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CHEMISTRY

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CLASS 11&12th

CLASS 12th

Solution

01. Introduction

When two or more chemically non-reacting substances are mixed and form homogeneous mixture it is called solution. When the solution is composed of only two chemical substances, it is termed a binary solution, similarly, it is called ternary and quaternary if. it is composed of three and four components respectively.
Solution = solute + solvent

Solute
Generally the component present in lesser amount than other component in solution is called solute.

Solvent
Generally, the component present in greater amount is called the solvent. Physical state of solution is determined by solvent.

02. Types of Solution

	Solvent	Solute	Examples
1.	Gas	Gas	Mixture of gases, eg. air
2.	Gas	Liquid	Water vapour in air, mist. $CHCl_3(l)$ + $N_2(g)$
3.	Gas	Solid	Smoke, camphor (s) + $N_2(g)$
4.	Liquid	Gas	CO_2 gas dissolve in water (aerated drink), soda water.
5.	Liquid	Liquid	Mixture of miscible liquids e.g. alcohol in water.
6.	Liquid	Solid	Salt in water, sugar in water.
7.	Solid	Gas	hydrogen over palladium.
8.	Solid	Liquid	Mercury in zinc, mercury in gold i.e. all amalgams.
9.	Solid	Solid	Alloys e.g. copper in gold. zinc in copper.

03. Mass Percentage

It may be defined as the number of parts of mass of solute per hundred parts by mass of solution.

$$\% \text{ by mass} \left(\frac{w}{W}\right): = \frac{\text{Wt. of solute}}{\text{Wt. of solution}} \times 100$$

[X % by mass means 100 gm solution contains X gm solute; (100−X) gm solvent]

04. Mass-Volume Percentage (W/V %) :

It may be defined as the mass of solute present in 100 cm^3 of solution. For example, If 100 cm^3 of solution contains 5 g of sodium hydroxide, than the mass-volume percentage will be 5% NaOH solution.

$$\%\left(\frac{w}{V}\right) = \frac{\text{wt. of solute (in gm)}}{\text{volume of solution (in mL)}} \times 100$$

$$[X\,\%\left(\frac{w}{V}\right) \text{means 100 ml solution contains X gm solute}]$$

05. Volume Percent

It can be represented as % v/v or % volume and used to prepare such solutions in which both components are in liquids state. It is the number of parts of by volume of solute per hundred parts by volume of solution
Therefore,

$$\%\left(\frac{v}{V}\right) = \frac{\text{volume of solute}}{\text{volume of solution}} \times 100$$

06. Parts Per Million (ppm)

This method is used for expressing the concentration of very dilute solutions such as hardness of water, air pollution etc.

$$\text{ppm of substance} = \frac{\text{Mass of solute} \times 10^6}{\text{Mass of solution}} = \frac{\text{Volume of solute} \times 10^6}{\text{Volume of solution}}$$

07. Mole Fraction:

The ratio of the number of moles of one component to the total number of all the components present in the solution, is called the mole fraction of that component.

Mole fraction of solute X_A is given by $X_A = \frac{n_A}{n_A + n_B} = \frac{n_A}{\sum n}$

Mole fraction of solvent X_B is given by $X_B = \frac{n_B}{n_A + n_B} = \frac{n_B}{\sum n}$

where n_A is moles of solute A and n_B is moles of solvent B.

For binary solution of A & B $X_A + X_B = 1$

08. Molarity (Molar Concentration) :

It is defined as the number of moles of the solute dissolved in per litre of the solution, i.e.,

$$\text{Molarity (M)} = \frac{\text{Number of moles of solute}}{\text{Volume of solution (in } l)} = \frac{w_A}{m_A \times V} = \frac{c(\text{gm}/l)}{m_A} = \frac{\% \frac{W}{W} \times d \times 10}{m_A}$$

where let w_A g of the solute of molecular mass m_A be dissolved in V litre of solution, d = density of solution in g/mL.

09. Molarity of Dilute Solution :

Before dilution		After dilution
M_1V_1	=	M_2V_2

Molarity of mixing :

Let there be three samples of solution (containing same solvent and solute) with their molarity M_1, M_2, M_3 and volumes V_1, V_2, V_3 respectively. These solutions are mixed; molarity of mixed solution may be given as:

$M_1V_1 + M_2V_2 + M_3V_3 = M_R (V_1 + V_2 + V_3)$
where, M_R = Resultant molarity
$V_1 + V_2 + V_3$ = Resultant volume after mixing

10. Some Important Point :

[Note : Molarity is dependent on volume, therefore, it depends on temperature.]

1 M	Molar solution, i.e., molarity is 1
0.5 M or M/2	Semimolar
0.1 M or M/10	Decimolar
0.01 M or M/100	Centimolar
0.001 M or M/1000	Millimolar

11. Molality (m) :

The number of moles or gram-mole of solute dissolve in 1000 gram of the solvent is called molality of the solution.

$$\text{Molality of a solution} = \frac{\text{Number of moles of solute}}{\text{Amount of solvent in kg.}} = \frac{\text{Number of moles of solute} \times 1000}{\text{Amount of solvent in grams.}}$$