SOLUTION & COLLIGATIVE PROPERTIES

EXPRESSING CONCENTRATION OF SOLUTIONS

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CONCENTRATION:
Mass and Volume Percentage:
MOLARITY (MOLAR CONCENTRATION)
It is expressed as the quantity of moles of the solute dissolved per litre or per cubic decimetre of the solution. i.e.,

$$\text{Molarity (M)} = \frac{\text{Number of moles of solute}}{\text{Number of litres of solution}}$$

or

$$\text{Molarity} \times \text{Number of litres of solution} = \text{Number of moles of solute}$$

Let w_A g of the solute of molecular mass m_A be dissolved in V litre of solution.

$$\text{Molarity of solution} = \frac{w_A}{m_A \times V}$$

or

$$\text{Molarity} \times m_A = \frac{w_A}{V} = \text{Strength of the solution}$$

If V is taken in mL (cm^3), then Molarity of the solution $= \frac{w_A}{m_A \times V} \times 1000$

The unit of molarity is mol L^{-1} s mol or mol dm^3

Percentage by weight
The weight fraction of the solute is determined by the amount of solute in grams dissolved in one gram of the solution. Therefore,

$$\text{weight fraction} = \frac{w}{w + W}$$

Where 'w' grams of solute is dissolved in W grams of solvent.

$$\text{weight percent} = \frac{\text{weight of solute in grams} \times 100}{\text{weight of solution in grams.}}$$

$$w = \frac{w \times 100}{w + W}$$

Percent by volume (Volume fraction)
This technique is employed for liquid-in-liquid solutions. The volume fraction is defined as the volume of liquid (solute) in millilitres dissolved in one millilitre of the solution.

$$\text{Volume fraction} = \frac{\text{Volume of liquid solute in mL}}{\text{volume of solution in mL}}$$

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

Ex. If we have 6% w/w urea solution with density 1.060 g/mL, then calculate its strength in g/L ?

Sol. 6 g urea is present in 100 gm solution.

$$6 \text{ g in} \frac{100}{1.060} \text{ mL}$$

$$\frac{100}{1.060} \text{ mL} \longrightarrow 6 \text{ gm.}$$

$$\therefore \quad 1000 \text{ mL} = \frac{6}{100} \times 1.060 \times 1000 = 10.6 \times 6 = 63.6$$