Solutions

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A homogeneous mixture of two or more pure non-reacting substances whose composition can be varied within certain limits.

1) Types of solution - A solution may contain two or more substances also called components or constituents. ~~A solution~~
A solution which has two components is known as binary solution (eg. NaCl + H_2O).
A solution with three components is called ternary solution (eg. NaCl + KCl + H_2O).
In binary solution, the component or constituent present in smaller proportion or amount is called solute, while one present in excess is known as solvent. [Table (2.1)].

2) Expressing concentration of solution - Concentration of a solution implies the amount of the solute present in a given quantity of the solution or the solvent. Thus, while expressing the concentration of a solution, only the relative amounts of the components are considered.
The concentration of a binary solution can be expressed in following ways -

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Table 2.1: Types of Solutions

Type of Solution	Solute	Solvent	Common Examples
Gaseous Solutions	Gas	Gas	Mixture of oxygen and nitrogen gases
	Liquid	Gas	Chloroform mixed with nitrogen gas
	Solid	Gas	Camphor in nitrogen gas
Liquid Solutions	Gas	Liquid	Oxygen dissolved in water
	Liquid	Liquid	Ethanol dissolved in water
	Solid	Liquid	Glucose dissolved in water
Solid Solutions	Gas	Solid	Solution of hydrogen in palladium
	Liquid	Solid	Amalgam of mercury with sodium
	Solid	Solid	Copper dissolved in gold

2.1) Strength - Amount of solute in grams present in one litre (or dm^3) of the solution.

$$\text{Strength} = \frac{\text{Mass of solute (g)}}{\text{Vol. of solution } (dm^3)}$$

2.2) Mass percentage (w/w) - (No units)

$$\text{Mass \% of component} = \frac{\text{Mass of the component in solution}}{\text{Total mass of the solution}} \times 100.$$

If A and B are two components of binary solution,

$$\text{Mass \% of A} = \frac{W_A}{W_A + W_B} \times 100.$$

Eg. a) 10 % of glucose in water by mass represents

$$\text{Mass \% of glucose} = \frac{10}{10+90} \times 100.$$ [10g = Glucose, 90g = Water. resulting in 100g solution].

b) Commercial bleaching solution contains 3.62 mass % of sodium hypochlorite in Water.

2.3) Volume percentage (v/v) - (No units)

$$\text{Volume \% of component} = \frac{\text{Volume of the component in solution}}{\text{Total volume of solution}} \times 100$$

Eg: a) 10 % of 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.

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b) 35% (v/v) solution of ethylene glycol, an anti-freeze, is used in cars for cooling the engine. At the concentration the antifreeze lowers the freezing point of water to 255.4K (-17.6°C)

2.4) Mass by volume percentage (w/v): This unit is especifically used in medicine and pharamacy. It is the mass of solute dissolved in 100 ml of the solution.

2.5) Parts per million: When a solute is present in trace quantities, it is expressed in parts per million (ppm):

Parts per million = $\frac{\text{Number of parts of component}}{\text{Total no. of parts of all components of the solution}} \times 10^6$

Eg: If the hardness of water due to presence of $Ca(HCO_3)_2$ is 16.7 ppm, ie. 16.7 parts of $Ca(HCO_3)_2$ are present in 10^6 parts of the solution of hard water.