Chapter 6

Dilute solutions

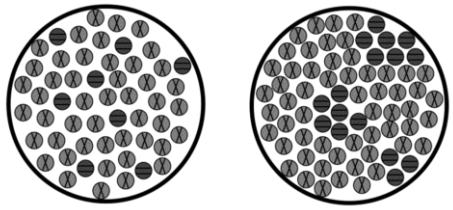
Day - 1

SOLUTIONS

When two or more than two substances are mixed with each other but do not react with each other it is called a solution.

Solutions are of two types

Homogeneous Solutions are mixtures of two or more than two components whose composition and properties are uniform throughout the mixture. Heterogeneous mixture don't have uniform composition and properties



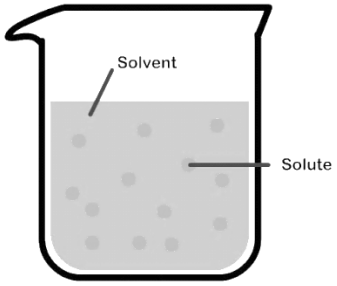
Homogeneous Heterogeneous

BINARY SOLUTIONS

Binary solution is a solution which contains only two components which are called solute and solvent

Solvent: The component whose mole fraction is greater than other

Solute: The component whose mole fraction is smaller than solvent



TYPES OF BINARY 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

CONCENTRATION OF BINARY SOLUTIONS

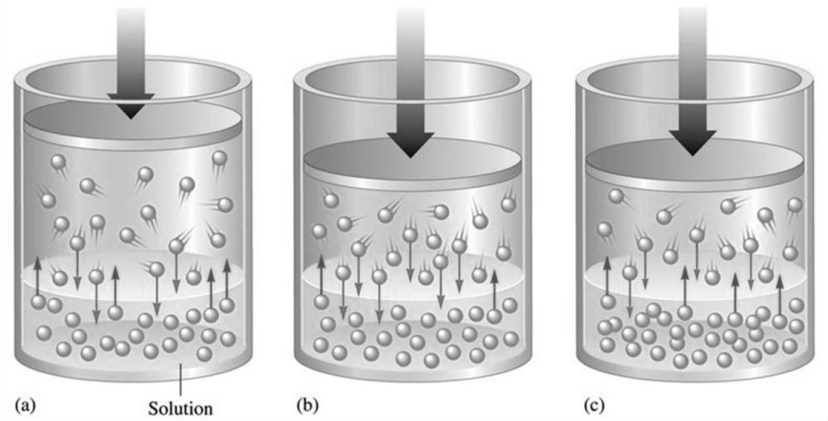
If we take a binary solution consisting of A & B.

1. Mass percentage : $\frac{W_A}{W_A+W_B} \times 100 = \frac{W_A}{W_{Solution}} \times 100$
2. Volume percentage : $\frac{V_A}{V_A+V_B} \times 100 = \frac{V_A}{V_{Solution}} \times 100$
3. Mass/volume percentage = $\frac{W_A}{W_{Solution}} \times 100$
4. Parts per million (ppm) = $\frac{W_A}{W_{Solution}} \times 10^6$

Solution

5. Mole fraction: moles of A in one mole of solution $X_A = \frac{n_A}{n_A+n_B} = \frac{W_A/M_A}{W_A/M_A+W_B/M_B}$
6. Molality: mole of A in one kg of B $m^1 = \frac{n_A}{\text{kg of solution}} = \frac{W_A/M_A}{W_B/1000}$
7. Molarity: moles of A in one litre of solution (A + B) $M = \frac{n_A}{\text{Lipe of solution}} = \frac{W_A/M_A}{V_{Solution}(\text{m litre})}$
8. Normality: gm eqn. of A per lite of solution $M = \frac{\text{gm Eq}}{\text{lit of solution}} = \frac{W_A/E_A}{V_{solution}}$

SOLUTION OF GASES IN LIQUIDS



HENRY'S LAW

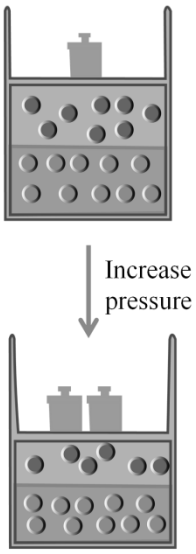
The mole fraction of volatile solute is proportional to the vapor pressure of the solute.

$P = K_H X$

K_H= Henry's Law constant, X = mole fractions.

Increasing the partial pressure of a gas over a liquid increases the amount of gas dissolved in the liquid

K_H depends on temperature



Henry's law finds several applications in industry

To increase the solubility of CO_2 in soft drinks and soda water, the bottle is sealed under high pressure

Bends: Scuba divers while breathing air at high pressure underwater increases the solubility of atmospheric gases in blood. When the divers come towards surface, the pressure gradually decreases. This releases the dissolved gases and leads to the formation of bubbles of nitrogen in the blood. This blocks capillaries and creates a medical condition known as bends, which are painful and dangerous to life

Anoxia: at high altitudes due to low pressure the solubility of oxygen in blood decreases.