

Chapter 2 - Solution

Solution:

A solution is homogeneous mixture (composition and properties are uniform throughout) of two or more than two components.

A solution is made up of two parts :-

Solute	Solvent
components other than solvent or small amount in mass.	Determines the physical state of the solution. present in largest amount in mass.

Types of Solution :-

⇒ Binary Solution → one solute and one solvent.
e.g. (NaCl + H₂O)

⇒ Ternary Solution → 3 components.
e.g. C₂H₅OH + CH₃COOH + H₂O

Type of Binary solution

Types of Solution	Solute	Solvent	example.
Gaseous solution	Solid Liquid gas	Gas Gas Gas	Camphor in N ₂ chloroform in N ₂ mixture of N ₂ & O ₂
Liquid soln	Solid Liquid gas	Liquid Liquid Liquid	Glucose dissolved in water ethanol in water oxygen dissolved in water
	Solid Liquid gas	Solid Solid Solid	Copper dissolved in gold amalgams of Hg with Na solutions of H ₂ in Pd.

Concentration Terms

① Mass Percentage (w/w)

$$\left. \begin{array}{l} \text{Mass \% of a component} \\ \frac{\text{mass of the component in the sol}^n}{\text{Total mass of the solution}} \times 100 \end{array} \right\} \begin{array}{l} \text{w/w} \\ \text{w/v} \\ \text{v/v} \end{array} \Rightarrow \frac{\text{solute}}{\text{solution}}$$

e.g. 10% (w/w) ^(water solvent) aqueous solution of glucose.

10 g solute present in 100 g of solution.

$$\Rightarrow W_{\text{solution}} = W_{\text{solute}} + W_{\text{solvent}}$$

$$\text{if } 100 = 10 + W$$

① Volume percentage (v/v)

$$\text{volume \% of a component} = \frac{\text{volume of the component}}{\text{volume of solution}} \times 100$$

e.g. 15% v/v aqueous solution of ethanol.

15 ml solute, 85 ml solvent \Rightarrow 100 ml solution.

①① Mass by volume percentage (w/v) :-

$$\frac{\text{w/v \% of a component} \\ \text{Mass of the component}}{\text{Total volume of the solution}} \times 100$$

e.g. 18% (w/v) of aqueous solution of glucose
18 g of solute present in 100 ml volume of solution.

(*) Parts per million (10^6) \rightarrow

$$\text{ppm} \Rightarrow \frac{\text{No. of parts of the component}}{\text{Total no. of parts of all components of the solution}} \times 10^6$$

Density :- (d) $\Rightarrow \frac{\text{mass}}{\text{volume}} \cdot (\text{w/v})$

e.g. - 0.9 g/ml. \Rightarrow this is density
0.9 g present in 1 ml

1 ml \rightarrow 0.9

100 ml \rightarrow 90 g

1000 ml \rightarrow 900 g

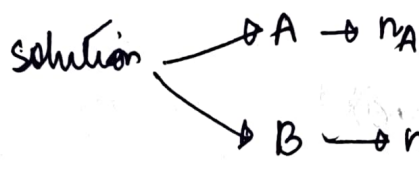
} density

* Mole fraction :-

Mole fraction of a component

$$= \frac{\text{no. of moles of the component}}{\text{Total no. of moles of all the components}} \\ (\Rightarrow \text{total moles of solution})$$

$$\therefore \text{Mole} = \frac{\text{given mass}}{\text{molar mass}} = \frac{\text{volume of gas (STP) (L)} \text{ for gas}}{22.4 \text{ L}}$$



Total moles of solutions
= moles of A + moles of B.
 $n_T = n_A + n_B$

$$\therefore x_A \text{ mole fraction of A} = \frac{n_A}{n_T}$$

$$\therefore x_B \text{ " " " B} = \frac{n_B}{n_T}$$

if. $x_A + x_B = 1$

\Rightarrow If A, B, C, D, ...

then $x_A + x_B + x_C + x_D + \dots = 1$

Q \rightarrow Calculate the mass percentage of benzene (C_6H_6) and CCl_4 . If 22 g of benzene is dissolved in 122 g of CCl_4 .

Soln. mass percentage (w/w)

$$\text{benzene} \rightarrow \frac{W_{\text{benzene}}}{W_{\text{benzene}} + W_{\text{CCl}_4}} \times 100 = \frac{22}{22 + 122} \times 100 = \frac{22}{144} \times 100 = 15.28\%$$

$$\Rightarrow \text{CCl}_4 = \frac{122}{144} \times 100$$

$$= 84.72 \%$$

⇒ Calculate the mole fraction of benzene in solution containing 30% by mass in carbon tetrachloride.

Solⁿ → 30 g benzene in 100 g of solution

~~30 g CCl₄~~ So, 100 g = 30 g of benzene + w g of CCl₄

⇒ w = 70 g

So, mole fraction of benzene = $\frac{30}{78}$

" " " " CCl₄ = $\frac{70}{154}$

Mole fraction of benzene = $\frac{30/78}{\frac{30}{78} + \frac{70}{154}}$

$x_{\text{CCl}_4} = 1 - x$

benzene

Molality (m)

No. of moles of solute present in 1 kg weight
of solvent.

$$m = \frac{\text{moles of solute}}{\text{mass of solvent (kg)}}$$

$$m = \frac{n_{\text{solute}}}{W_{\text{solvent in kg}}}$$

$$m = \frac{n_{\text{solute}}}{W_{\text{solute in gm}}} \times 1000$$

- ① Mass %, mole fraction and molality are independent of Temp^r, where molality is a function of Temp^r.
This because volume depends on Temp^r and the mass does not.