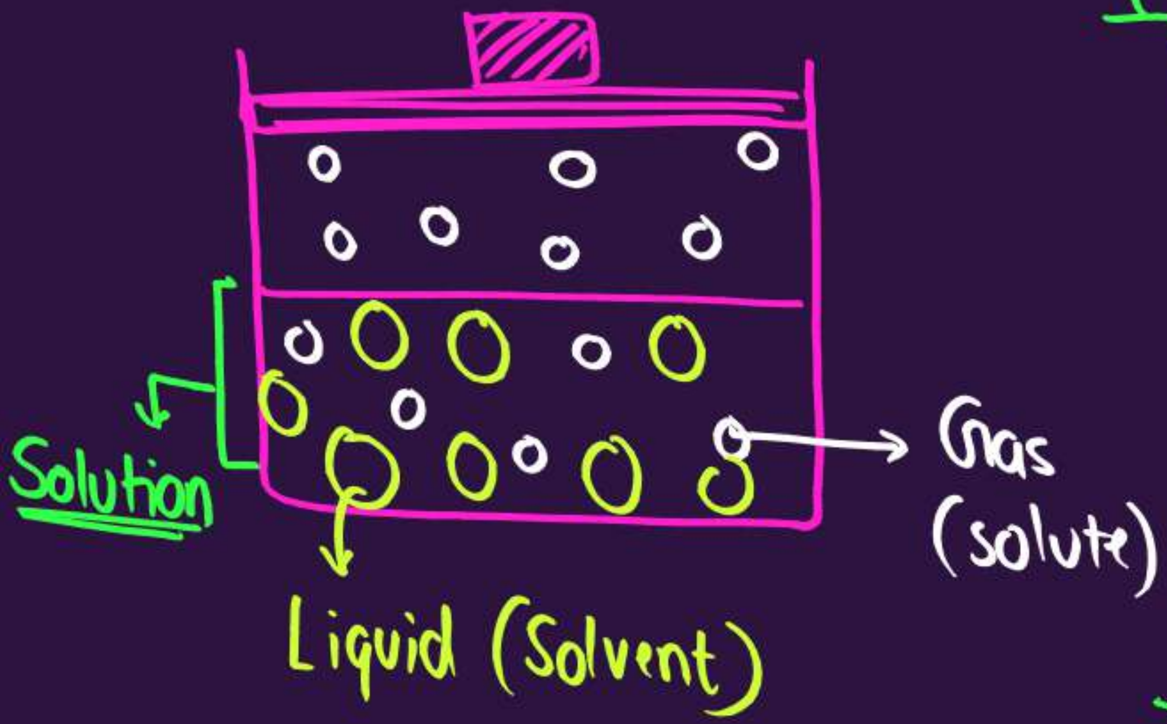
Bhaiya gas pressure, partial pressure of gas and total pressure of gas mein kya difference hai. Henry's law mein kb kya lgana hai.

Agar ek hi gas ho liquid/solution ke upar

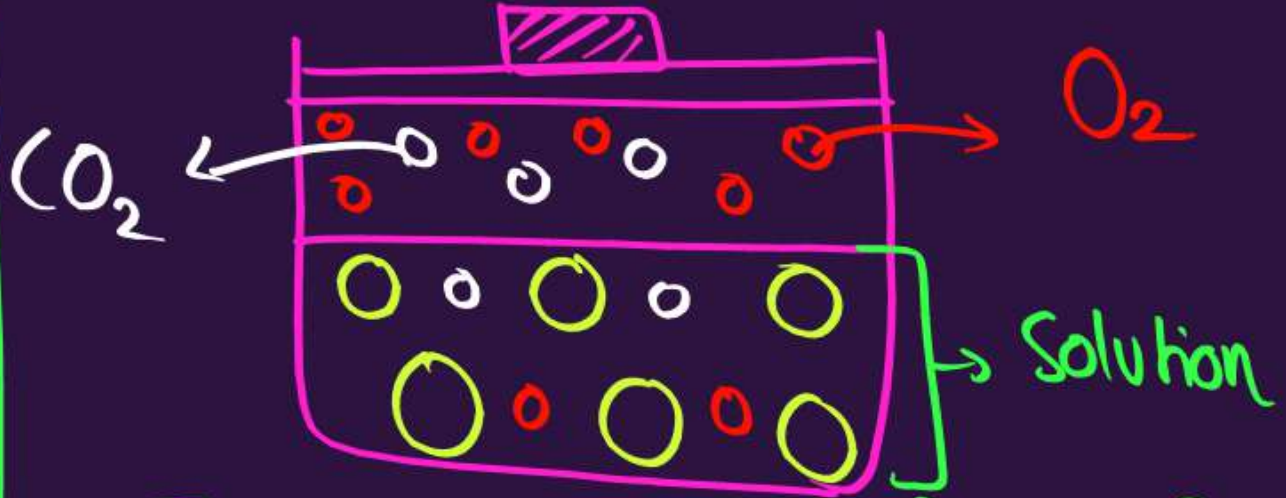
Only 1 gas so, I can use $\boxed{\text{Gas pressure}}$

$$P \propto X$$

$$\boxed{P = K_H X}$$



Agar mixture of gases ho liquid/solution ke upar



Total gas pressure (P) = $p_{CO_2} + p_{O_2}$

partial Pressure

DOUBT

Bhaiya K_H ki value badhegi toh gas ki solubility in liquid par kya farak padega jab temperature aur pressure of gas constant ho.

$$P_{gas} = K_H \chi$$ at constant temp.

$$\frac{P_{gas}}{\chi} = K_H$$

$$\boxed{\frac{1}{\chi} \propto K_H}$$

$K_H (\uparrow)$, Solubility of gas-in-liquid $(\downarrow)$ or $\chi (\downarrow)$

$K_H (\downarrow)$, Solubility of gas-in-liquid $(\uparrow)$ or $\chi (\uparrow)$

DOUBT

Bhaiya gas ki solubility in liquid par kya farak padega jab temperature badhe par pressure of gas constant ho.

(I) $T(\uparrow)$, $K_H(\uparrow)$

$\therefore$ $\boxed{T \propto K_H}$

(II) $p_{gas} = K_H \chi$

$$\frac{p_{gas}}{\chi} = K_H$$

$$\boxed{\frac{1}{\chi} \propto K_H}$$

So, $K_H(\uparrow)$ then $\chi(\downarrow)$

Gas	Temperature/K	K_H /kbar
He	293	144.97
H_2	293	69.16
N_2	293	76.48
N_2	303	88.84
O_2	293	34.86
O_2	303	46.82

$T(\uparrow)$ $K_H(\uparrow)$

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CONCEPT POLISH – HOMEWORK DISCUSSION

QUESTION

What is the unit of Henry's law constant?

$$P_{gas} = K_H \, \chi$$ → Solubility here is expressed in terms of mole fraction

$$\frac{P_{gas}}{\chi} = K_H$$

'unitless' ← χ

$$\boxed{Pa} \text{ or } \boxed{atm} \text{ or } \boxed{bar} = K_H$$

$$\underset{\substack{\downarrow \\ y}}{\rho_{gas}} = \underset{\substack{\downarrow \\ m}}{K_H}\ \underset{\substack{\downarrow \\ x}}{X}$$

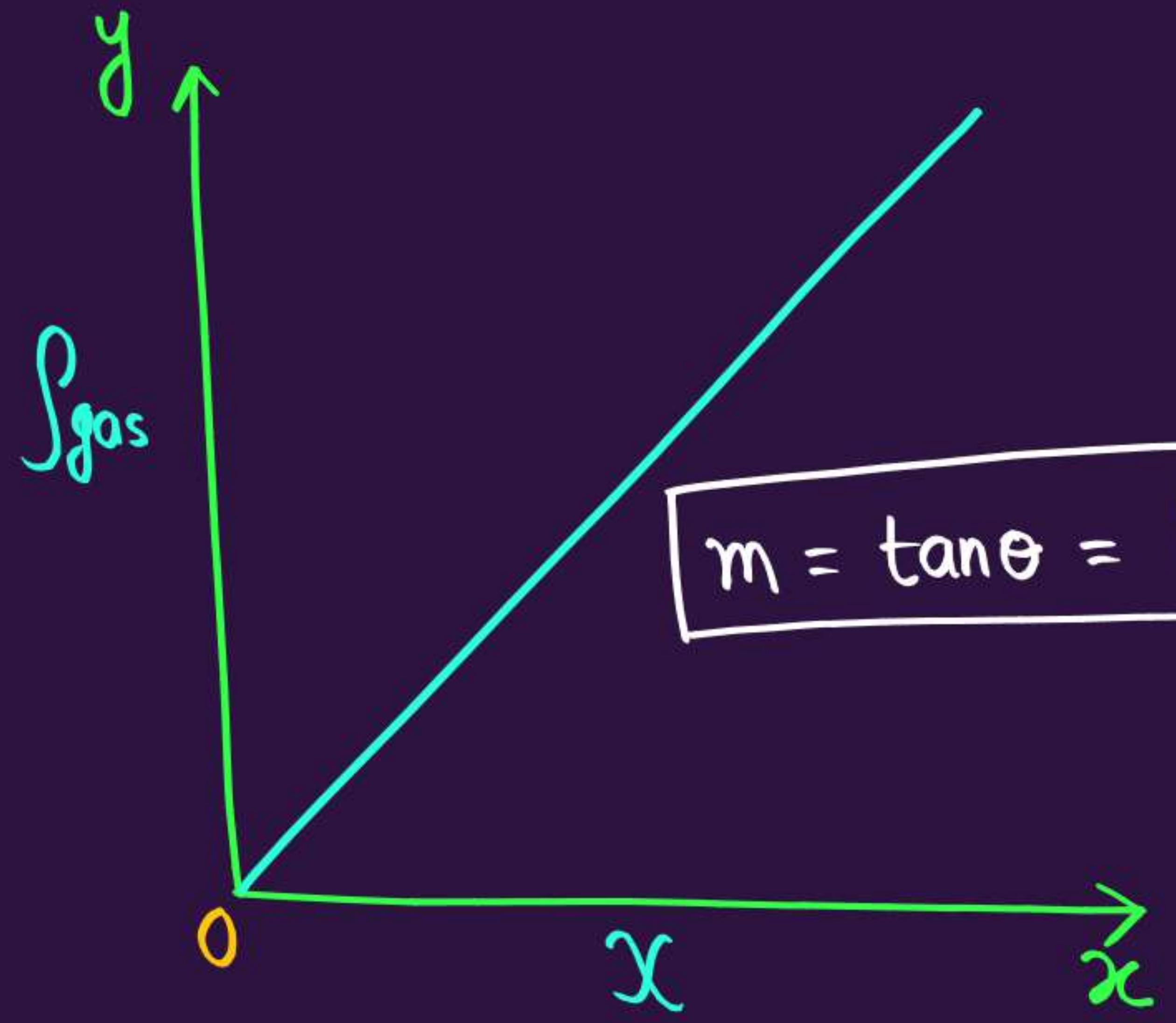
$$y = mx + c$$

if $c = 0$

$$\boxed{y = mx}$$

$\downarrow$

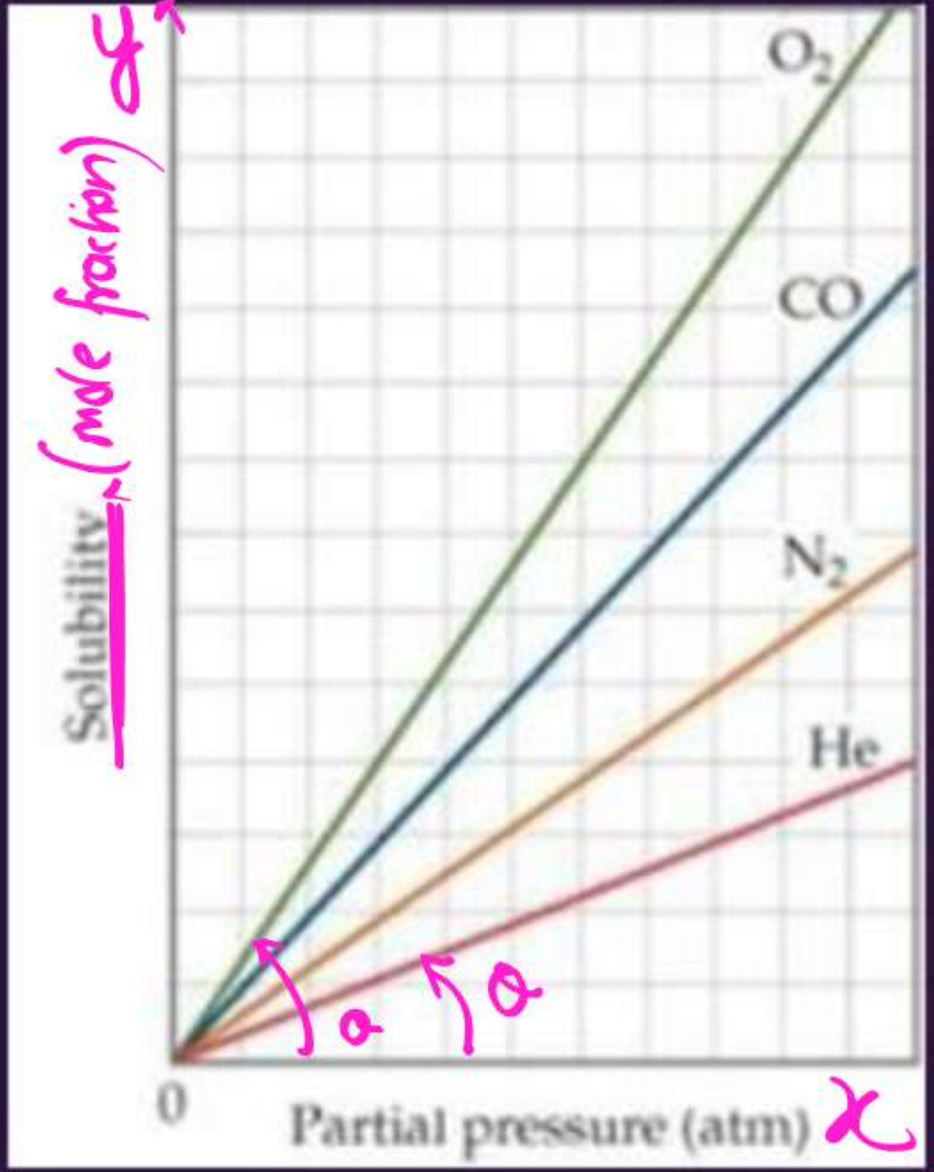
Straight line passing through origin



$$\boxed{m = \tan\theta = K_H}$$

QUESTION

Which gas will have higher solubility in the liquid at the same pressure?



$$p_{gas} = K_H \chi$$ Rearranging the eqn

$$\boxed{\chi = \frac{1}{K_H} \times p_{gas}}$$

$\chi \downarrow y$ $\quad \frac{1}{K_H} \downarrow m$ $\quad p_{gas} \downarrow x$

$$\boxed{m = \tan\theta = \frac{1}{K_H}} \rightarrow \boxed{K_H = \frac{1}{\tan\theta}}$$

- Greater tan(θ) ⇒ greater slope ⇒ lower KH ⇒ greater solubility ✓ — O_2
- Smaller tan(θ) ⇒ flatter slope ⇒ higher KH ⇒ lower solubility — He

QUESTION

How scuba divers can avoid decompression sickness or bends?

- The scuba divers should return to the surface slowly, so that the pressure changes slowly and dissolved gas in blood comes out slowly.
- To avoid bends, as well as, nitrogen narcosis due to high concentrations of nitrogen in the blood, the tanks used by scuba divers are filled with helium + nitrogen + oxygen (for lower depths) and helium + oxygen (for extreme depths).

excessive N_2 is dissolved in blood

$\downarrow$

same condition as someone is drunk

NCERT Solved Example 1.4

If N_2 gas is bubbled through water at 293 K, how many millimoles of N_2 gas would dissolve in 1 litre of water? Assume that N_2 exerts a partial pressure of 0.987 bar. Given that Henry's law constant for N_2 at 293 K is 76.48 kbar.

$\rightarrow 76.48 \times 10^3$ bar

$$p_{N_2} = (K_H)(\chi_{N_2})$$

$$= .987 = (76.48 \times 10^3)(\chi_{N_2})$$

$$= 98.7 \times 10^{-2} = (76.48 \times 10^3)(\chi_{N_2})$$

$$= \frac{98.7 \times 10^{-2}}{76.48 \times 10^3} = \chi_{N_2}$$

$$\approx \frac{\cancel{100}^{4} \times 10^{-5}}{\cancel{75}_{3}} = \chi_{N_2}$$

$$\approx \frac{4 \times 10^{-5}}{3} = \chi_{N_2}$$

$$\boxed{\approx 1.33 \times 10^{-5} = \chi_{N_2}}$$

$$\chi_{N_2} = \frac{n_{N_2}}{n_{N_2} + n_{H_2O}}$$

$$\approx 1.33 \times 10^{-5} = \frac{n_{N_2}}{55.5}$$

$n_{N_2} <<< n_{H_2O}$
↓
ignore n_{N_2}

$$\approx 1.33 \times 10^{-5} \times 55.5 = n_{N_2}$$

$$\boxed{\approx 73.815 \times 10^{-5} = n_{N_2}}$$
mol

$$n_{H_2O} = \frac{\text{given mass}}{\text{molar mass}} \quad \text{- (1)}$$

Density of water $= \frac{1\,g}{mL} = \frac{1000\,g}{L}$

means 1 L of water = 1000 g

Putting this value in (1)

$$n_{H_2O} = \frac{\overset{500}{\cancel{1000}}\,\cancel{g}}{\underset{9}{\cancel{18}}\,\cancel{g}} = \frac{500}{9} = \underline{\underline{55.5}}$$

$1 \text{ mmol} = 10^{-3} \text{ mol}$

$'x' = 73.815 \times 10^{-5} \text{ mol}$

milli $\rightarrow$ 10^{-3}

$x \times 10^{-3} = 73.815 \times 10^{-5}$

$x = \dfrac{73.815 \times 10^{-5}}{10^{-3}}$

$x = 73.815 \times 10^{-2}$

$= .73815 \times 10^{-2} \times 10^{2}$

$= \boxed{1.73815 \text{ mmol approximately of } N_2}$

Remember

$\Rightarrow$ CBSE gives very easy calculation based numericals

**

$\boxed{\text{if calculation is difficult use approximation.}}$

SAMAJ AAYA TOH
LIKH DO.

AYE BHAIYA

(I) Handwritten notes by me

(II) Notes concise karna by AI

(III) Both

CBSE Previous Year Questions

CBSE PYQ

Define the following terms.

(i) Mole fraction

(ii) Molarity

(iii) Molality

(i) Mole fraction (χ): It is the ratio of number of moles of a particular component to the total number of moles of the solution.

(ii) Molarity (M): It is the number of moles of solute in each litre or 1 L of solution.

(iii) Molality (m): It is the number of moles of solute in each kilogram of solvent.

CBSE PYQ

Define the term molarity. State one disadvantage in using molarity as unit of concentration.

- It is the number of moles of solute in each litre or 1 L of solution.
- Molarity is considered as less reliable unit of concentration because volume of the solution changes on changing temperature due to thermal expansion or contraction of the solution. So, molarity also changes with temperature.

CBSE PYQ

Differentiate between molarity and molality for a solution. How does a change in temperature influence their values?

- Molality (M) is the number of moles of solute in each kilogram of solvent. It is not affected by temperature.
- Molarity (M): It is the number of moles of solute in each litre or 1 L of solution. It ~~decreases with increase~~ in temperature.
  changes with change in

CBSE PYQ

State Henry's law and write its two applications.

- According to Henry, at a constant temperature the solubility of a gas in a liquid is directly proportional to the pressure of the gas present above the surface of liquid or solution.

Applications of Henry's Law

- To increase the solubility of CO_2 in soft drinks and soda water, the bottle is sealed under high pressure.
- At deep depths, high pressure dissolves more N_2 in blood (Henry's Law).

  To avoid bends, as well as, nitrogen narcosis due to high concentrations of nitrogen in the blood, the tanks used by scuba divers are filled with helium + nitrogen + oxygen (for lower depths) and helium + oxygen (for extreme depths).

CBSE PYQ

Low concentration of oxygen in the blood and tissues of people living at high altitude is due to:

(A) High atmospheric pressure

(B) Low temperature

(C) Low atmospheric pressure

(D) Both low temperature and high atmospheric pressure.

CBSE PYQ

Gas A is more soluble in water than Gas B at the same temperature. Which of the following gases will have the higher value of K_H (Henry's constant) and why?

$$\boxed{K_H \propto \frac{1}{x}}$$

K_H for 'A' will be less than 'B' because gas 'A' is more soluble than gas 'B'. Higher the value of K_H, lower will be the solubility.

CBSE PYQ

Aquatic organisms feel more comfortable in cold water than hot water.

HOT WATER → Temp. (↑), K_H (↑) & solubility of gas in water (↓)

COLD WATER → Temp. (↓), K_H (↓) & — " ———— (↑)

↓

Dissolved gases (O_2) is more. Hence, aquatic organisms feel more comfortable.

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LIKH DO.

AYE BHAIYA ✓

VAPOUR PRESSURE AND FACTORS AFFECTING IT

INTRODUCTION

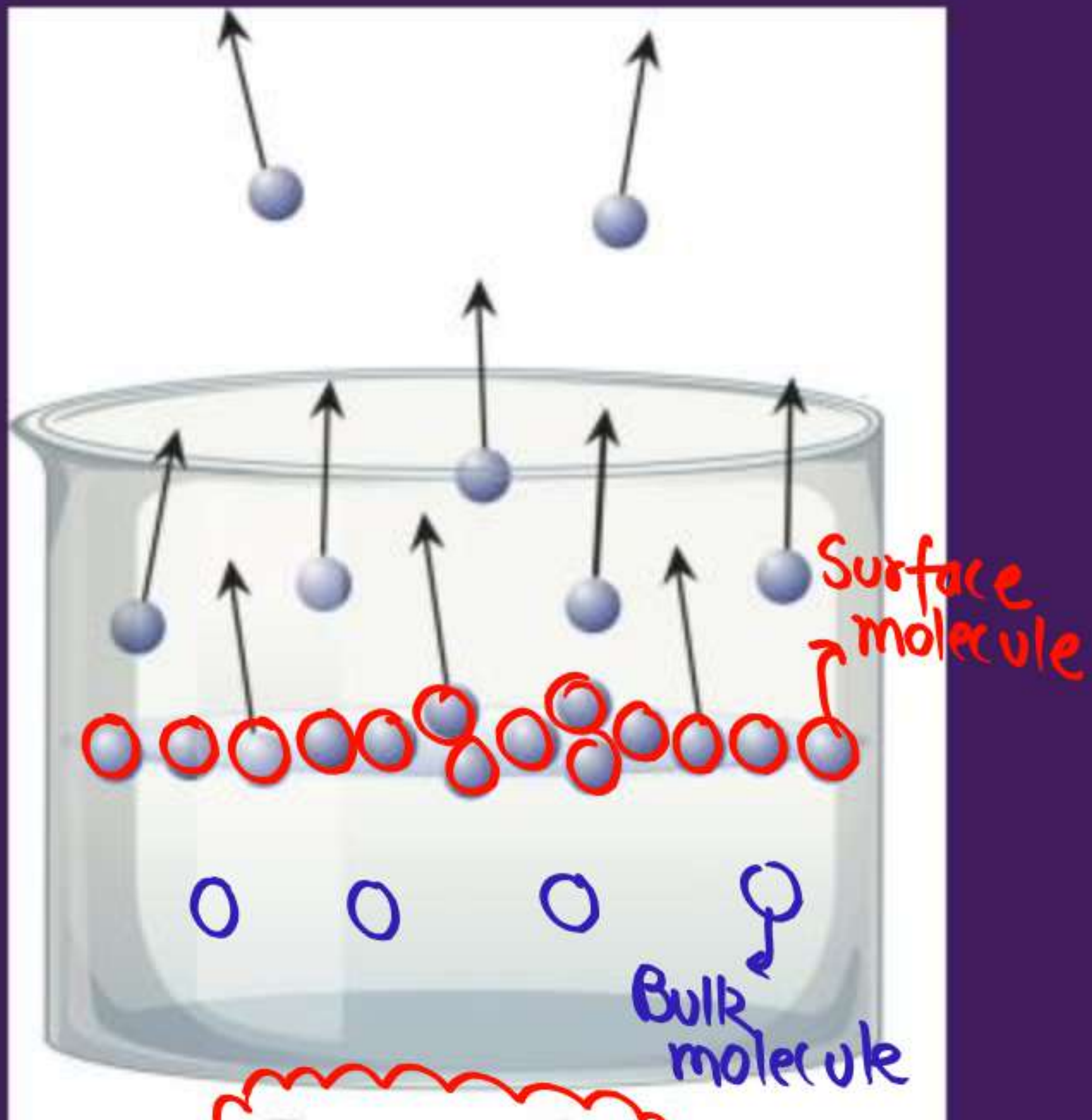
LIQUID → VAPOUR (GAS)

- Evaporation is a surface phenomenon as the surface molecules evaporate because:

(i) They experience lesser force of attraction as compared to the bulk molecules.

(ii) Due to this reduced force of attraction they have more freedom means higher kinetic energy.

overcome force of attraction btw. liquid molecules & escape into vapour

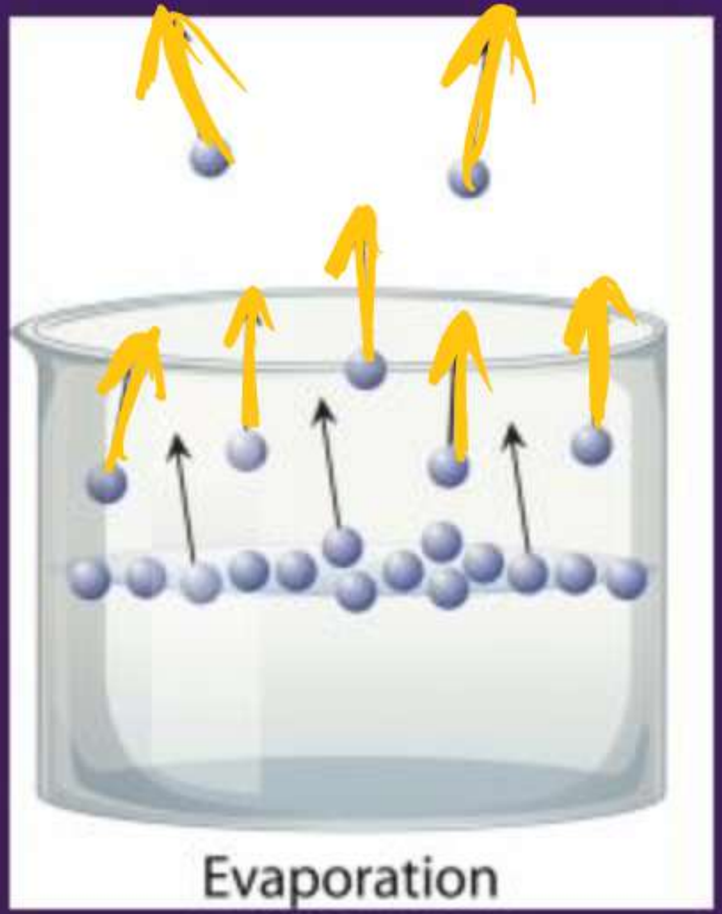


Evaporation

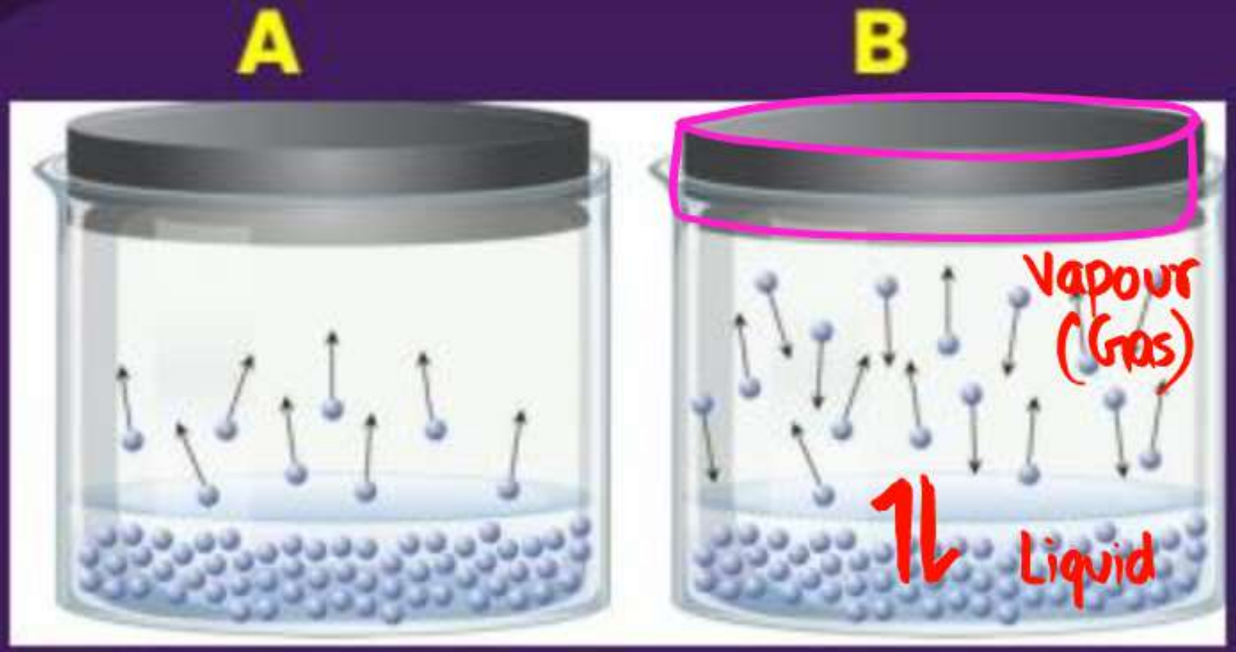
IMPORTANT TO REMEMBER

I In case of open container, mass of the liquid will decrease as the vapours escape.

II Also, we don't talk about vapour pressure in case of open containers.



MEANING OF VAPOUR PRESSURE



- In a closed container, vapours can't escape, so the overall mass remains unchanged.
- Initially, rate of evaporation > rate of condensation, but as vapour builds up, rate of condensation increases.
- Eventually:
  Rate of evaporation = Rate of condensation → Dynamic equilibrium.

The pressure exerted by the vapour when a liquid is in dynamic equilibrium with its vapour in a closed container

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AYE BHAIYA ✓

FACTORS AFFECTING VAPOUR PRESSURE

I
- The vapour pressure does not depend on the shape or size of container.

II
- Vapour pressure of a substance is inversely proportional to its intermolecular force of attraction.

Stronger Intermolecular Forces $\Rightarrow$ Lower Vapour Pressure

Weaker Intermolecular Forces $\Rightarrow$ Higher Vapour Pressure

IFA

Water

Relatively stronger

↓

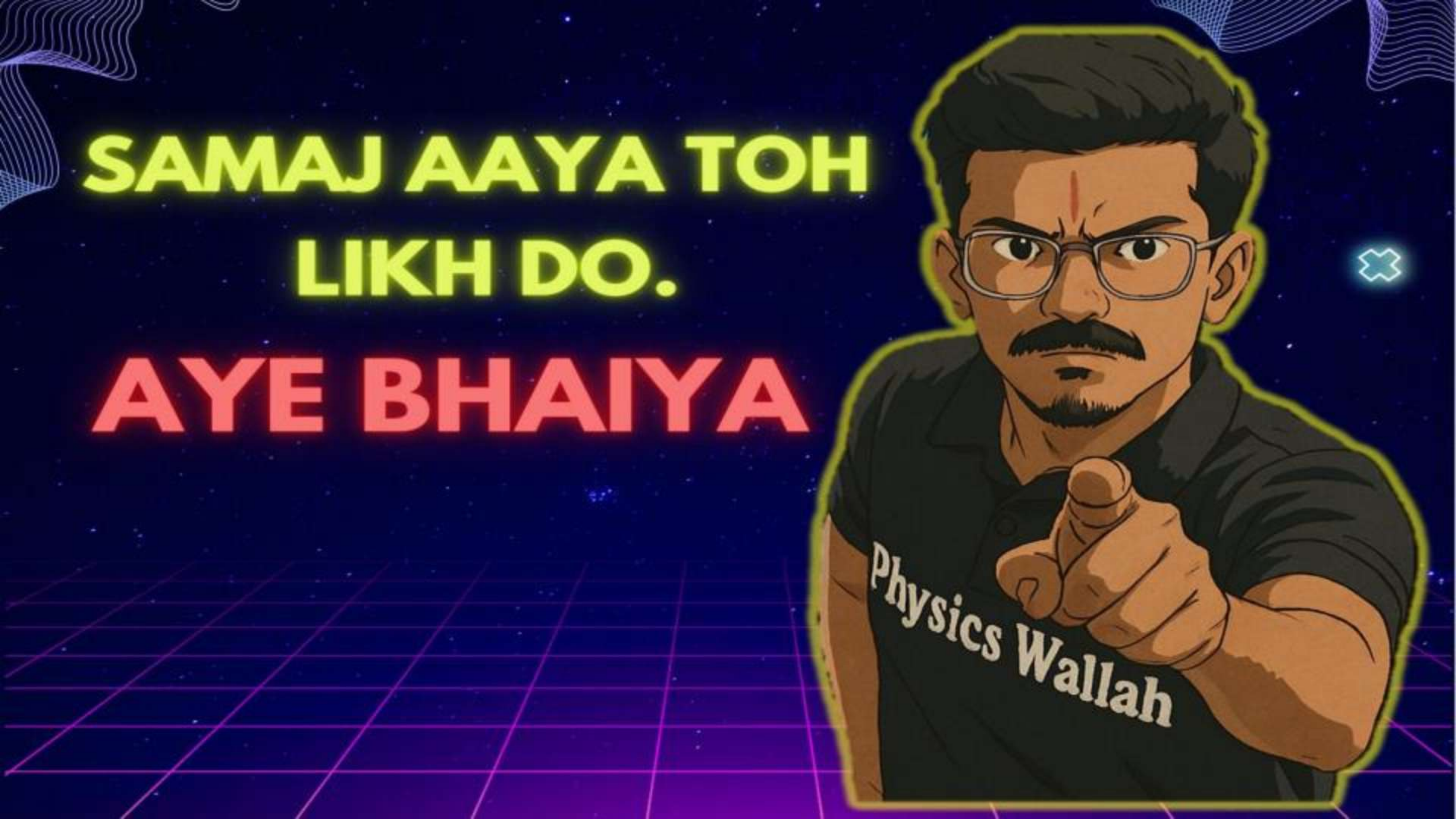
Less V.P. than ethanol

Ethanol

Relatively weaker

↓

more V.P. than H_2O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Physics Wallah

CONCEPT POLISH – HOMEWORK

GIVE A THOUGHT

H.W.

Glycol has stronger intermolecular force of attraction than ethanol. So, the vapour pressure of ethanol is more as compared to glycol.

A. Yes

B. No

EFFICIENCY HACKS BY SUNIL BHAIYA

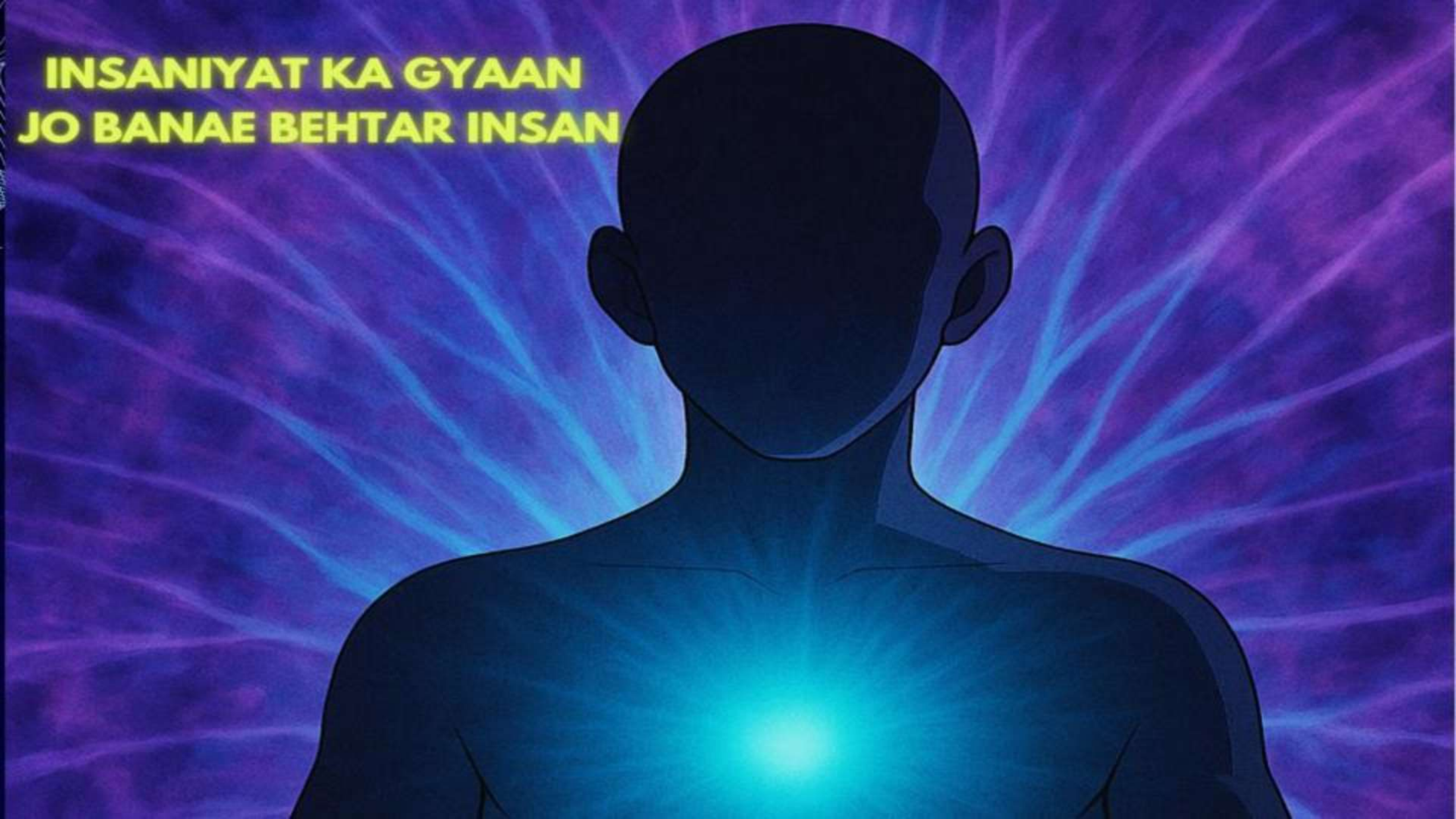
IMPORTANCE OF HAVING BREAKFAST

(i) Restores energy after overnight fast

(ii) Boosts brain function

(iii) Improves physical energy and performance

(iv) Helps maintain healthy weight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#sbsathhai

#pwsathhai

Thank You

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2026

CHEMISTRY

Bharat Mata Ki Jai

Lecture 07

SOLUTIONS

(Vapoure Pressure (Contd.) and Raoult's Law)

BY – PRIYA-PUTRA-SUNIL

TOPICS TO BE COVERED

(i) Vapour Pressure and Factors Affecting It – Part II ✓

(ii) Vapour Pressure of Liquid Solutions ✓

(iii) Raoult's Law ✓

(iv) Composition of Vapour Phase ✓


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CONCEPT POLISH – HOMEWORK DISCUSSION

LIMITATIONS OF HENRY'S LAW

where it is not applicable

- Henry's law applies only at constant temperature because "if temperature changes solubility of gas changes."
- Does not apply to gases that react with the ~~solvent~~ solution like CO_2 with NaOH (aq).
- Gas must not associate or dissociate in water like HCl.

$$HCl(g) \xrightarrow[H_2O]{in} HCl(aq) \longrightarrow H^+(aq) + Cl^-(aq)$$

GIVE A THOUGHT

Glycol ($C_2H_6O_2$) has stronger intermolecular force of attraction than ethanol (C_2H_5OH). So, the vapour pressure of ethanol is more as compared to glycol.

A. Yes

B. No

$$\boxed{V.P. \propto \frac{1}{\text{Intermolecular f.o.a.}}}$$

VAPOUR PRESSURE AND FACTORS AFFECTING IT – PART II

FACTORS AFFECTING VAPOUR PRESSURE

volatile → $P^\circ \neq 0$
non-volatile → $P^\circ = 0$

III (P°)

- Vapour pressure also depends on the nature of substance, i.e. it is volatile or non-volatile.

* it evaporates easily
उड़ सकता है

* don't evaporate easily
नहीं उड़ सकता

Substance	State	Volatile?	Reason **
NaCl (salt)	Solid	❌ No (non-volatile)	Strong ionic bonds ✓
Sugar	Solid	❌ No (non-volatile)	Strong covalent structure ✓
Alcohol →	Liquid	✅ Yes	Weak IMF
Acetone →	Liquid	✅ Yes	Weak IMF

(non-volatile)

Glucose, sucrose & urea have vapour pressure equal to:

(A) $P^0 = 0$

(B) $P^0 \neq 0$

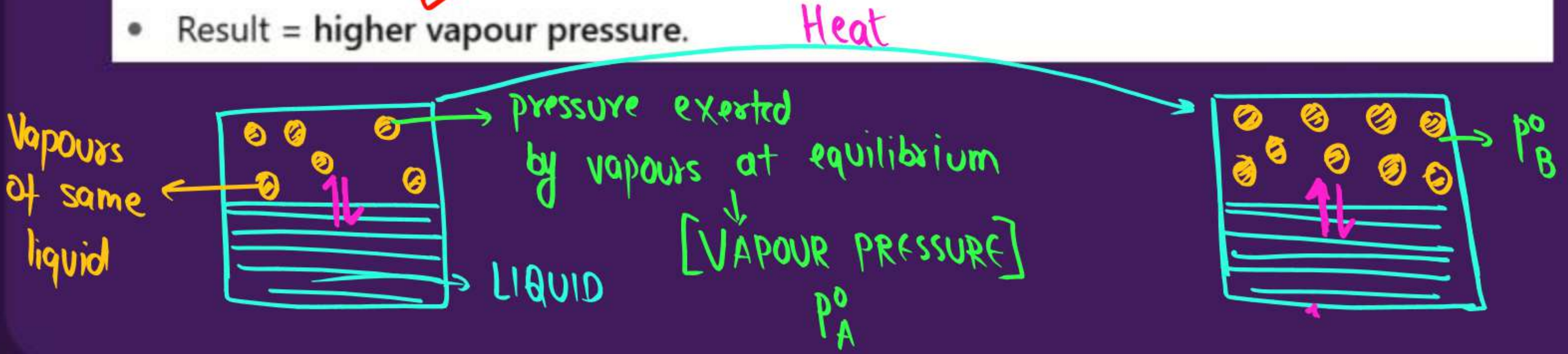
FACTORS AFFECTING VAPOUR PRESSURE

IV

- Vapour pressure increases with increasing temperature.

- Increasing temperature → molecules gain more **kinetic energy**.
- More molecules can **overcome intermolecular forces** and escape into the vapour phase.
- More molecules in the vapour phase = **more collisions** with the container walls.
- Result = **higher vapour pressure.**

[$p^0_B > p^0_A$]



[Live note making]

(*) V.P. (↑) when temp. (↑)

(*) <u>Reason:</u> On heating → K.E. of molecules (↑) → molecules overcome IFA & converts to vapour → vapours (↑) V.P. (↑)

Temp. (↑)

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LIKH DO.

AYE BHAIYA

VAPOUR PRESSURE OF LIQUID SOLUTIONS

INTRODUCTION

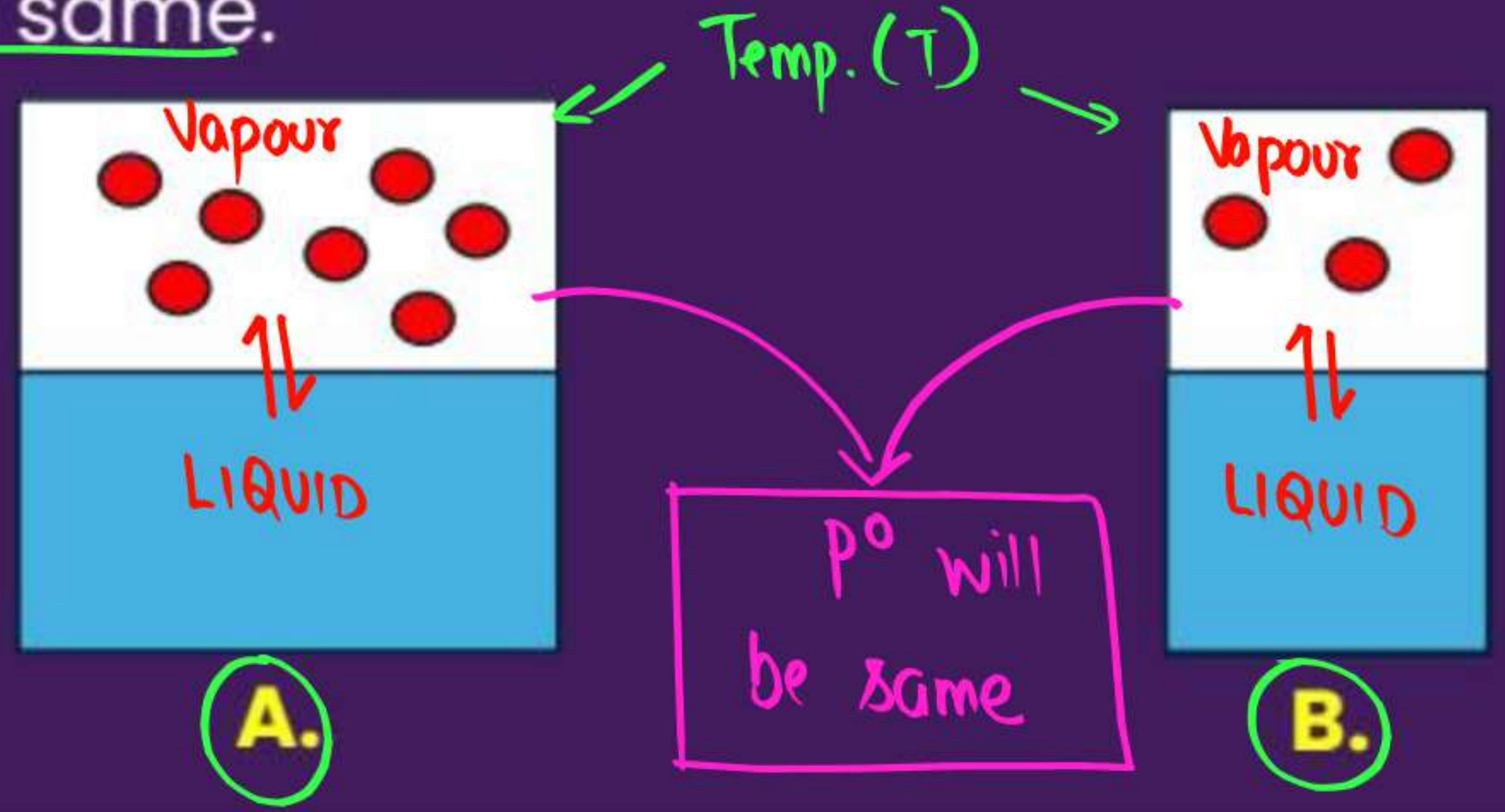
- We have already discussed gas-in-liquid solutions and now we will be discussing solid-in-liquid and liquid-in-liquid solutions.
- In our discussions we will be focused that:
  (a) the solutions are binary solutions (only 2 components).
  (b) generally, liquid solvents are volatile.

GIVE A THOUGHT

In the below cases A and B, the vapour pressure of the same liquid at the same temperature (T) in different shape or size of container is same.

A. Yes

B. No

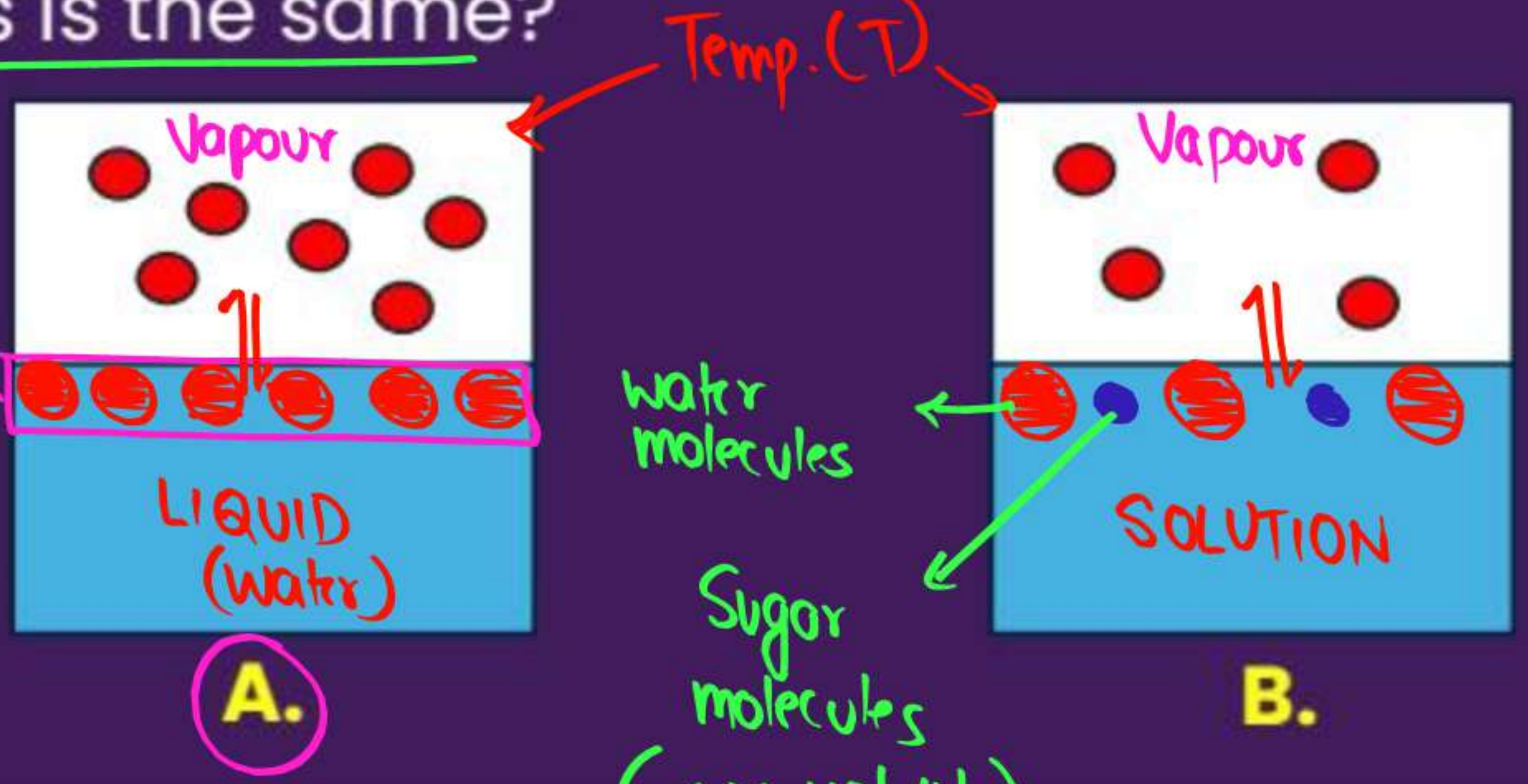


GIVE A THOUGHT

In case A we have pure liquid (water) and in case B (sugar + water) at the same temperature. Then vapour pressure in both the cases is the same?

A. Yes

B. No



Surface molecules that evaporate are of H_2O.

$$\boxed{P^o_{water} > P^o_{solution}}$$

REASON

- Volatile solvent vapourises less in case a non-volatile solute is present because particles of the volatile solvent reduces at the surface due to the presence of non-volatile solute particles.

- Hence, vapour pressure of pure liquid (P^o) > Vapour pressure of solution (P_s)

GIVE A THOUGHT

In A and B we have volatile liquids and on mixing they form solution C. Now, total vapour pressure in C would be the sum of partial vapour pressures of A and B.

A. Yes

B. No

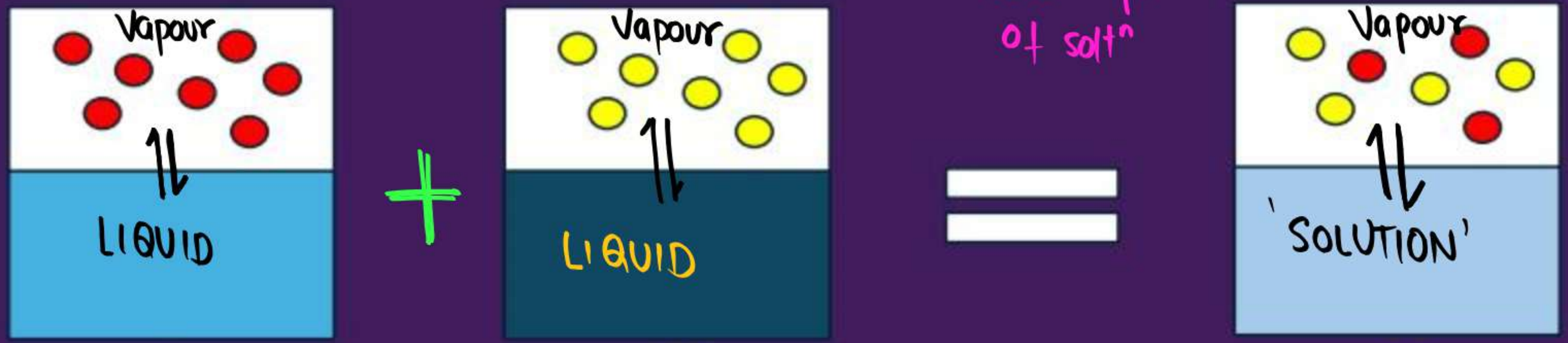
Dalton's Law

$$P_S = P_A + P_B$$

partial v.p. due to B

Total v.p. of soln

partial v.p. due to A



A. B. C.

GIVE A THOUGHT

In A and B we have volatile liquids and on mixing they form solution C. The partial vapour pressure of component A and B in case C is lesser than the vapour pressures (P°) of pure A and B.

A. Yes

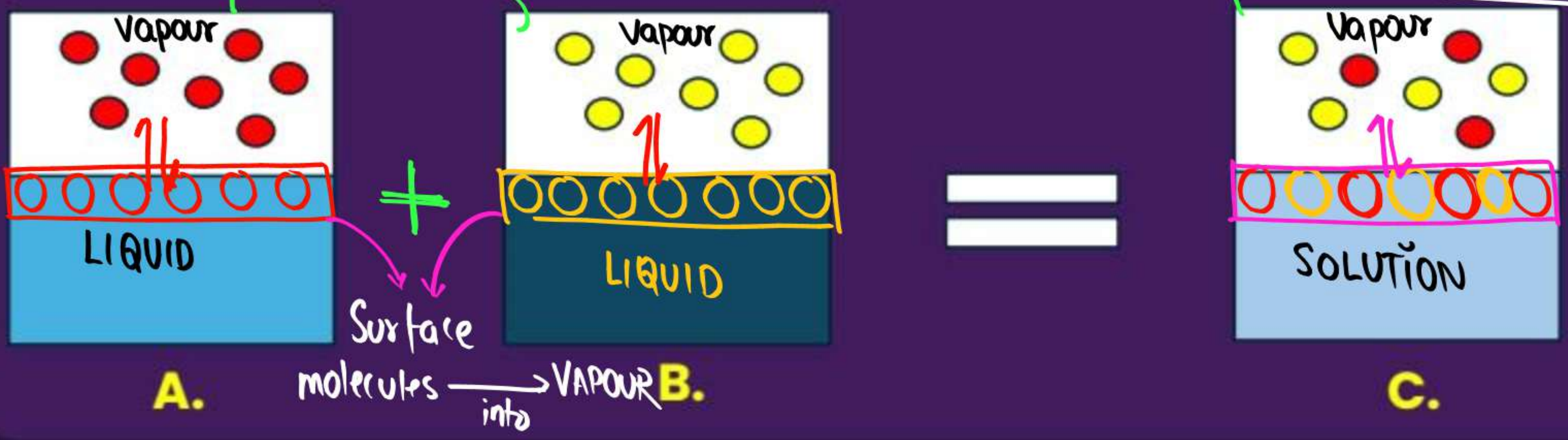
B. No

$p_A^o \rightarrow$ vapour pressure of pure A

$p_B^o \rightarrow$ v.p. of pure B

$\boxed{P_S = P_A + P_B}$

$\boxed{P_A < P_A^o \ \& \ P_B < P_B^o}$



REASON

- Because in a mixture, each volatile liquid has fewer molecules at the surface, so fewer escape into vapor, resulting in lower partial pressure than their vapour pressure in pure liquid.
- Hence, vapour pressure of a pure liquid (P^o) > Partial vapour pressure of the same liquid in a mixture

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RAOULT'S LAW

RAOULT'S LAW

For any solution, the partial vapour pressure of each volatile component in the solution is directly proportional to its mole fraction in the solution.

Let suppose we have a binary solution [Solute (non-volatile solid) + Solvent (volatile liquid)]

V.P. = 0

$P_A \propto X_A$

$P_A = K X_A$ - (1)

pure A, then $X_A = 1$

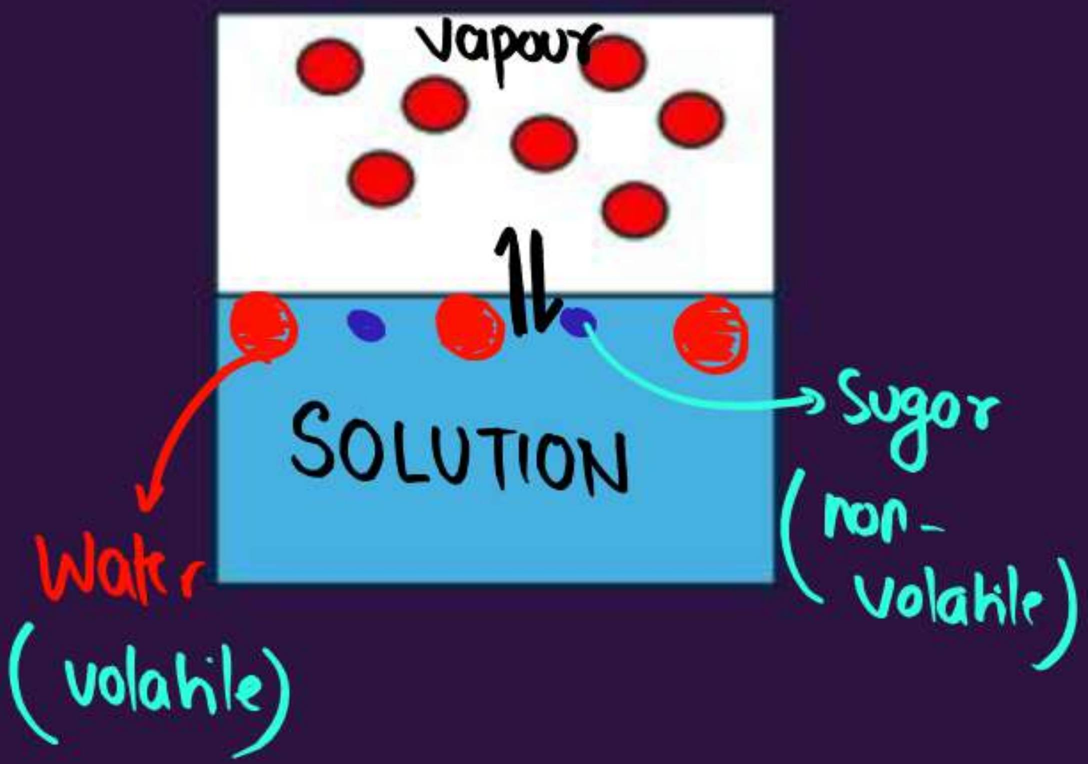
$P_A = K$

$\boxed{P^o_A = K}$ - (2)

from (1) & (2)

$$\boxed{P_A = P^o_A X_A}$$

CASE I: Non-volatile Solute and Volatile Solvent



ex: Sugar in water
Salt in water

$$P_{Total} \mid P_{soln} = \cancel{P_{sugar}}^{\,0} + P_{water}$$

(vapour pressure of soln)

$$\boxed{P_{soln} = P_{water} = P^{\circ}_{water} \chi_{water}}$$

(Sunil Bhaiya Doubt Hai)

$$\boxed{P_{soltn} = P_{H_2O} = P^{\circ}_{H_2O} \chi_{H_2O}}$$

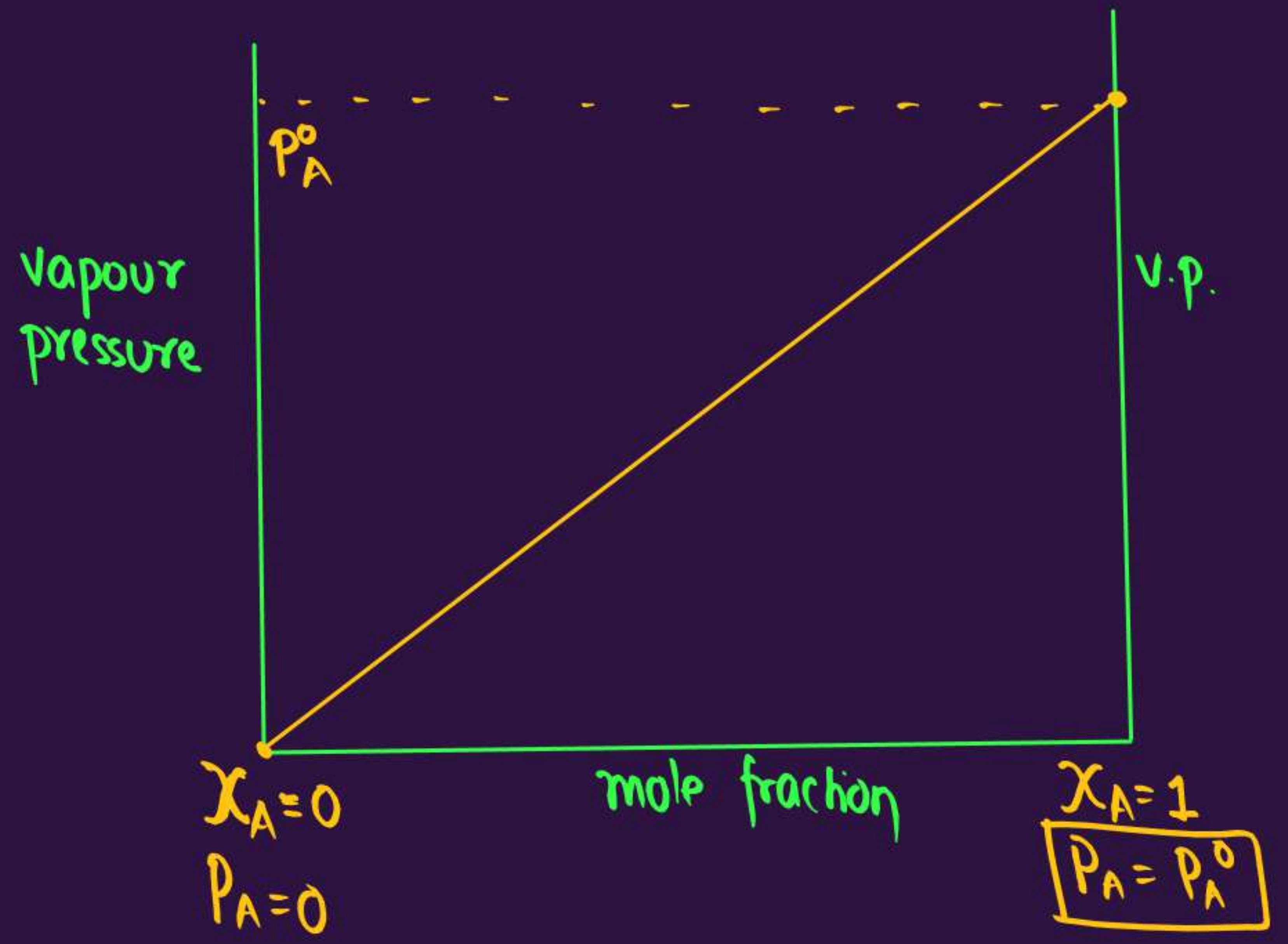
P_{soltn} or $P_{H_2O} < P^{\circ}_{H_2O}$

$\chi_{soltn} = 1$

$\chi_{H_2O} + \chi_{sugar} = 1$

it means $\boxed{\chi_{H_2O} < 1}$

Graph - Non-volatile Solute and Volatile Solvent



$$P_{soln} = \underbrace{\overset{\text{solvent}}{P_A}}_{v.p. \neq 0} + \underbrace{\overset{\text{solute}}{P_B}}_{v.p. = 0}$$

so,

$$\boxed{P_{soln} = P_A}$$

$$\downarrow$$

$$\boxed{\underbrace{P_A}_{y} = \underbrace{P_A^o}_{m} \underbrace{X_A}_{x}}$$

PYQS' WALLAH

CBSE PYQ

State Raoult's law for a solution containing volatile components.

For a solution containing volatile components, the partial vapour pressure of each volatile component in the solution is directly proportional to its mole fraction in the solution.

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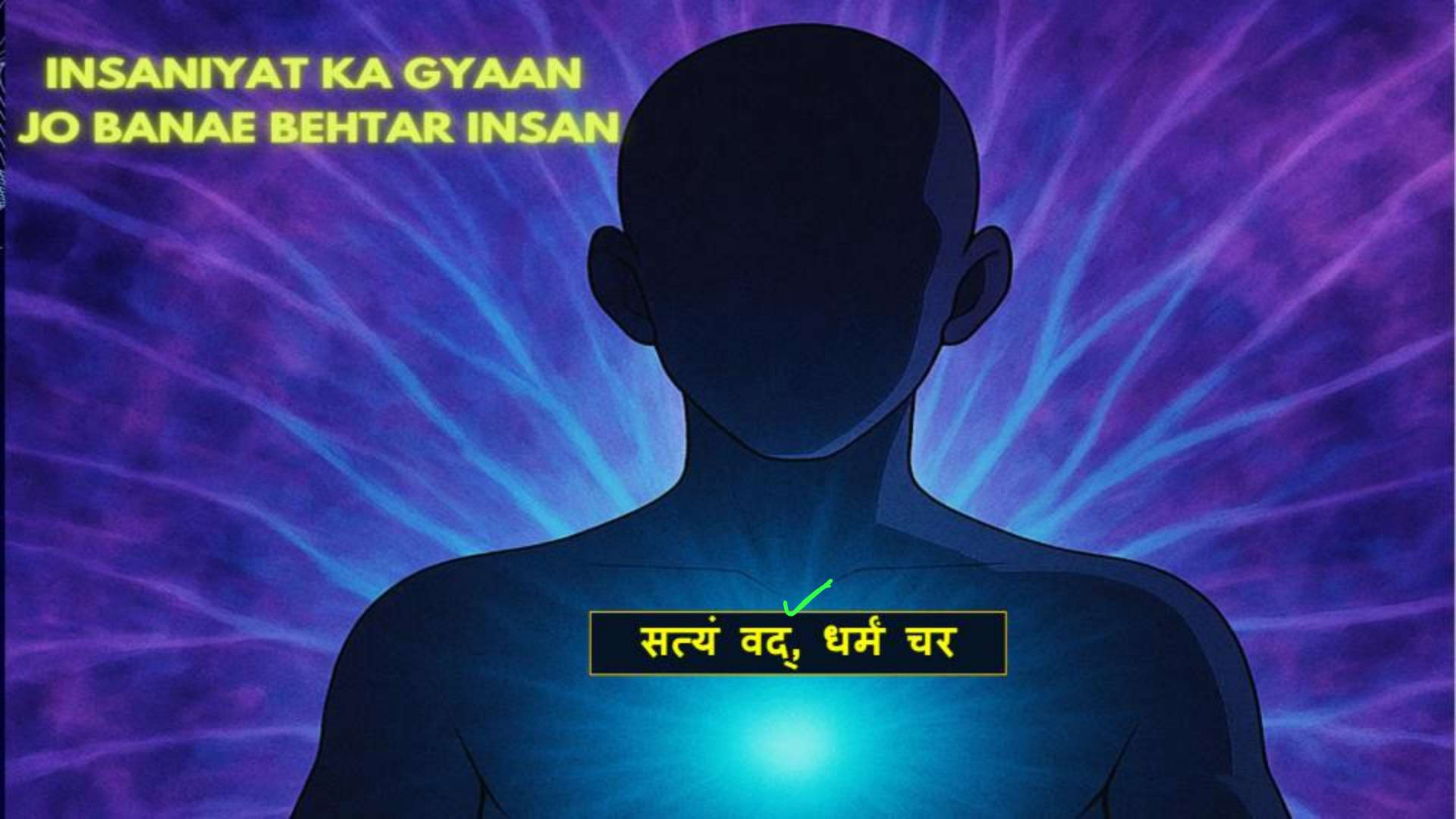
CONCEPT POLISH – HOMEWORK

Try to draw graph of two volatile components of a liquid-in-liquid solt^n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#pwsathhai (✓)

Thank You

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2026

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CHEMISTRY

Lecture 08

SOLUTIONS

Raoult's Law (Contd.), Ideal/Non-ideal Solutions and Azeotropes

BY – PRIYA-PUTRA-SUNIL

TOPICS TO BE COVERED

(i) Raoult's Law (Contd.)

(ii) Composition of Vapour Phase

(iii) Ideal and Non-ideal Solutions

(iv) Azeotropes and Their Types


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RAOULT'S LAW (CONTD.)

RAOULT'S LAW

For any solution, the partial vapour pressure of each volatile component in the solution is directly proportional to its mole fraction in the solution.

Last Class → binary soltⁿ [volatile solute & volatile solvent]

$P_A \propto X_A$

$$\boxed{P_{soltn/Total} = P_A + P_B}$$

(Total vapour pressure / Vapour pressure of soltⁿ)

$$\boxed{P_A = P^{\circ}_A X_A}$$

$$\boxed{P_B = P^{\circ}_B X_B}$$

$$\boxed{P_{soltn} = P^{\circ}_A X_A + P^{\circ}_B X_B} \quad ** \quad (1)$$

$X_A + X_B = 1$

$X_A = 1 - X_B$

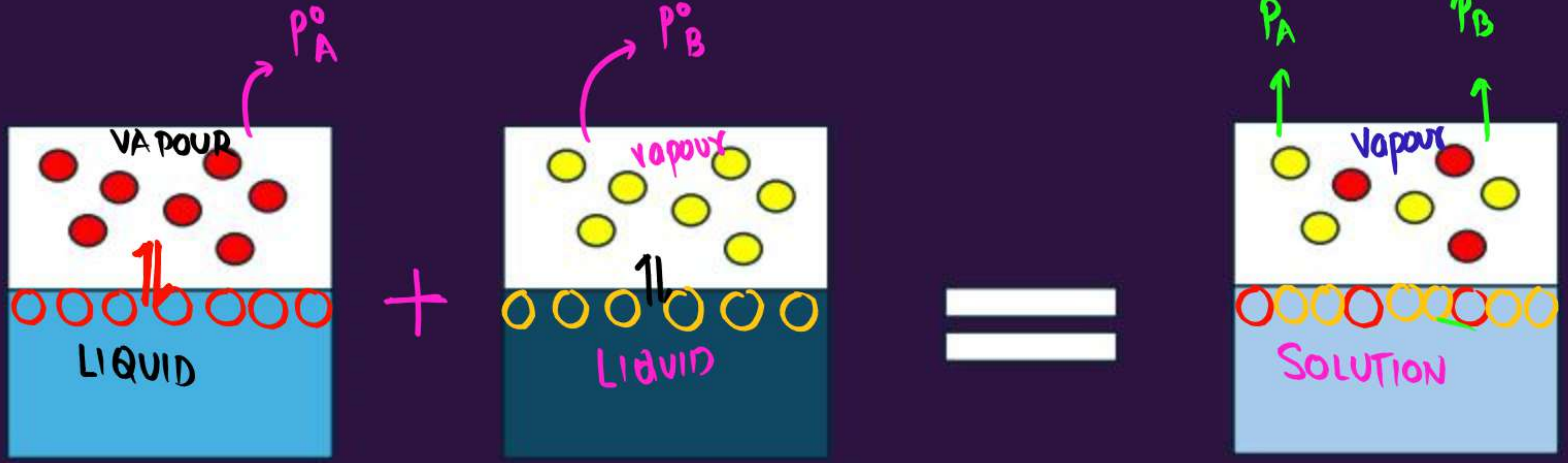
$$P_{soltn} = P^{\circ}_A (1 - X_B) + P^{\circ}_B X_B$$

$$P_{soltn} = P^{\circ}_A - P^{\circ}_A X_B + P^{\circ}_B X_B$$

$$\boxed{P_{soltn} = P^{\circ}_A + X_B (P^{\circ}_B - P^{\circ}_A)} \quad ** \quad (2)$$

Revision

CASE II: Volatile solute and Volatile Solvent



A. 'Solute'

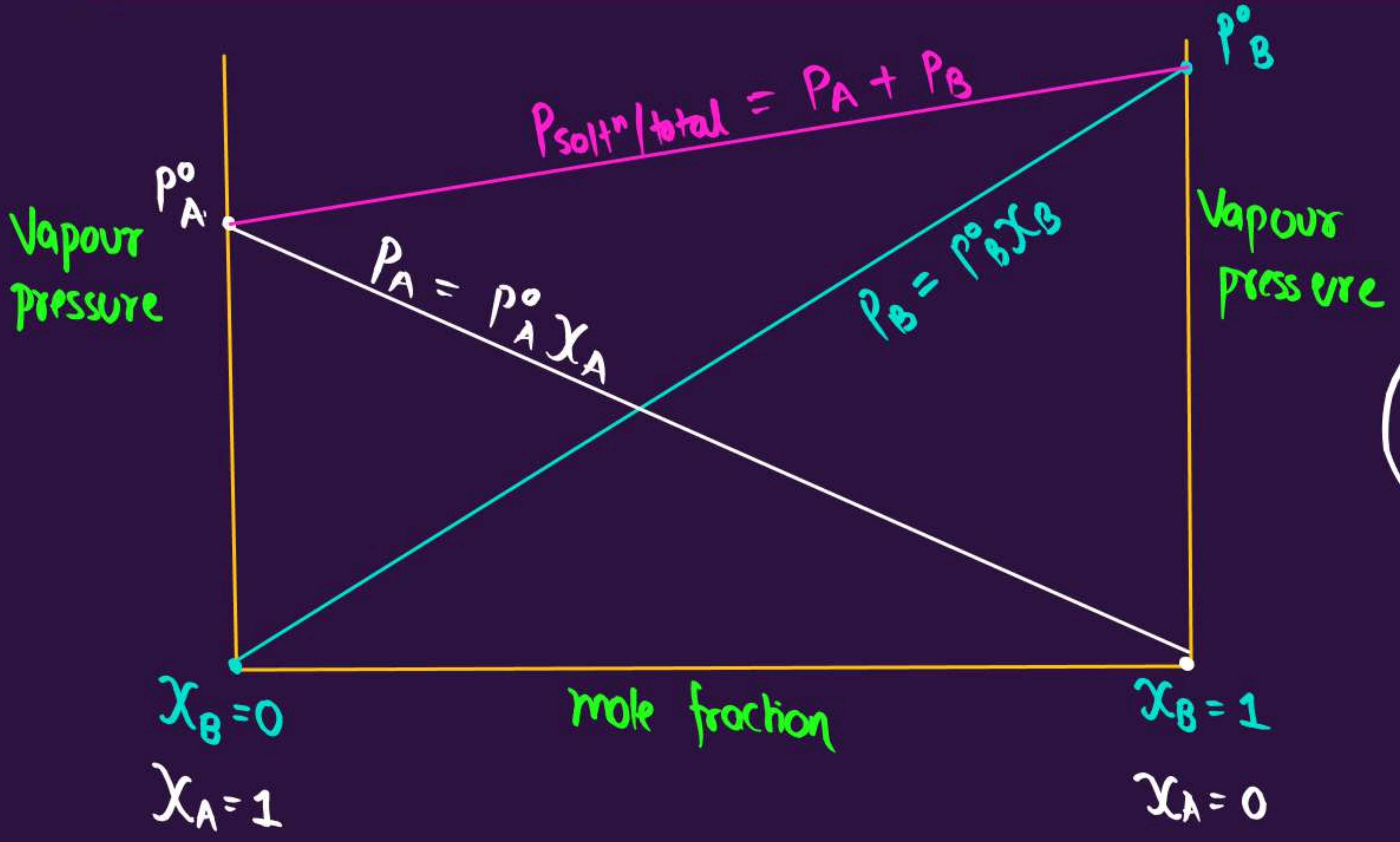
B. 'Solvent'

C.

$$\boxed{P_{soln} = P_A + P_B}$$

further derived in slide 5

Graph: Volatile solute and Volatile Solvent



$P_A = P^\circ_A \chi_A$

$P_B = P^\circ_B \chi_B$

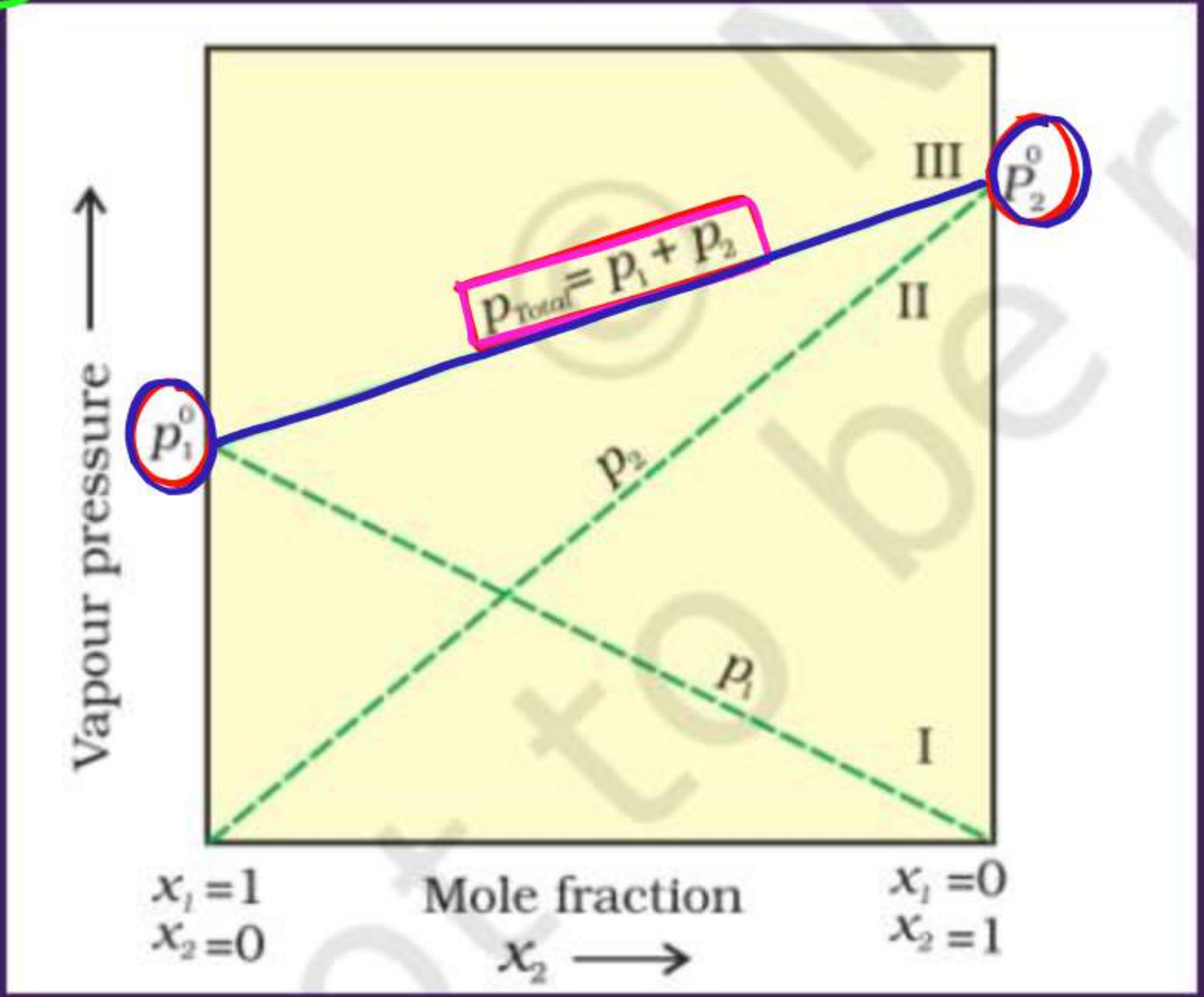
Here, B is more volatile than A

GIVE A THOUGHT

The minimum value of P_{total} is p_1^0 and the maximum value is p_2^0.

A. Yes

B. No

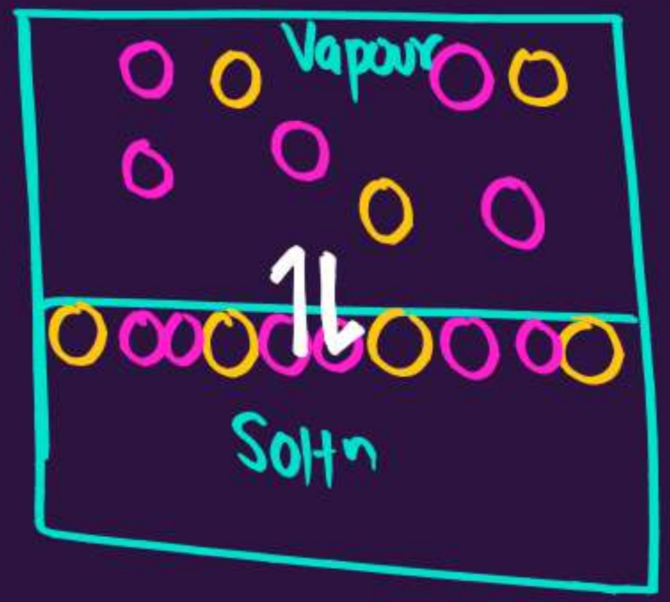


GIVE A THOUGHT

At equilibrium, vapour phase will be always rich in the component which is more volatile.

A. True

B. False



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LET'S PRACTICE

QUESTION

$(12\times6+6\times1) \rightarrow 72+6 \rightarrow 78$

92

If .78 g benzene (C_6H_6) and .92 g of toluene ($C_6H_5CH_3$) are mixed. Given that, P^o of benzene and toluene are 400 mm Hg and 200 mm Hg).

(a) Partial vapour pressure of benzene and toluene

(b) Total vapour pressure $\rightarrow 200+100 \rightarrow 300$ mm Hg

$$P_{soln} = P_b + P_t$$

$$P_{soln} = P^o_b \chi_b + P^o_t \chi_t$$

$$\chi_b + \chi_t = 1 \quad -(1)$$

$$\chi_b = \frac{n_b}{n_b+n_t} \quad -(2)$$

$$n_b = \frac{.78}{78\times10^2} = \frac{1}{10^2} = .01$$

$$n_t = \frac{.92}{92\times10^2} = \frac{1}{10^2} = .01$$

$$\chi_b = \frac{.01}{.02}$$

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

$\chi_t = \frac{1}{2} \leftarrow$ from (1)

$$P_b = P^o_b\chi_b = 400\times\frac{1}{2} = \boxed{200 \text{ mm Hg}}$$

$$P_t = P^o_t\chi_t = 200\times\frac{1}{2} = \boxed{100 \text{ mm Hg}}$$

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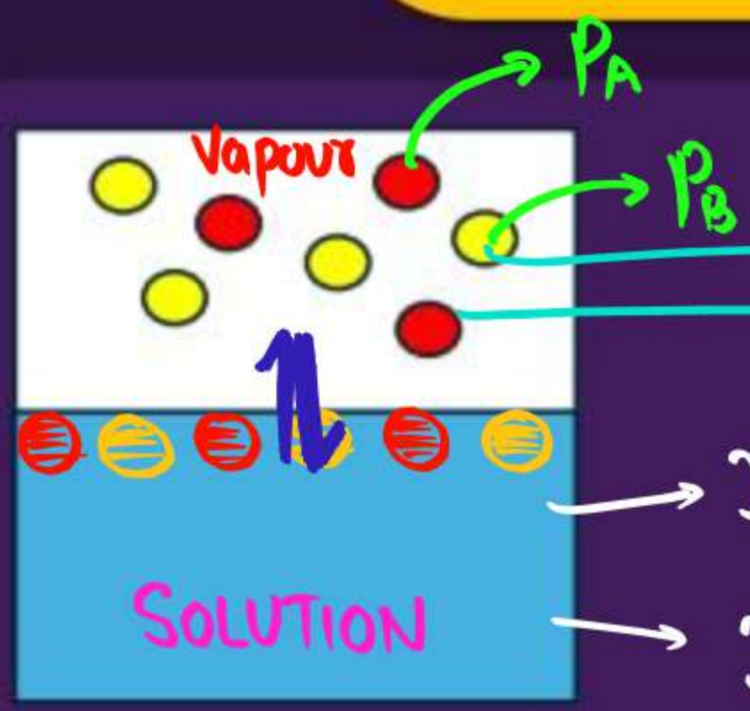
COMPOSITION OF VAPOUR PHASE

Competitive exams

COMPOSITION OF VAPOUR PHASE



y_B (mole fraction of A & B in vapour phase)
y_A

χ_A [mole fraction of A & B is soln)
χ_B

Dalton's law

mole fraction of A & B in soln

$$y_A = \frac{P_A}{P_{soln}} = \frac{P_A}{P_A + P_B} = \frac{P^o_A \chi_A}{P^o_A \chi_A + P^o_B \chi_B}$$

$$y_B = \frac{P_B}{P_{soln}} = \frac{P_B}{P_A + P_B} = \frac{P^o_B \chi_B}{P^o_A \chi_A + P^o_B \chi_B}$$

LET'S PRACTICE

NCERT INTEXT 1.8

The vapour pressure of pure liquids A and B are 450 and 700 mm Hg respectively, at 350 K . Find out the composition of the liquid mixture if total vapour pressure is 600 mm Hg. Also find the composition of the vapour phase.

Given: $P^\circ_A = 450$ mm Hg

$P^\circ_B = 700$ mm Hg

$P_{soln} = 600$ mm Hg

To find: (i) mole fraction of solⁿ (χ_A & χ_B)

(ii) — " — vapour phase

(i) $P_{soln} = P_A + P_B$

$P_{soln} = P^\circ_A \chi_A + P^\circ_B \chi_B$ On simplifying

$P_{soln} = P^\circ_A + \chi_B (P^\circ_B - P^\circ_A)$

$600 = 450 + \chi_B (700 - 450)$

$600 = 450 + \chi_B (250)$

$\overset{3}{\cancel{150}} = \chi_B \times \underset{5}{\cancel{250}}$

$\chi_B = \frac{3}{5} = .6$

$$x_A + x_B = 1$$

$$x_A = 1 - x_B$$

$$= 1 - \frac{3}{5}$$

$$= \frac{2}{5} = .4$$

(ii) $$y_A = \frac{P_A}{P_{soln}} = \frac{\cancel{180}}{\cancel{600}} = \frac{3}{10} = .3$$

$$P_A = P^0_A x_A$$

$$P_A = \cancel{450}^{90} \times \frac{2}{\cancel{5}}$$

$$P_A = 180$$

$$y_B = \frac{P_B}{P_{soln}} = \frac{\cancel{420}^{21}}{\cancel{600}_{30}} = \frac{\cancel{21}^{7}}{\cancel{30}_{10}} = \frac{7}{10} = .7$$

$$P_B = P^0_B x_B$$

$$= \cancel{700}_{140} \times \frac{3}{\cancel{5}} = 420$$

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LIKH DO.

AYE BHAIYA

IDEAL AND NON-IDEAL SOLUTIONS

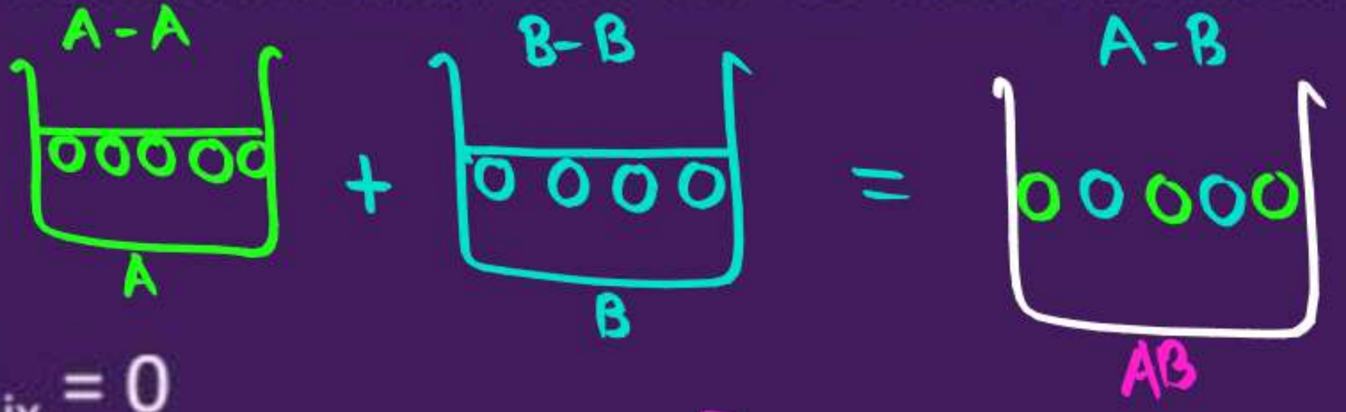
Liquid-liquid solt^n

IDEAL SOLUTIONS

- The solutions which obey Raoult's law over the entire range of concentration are known as ideal solutions.

$\boxed{P_{soltn} = P^\circ_A \chi_A + P^\circ_B \chi_B}$ → from Raoult's law (R.L.) , $\boxed{P_{soltn(experiment)} = P_{soltn(R.L.)}}$

- Intermolecular force of attraction:



$\boxed{A\text{-}A = B\text{-}B = A\text{-}B}$

- $\Delta V_{mix} = 0$

REASON:

ΔV_{mix} [change in volume of solt^n on mixing) $= V_{AB} - (V_A + V_B) = 0$

↳ no change occurs in intermolecular f.o.a. from solute & solvent to solution

ex: $50 - (30 + 20) = 0$

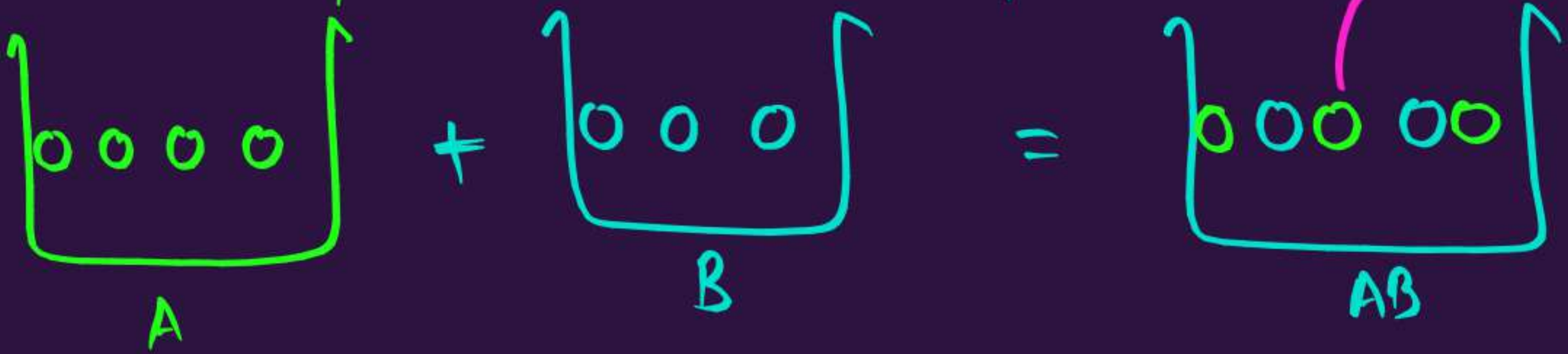
- $\boxed{\Delta H_{mix} = 0}$

REASON: ↓ next slide

A-A intermolecular f.o.a.

B-B intermolecular f.o.a.

A-B intermolecular f.o.a.



A ⁓ A

B ⁓ B

A - B

↓

Heat is released

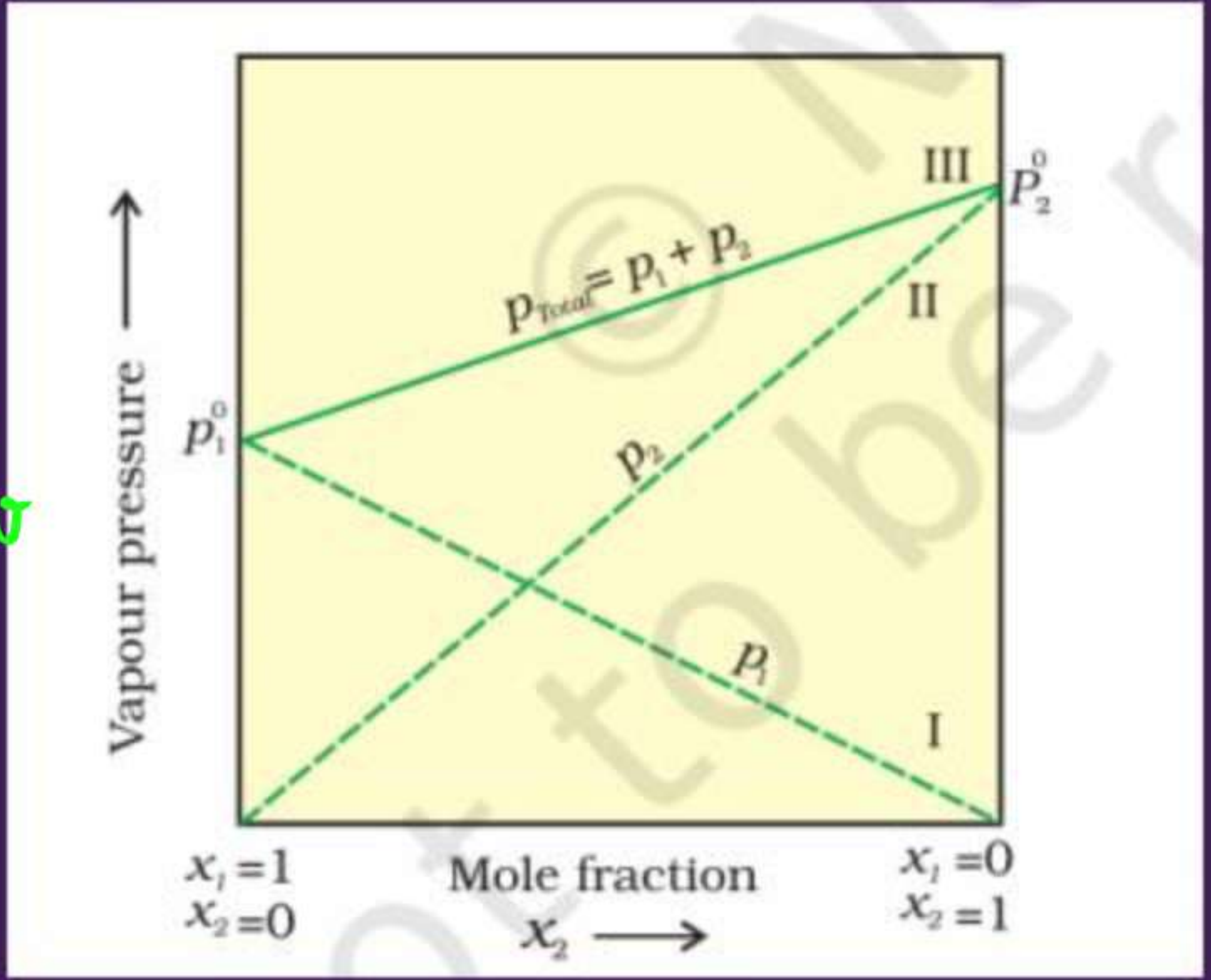
Heat is absorbed to break bonds

ΔH_{mix} [change in enthalpy on mixing] = Heat released − Heat absorbed = 0

EXAMPLE OF IDEAL SOLUTIONS

- n-hexane (C_6H_{14}) and n-heptane (C_7H_{16})
- bromoethane (C_2H_5Br) and chloroethane (C_2H_5Cl)
- benzene (C_6H_6) and toluene ($C_6H_5CH_3$)

follows Raoult's law



Liquid-liquid soltn

NON-IDEAL SOLUTIONS

- The solutions which do not obey Raoult's law over the entire range of concentration are known as non-ideal solutions.

$\boxed{P_{soltn} = P^o_A x_A + P^o_B x_B} \rightarrow$ Raoult's law

$\boxed{P_{soltn(exp)} \neq P_{soltn(R.L.)}}$

- Intermolecular force of attraction:

solute & solvent: A-A & B-B $\neq$ soltn: A-B

- $\boxed{\Delta V_{mix} \neq 0}$
- $\boxed{\Delta H_{mix} \neq 0}$

NON-IDEAL SOLUTIONS – NEGATIVE DEVIATION FROM RAOULT'S LAW

- $P_{total(exp.)} < P_{soln\,(R.L.)}$
- Intermolecular force of attraction: $\boxed{A-B > A-A \text{ or } B-B}$
- $\boxed{\Delta V_{mix} < 0}$
- $\Delta H_{mix} < 0$

A-B has strong intermolecular f.o.a. than A-A & B-B so molecules come more closer so occupies less volume

$$\Delta V_{mix} = V_{AB} - (V_A + V_B)$$

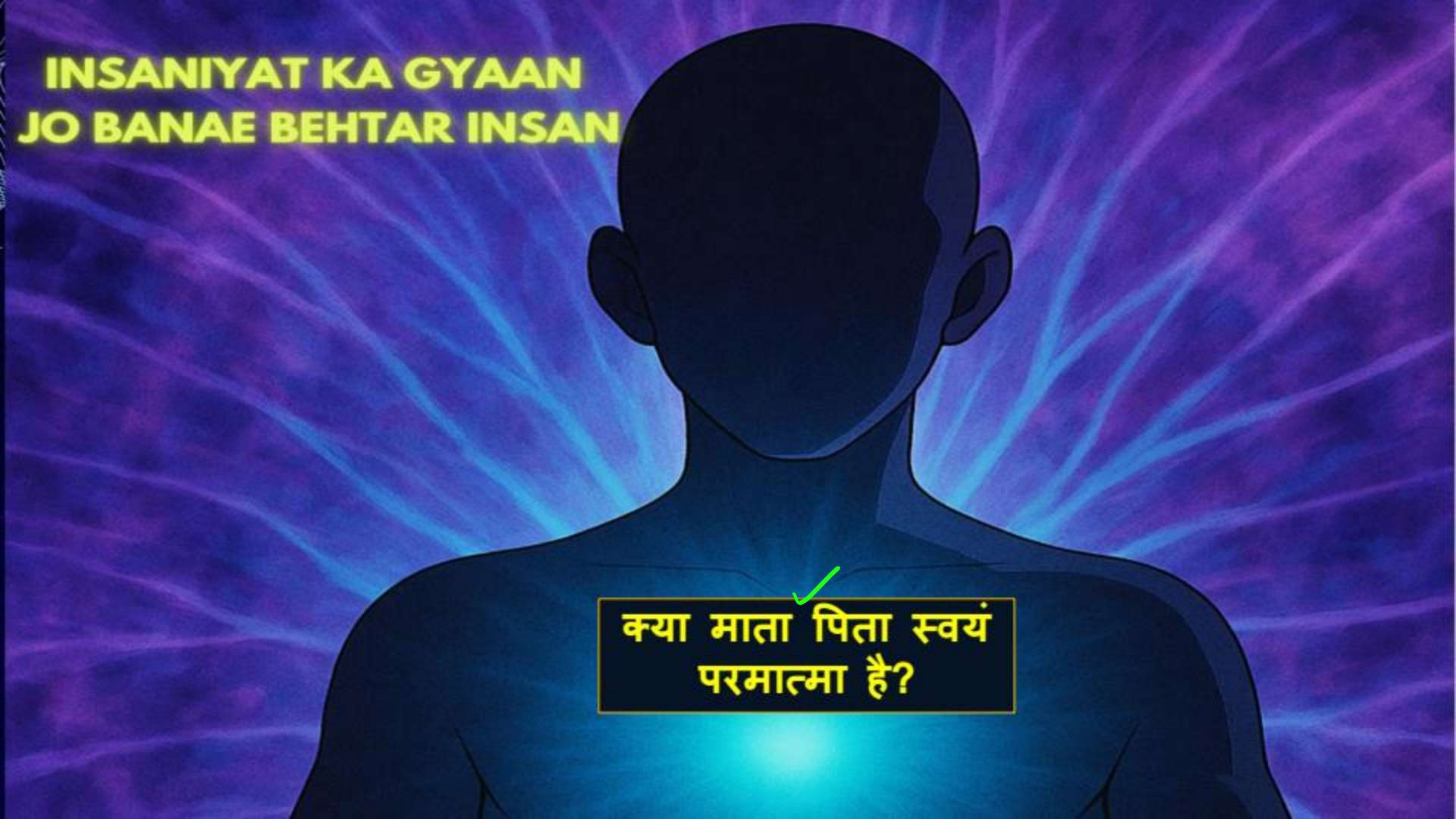
$$\boxed{\Delta V_{mix} < 0}$$

SAMAJ AAYA TOH LIKH DO.

AYE BHAIYA ✓

CONCEPT POLISH – HOMEWORK

NO HOMEWORK


INSANIYAT KA GYAAN
JO BANAE BEHTAR INSAN
क्या माता पिता स्वयं
परमात्मा है?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#pwsathhai

Thank You

PARISHRAM

2026

CHEMISTRY

Lecture 09

SOLUTIONS

Non-ideal Solutions, Azeotropes and Colligative Properties – Part I

BY – PRIYA-PUTRA-SUNIL

TOPICS TO BE COVERED

(i) Non-ideal Solutions (✓)

(ii) Azeotropes and Their Types (✓)

(iii) Introduction to Colligative Properties and RLVP (✓)


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NON IDEAL SOLUTIONS

(Liquid-liquid soltn)

NON-IDEAL SOLUTIONS

(I) • The solutions which do not obey Raoult's law over the entire range of concentration are known as non-ideal solutions.

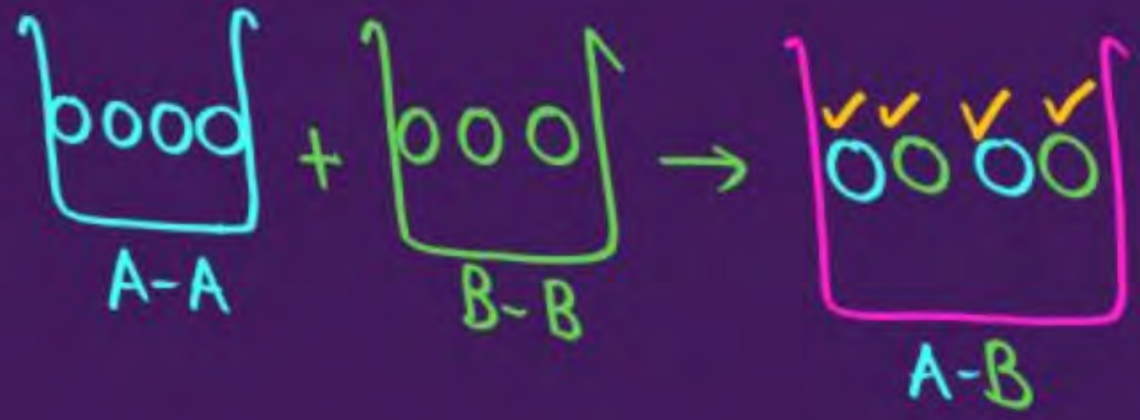
from Raoult's law →

$$P_{\text{solution}} = P_A^0 \cdot X_A + P_B^0 \cdot X_B$$

$$P_{(\text{experiment})} \neq P_{\text{solution (Raoult's Law)}}$$

The vapour pressure of solution is either higher or lower than that predicted by Raoult's law

(II) • Intermolecular force of attraction:
$\boxed{\text{A–A and B–B} \neq \text{A–B}}$



(III) • $\Delta V_{mix} \neq 0$

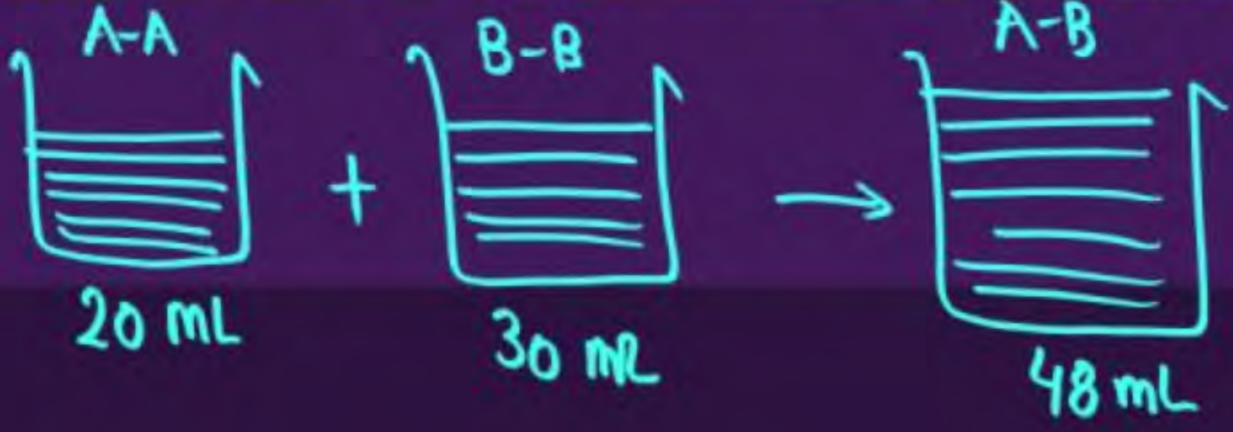
(IV) • $\Delta H_{mix} \neq 0$

NON-IDEAL SOLUTIONS – NEGATIVE DEVIATION FROM RAOULT'S LAW

v.p. of solt^n is lesser than v.p. of solution
[experimentally]   [calculated by Raoult's law]

- I. $P_{\cancel{total}\,soln}(exp.) < P_{solution(Raoult's\ Law)}$
- II. Intermolecular force of attraction: A–B > A–A or B–B
- III. $\Delta V_{mix} < 0$

A–B has strong intermolecular force of attraction than A–A and B–B. So, molecules A–B come closer and occupies less volume.



$$\Delta V_{mix} = 48 - (20 + 30)$$

$$\boxed{\Delta V_{mix} < 0}$$

NON-IDEAL SOLUTIONS – NEGATIVE DEVIATION FROM RAOULT'S LAW

IV • $\Delta H_{mix} < 0$ +100 kJ , −150 kJ

A-A and B-B absorbs less heat in breaking the bonds as compared to the heat released on the formation of stronger bonds A-B.

So, $\boxed{\Delta H_{mix} < 0}$ (exothermic, $\Delta H = -ve$).

NON-IDEAL SOLUTIONS – NEGATIVE DEVIATION FROM RAOULT'S LAW

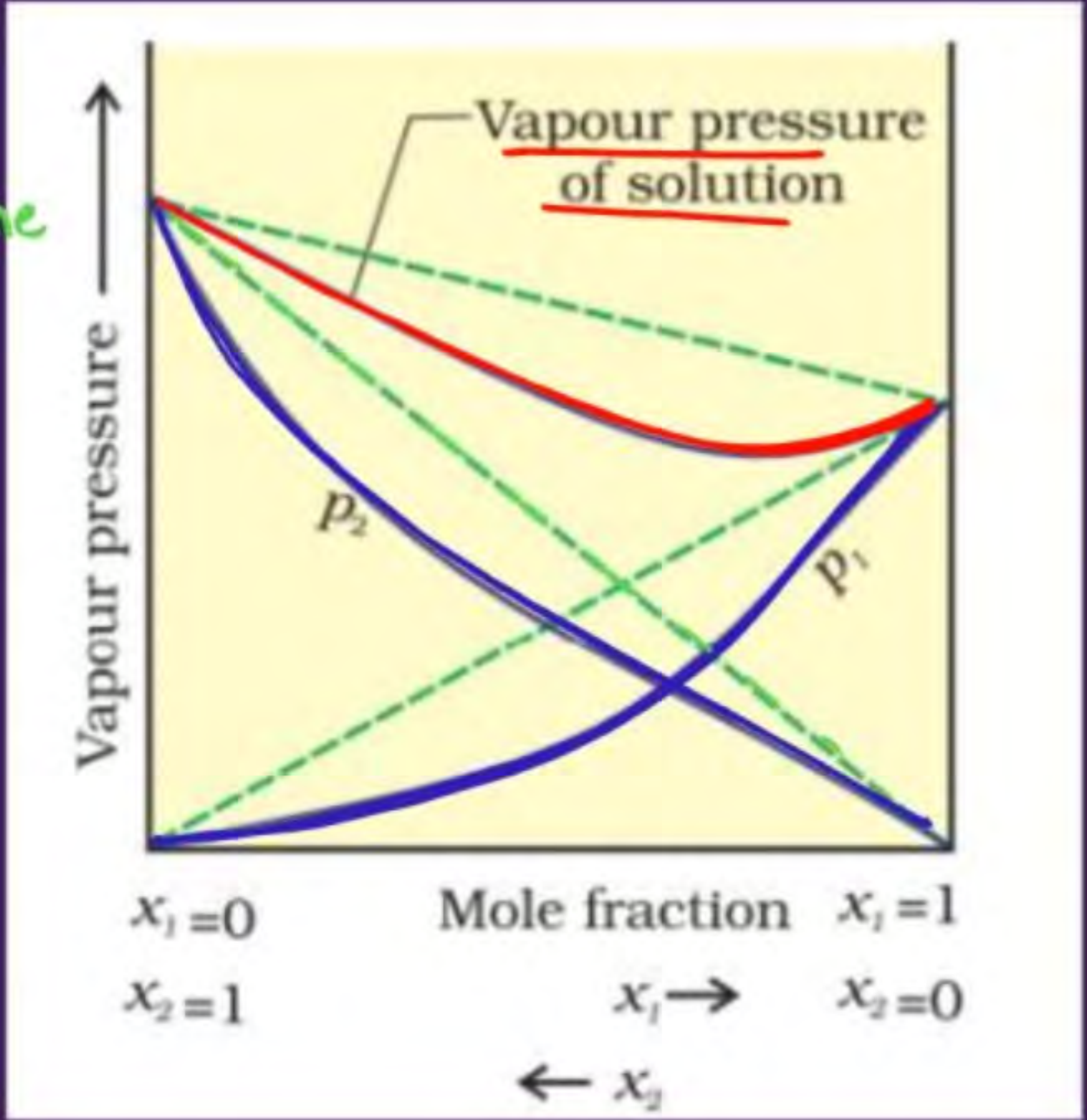
intermolecular f.o.a.

H.B. ↑ H.B ↑

- phenol and aniline
- acetone and chloroform

Stronger H.B. between phenol & aniline than phenol-phenol & aniline-aniline

Molecule Pair	Type of Interaction
Acetone – Acetone	Dipole–Dipole interactions
Chloroform – Chloroform	Dipole–Dipole + London dispersion
Acetone – Chloroform	Strong Hydrogen Bonding

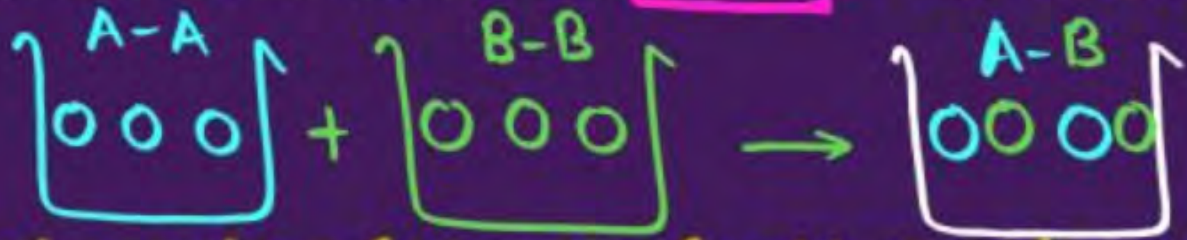


NON-IDEAL SOLUTIONS – POSITIVE DEVIATION FROM RAOULT'S LAW

v.p. of solⁿ (experimentally) is more than v.p. of solⁿ (from Raoult law)

(I) • $\boxed{P_{\cancel{\text{total}}\ \text{sol}}(\text{exp.}) > P_{\text{solution}}(\text{Raoult's Law})}$

(II) • Intermolecular force of attraction: A–B < A–A or B–B



(III) • $\Delta V_{mix} > 0$

A–B has weak intermolecular force of attraction than A–A and B–B. So, molecules of A–B goes further apart and occupies more volume.

$$\Delta V_{mix} = 52\ mL - (20\ mL + 30\ mL)$$

$$\boxed{\Delta V_{mix} > 0}$$

NON-IDEAL SOLUTIONS – POSITIVE DEVIATION FROM RAOULT'S LAW

IV

- $\Delta H_{mix} > 0$

A–A and B–B absorbs more heat in breaking the bonds as compared to the heat released on the formation of weaker bonds A–B.

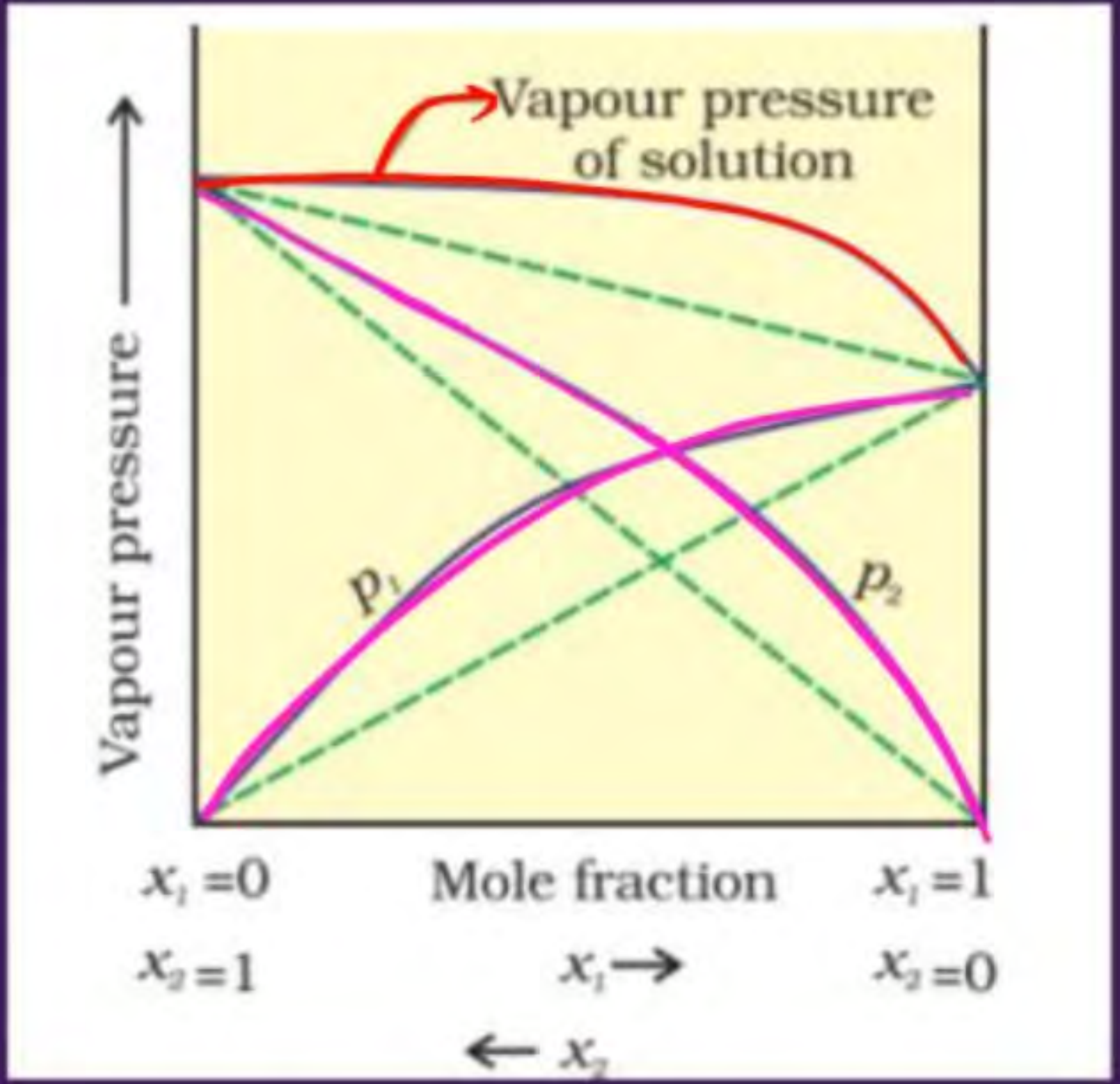
So, $\Delta H_{mix} > 0$ (endothermic, $\Delta H = +ve$).

NON-IDEAL SOLUTIONS – POSITIVE DEVIATION FROM RAOULT'S LAW

- ethanol and acetone
- carbon disulphide and acetone

Interaction Pair	Type of Interactions	Relative Strength
Ethanol–Ethanol	Hydrogen bonding, dipole-dipole	Very Strong
Acetone–Acetone	Dipole-dipole	Moderate
Ethanol–Acetone	Hydrogen bonding	Strong

Interaction Pair	Type of Interactions	Relative Strength
Acetone–Acetone	Dipole-dipole	Moderate
CS_2–CS_2	London dispersion only	Very Weak
Acetone–CS_2	Dipole-induced dipole, dispersion	Weak



SAMAJ AAYA TOH LIKH DO.

AYE BHAIYA

PYQS' WALLAH

CBSE PYQ

Define the following terms:
(a) Ideal solutions
(b) Non-ideal solutions

- The solutions which obey Raoult's law over the entire range of concentration are known as ideal solutions.
- When a solution does not obey Raoult's law over the entire range of concentration, then it is called non-ideal solution

CBSE PYQ

Write two characteristics of solution that obey Raoult's law at all concentrations.

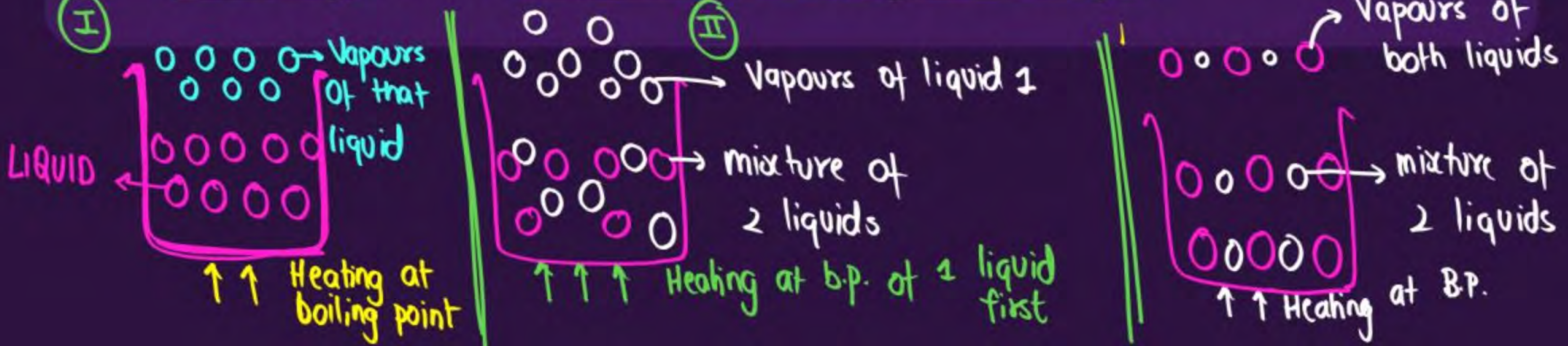
- The solutions which obey Raoult's law over the entire range of concentration are known as ideal solutions. For such solutions:
- $\Delta V_{mix} = 0$
- $\Delta H_{mix} = 0$

AZEOTROPES

AZEOTROPES

having 2 components

- They are binary mixtures having the same composition in liquid and vapour phase and boil at a constant temperature.
- In such cases, it is not possible to separate the components by fractional distillation. / distillation → used when there exists a boiling point difference b/w. liquids
- There are two types of azeotropes called **minimum boiling azeotrope** and **maximum boiling azeotrope**.



TYPES OF AZEOTROPES

MINIMUM BOILING AZEOTROPE

- Positive deviation from Raoult's law
- Molecules attract each other **less strongly** than pure components → vapour pressure **higher** → boiling point **lower**.
- Example: **Ethanol + Water (95.6% ethanol)** boils at **78.1 °C** (boiling point of ethanol = 78.3 °C, water = 100 °C)

mixture ka boiling point, individual components se kam hai.

TYPES OF AZEOTROPES

MAXIMUM BOILING AZEOTROPE

- Negative deviation from Raoult's law
- Molecules attract each other **more strongly** than pure components → vapour pressure **lower** → boiling point **higher**.
- Example: **Nitric acid + Water (68% nitric acid)** boils at **120.5 °C**
  (boiling point of nitric acid = 86 °C, water = 100 °C)

→ mixture ka b.p., individual component ke b.p. से high hai!

PYQS' WALLAH

CBSE PYQ

Why a mixture of carbon disulphide and acetone shows positive deviation from Raoult's law? What type of azeotrope is formed by this mixture?

- It is because the intermolecular force of attraction between carbon disulphide and acetone molecules are weaker than those in pure carbon disulphide and pure acetone.
- As a result the molecules can escape more easily into the vapour phase, increasing vapour pressure and showing positive deviation from Raoult's law.
- This mixture forms a minimum boiling azeotrope because of the higher vapour pressure and lower boiling point than either component.

(Boards में most of the sawaal)

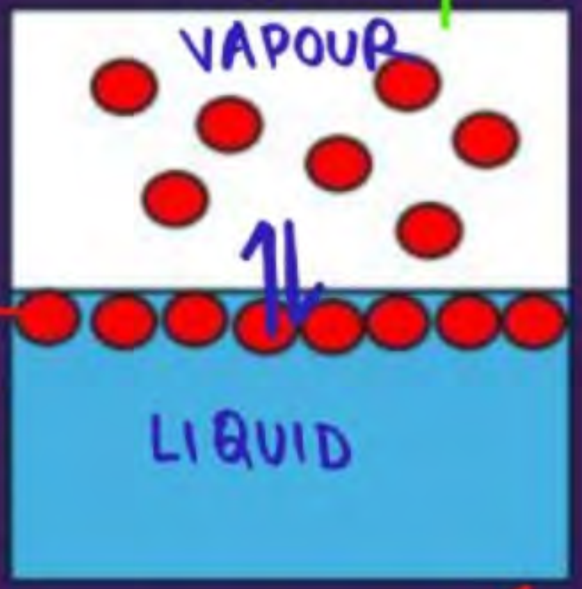
*****

INTRODUCTION TO COLLIGATIVE PROPERTIES AND RLVP

NON-VOLATILE SOLUTE IN VOLATILE SOLVENT

$P^{\circ}_{H_2O} \rightarrow$ vapour pressure of pure H_2O

Surface molecule



P_{H_2O}

Sugar particles

Water

A. Volatile ~~Solvent~~ liquid

ex: H_2O

B. Non-volatile solute in volatile solvent

ex: Sugar in water

$P^{\circ}_{H_2O} > P_{H_2O}$ — (I)

$P_{solution} = P_{H_2O} + \cancel{P_{sugar}}$ 0

$\boxed{P_{solution} = P_{H_2O}}$ — (II)

$\boxed{P^{\circ}_{H_2O} > P_{solution}}$

INTRODUCTION TO COLLIGATIVE PROPERTIES

- The vapour pressure of solution decreases when a non-volatile solute is added to a volatile solvent.
- Properties like relative lowering of vapour pressure of solvent, depression of freezing point of solvent, elevation of boiling point of solvent and osmotic pressure of the solution are connected with this lowering of vapour pressure and are called colligative properties.
- Colligative properties depend 'only on number of solute particles' relative to total number of particles of solution and not on their type and nature.

RELATIVE LOWERING OF VAPOUR PRESSURE OF SOLVENT

Solvent → A

Solute → B

The vapour pressure of a solvent in solution (non-volatile solute + volatile solvent) is less than that of the pure solvent. So, according to Raoult's law:

$$\boxed{P_A = P^\circ_A \chi_A}$$

$[P_A < P^\circ_A]$

$\chi_A + \chi_B = 1$

$\chi_B = 1 - \chi_A$

Lowering of vapour pressure → $\boxed{P^\circ_A - P_A = \Delta P_A}$

$$\Delta P_A = P^\circ_A - P^\circ_A \chi_A$$

$$\Delta P_A = P^\circ_A (1 - \chi_A)$$

$$\Delta P_A = P^\circ_A \chi_B$$

$$P^\circ_A - P_A = P^\circ_A \chi_B$$

$$\boxed{\frac{P^\circ_A - P_A}{P^\circ_A} = \chi_B}$$

mole fraction of non-volatile solute

Relative to

LOWERING OF V.P.

$$\Rightarrow \frac{P^\circ_A - P_A}{P^\circ_A} = X_B$$

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

$$\Rightarrow \frac{P^\circ_A - P_A}{P^\circ_A} = \frac{n_B}{n_B + n_A}$$

for dilute solt^n

$(n_B << n_A)$

↓

so neglect n_B in denominator

$$\Rightarrow \frac{P^\circ_A - P_A}{P^\circ_A} = \frac{n_B}{n_A}$$

$$\Rightarrow \frac{P^\circ_A - P_A}{P^\circ_A} = \frac{\frac{W_B}{M_B}}{\frac{W_A}{M_A}} \Rightarrow \boxed{\frac{P^\circ_A - P_A}{P^\circ_A} = \frac{W_B}{M_B} \times \frac{M_A}{W_A}}$$

**

PYQS' WALLAH

CBSE PYQ

Derive a relationship between relative lowering of vapour pressure and molar mass of solute.

(Slide no. 27 & 28)

CBSE PYQ

Vapour pressure of water at 20 ^{0}C is $\boxed{17.5 \text{ mm Hg}}$. Calculate the vapour pressure of water at 20 ^{0}C when 15 g of glucose (molar mass = 180 g/mol) is dissolved in 150 g of water.

non-volatile solute

Given: $P_A^0 = 17.5$ mm Hg

$P_A = ?$, $W_B = 15$ g , $M_B = 180$ g/mol , $W_A = 150$ g , $M_A = 18$ g/mol

$$\Rightarrow \frac{P_A^0 - P_A}{P_A^0} = \frac{W_B}{M_B} \times \frac{M_A}{W_A}$$

$$\Rightarrow \frac{17.5 - x}{17.5} = \frac{\cancel{15}}{\cancel{180}_{10}} \times \frac{\cancel{18}}{\cancel{150}_{10}}$$

$$\Rightarrow 17.5 - x = \frac{17.5}{100}$$

$$\Rightarrow 17.5 - x = .175$$

$$\Rightarrow \boxed{17.325 = x}$$

$$\begin{array}{r} 17.500 \\ .175 \\ \hline 17.325 \\ \hline \end{array}$$

CBSE PYQ

A solution is prepared by dissolving 5 g of non-volatile solute in 95 g of water. It has a vapour pressure of 23.375 mm Hg at 25 ^{0}C. Calculate the molar mass of solute (vapour pressure of pure water at 25 ^{0}C is 23.75 mm Hg).

$$\begin{array}{r} 23.750 \\ 23.375 \\ \hline 00.375 \end{array}$$

Given: $W_B = 5\ g$, $W_A = 95\ g$, $M_A = 18\ g/mol$

$P_A = 23.375$ mm Hg, $M_B = ?$ $\quad P^o_A = 23.75$ mm Hg

$$\Rightarrow \frac{P^o_A - P_A}{P^o_A} = \frac{W_B}{M_B} \times \frac{M_A}{W_A}$$

$$\Rightarrow \frac{23.75 - 23.375}{23.75} = \frac{\cancel{5}}{x} \times \frac{18}{\cancel{95}_{19}}$$

$$x = \frac{\cancel{18}^{6} \times \cancel{23.75}^{\cancel{475}\ \cancel{95}\ 5} \times \cancel{1000}^{2}}{\cancel{19} \times \cancel{.375}_{\cancel{75}\ \cancel{15}\ \cancel{3}} \times \cancel{100}}$$

$x = 60$

CONCEPT POLISH - HOMEWORK

QUESTION

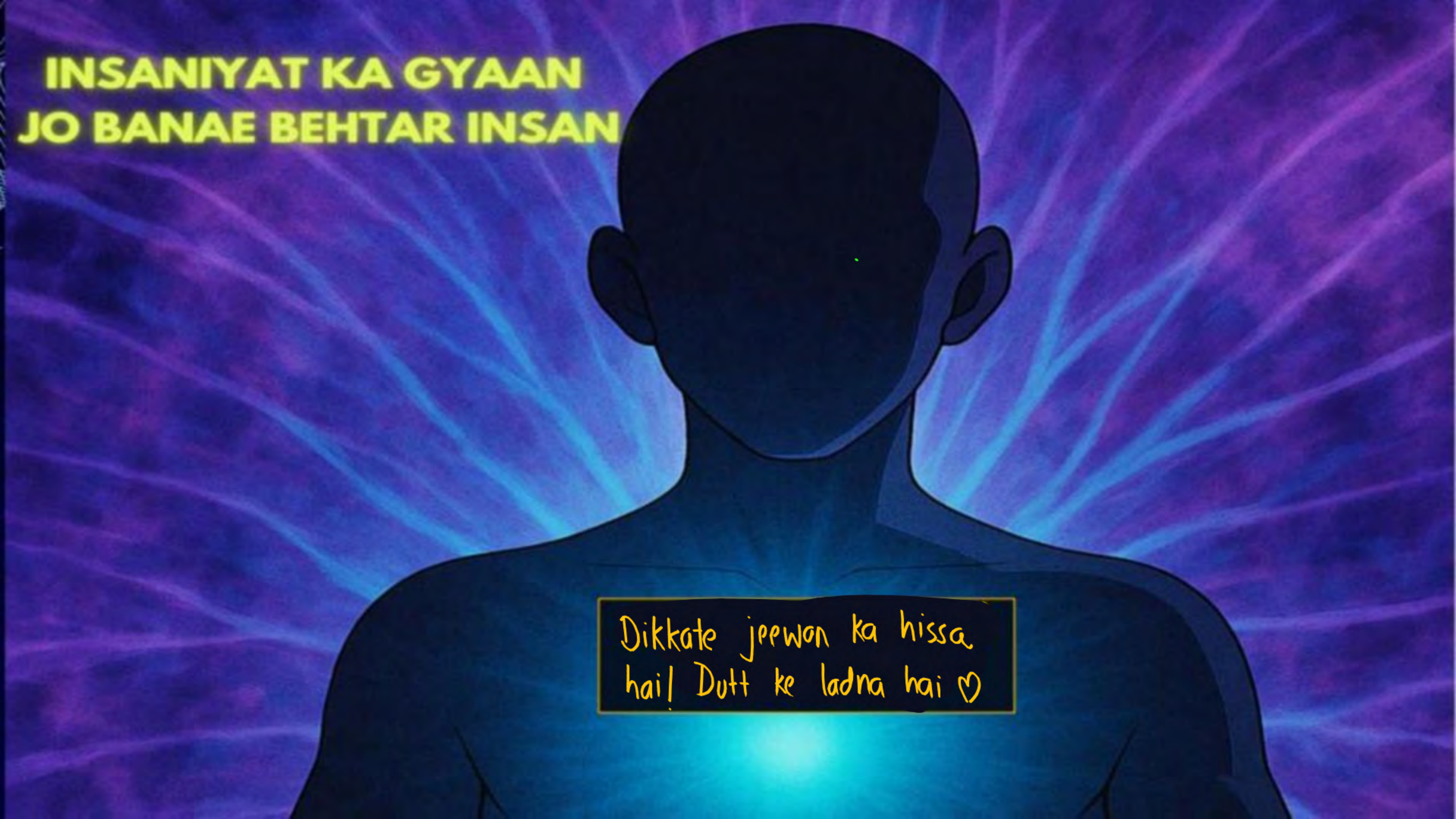
Do a research through AI about how Raoult's law as a special case of Henry's law.

QUESTION

Why a mixture of ethanol-acetone and carbon disulphide-acetone shows positive deviation?

CBSE PYQ

A solution is prepared by dissolving 10 g of non-volatile solute in 200 g of water. It has a vapour pressure of 31.84 mm Hg at 308 K. Calculate the molar mass of solute (vapour pressure of pure water at 308 K is 32 mm Hg).


INSANIYAT KA GYAAN
JO BANAE BEHTAR INSAN
Dikkate jeewon ka hissa
hai! Dutt ke ladna hai ♡

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#sbsathhai ✓

#pwsathhai ✓

Thank You

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2026

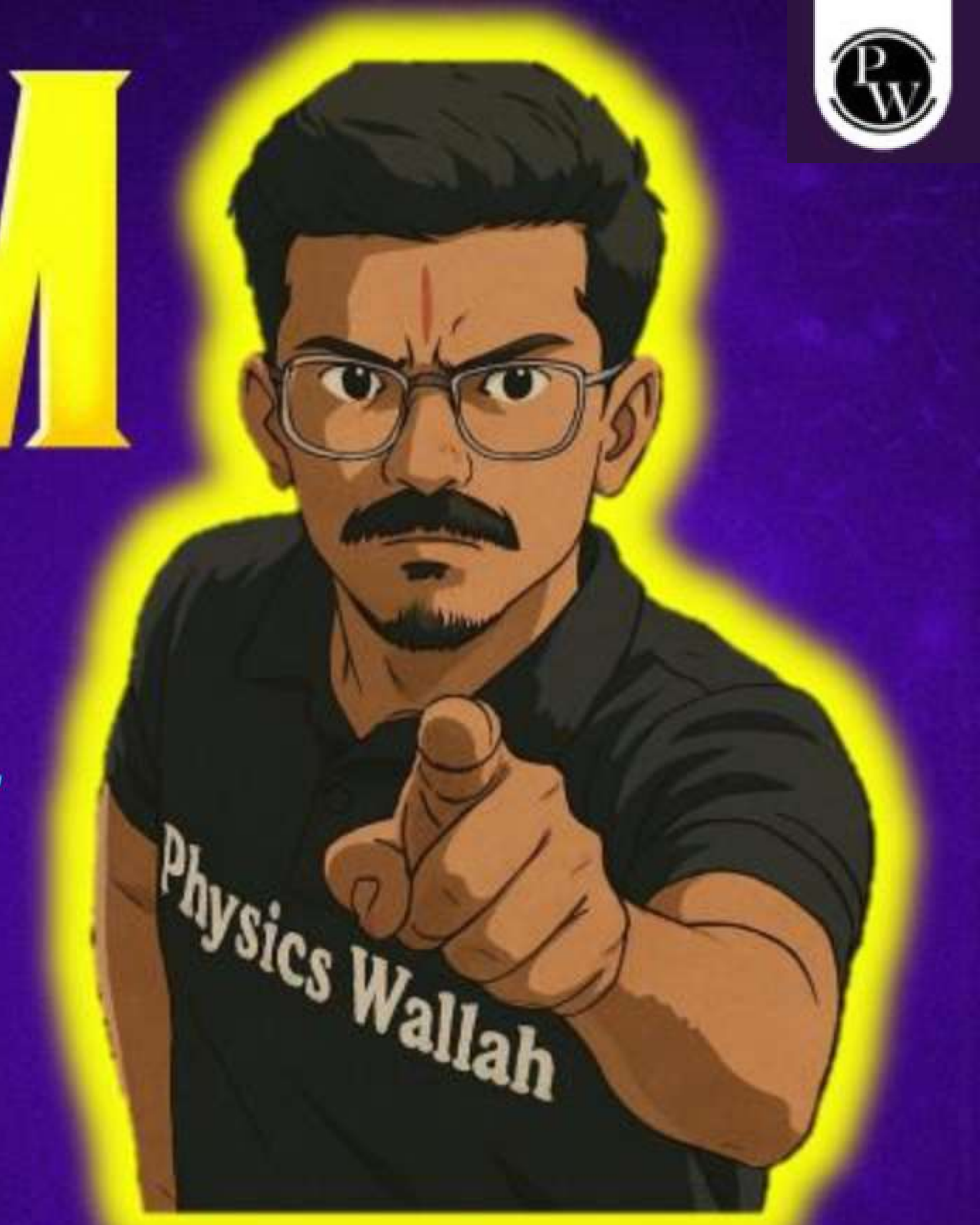
CHEMISTRY

Bharat Mata Ki Jai ♡

Lecture 10

SOLUTIONS

Colligative Properties – Part II (Elevation of Boiling Point and Depression of Freezing Point)



BY – PRIYA-PUTRA-SUNIL

TOPICS TO BE COVERED

'crystal clear'

(i) What is boiling and Boiling Point? (✓)

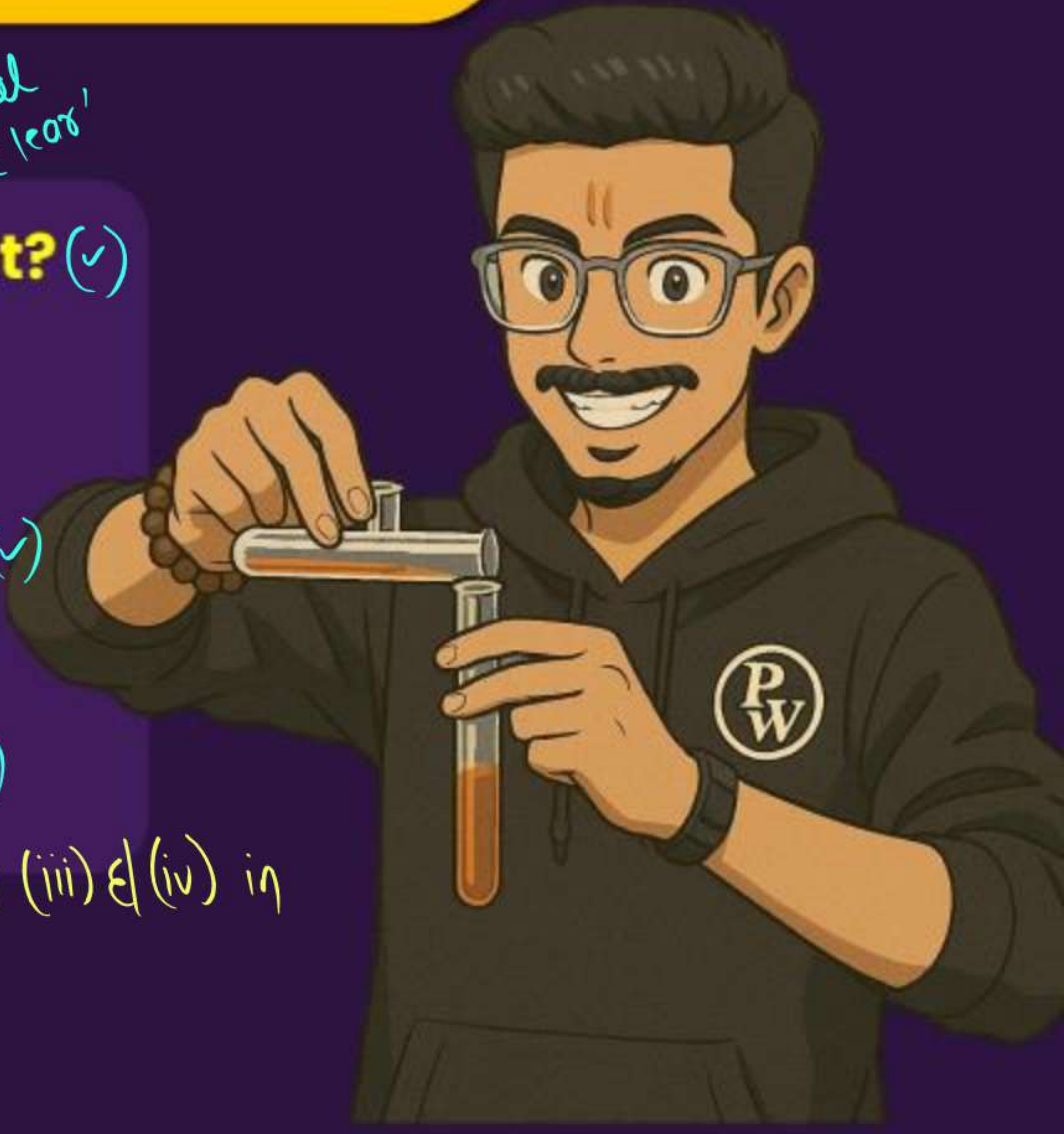
(ii) Elevation of Boiling Point (✓)

(iii) What is Freezing and Freezing Point? (✓)

'In next class'

(iv) Depression of Freezing Point (✓)

SKIP QUESTIONS FROM (iii) & (iv) in DHA

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CONCEPT POLISH – HOMEWORK DISCUSSION

QUESTION

Why a mixture of ethanol-acetone and carbon disulphide-acetone shows positive deviation?

- Ethanol molecules have strong hydrogen bonding between them which gets disrupts when acetone is mixed with ethanol. The interaction between ethanol-acetone molecules is also hydrogen bonding but weaker than ethanol-ethanol.
- Similarly, acetone-acetone molecules have strong dipole-dipole interaction which becomes weaker when carbon disulphide is mixed with acetone.
- In both the cases the total vapour pressure of solution observed experimentally is more than what is calculated by Raoult's law.

CBSE PYQ

'RLVP of solvent'

A solution is prepared by dissolving 10 g of non-volatile solute in 200 g of water (solvent). It has a vapour pressure of 31.84 mm Hg at 308 K. Calculate the molar mass of solute (vapour pressure of pure water at 308 K is 32 mm Hg).

$$\frac{P_A^\circ - P_A}{P_A^\circ} = \frac{W_B}{M_B} \times \frac{M_A}{W_A}$$

$$= \frac{32 - 31.84}{32} = \frac{10}{x} \times \frac{18}{200}$$

$$= \frac{.16}{32} = \frac{9}{10 \times x}$$

$$= x = \frac{9 \times 32 \times 100}{10 \times .16}$$

$$\boxed{x = 180 \ \frac{g}{mol}}$$

QUESTION

Do a research through AI about how Raoult's law as a special case of Henry's law.

Henry's Law

Gas-in-Liquid Soltⁿ

Liquid-in-liquid soltⁿ → Raoult's law is also applicable

↓

excessively volatile

↓

Converts to gas

↓

gas-in-liquid soltⁿ

↓

$$\boxed{P = K_H \chi} \quad -(1)$$

↓

$$P_A = P_A^\circ \chi_A \quad -(2)$$

from (1) & (2)

(i) $P = P_A$

(ii) mole fraction is also same

(iii) $K_H = P_A^\circ$

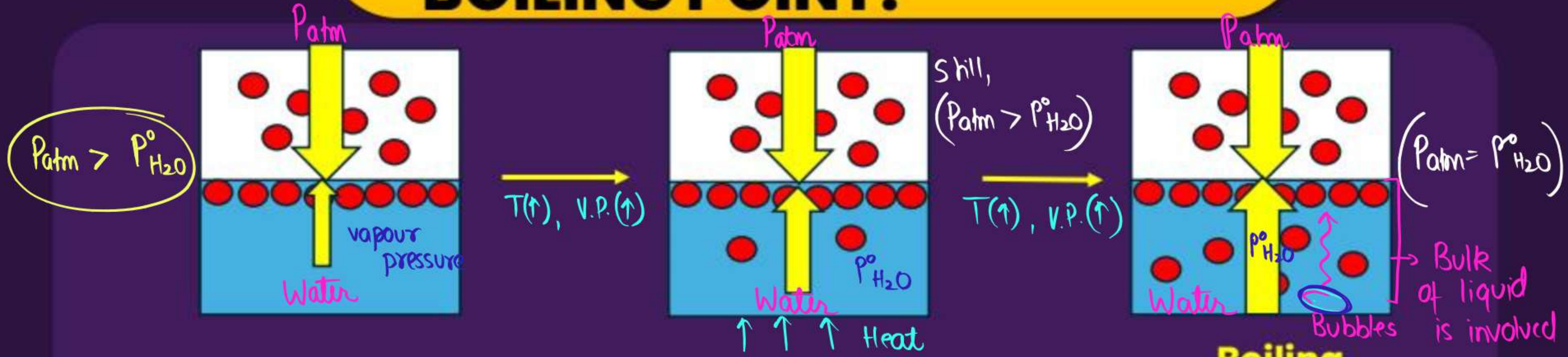
SAMAJ AAYA TOH LIKH DO.

AYE BHAIYA ✓

WHAT IS BOILING AND BOILING POINT?

Patm → atmospheric pressure

WHAT IS BOILING AND BOILING POINT?



Evaporation

Only surface molecules evaporate

(Heating the liquid so temperature increases and vapour pressure increases)

Boiling

At this temperature, vapour pressure of liquid = atmospheric pressure.

This temperature is called boiling point.

BEAT YOUR BRAINS OUT

Sunil Bhaiya, we have studied that an equilibrium will exist at the boiling point between liquid and vapour phase. It means a liquid can never be completely converted to vapour?

BEAT YOUR BRAINS OUT

Sunil Bhaiya, we have studied that an equilibrium will exist at the boiling point between liquid and vapour phase. It means a liquid can never be completely converted to vapour?

Equilibrium exists when we have a closed container. But when we are talking about an open container, entire liquid converts to vapour.

BEAT YOUR BRAINS OUT

'closed container'

Sunil bhaiya, will vapour pressure still be a part of the definition of boiling point if we talking about an open container?

BEAT YOUR BRAINS OUT

Sunil bhaiya, will vapour pressure still be a part of the definition of boiling point if we talking about an open container?

In an open container, the temperature at which liquid forms vapour bubbles throughout the bulk, because the pressure inside the bubbles equals the atmospheric pressure is called boiling point of liquid.

SAMAJ AAYA TOH
LIKH DO.

AYE BHAIYA

ELEVATION OF BOILING POINT

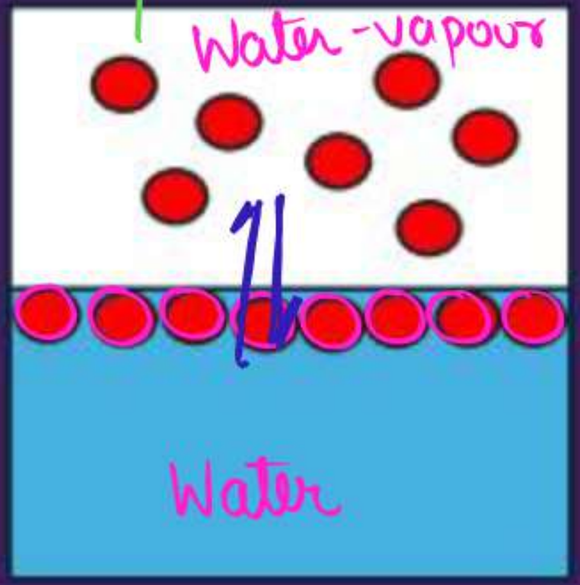
'बढ़ना'

Same temp. (T)

NON-VOLATILE SOLUTE IN VOLATILE SOLVENT

$P^{o}_{H_2O}$

P_{H_2O}



A. Volatile Solvent

B. Non-volatile solute in volatile solvent

$$P_{solution} = P_{H_2O} + \cancel{P_{sugar}} \rightarrow 0$$

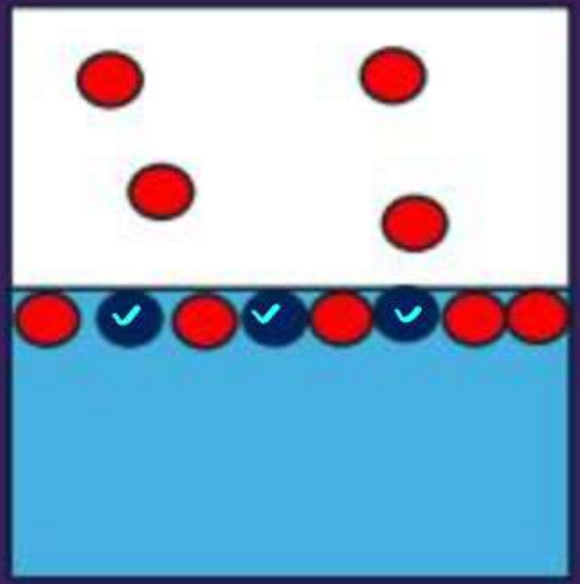
$$P_{solution} = P_{H_2O}$$

$$P^{o}_{H_2O} > P_{H_2O}$$

- The vapour pressure of solution (a non-volatile solute with volatile solvent) decreases as compared to only pure solvent at the same temperature.

ELEVATION OF BOILING POINT

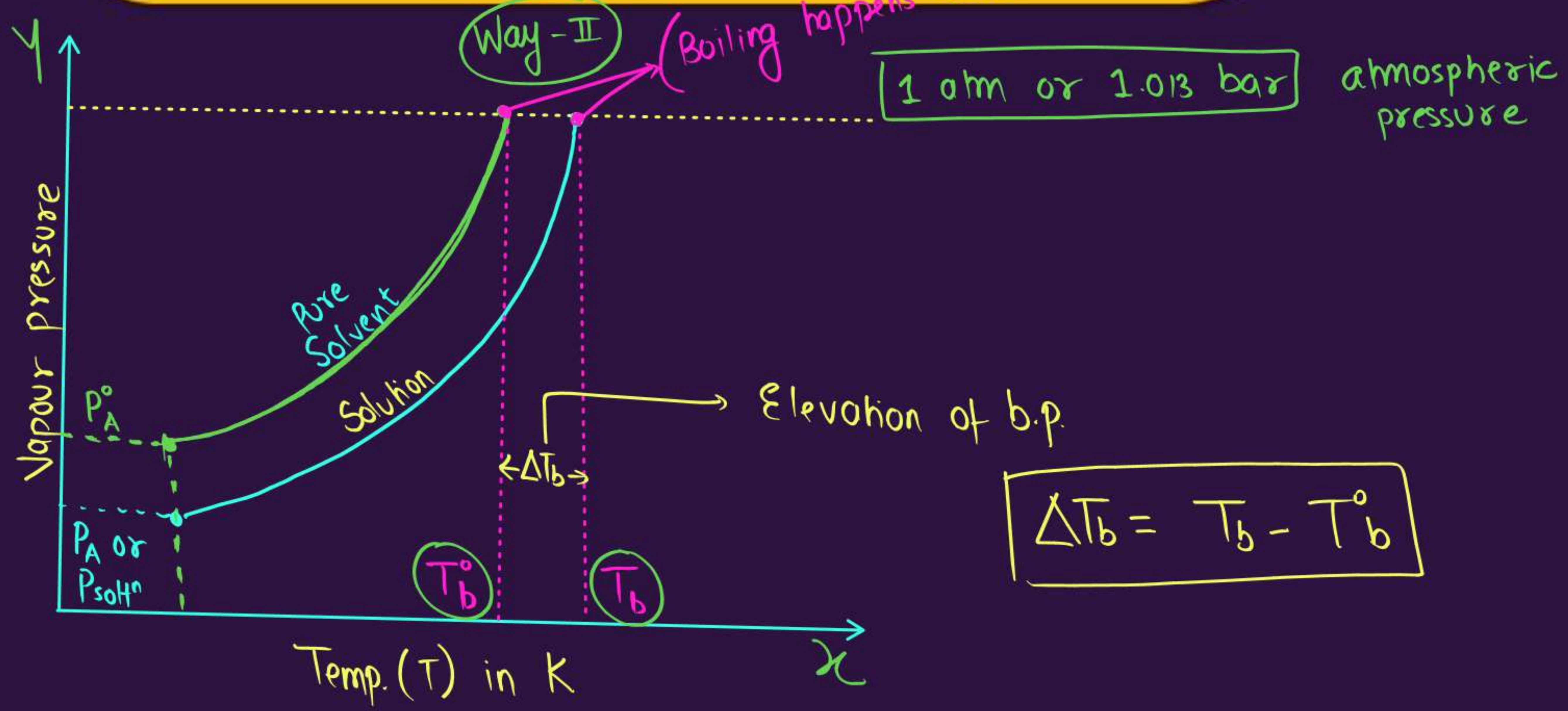
Way - I



Non-volatile solute in volatile solvent

- Solute particles occupy space at the liquid surface making it harder for solvent particles to escape into the vapour phase.
- Vapour pressure of solution decreases.
- Lower vapour pressure → requires higher temperature to boil.

GRAPH OF ELEVATION OF BOILING POINT



$$\boxed{\Delta T_b = T_b - T_b^o}$$

ELEVATION OF BOILING POINT

- Experiments have shown that for dilute solutions the elevation of boiling point (ΔT_b) is directly proportional to the molal concentration of the solute in a solution.

(molality is independent of temp. while molarity changes with temp.)

$$\Delta T_b \propto m$$

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

boiling point elevant constant
molal elevation constant
ebullioscopic constant

property of solvent

$$T_b - T_b^\circ = \frac{K_b \times n_{solute}}{W_{solvent}\ (\text{in kg})}$$

$$T_b - T_b^\circ = \frac{K_b \times W_{solute}}{M_{solute}} \times \frac{1}{W_{solvent}\ (\text{in kg})}$$ ✓

$$T_b - T_b^\circ = \frac{K_b \times W_{solute}}{M_{solute}} \times \frac{1000}{W_{solvent}\ (\text{in g})}$$ ✓

UNIT AND CALCULATION OF K_b

$m = \frac{mol}{kg} = mol \cdot kg^{-1}$

→ The unit of K_b is: $\Delta T_b = K_b \times m \Rightarrow K_b = \frac{\Delta T_b}{m} = \frac{K}{mol \cdot kg^{-1}} = K \cdot kg \cdot mol^{-1}$

*** Imp. for competitive exams

→ The value of K_b, which depend upon the nature of the solvent, can be ascertained from the following relation.

gas constant → molar mass of solvent

$$K_b = \frac{R \times M_1 \times T_b^2}{1000 \times \Delta_{vap} H}$$

boiling point of pure solvent

enthalpy of vapourisation

PYQS' WALLAH

CBSE PYQ

Define ebullioscopic constant and write its unit.

$\Delta T_b = K_b \times m$

$m = 1$, $\Delta T_b = K_b$

- Ebullioscopic constant is elevation in boiling point of 1 molal solution of a non-volatile solute.
- Its unit is $K \cdot kg \cdot mol^{-1}$

CBSE PYQ

When 1.5 g of a non-volatile solute was dissolved in 90 g of benzene, the boiling point of benzene raised from 353.23 K to 353.93 K. Calculate the molar mass of solute.
(K_b of benzene is 2.52 K Kg mol^{-1})

$$T_b - T_b^\circ = \frac{K_b \times W_{solute}}{M_{solute}} \times \frac{1000}{W_{solvent}\,(\text{in g})}$$

$$\Rightarrow 353.93 - 353.23 = \frac{2.52 \times 1.5 \times 1000}{x \times 90}$$

$$\Rightarrow \frac{.7\cancel{0}}{1\cancel{00}} \times x \times 9\cancel{0} = \frac{2.52 \times 1.5 \times 10\cancel{0}0}{}$$

$$x \times \cancel{63}^{\cancel{21}} = \cancel{252}^{12} \times \cancel{15}^{5} \times \cancel{1000} = 60 \ \frac{g}{mol}$$

CBSE PYQ

$[K = 273 + {}^\circ C]$

A solution of glycerol ($C_3H_8O_3$) (solute) in water (solvent) was prepared by dissolving some glycerol in 500 g of water. This solution has a boiling point of 100.42 °C. What mass of glycerol was dissolved to make this solution? (K_b for water = .512 K·Kg·mol^{-1}).

$$T_b - T_b^\circ = \frac{K_b \times W_{solute} \times 1000}{M_{solute} \quad W_{solvent}\ (\text{in g})}$$

$T_b^\circ \to 100\,^\circ C \to 373\,K$

$T_b \to 100.42\,^\circ C \to 373.42\,K$

$$= 373.42 - 373 = \frac{.512 \times x \times \cancel{1000}^{2}}{\cancel{92}_{46} \times \cancel{500}}$$

$$= \frac{42}{100} \times 46 = \frac{512}{1000} \times x$$

$$= \boxed{\frac{420 \times 46}{512} = x} \longrightarrow 37.31\,g$$

$C_3H_8O_3$

$\downarrow$

$= 36 + 8 + 48$

$= 92$

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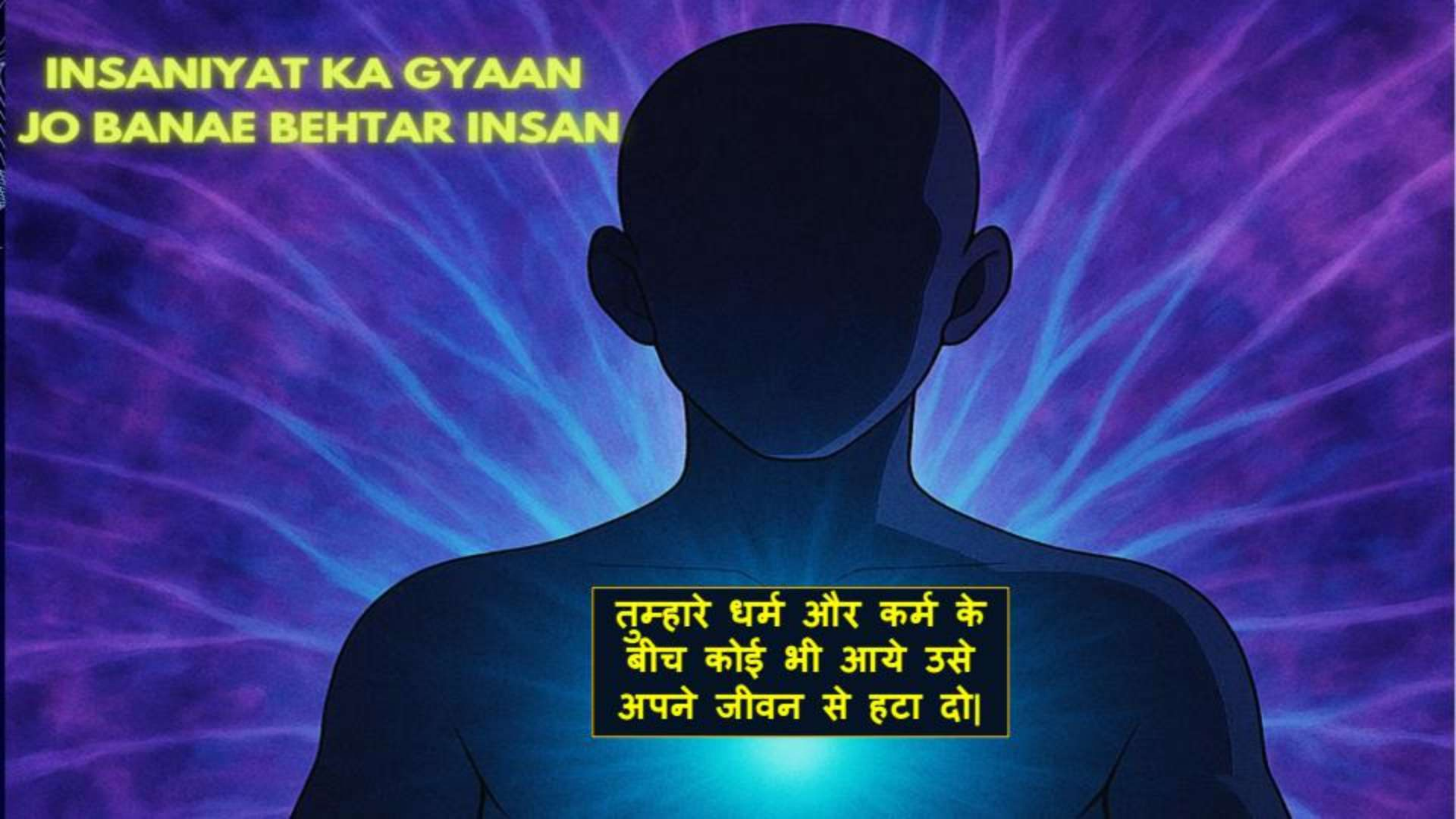
AYE BHAIYA

CONCEPT POLISH – HOMEWORK

'NO HOMEWORK'


INSANIYAT KA GYAAN
JO BANAE BEHTAR INSAN
तुम्हारे धर्म और कर्म के
बीच कोई भी आये उसे
अपने जीवन से हटा दो|

SUNIL BHAIYA IS ALWAYS THERE FOR YOU.

#sbsathhai

#pwsathhai

Thank You

PARISHRAM

2026

Bharat Mata Ki Jai ♡

CHEMISTRY

Lecture 11

SOLUTIONS

Colligative Properties – Part III (Depression of Freezing Point, Osmosis and Osmotic Pressure)

BY – PRIYA-PUTRA-SUNIL

TOPICS TO BE COVERED

(i) What is Freezing and Freezing Point? ✓

(ii) Depression of Freezing Point ✓

(iii) Osmosis and Osmotic Pressure ✓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WHAT IS FREEZING AND FREEZING POINT?

FREEZING AND FREEZING POINT

- As the temperature of the liquid decreases, the kinetic energy of the molecules decreases which means they escape less now; comes closer to each other and vapour pressure of liquid decreases.
- Vapour pressure of liquid decreases to a point that vapour pressure of liquid equals the vapour pressure of solid and this process is called freezing.
- The temperature where the vapour pressure of the liquid equals the vapour pressure of solid phase is called freezing point.

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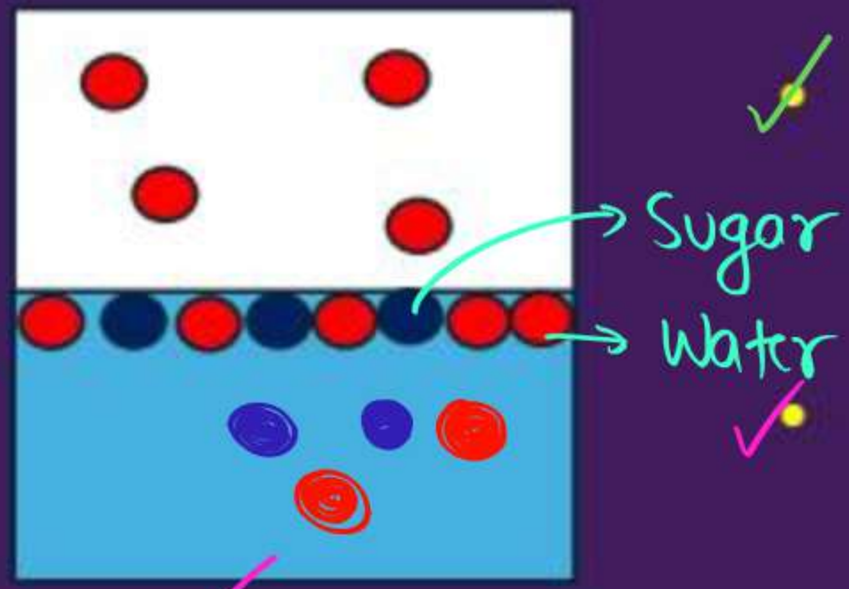
(Colligative Property)

DEPRESSION OF FREEZING POINT

(घटना)

DEPRESSION OF FREEZING POINT



Non-volatile solute in volatile solvent

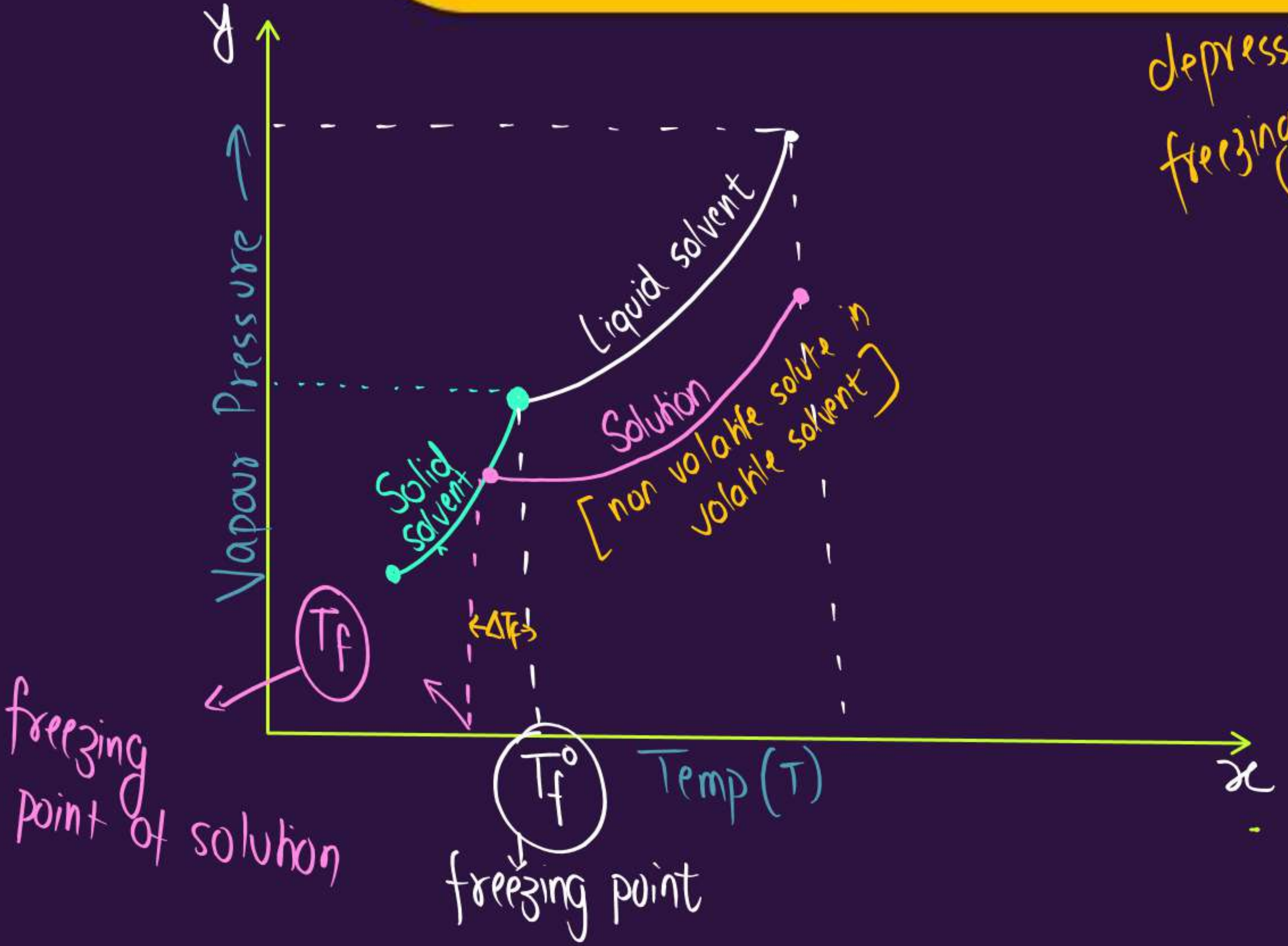
- In order to freeze, solvent molecules must organize into a fixed solid structure.

non-volatile

- Solute particles block or disturb this arrangement.

- So, the solution needs to be cooled further to freeze which ensures reducing the kinetic energy of particles which in turn brings solvent particles closer to each other.

GRAPH OF DEPRESSION OF FREEZING POINT



depression in freezing point

$$\boxed{\Delta T_f = T_f^\circ - T_f}$$

freezing point of pure liquid

freezing point of soltn

DEPRESSION OF FREEZING POINT

- Experiments have shown that for dilute solutions the depression of freezing point (ΔT_f) is directly proportional to the molal concentration of the solute in a solution.

molality → independent of temp.

$$\Delta T_f \propto m$$

property of solvent

$$\boxed{\Delta T_f = K_f m}$$

- → freezing point depression constant
- → molal depression constant
- → cryoscopic constant

$$T_f^{\circ} - T_f = \frac{K_f \times n_{solute}}{W_{solvent}\ (\text{in kg})}$$

$$\boxed{T_f^{\circ} - T_f = \frac{K_f \times W_{solute}}{M_{solute} \times W_{solvent}\ (\text{in kg})}}$$ **

$$\boxed{T_f^{\circ} - T_f = \frac{K_f \times W_{solute} \times 1000}{M_{solute} \times W_{solvent}\ (\text{in g})}}$$ **

UNIT AND CALCULATION OF K_f

$m = \frac{n_{solute}}{W_{solvent}\,(\text{in kg})}$ → $\frac{mol}{kg}$ → $\boxed{mol \cdot kg^{-1}}$

- The unit of K_f is: $\Delta T_f = K_f \times m \Rightarrow K_f = \frac{\Delta T_f}{m} = \frac{K}{mol \cdot kg^{-1}} = \boxed{K \cdot kg \cdot mol^{-1}}$

for competitive exams

- The value of K_f, which depend upon the nature of the solvent, can be ascertained from the following relation.

gas constant

molar mass of solvent

$$K_f = \frac{R \times M_1 \times T_f^2}{1000 \times \Delta_{fus} H}$$

freezing point of pure solvent

enthalpy of fusion

GIVE A THOUGHT

Freezing point and boiling point are not colligative properties but elevation of boiling point and depression of freezing point are.

A. YES

B. NO

PYQS' WALLAH

CBSE PYQ

'2 minute'

$K = 273 + °C$

Calculate the freezing point of the solution (T_f) when 31 g of ethylene glycol ($C_2H_6O_2$) is dissolved in 500 g of water. (K_f for water = 1.86 $K \cdot kg \cdot mol^{-1}$).

Given: $W_{solute} = 31\ g$

$W_{solvent} = 500\ g$

$K_f = 1.86\ K \cdot kg \cdot mol^{-1}$

$T_f = ?$

We know, $T_f^\circ = 0°C = 273\ K$

$M_{solute} \rightarrow (2 \times 12) + (6 \times 1) + (2 \times 16)$

$\rightarrow 24 + 6 + 32$

$\rightarrow \boxed{62}$

$$T_f^\circ - T_f = \frac{K_f \times W_{solute} \times 1000}{M_{solute} \times W_{solvent}\,(\text{in } g)}$$

$$273 - T_f = \frac{1.86 \times \cancel{31} \times \cancel{1000}^{2}}{\cancel{62}_{2} \times \cancel{500}}$$

$$273 - 1.86 = T_f$$

$$\boxed{271.14\ K = T_f}$$

CBSE PYQ

$K = 273 + {}^\circ C$
$= 273 - .34$
$=$

15 g of an unknown substance was dissolved in 450 g of water. The resulting solution freezes at −0.34 °C. What is the molar mass of substance? (K_f for water is 1.86 K Kg mol^{-1})

Given: $W_{solute} = 15\,g$ $\quad M_{solute} = ?$

$W_{solvent} = 450\,g$

$T_f = -.34\,{}^\circ C = 272.66\,K$

$T_f^\circ = 0\,{}^\circ C = 273\,K$

$K_f = 1.86\ K \cdot kg \cdot mol^{-1}$

$$T_f^\circ - T_f = \frac{K_f \times W_{solute} \times 1000}{M_{solute} \times W_{solvent}\,(\text{in } g)}$$

$$273 - 272.66 = \frac{1.86 \times 15 \times 1000}{x \times 450}$$

$$\frac{.34}{\cancel{100}} = \frac{\overset{62}{\cancel{1.86}} \times \cancel{15} \times 100\cancel{0}}{x \times \underset{3}{\cancel{450}} \times 1\cancel{00}}$$

$$x \times 34 = 6200$$

$$x = \frac{\overset{3100}{\cancel{6200}}}{\underset{17}{\cancel{34}}} = \frac{3100}{17} = 182.33$$

QUESTION

Why is salt sprinkled on roads during snowfall? Does it help to avoid the formation of ice?

Yes, salt is sprinkled on roads during snowfall to avoid the formation of ice.

Salt lowers the **freezing point of water** (a phenomenon called **freezing point depression**), which **prevents water from freezing at 0°C**.

As a result, ice melts and further ice formation is avoided, making roads safer for travel.

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LIKH DO.

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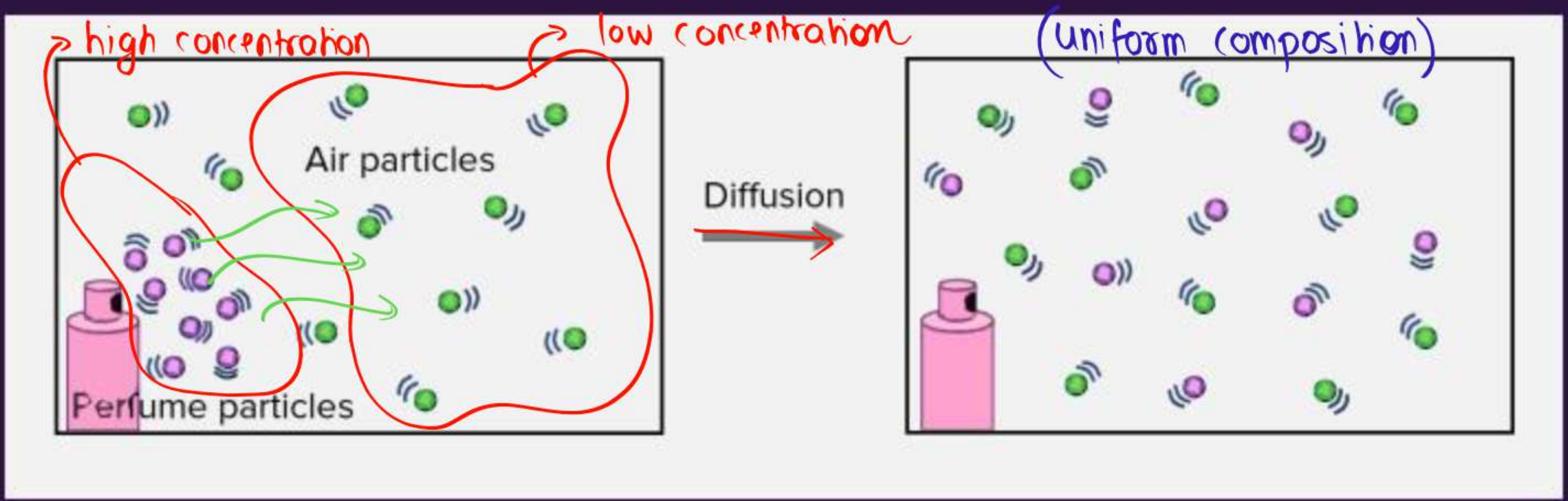
OSMOSIS AND OSMOTIC PRESSURE

WHAT IS DIFFUSION?

Class IX

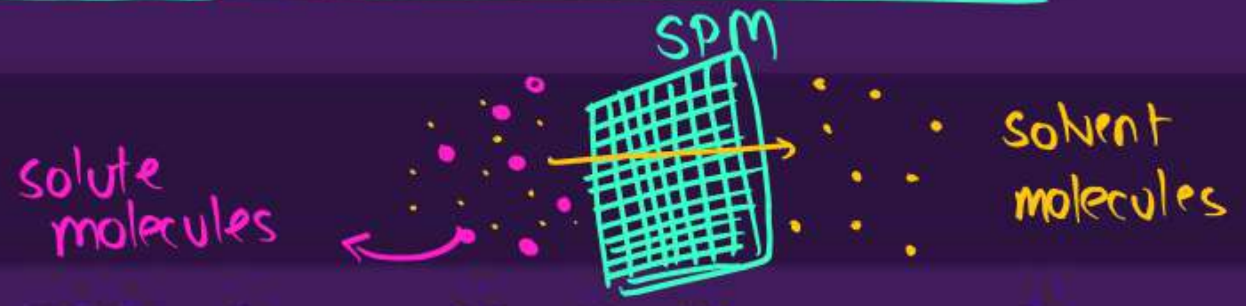
Movement of any substance from its higher to its lower concentration is called diffusion.



OSMOSIS

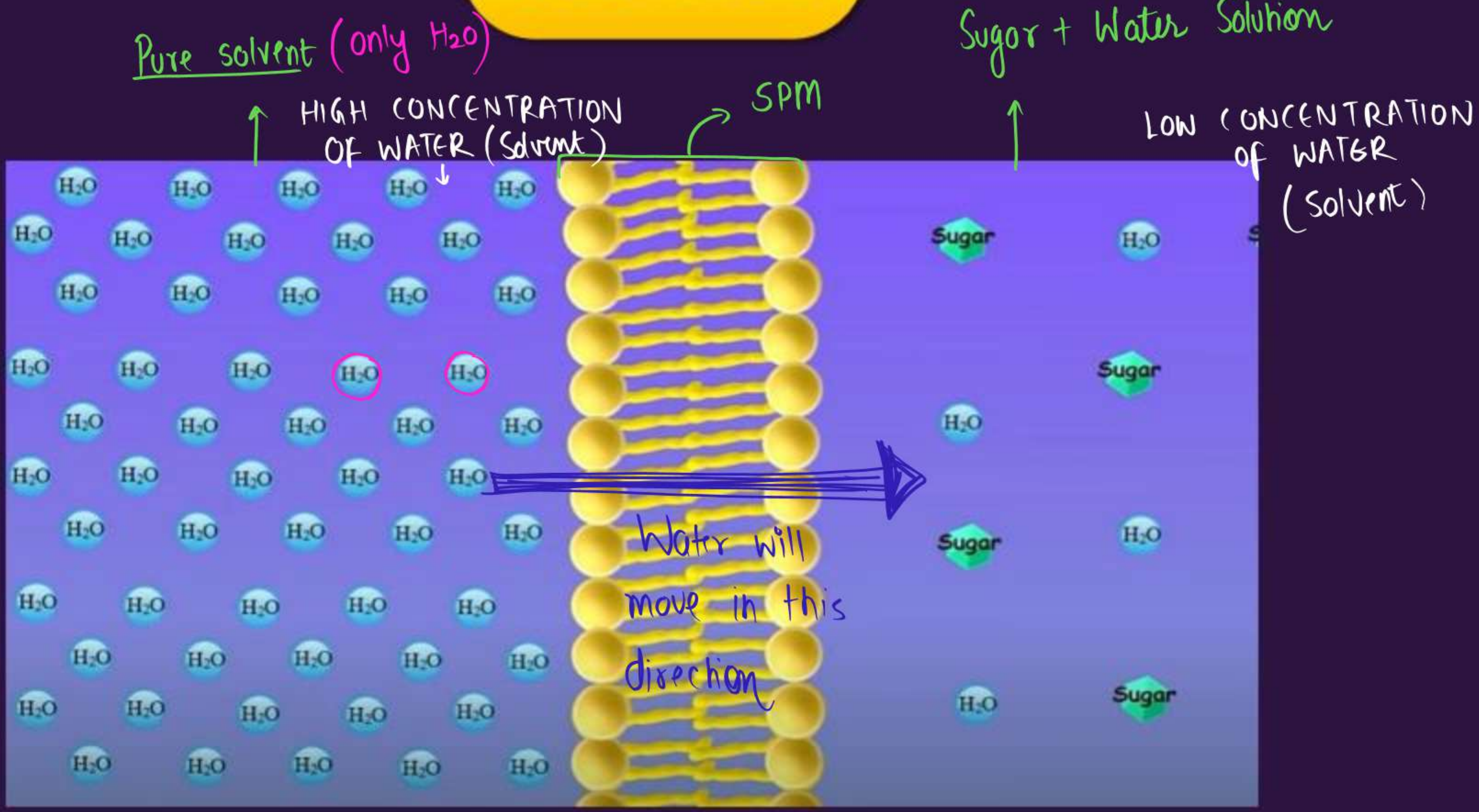
(relatively smaller in size than solute molecules)

It is 'a special type of diffusion' in which solvent molecules moves from 'its higher concentration' to 'its lower concentration' through a semi-permeable membrane is called osmosis.



- *A semipermeable membrane is a thin layer that allows only small molecules like water (solvent) to pass through, but blocks larger molecules like sugar or salt (solute)*
- *These membranes can be of animal or vegetable origin and these occur naturally such as pig's bladder or parchment (made from sheep or goat skin) or can be synthetic such as cellophane (made from cellulose).*

OSMOSIS

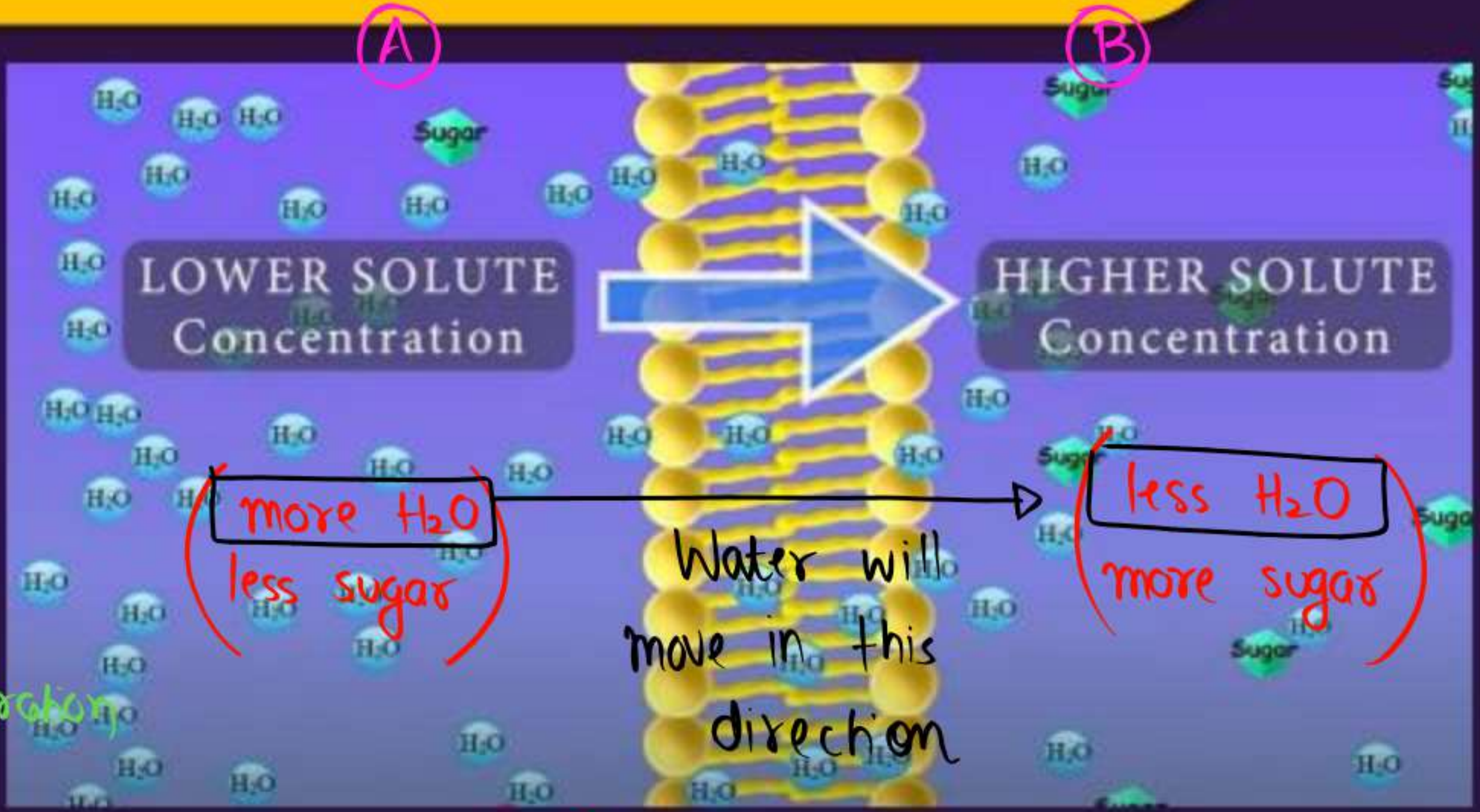


Pure solvent (only H_2O)
HIGH CONCENTRATION OF WATER (Solvent)
SPM
Sugar + Water Solution
LOW CONCENTRATION OF WATER (Solvent)
H2O
Sugar
Water will move in this direction

ANOTHER DEFINITION OF OSMOSIS

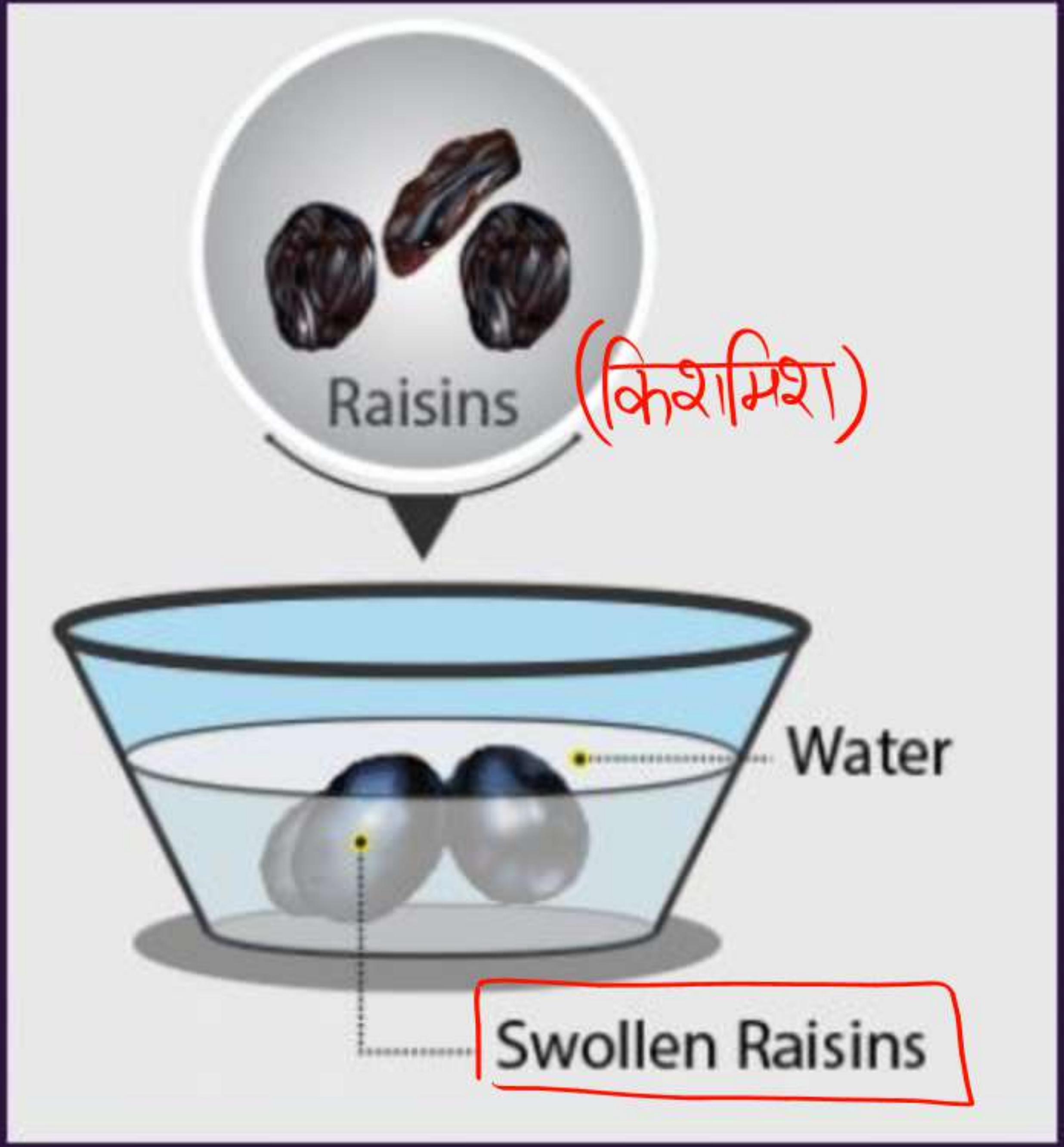
Osmosis can also be defined as the movement of solvent molecules from a region of ~~lower solute concentration to high solute concentration~~.

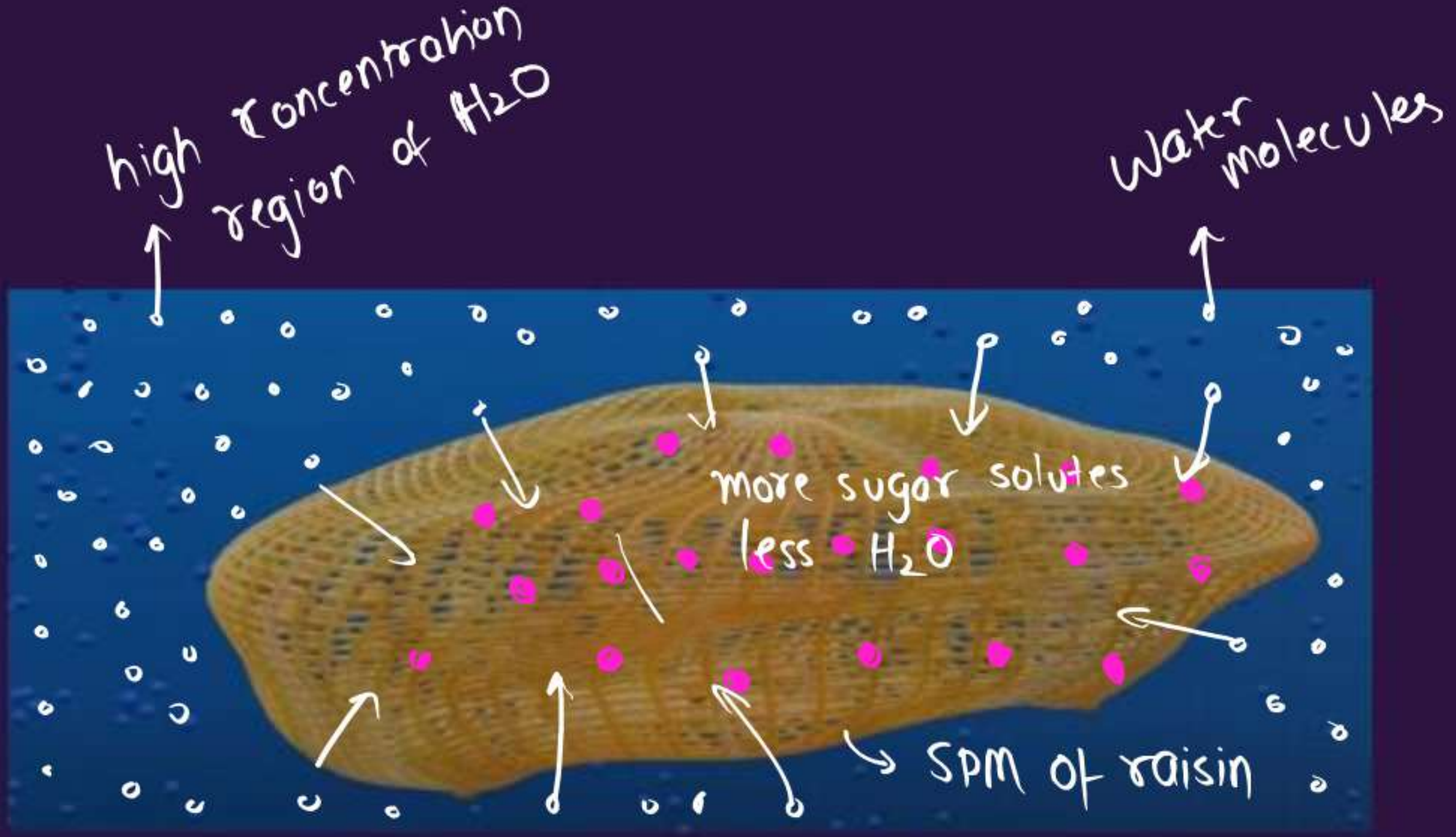
low concentration soltn
↓
high concentration soltn



A LOW CONCENTRATION SOLUTION	B HIGH CONCENTRATION SOLUTION
Solute: Relatively less	Solute: Relatively more
Solvent: Relatively more	Solvent: Relatively less

REAL LIFE EXAMPLE OF OSMOSIS





GIVE A THOUGHT

The solvent molecules will flow from region of its high concentration to region of its low concentration till equilibrium is reached.

A. YES

B. NO

Till there is a net movement of solvent molecules

→ occurs from a region of high concentration to low concentration we say osmosis is happening.

→ At equilibrium, there is no NET MOVEMENT OF SOLVENT MOLECULES.

GIVE A THOUGHT

Is osmosis a spontaneous process?

A. YES

B. NO

'happens on its own'

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AYE BHAIYA

OSMOTIC PRESSURE – WAY 01

- It is denoted by π
- The hydrostatic pressure which stops osmosis is called osmotic pressure.

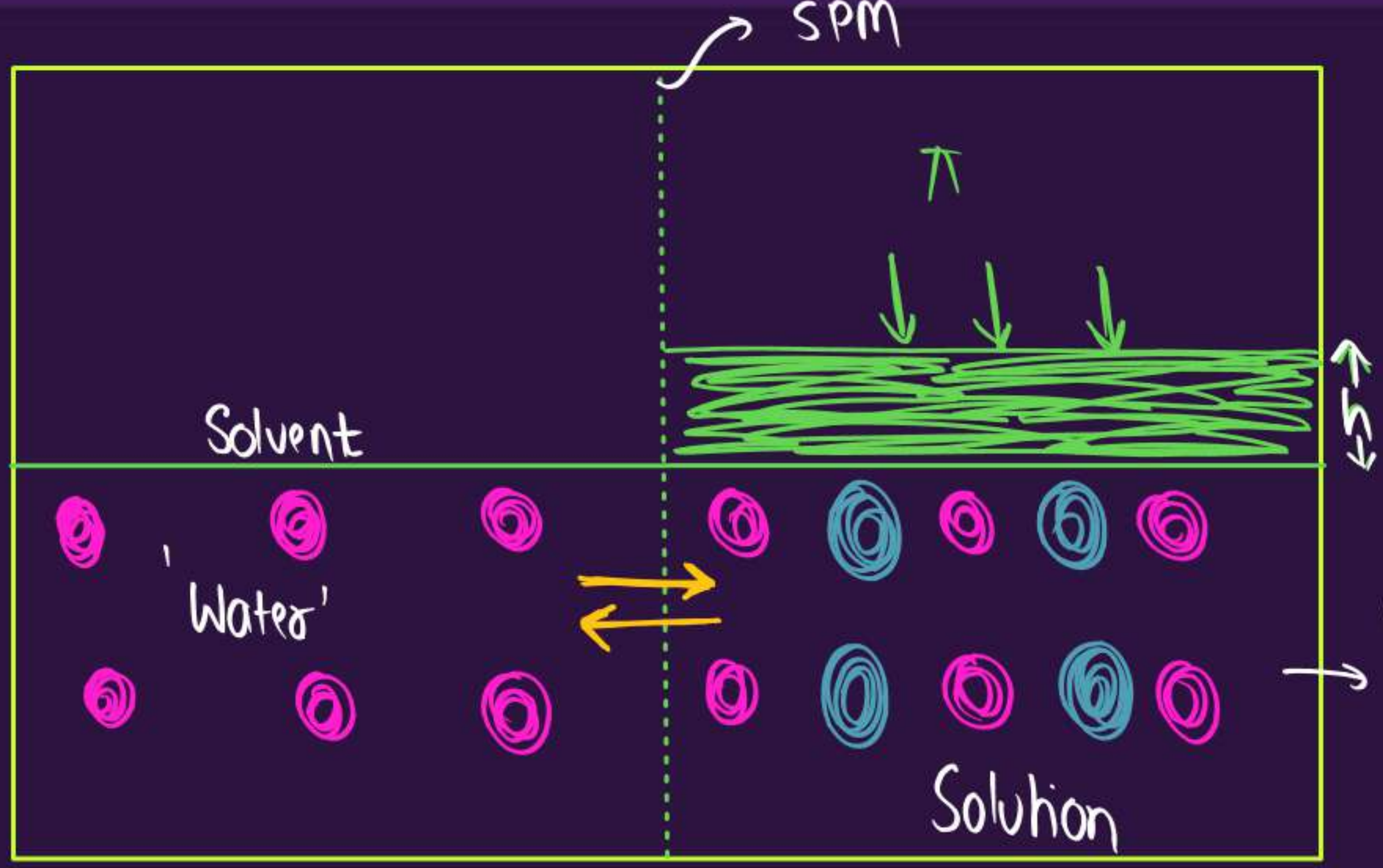
hydrostatic pressure

$$\pi = \rho g h$$

at equilibrium, there is no NET MOVEMENT OF SOLVENT MOLECULES

↓

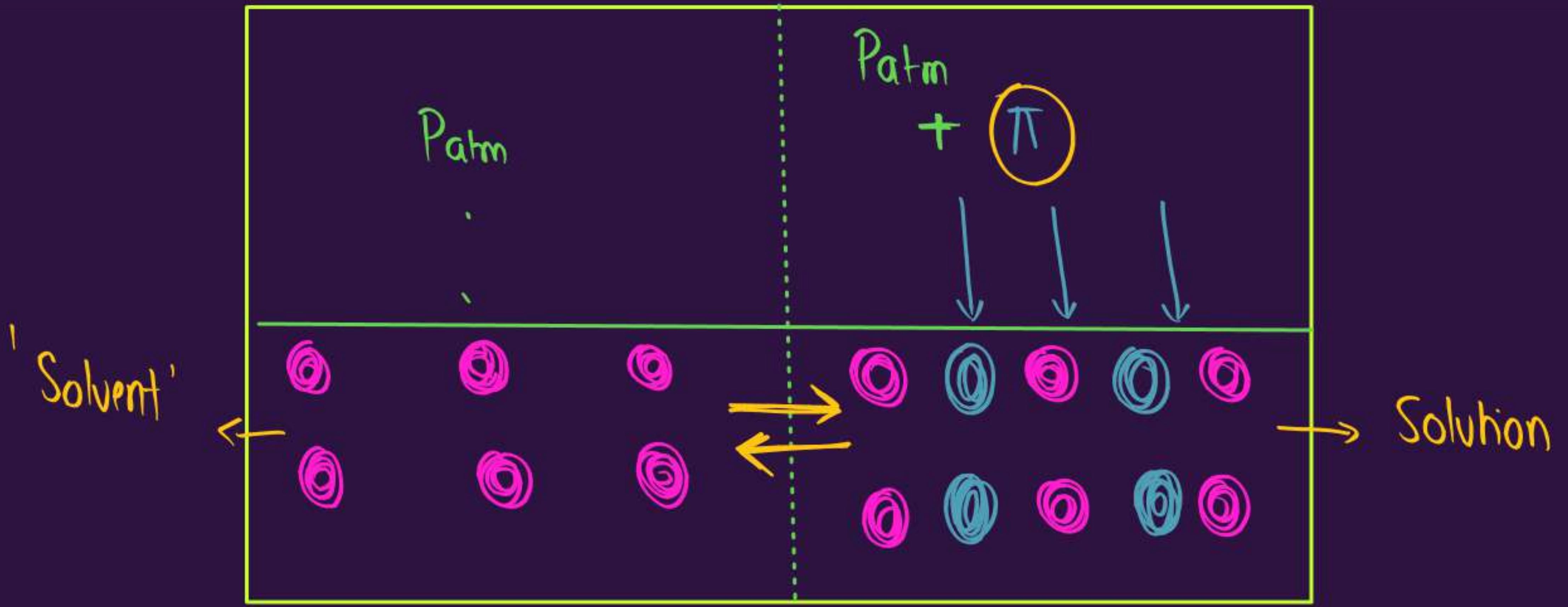
'NO OSMOSIS'



OSMOTIC PRESSURE – WAY 02

pressure apart from atmospheric pressure

The extra pressure applied on the high concentration solution which stops the flow of solvent molecules from low concentration solution or pure solvent is called osmotic pressure.



PYQS' WALLAH

CBSE PYQ

Define the term osmosis and osmotic pressure. Is osmotic pressure of a solution a colligative property? Explain.

Osmosis: It is a special type of diffusion in which solvent molecules moves from its higher concentration to its lower concentration through a semi-permeable membrane is called osmosis.

Osmotic Pressure: The extra pressure applied on the high concentration solution which stops the flow of solvent molecules from low concentration solution or pure solvent is called osmotic pressure.

Yes, it is a colligative property because it depends on the number of solute particles not on their type or nature.

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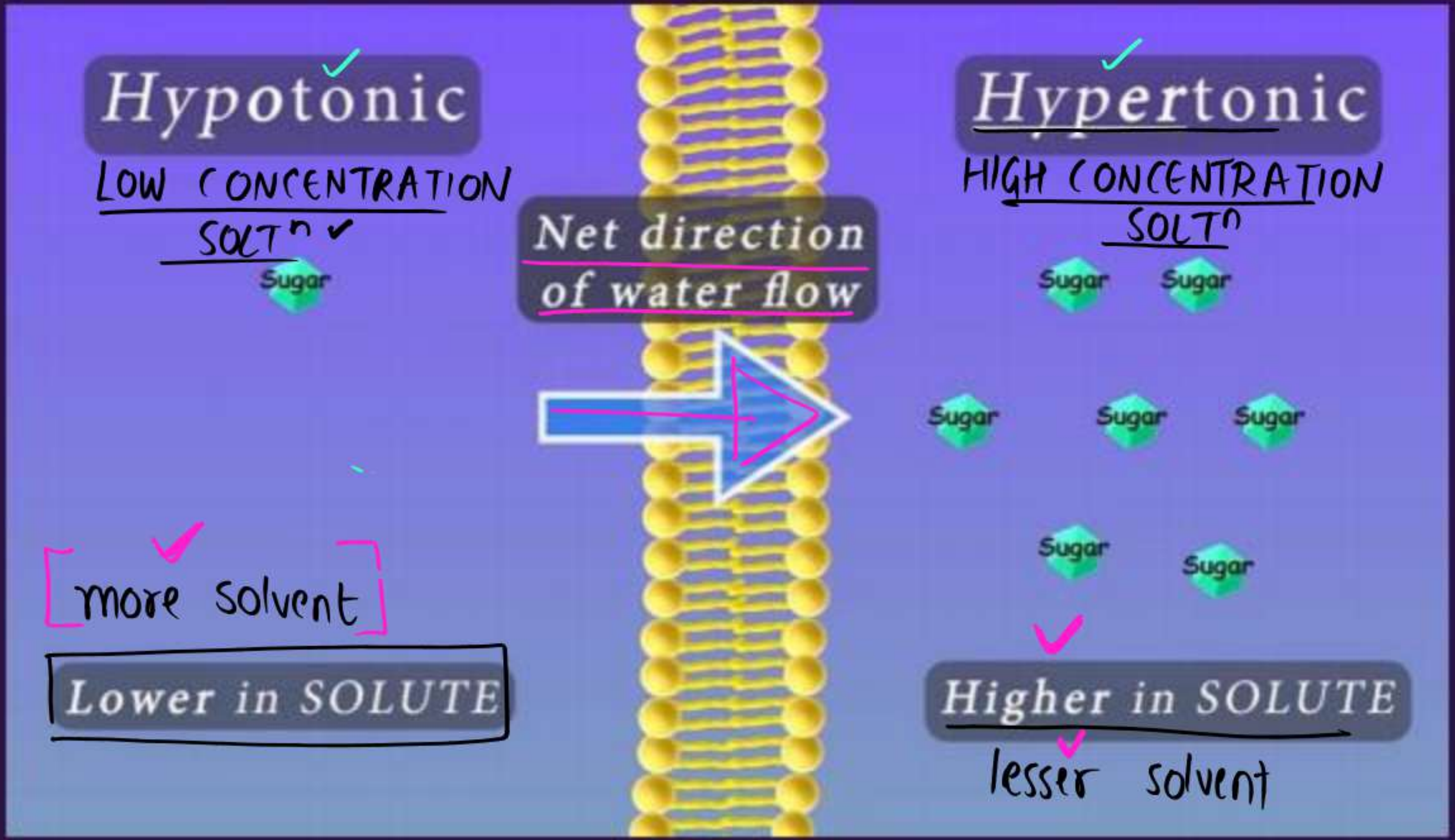
TYPES OF SOLUTION ON BASIS OF RELATIVE OSMOTIC PRESSURE

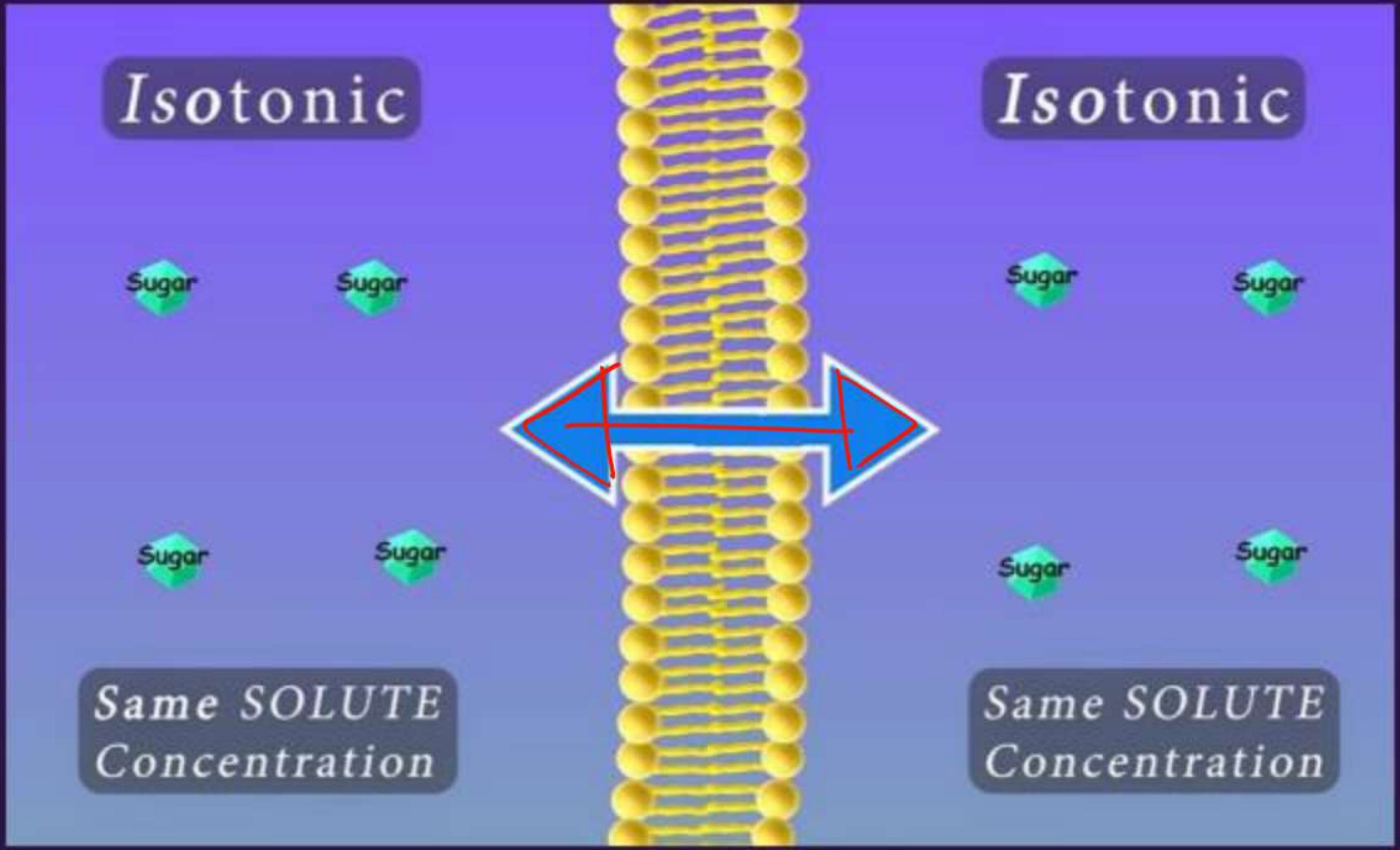
Hypotonic:
- Lower osmotic pressure (less solute) than the other solution.

Hypertonic:
- Higher osmotic pressure (more solute) than the other solution.



TYPES OF SOLUTION ON BASIS OF RELATIVE OSMOTIC PRESSURE

- Two solutions having same osmotic pressure at a given temperature are called isotonic solutions.
- There is no net movement of water.



LET'S PRACTICE

QUESTION

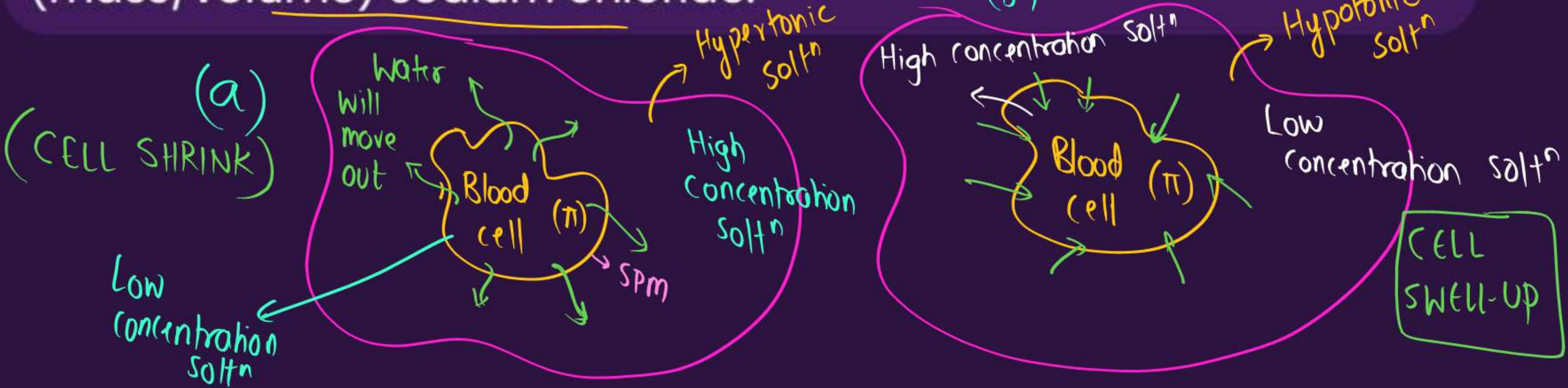
NCERT Theory

The osmotic pressure associated with the fluid inside the blood cell is equivalent to that of 0.9% (mass/volume) sodium chloride solution, called normal saline solution.

What will happen if:

(a) if we place the cells in a solution containing more than 0.9% (mass/ volume) sodium chloride.

(b) If we place the cells in a solution containing less than 0.9% (mass/volume) sodium chloride.



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'CALCULATION OF OSMOTIC PRESSURE'

$$PV = nRT$$

$$\pi V = nRT$$

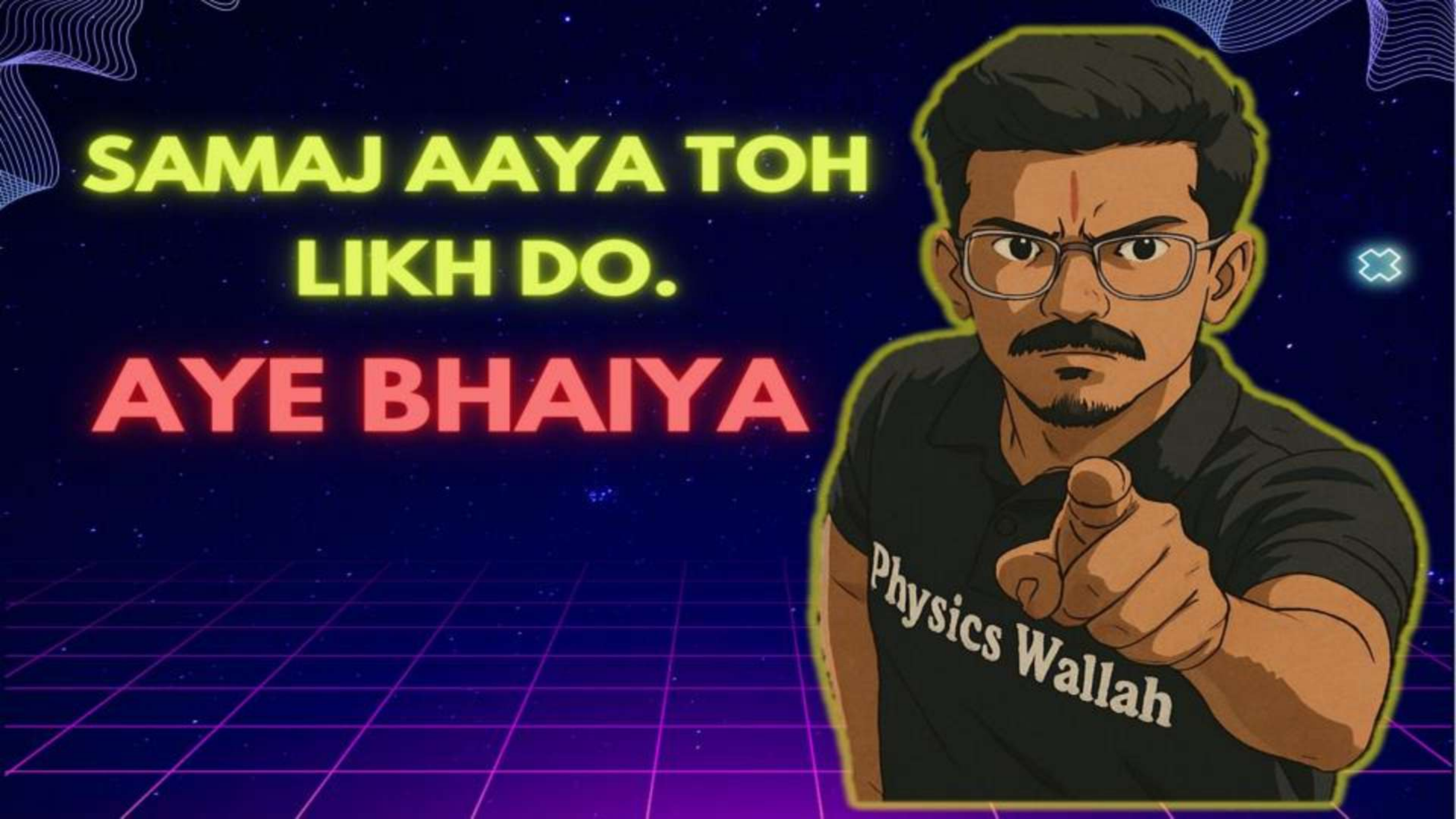
$$\pi = \frac{nRT}{V} \Rightarrow \pi = \frac{n_{solute} \times R \times T}{V_{solution}}$$

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

C → molarity (M)

$$\boxed{\pi = \frac{W_{solute} \times R \times T}{M_{solute} \times V_{solution}}}$$ **

$$\boxed{M_{solute} = \frac{W_{solute} \times R \times T}{V_{solution} \times \pi}}$$ **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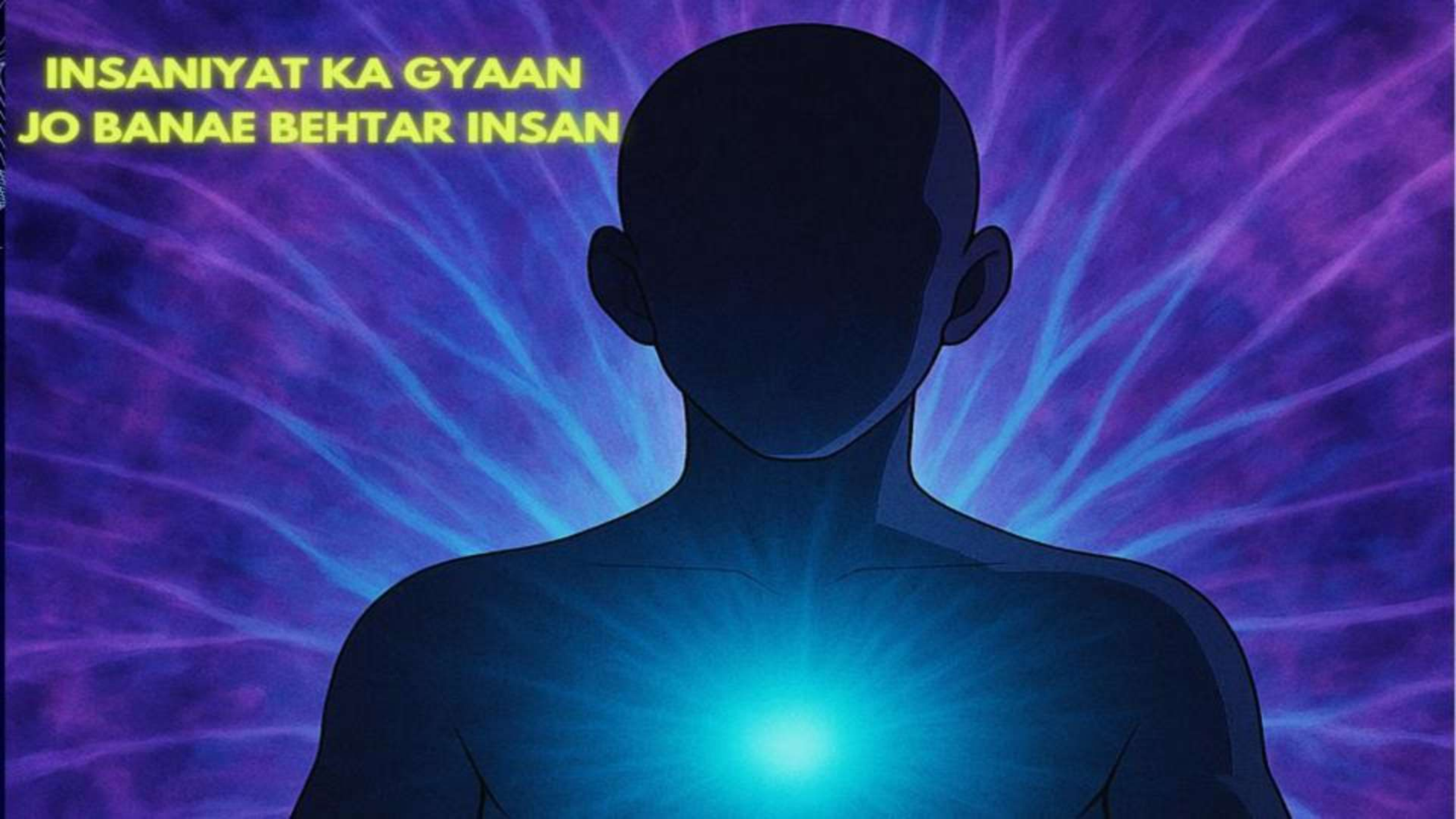
CONCEPT POLISH – HOMEWORK

QUESTION

Why osmotic pressure method is widely used to determine molar mass of solute?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#pwsathhai ✓

Thank You

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2026

CHEMISTRY

Bharat Mata
Ki Jai ♡

Lecture 12

SOLUTIONS

Reverse Osmosis, Van't Hoff Factor, Abnormal Molar Mass and PYQs'

BY – PRIYA-PUTRA-SUNIL

TOPICS TO BE COVERED

(i) Reverse Osmosis

(ii) Van't Hoff Factor and Abnormal Molar Mass

(iii) CBSE Previous Year Questions

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CONCEPT POLISH – HOMEWORK DISCUSSION

QUESTION

***

Why osmotic pressure method is widely used to determine molar mass of solute?

$\pi = CRT$

OR

$\pi = \frac{W_{solute} \times R \times T}{M_{solute} \times V_{soln}}$

Osmotic pressure method is widely used to determine molar mass of solute because:

(i) Can be used for even dilute solutions because value of π is large even for very dilute solutions which is not true for other colligative properties.

(ii) biomolecules like proteins which are generally not stable at high temperatures but π is measured around the room temperature

(iii) molarity of the solution is used which makes both calculation and solution preparation easier.

'OSMOSIS'

LET'S DECODE NCERT – P.N. 22–23

(कैरी) shrink

- Raw mango in salt solution shrivels

  - **Reason:** Salt solution is concentrated (hypertonic solution) → water comes out of mango → **shrivels**

'murjhae hue'

- Wilted flowers in fresh water revive

  - **Reason:** Water enters flower cells → they swell up → **flowers become fresh**.

पिलपिली'

- Carrot that has become limp because of water loss into the atmosphere becomes firm by placing it in water

  - **Reason:** Water moves into carrot cells → **carrot becomes turgid (firm)**.

LET'S DECODE NCERT – P.N. 22-23

OSMOSIS

inside concentration is .9% salt in water

less than

- Blood cells in < 0.9% salt water swell
- Reason: Outside the cell solution is hypotonic → water enters cells → **cells swell**.

- Preservation of meat by salting and of fruits by adding sugar
- Reason: Salting meat and adding sugar to fruits create a **concentrated (hypertonic) environment** outside bacteria. By **osmosis**, water moves out from the bacterial cells into this concentrated solution.
  As a result, bacteria **lose water**, **shrink (shrivel)**, and **die**.

Hypertonic soltn

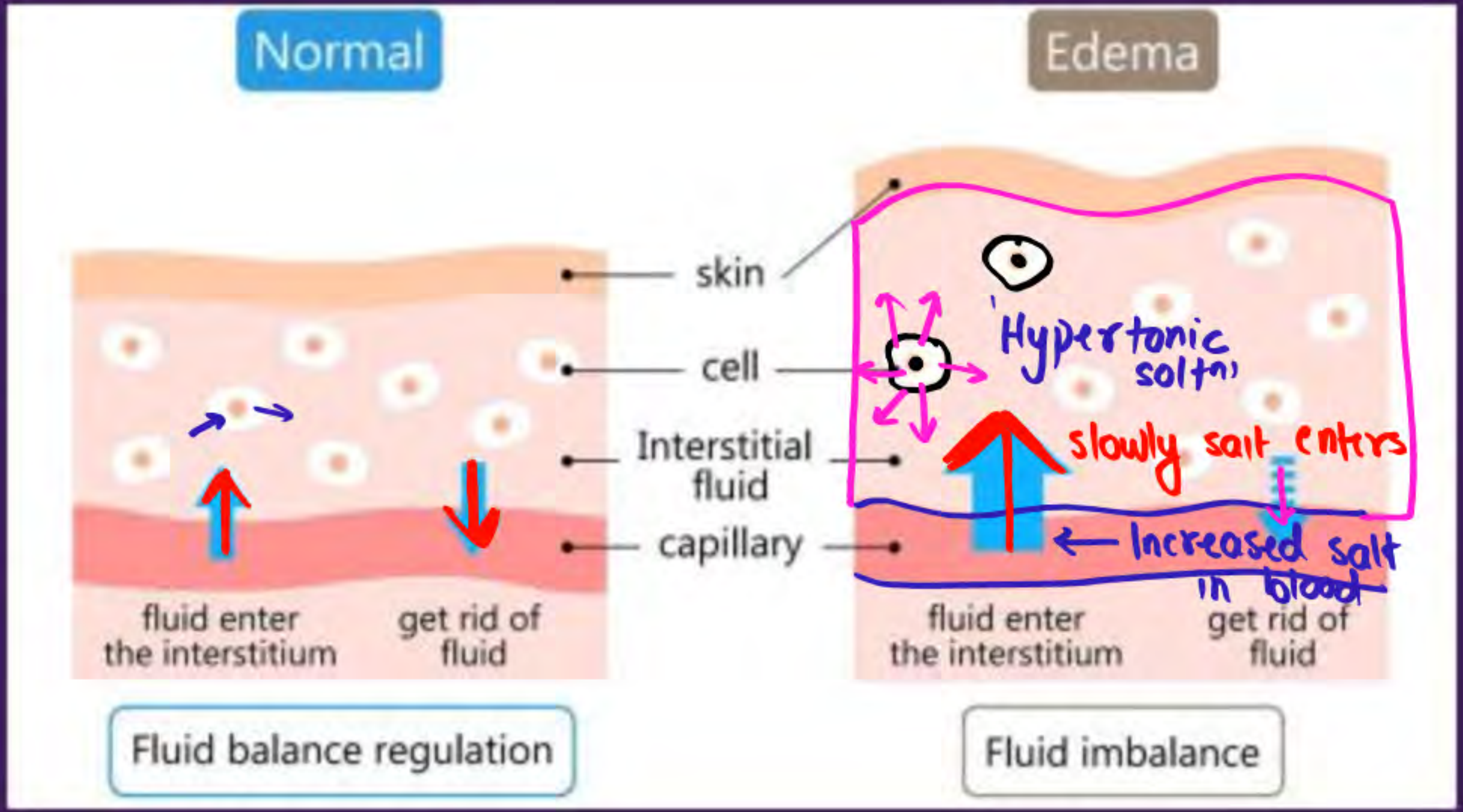
salt

'osmosis'

LET'S DECODE NCERT

'P.N. 22-23'

- Body swells due to increase intake of salt.
- Reason: Increased salt intake raises the salt concentration in blood. This makes the surrounding fluid hypertonic, which pulls water out of nearby cells by osmosis. The extra water collects in the tissues, causing swelling or puffiness which is called edema.

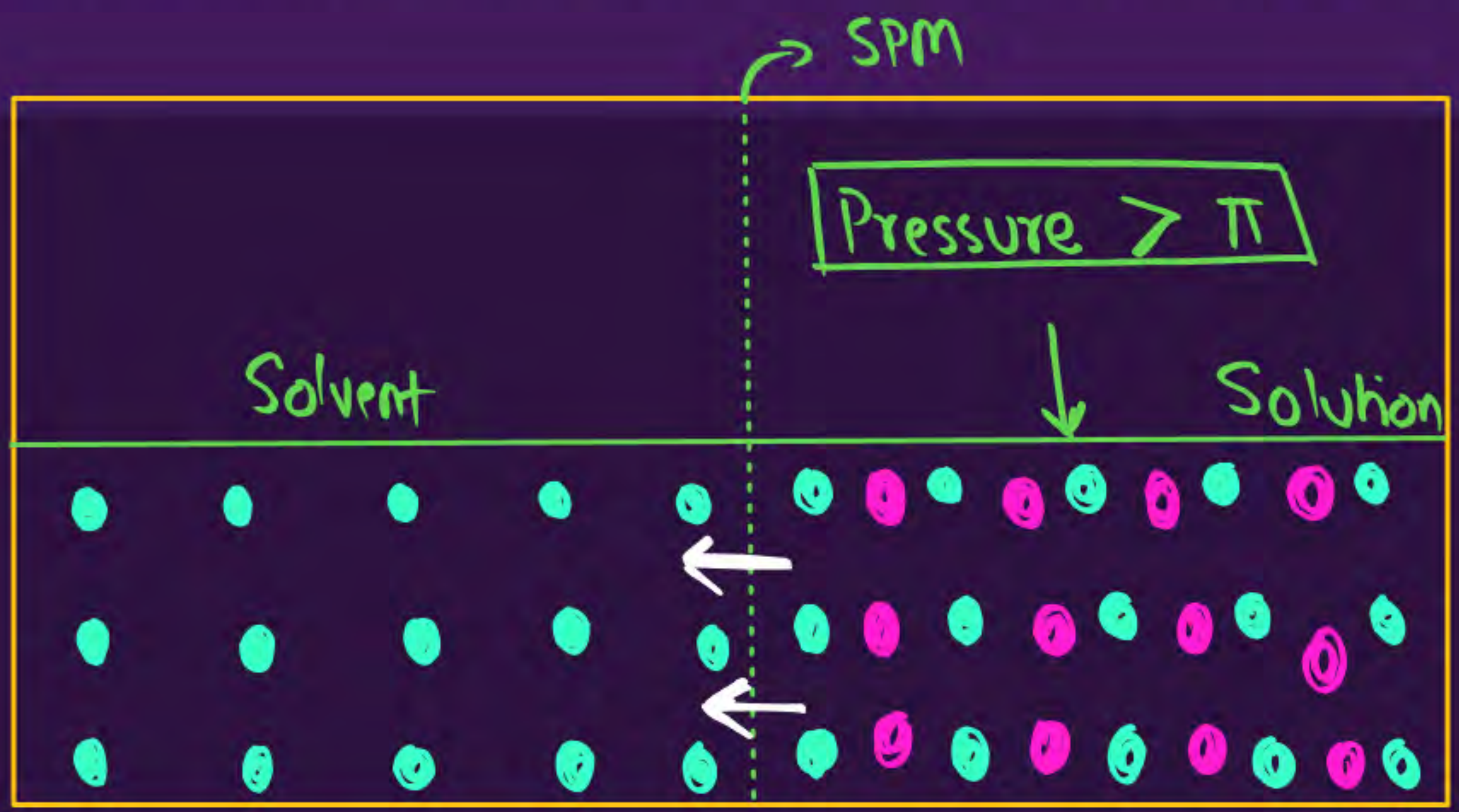


REVERSE OSMOSIS

REVERSE OSMOSIS

If pressure greater than the osmotic pressure is applied on the solution side then the solvent present in the solution will start to move towards the pure solvent side.

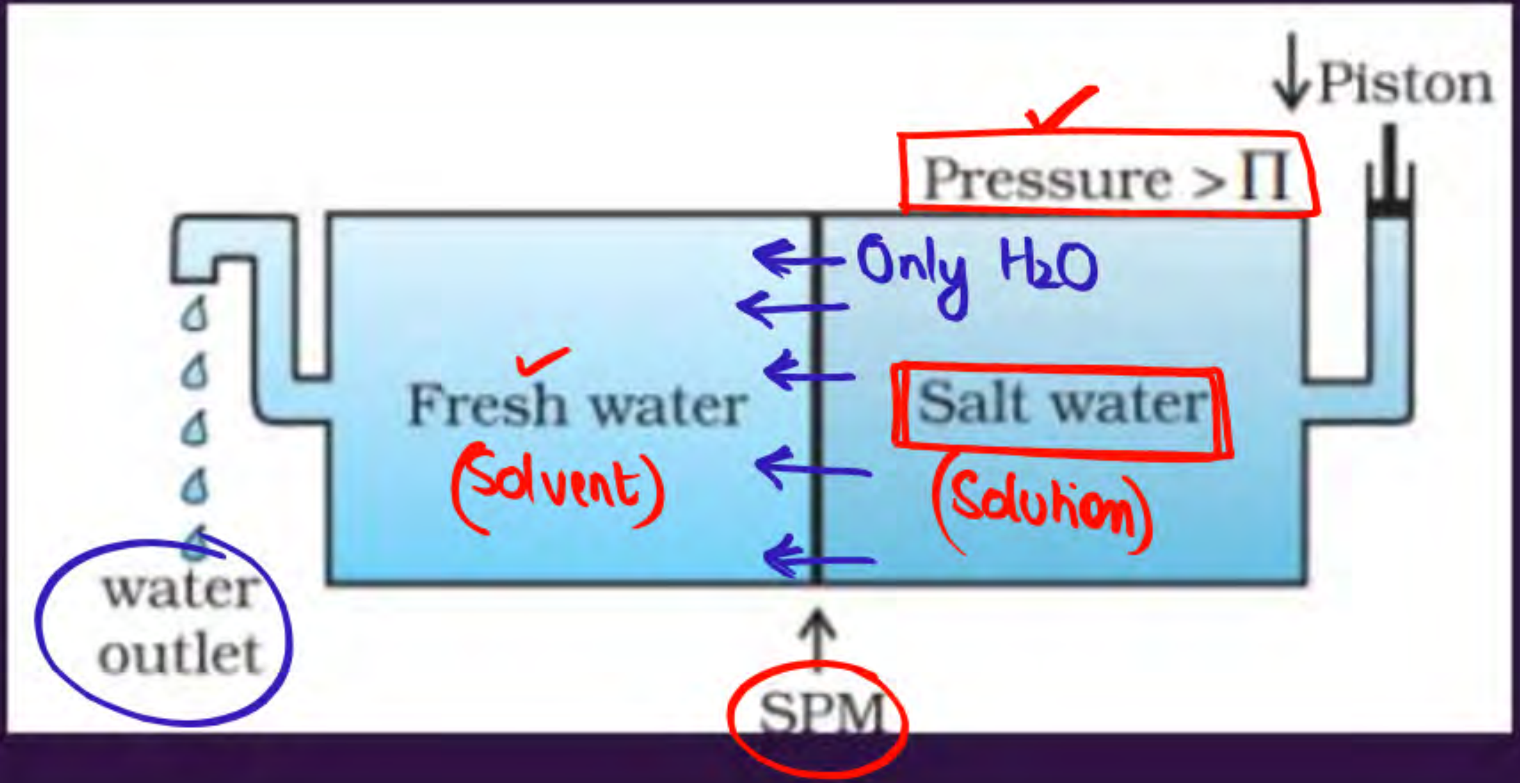
The direction of osmosis is reversed and it is called reverse osmosis.



APPLICATION OF REVERSE OSMOSIS

*KK

- Reverse osmosis is used in the desalination of salt water.
- When pressure greater than osmotic pressure is applied, forcing pure water out of seawater through a semipermeable membrane.
- Cellulose acetate (chemically modified cellulose) membranes are commonly used; they allow water to pass but block salts and impurities.



VAN'T HOFF FACTOR AND ABNORMAL MOLAR MASS

SUMMARY OF COLLIGATIVE PROPERTIES

[non-volatile solute + volatile solvent = binary liquid solution]

- Colligative properties depend only on number of solute particles relative to total number of particles of solution and not on their type and nature.

- Relative Lowering of Vapour Pressure

$$\boxed{\frac{P^\circ_{solvent} - P_{solution}}{P^\circ_{solvent}} = \chi_{solute}}$$

OR

$$\boxed{\frac{P^\circ_{solvent} - P_{solution}}{P^\circ_{solvent}} = \frac{W_{solute}}{M_{solute}} \times \frac{M_{solvent}}{W_{solvent}}}$$

- Elevation of Boiling Point $\Delta T_b = K_b m$

OR

$$T_b - T^\circ_b = \frac{K_b \times W_{solute} \times 1}{M_{solute} \quad W_{solvent}\,(\text{in kg})}$$

OR

$$T_b - T^\circ_b = \frac{K_b \times W_{solute} \times 1000}{M_{solute} \quad W_{solvent}\,(\text{in g})}$$

SUMMARY OF COLLIGATIVE PROPERTIES

- Colligative properties depend only on number of solute particles relative to total number of particles of solution and not on their type and nature.

- Depression of Freezing Point

$\Delta T_f = K_f m$

OR

$T_f^\circ - T_f = K_f \times \frac{W_{solute}}{M_{solute}} \times \frac{1}{W_{solvent} \text{ (in kg)}}$

OR

$T_f^\circ - T_f = \frac{K_f \times W_{solute} \times 1000}{M_{solute} \times W_{solvent} \text{ (in g)}}$

- Osmotic Pressure

$\pi = CRT$

OR

$\pi = \frac{W_{solute} \times R \times T}{M_{solute} \times V_{soln}}$

$\left[C = \frac{n_{solute}}{V_{solution}} = \frac{W_{solute}}{M_{solute}} \times \frac{1}{V_{solution}} \right]$

What is the unit of π if R has a value .0821?

$$\frac{L \cdot atm}{mol \cdot K}$$

$$\pi = \underbrace{C}\,\underbrace{R}\,\underbrace{T}$$

$$\pi = \frac{\cancel{mol}}{\cancel{L}} \times \frac{\cancel{L} \times atm}{\cancel{mol} \times \cancel{K}} \times \cancel{K}$$

$$\boxed{\pi = atm}$$

'deviating from normal'

ABNORMAL MOLAR MASS

- $\boxed{\text{Colligative properties} \propto \text{Number of solute particles}}$
- $\boxed{\text{Colligative properties} \propto 1/\text{Molar mass of solute}}$
- Till now, the non-volatile solutes were urea, glucose, sugar etc. which don't dissociate into ions neither they associate.
- Dissociation 
- Association 
- Due to dissociation or association of non-volatile solute, the number of solute particles changes which means colligative property changes and hence, molar mass of solute changes.
- The molar mass which is higher or lower than theoretical value or normal value is called abnormal molar mass.

VAN'T HOFF FACTOR

- It is represented by 'i'
- It tells us how much a solute **dissociates** (breaks into ions) or **associates** (joins together) in a solution — and affects **colligative properties** like boiling point elevation, freezing point depression, etc.

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

II $$= \frac{\text{Observed colligative property}}{\text{Calculated colligative property}}$$

I $$i = \left[\frac{\text{Total number of moles of particles after association/dissociation}}{\text{Number of moles of particles before association/dissociation}}\right]$$

1 mol ← 2 mol →

$\bigcirc \rightarrow \bigcirc + \bigcirc$

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

VAN'T HOFF FACTOR

- **No dissociation or association**
  - Particles stay as they are
  - i = 1

Urea, Glucose, Sugar etc.

$\boxed{i = 1}$

also called

Non-electrolyte

↓

don't dissociate into ions

Electrolyte → dissociate into ions

CONCEPT RECAP

STRONG ELECTROLYTE	WEAK ELECTROLYTE
(i) They completely dissociate into ions in aqueous or molten state.	(i) They partially dissociate into ions in aqueous or molten state.
(ii) Contains only ions.	(ii) Contains both ions and molecules.
(iii) Degree of dissociation (α) is 1.	(iii) Degree of dissociation (α) is: $\boxed{0 < \alpha < 1}$

ex: Strong acids, strong bases and all salts

ex: weak acids & weak bases

$$\alpha = \frac{\text{Number of moles dissociated}}{\text{Initial number of moles}}$$

$$\boxed{NaCl \xrightarrow[H_2O]{in} \underbrace{Na^{1+} + Cl^{1-}}_{\text{only ions}}}$$

$$\underbrace{CH_3COOH}_{\text{molecules}} \rightleftharpoons \underbrace{CH_3COO^- + H^+}_{\text{ions}}$$

VAN'T HOFF FACTOR

(Derivation not in syllabus → Concept in syllabus)

Step 1: Mole calculation

$CH_3COOH \rightleftharpoons CH_3COO^- + H^+$

Species	Initial moles	Change in moles	Final moles
Undissociated electrolyte	1 mole	$-\alpha$	$\boxed{1-\alpha}$
Dissociated particles	0	$\boxed{+\alpha \times n}$	$\boxed{\alpha n}$

↳ dissociated into how many particles

Step 2: Total number of particles after dissociation

$$\text{Total particles} = (1-\alpha) + \alpha n = 1 - \alpha + \alpha n = 1 + \alpha(n-1)$$

Step 3: Van't Hoff factor definition

$$i = \frac{\text{Total number of particles after dissociation}}{\text{Initial number of particles}}$$

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

What is Van't Hoff factor for NaCl?

for dissociation

$$\boxed{i = 1 + \alpha(n-1)}$$

$\boxed{\alpha = 1} \rightarrow$ Strong electrolyte

$$\underset{1\text{ mol}}{NaCl} \longrightarrow \underset{1\text{ mol}}{Na^{1+}} + \underset{1\text{ mol}}{Cl^{1-}}$$

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

$$i = 1 + 1$$

$$i = 2$$

$i > 1$ for dissociation

What is Van't Hoff factor for $CaCl_2$?

for dissociation,

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

[for strong electrolyte $\alpha = 1$]

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

$$i = 1 + 2$$

$$\boxed{i = 3}$$ ($i > 1$ for dissociation)

$$\underbrace{CaCl_2}_{1\ mol} \longrightarrow \underbrace{Ca^{2+}}_{1\ mol} + \underbrace{2Cl^{1-}}_{2\ mol}$$

$n = 3$

because 1 formula unit of $CaCl_2$ breaks into 1 Ca^{2+} ion & 2 Cl^{1-} ions

GIVE A THOUGHT

Acetic acid (CH_3COOH) weak electrolyte, dissociates into 2 ions (CH_3COO^- and H^+), so n=2.
If α=0.1 (10% dissociation), so 'i' will be:

$$CH_3COOH \xrightleftharpoons{\text{in } H_2O} CH_3COO^- + H^+$$

n=2

for dissociation,

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

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

$$i = 1 + .1$$

$$\boxed{i = 1.1}$$

VAN'T HOFF FACTOR

(Association of solute particles)

Species	Initial moles	Change in moles	Final moles
Monomers	1	$-n\alpha$	$1-n\alpha$
Associated Units	0	$+\alpha$	α

n → no of particles associating

α → degree of association

- **Total particles at equilibrium:**

$$\text{Total particles} = \underline{(1-n\alpha)} + \underline{\alpha} = 1 - n\alpha + \alpha = \boxed{1-\alpha(n-1)}$$

- **Van't Hoff factor:**

$$i = \frac{\text{Total particles at equilibrium}}{\text{Initial particles}} = \frac{1-\alpha(n-1)}{1}$$

$$\boxed{i = 1-\alpha(n-1)}$$

GIVE A THOUGHT

molecules combine to form a single molecule

CH_3COOH 'Solvent'

Molecules of ethanoic acid (acetic acid) dimerise in benzene due to hydrogen bonding. Calculate 'i' here if degree of association is .4!

$$\boxed{2}\,CH_3COOH \rightleftharpoons (CH_3COOH)_2$$

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

$$= 1 - .4(2-1)$$

$$= 1 - .4$$

$$\boxed{i = .6}$$

$(i < 1 \text{ for association})$

SUMMARY

'CHATGPT'

Process	Van't Hoff Factor (i)	Quantity of Solute Particles	Colligative Property	'Solute' Molar Mass (calculated)
Dissociation	$i > 1$	Increased	Increased	Decreased (calculated lower)
Association	$i < 1$	Decreased	Decreased	Increased (calculated higher)

**

MODIFIED COLLIGATIVE PROPERTIES

Relative lowering of vapour pressure of solvent,

$$\frac{p_1^{\circ} - p_1}{p_1^{\circ}} = i\frac{n_2}{n_1}$$

Elevation of Boiling point, $\Delta T_b = i\, K_b\, m$

Depression of Freezing point, $\Delta T_f = i\, K_f\, m$

Osmotic pressure of solution, $\Pi = i\, n_2\, R\, T\, /\, V$

CBSE PREVIOUS YEAR QUESTIONS

CBSE 2025

A solution of acetone in chloroform :

(A) obeys Raoult's law.

(B) forms azeotrope.

(C) shows a positive deviation from Raoult's law.

(D) shows a negative deviation from Raoult's law.

CBSE 2025

Assertion (A) : Henry's law constant (K_H) decreases with increase in temperature. (×)

Temp. (↑), K_H (↑)

Reason (R) : As the temperature increases, solubility of gases in liquids decreases. (✓) Temp. (↑), K_H (↑), x_{gas} (↓)

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).

(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is ***not*** the correct explanation of the Assertion (A).

(C) Assertion (A) is true, but Reason (R) is false.

(D) Assertion (A) is false, but Reason (R) is true.

CBSE 2025

Assertion (A) : Cooking time is reduced in pressure cooker. (✓)

Reason (R) : Boiling point of water inside the pressure cooker is lowered down. (×)

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).

(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is ***not*** the correct explanation of the Assertion (A).

(C) Assertion (A) is true, but Reason (R) is false.

(D) Assertion (A) is false, but Reason (R) is true.

An unripe mango placed in a concentrated salt solution to prepare pickle, shrivels because ________.

(A) it gains water due to osmosis

(B) it loses water due to reverse osmosis

(C) it gains water due to reverse osmosis

(D) it loses water due to osmosis

CBSE 2025

In case of association, abnormal molar mass of solute will

(A) increase
(B) decrease
(C) remain same
(D) first increase and then decrease

CBSE 2025

Which of the following aqueous solutions will have the highest osmotic pressure ?

(A) 1% KCl

(B) 1% glucose

(C) 1% urea

(D) 1% $CaCl_2$

$\pi = iCRT$

C, R, T → constant

[jiska i jyda uska π jyda]

(B), (C) → $i = 1$

(A) $i = 2$

(D) $i = 3$

CBSE PYQ

What possible value of 'i' will it have if solute molecules undergo association in solution?

$\boxed{i < 1}$

CBSE PYQ

Predict whether Van't Hoff factor (*i*) is less than one or greater than one in the following:

(i) CH_3COOH dissolved in water

(ii) CH_3COOH dissolved in benzene

(i) CH_3COOH dissolved in water, partially ionizes to give:

$$CH_3COOH \rightleftharpoons CH_3COO^- + H^+$$

Hence, number of particles increases and i > 1

(ii) CH_3COOH dissolved in benzene, CH_3COOH dimerises to give:

$$2\ CH_3COOH \rightleftharpoons (CH_3COOH)_2$$

Hence, number of particles decreases and i < 1

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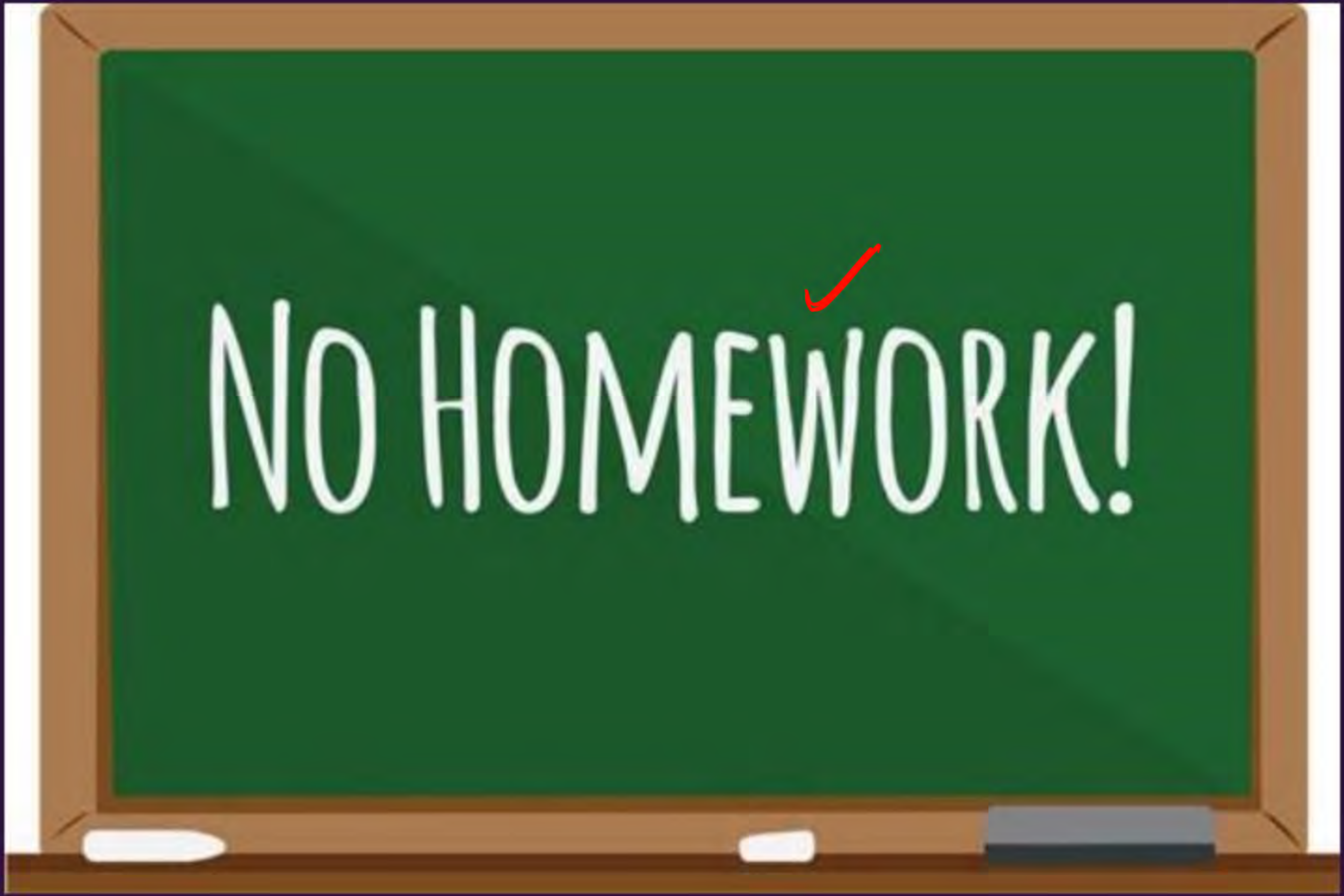
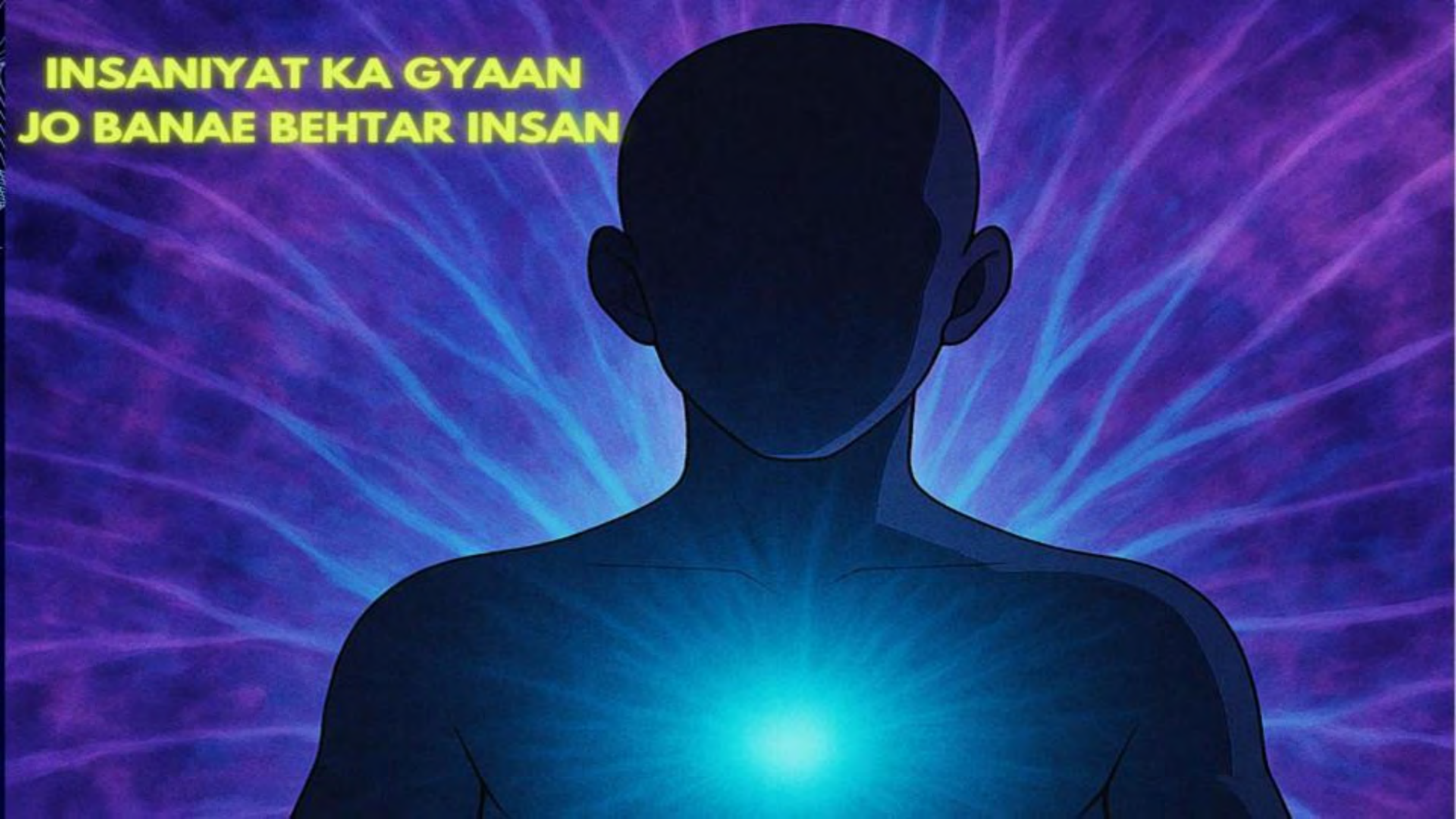
CONCEPT POLISH – HOMEWORK


No Homework!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SUNIL BHAIYA IS ALWAYS THERE FOR YOU.

#sbsathhai

#pwsathhai

Thank You

PARISHRAM

2026

Chemistry

Lecture 13

SOLUTIONS

[Important PYQs' and Practice Problems]

Bharat Mata Ki Jai

BY – PRIYA-PUTRA-SUNIL

TOPICS TO BE COVERED

(i) Some NCERT Exemplar Problems (✓) Based on your doubts

(ii) CBSE Previous Year Questions

Numerical


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SOME NCERT EXEMPLAR PROBLEMS

→ (Doubts के basis पर)

NCERT Exemplar Q.N. 01

Which of the following units is useful in relating concentration of solution with its vapour pressure?

(i) mole fraction (x)

(ii) parts per million

(iii) mass percentage

(iv) molality

NCERT Exemplar Q.N. 02

25 °C

On dissolving sugar in water at room temperature solution feels cool to touch. Under which of the following cases dissolution of sugar will be most rapid?

(i) Sugar crystals in cold water. ✗

(ii) Sugar crystals in hot water. ✗

(iii) Powdered sugar in cold water.

(iv) Powdered sugar in hot water. ✓

'endothermic'

Undissolved solute + Heat $\rightleftharpoons$ Dissolved solute

Surface area available for dissolution

Powdered sugar (पिसी हुई चीनी) > Sugar crystals

NCERT Exemplar Q.N. 03

At equilibrium the rate of dissolution of a solid solute in a volatile liquid solvent is ________.

(i) less than the rate of crystallisation

(ii) greater than the rate of crystallisation

(iii) equal to the rate of crystallisation

(iv) zero

$$\text{Undissolved solute} \underset{\text{Crystallisation}}{\overset{\text{Dissolution}}{\rightleftharpoons}} \text{Dissolved solute}$$

NCERT Exemplar Q.N. 05

Maximum amount of a solid solute that can be dissolved in a specified amount of a given liquid solvent does **not** depend upon ____________.

(i) Temperature ✓

(ii) Nature of solute ✓

(iii) Pressure ×

(iv) Nature of solvent ✓

NCERT Exemplar Q.N. 06

'Hypoxia'

Low concentration of oxygen in the blood and tissues of people living at high altitude is due to ____________.

(i) low temperature

(ii) $\boxed{\text{low atmospheric pressure}}$

(iii) high atmospheric pressure

(iv) both low temperature and high atmospheric pressure

NCERT Exemplar Q.N. 07

Considering the formation, breaking and strength of hydrogen bond, predict which of the following mixtures will show a positive deviation from Raoult's law?

(i) Methanol and acetone. → +ve deviation

(ii) Chloroform and acetone. → negative deviation

(iii) Nitric acid and water. → maximum boiling azeotrope → negative deviation from Raoult's law

(iv) Phenol and aniline. → negative deviation

NCERT Exemplar Q.N. 09

Which of the following aqueous solutions should have the highest boiling point?

(i) 1.0 M NaOH

(ii) 1.0 M Na_2SO_4

(iii) 1.0 M NH_4NO_3

(iv) 1.0 M KNO_3

'solvent is water'

$\Delta T_b = i K_b m$

K_b → property of solvent → same for all ∵ solvent is same

m → concentration is same

depends on 'i'

for dissociation,

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

(i) for NaOH, $i = 1 + 1(2-1) = 2$

(ii) for Na_2SO_4, $i = 1 + 1(3-1) = 3$

(iii) for NH_4NO_3, $i = 1 + 1(2-1) = 2$

(iv) for KNO_3 $i = 1 + 1(2-1) = 2$

$NaOH \longrightarrow Na^{1+} + OH^{1-}$

strong base

SALTS

$Na_2SO_4 \longrightarrow 2Na^{1+} + SO_4^{2-}$

$NH_4NO_3 \longrightarrow NH_4^{1+} + NO_3^{1-}$

$KNO_3 \longrightarrow K^{+} + NO_3^{1-}$

$\alpha = 1$

NCERT Exemplar Q.N. 11

In comparison to a 0.01 M solution of glucose, the depression in freezing point of a 0.01 M $MgCl_2$ solution is ___(iii)___.

(i) the same

(ii) about twice

(iii) about three times

(iv) about six times

$\Delta T_f = i K_f m$

same for both

concentration is same

$i = 1$ for glucose

$i = 3$ for $MgCl_2$

for dissociation,

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

$= 1 + 1(3-1)$

$= 1 + 2$

$= 3$

$MgCl_2 \longrightarrow Mg^{2+} + 2Cl^{1-}$

NCERT Exemplar Q.N. 15

$KCl \rightarrow K^{+} + Cl^{1-}$

$NaCl \rightarrow Na^{1+} + Cl^{1-}$

The values of Van't Hoff factors for KCl, NaCl and K_2SO_4, respectively, are __________.

(i) 2, 2 and 2

(ii) 2, 2 and 3

(iii) 1, 1 and 2

(iv) 1, 1 and 1

salt

$\alpha = 1$

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

for KCl

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

$i = 2$

$K_2SO_4 \longrightarrow 2K^{1+} + SO_4^{2-}$

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

$= 1 + 1(3-1)$

$\boxed{i = 3}$

for NaCl

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

$= 1 + 1(2-1)$

$\boxed{i = 2}$

NCERT Exemplar Q.N. 20

We have three aqueous solutions of NaCl labelled as 'A', 'B' and 'C' with concentrations 0.1M, 0.01M and 0.001M, respectively. The value of van't Hoff factor for these solutions will be in the order______.

(i) $i_A < i_B < i_C$

(ii) $i_A > i_B > i_C$

(iii) $i_A = i_B = i_C$

(iv) $i_A < i_B > i_C$

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

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

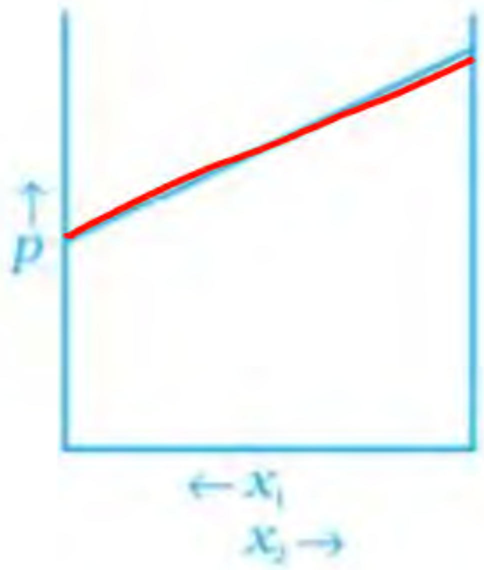
$$\boxed{i = 2}$$

NCERT Exemplar Q.N. 34

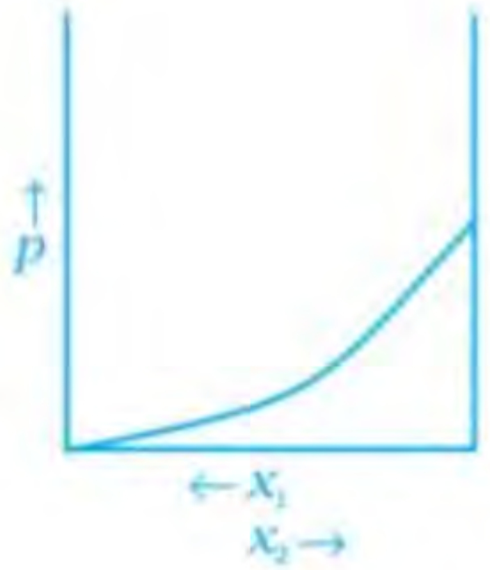
[More than 1 correct]

For a binary ideal liquid solution, the variation in total vapour pressure versus composition of solution is given by which of the curves?

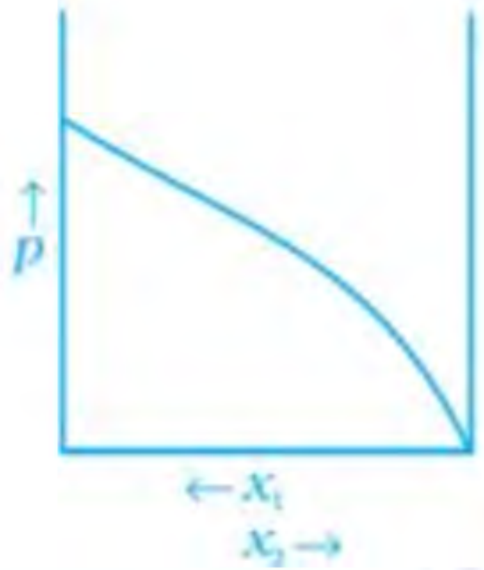
(i)



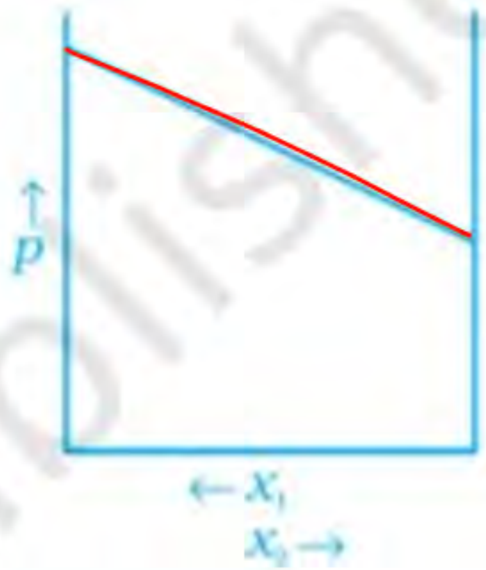
(ii)



(iii)



(iv)



NCERT Exemplar Q.N. 53

Assertion : When NaCl is added to water a depression in freezing point is observed. (✓)

Reason : The lowering of vapour pressure of a solution causes depression in the freezing point. (✓)

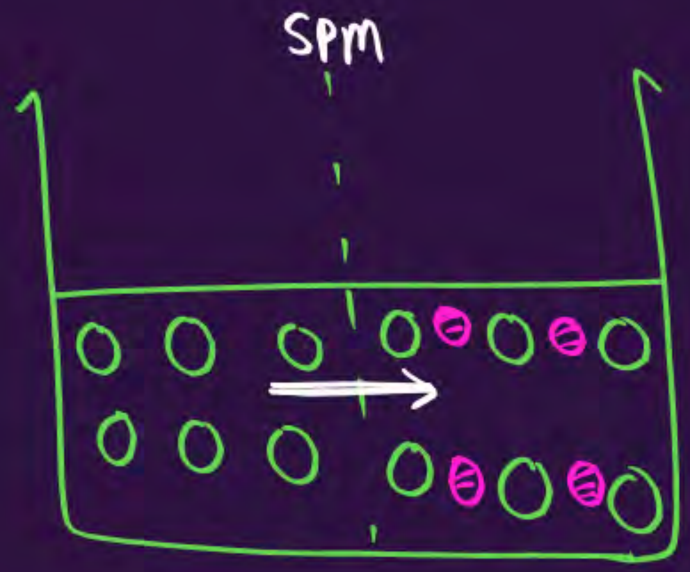
NCERT Exemplar Q.N. 54

Assertion : When a solution is separated from the pure solvent by a semi-permeable membrane, the solvent molecules pass through it from pure solvent side to the solution side. (✓)

low solvent
high solute

Reason : Diffusion of solvent occurs from a region of high concentration solution to a region of low concentration solution.

low solute
high solvent



CBSE PREVIOUS YEAR QUESTIONS

aye bhaiya

CBSE 2025

A solution of $\boxed{\text{acetone in ethanol}}$:

(A) obeys Raoult's law.

(B) forms an ideal solution.

(C) shows a positive deviation from Raoult's law.

(D) shows a negative deviation from Raoult's law.

CBSE 2025

Assertion (A) : Aquatic species are more comfortable in cold water than in warm water.

Reason (R) : Solubility of oxygen gas in water decreases with increase in temperature.

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).

(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is ***not*** the correct explanation of the Assertion (A).

(C) Assertion (A) is true, but Reason (R) is false.

(D) Assertion (A) is false, but Reason (R) is true.

CBSE PYQ

$12 \times 6 + 12 \times 1 + 6 \times 16 = 72 + 12 + 96$

$1L = \underline{\underline{180}}$

At 300 K, 36 g of glucose ($C_6H_{12}O_6$) present $\boxed{\text{per litre}}$ in its solution has an osmotic pressure of 4.98 bar. If osmotic pressure of another glucose solution is 1.52 bar at the same temperature, calculate the concentration of other solution.

Given: $\pi_1 = 4.98$ bar $\pi_2 = 1.52$ bar

$M_{glucose} \downarrow 180\ \frac{g}{mol}$

$W_{glucose} = 36$ g $T = 300$ K

$T = 300$ K $C_2 = ?$

$\boxed{i = 1 \text{ for glucose}}$

$\pi_1 = iC_1RT$ $\pi_2 = iC_2RT$

$\frac{\pi_1}{C_1} = iRT$ — (1) $\frac{\pi_2}{C_2} = iRT$ — (2)

from (1) & (2)

$\Rightarrow \frac{\pi_1}{C_1} = \frac{\pi_2}{C_2}$

$C_1 = \frac{n_{solute}}{V_{soln}} = \frac{n_{solute}}{1\ L} = \frac{W_{solute}}{M_{solute}} = \frac{\cancel{36}^{6}}{\cancel{180}_{\cancel{30}}} \frac{1}{5} = \underline{\underline{.2}}$

$\Rightarrow C_2 = \frac{\pi_2 \times C_1}{\pi_1} = \frac{1.52 \times .2 \times 100}{4.98 \times 100}$

249

$$C_2 = \frac{152}{249} \times \frac{1}{10}$$

$$\approx \frac{\overset{3}{\cancel{150}}}{\underset{5}{\cancel{250}}} \times \frac{1}{10}$$

$$\approx \frac{.6}{10}$$

$$\boxed{C_2 \approx .06 \ \frac{mol}{L}}$$

CBSE PYQ

Calculate the amount of KCl which must be added to 1 kg of water so that the freezing point is depressed by 2 K. (K_f for water is 1.86 K kg mol^{-1}).

electrolyte

$$\boxed{\Delta T_f = i K_f m}$$

$$\cancel{2} = \cancel{2} \times 1.86 \times m$$

$$\boxed{\frac{1}{1.86} = m}$$

$$m = \frac{n_{solute}}{W_{solvent}(\text{in kg})} = \frac{n_{solute}}{1} = \frac{W_{solute}}{M_{solute}}$$

$$\Rightarrow \frac{1}{1.86} = \frac{W_{solute}}{74.5} \Rightarrow \frac{74.5}{1.86} = W_{solute}$$

molar mass

$$KCl \longrightarrow K^+ + Cl^{1-}$$

$$= 39 + 35.5 \qquad \alpha = 1$$

$$= 74.5 \qquad i = 1 + \alpha(n-1)$$

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

$$i = 2$$

$$\frac{74.5 \times \cancel{100}}{\cancel{1.86} \times 1\cancel{0}} = \frac{745 \times 5}{93} = \boxed{\frac{3725}{93}} = 40.05 \text{ g}$$

CBSE PYQ

A .561 m solution of an unknown electrolyte depresses the freezing point of water by 2.93 °C. What is Van't Hoff Factor for this electrolyte? The freezing point depression constant for water is 1.86 °C kg mol^{-1}.

$$\Delta T_f = i K_f m$$

$$= \quad 2.93 = i \times 1.86 \times .561$$

$$= \quad \frac{2.93}{1.86 \times .561} = i$$

$$\approx \quad \frac{3}{\cancel{2} \times \frac{1}{\cancel{2}}} \approx \frac{3}{1} \approx 3 = i$$

[electrolyte shows complete dissociation & 1 formula unit gives 3 ions just like $MgCl_2$ $\longrightarrow$ $i = 1 + \alpha(n-1)$

$= 1 + 1(3-1)$

$\boxed{i = 3}$]

SAMAJ AAYA TOH
LIKH DO.

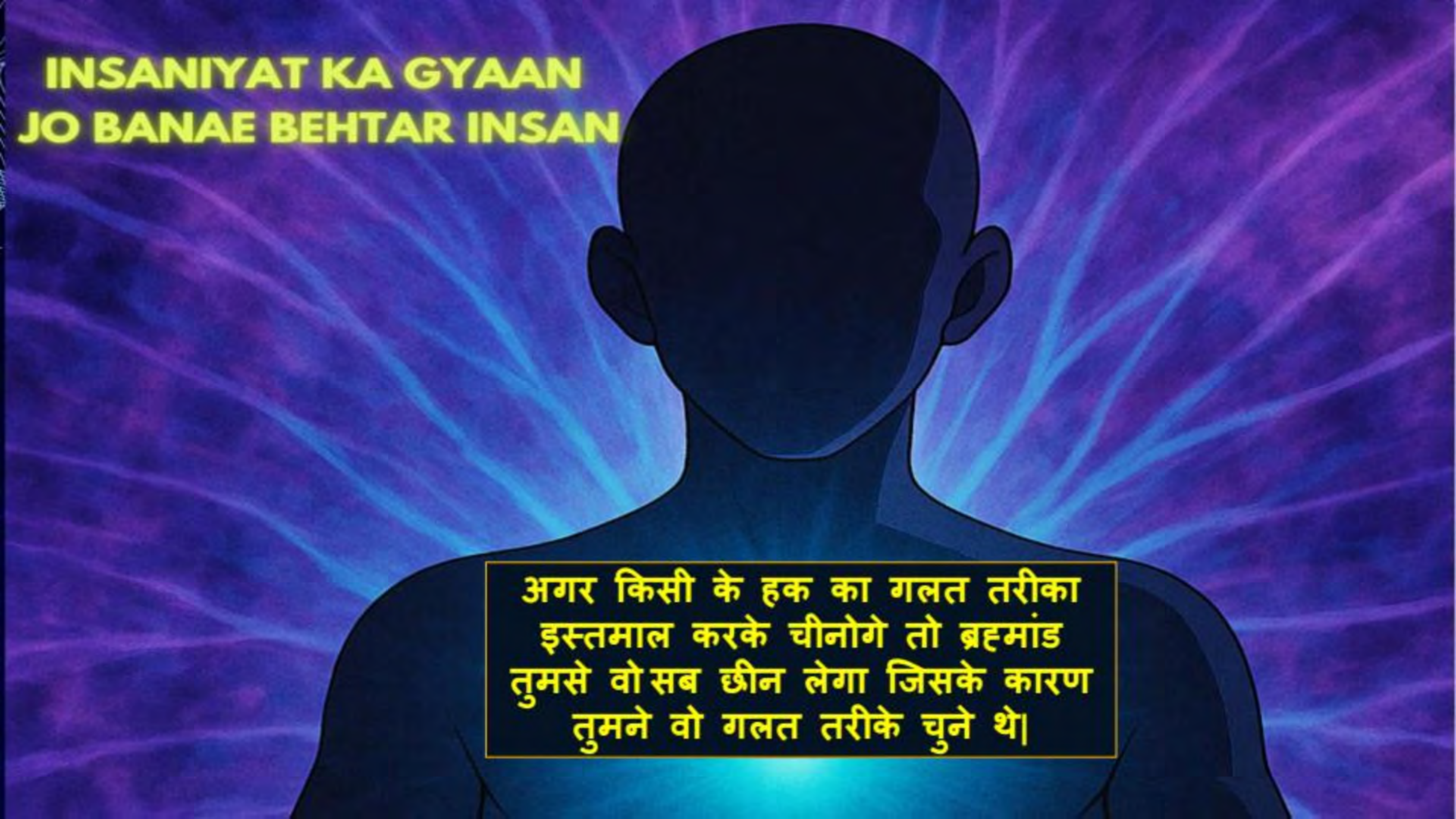
AYE BHAIYA

CONCEPT POLISH - HOMEWORK

CBSE PYQ

Calculate the boiling point of a solution prepared by adding 15 g of NaCl to 250 g of water.
[K_f of water is .512 K kg mol^{-1} and molar mass of NaCl is 58.44 g]

[I will provide short notes
& formula sheet]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अगर किसी के हक का गलत तरीका
इस्तमाल करके चीनोगे तो ब्रह्मांड
तुमसे वो सब छीन लेगा जिसके कारण
तुमने वो गलत तरीके चुने थे|

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Thank You