Expressing Concentration of Solution

What is Concentration of Solution?

The Concentration of a Solution is defined as the relative amount of solute present in a solution.

It basically talks about how to find the amount of solute present in solvent which together forms solution.There are various methods used to find this,

Methods of Expressing Concentration of Solutions

- Percentage by weight (w / w %)
- Percentage by volume (V / V%)
- Weight by volume (w / v%)
- Mole fraction (x)
- Parts per million (ppm)
- Molarity (M)
- Molality (m)
- Normality (N)
- Formality (F)

All of them are briefed below:

- **Percentage by Weight (Mass Percent)**

Symbol: (w / w %)
Definition: It is defined as the amount of solute present in 100 **g** of solution.
Unit: No unit

- **Percentage by Volume (Volume Percent**

Symbol: (V / V %)
Definition: It is defined as the volume of solute present in 100 **mL** of solution.
Unit: No unit

- **Weight by Volume (Mass-Volume Percent)**

Symbol: (W / V %)
Definition: It is defined as the amount of solute present in 100 **mL** of solution.

Unit: mg/L or g/100cm^3

Formula:
Percent Concentration

a. Weight Percent $\left(\frac{W}{W}\right) = \frac{\text{Weight Solute}}{\text{Weight Solution}} \times 100\%$

b. Volume Percent $\left(\frac{V}{V}\right) = \frac{\text{Volume Solute}}{\text{Volume Solution}} \times 100\%$

c. Weight /Volume Percent $\left(\frac{W}{V}\right) = \frac{\text{Weight Solute, g}}{\text{Volume Soln, L}} \times 100\%$

Example:

As an example consider 5 g sugar dissolved in 20 g of water. What is the w/w% concentration of sugar in this solution?

$$\frac{5\text{ g sugar}}{25\text{ g solution}} \times 100 = 20\text{ w/w \%}$$

How would you prepare the following solutions?

(a)6 % NaoH

(b)5 % C_2H_5OH

(c)200 cm^3 of 10% NaOH

soln:

100 cm^3 require salt=10 g

1 cm^3 of solution require salt=10/100

200 cm^3 ----------=10/100x200=20g

- **Mole Fraction**

Symbol : X (lower-case Greek letter chi, χ)

Definition: It is the ratio of the number of moles of solute and the total number of moles of solute and solvent.

Unit: No unit

Formula:

$$\text{Mole Fraction of Solute, } X_{solute} = \frac{n_{solute}}{n_{solute} + n_{solvent}}$$

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$$\text{Where, } X_{solute} + X_{solute} = 1$$

Mole Fraction (X): This is the number of moles of a compound divided by the total number of moles of all chemical species in the solution.

$$X_{solute} = \frac{\text{Moles of Solute}}{\text{Total moles of all components}}$$

Example:

What are the mole fraction of the components of the solution formed when 92 g glycerol is mixed with 90 g water? (molecular of weight water = 18; molecular weight of glycerol = 92)

Solution:

90 g water = 90 g x 1 mol / 18 g = 5 mol water

92 g glycerol = 92 g x 1 mol / 92 g = 1 mol glycerol

Total mol = 5 + 1 = 6 mol

X water = 5 mol / 6 mol = 0.833

X glycerol = 1 mol / 6 mol = 0.167

It's a good idea to check your math by making sure the mole fractions add up to 1:

xwater + xglycerol = .833 + 0.167 = 1.000