Chapter 2

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TYPES OF SOLUTIONS

Brief introduction of solution

A solution is formed when two or more substances that do not chemically react with each other are mixed to create a homogeneous mixture.

Homogeneous Mixture

If a solution consists of only two chemical substances, it is referred to as a binary solution. Likewise, it is termed a ternary solution if composed of three components, and a quaternary solution if made up of four components

$$\text{Solution} = \text{Solute} + \text{Solvent}$$

Solute

Generally, the constituent present in a solution in a lesser quantity than the other component is referred to as the solute.

Solvent

Generally, the component that surpasses any or all other components in quantity is termed the solvent.

- Physical state of solvent and solution is same.

Ex. In a syrup (liquid solution) containing 60% sugar (a solid) and 40% water (a liquid - same aggregation as solution), water is termed as the solvent.

Properties of Solutions

Solutions exhibit distinctive properties that diverge from those of their individual solute or solvent components. These encompass phenomena such as the elevation of boiling points, depression of freezing points, imposition of osmotic pressure, and the manifestation of colligative properties.

Dilute Solution

A solution characterized by the dissolution of a relatively small amount of solute in a substantial amount of solvent is termed a dilute solution.

Concentrated solution

A solution characterized by the presence of a relatively large amount of solute is referred to as a concentrated solution.

- Solubility of gas in a liquid, Solubility - Effect of Pressure
- Vapour Pressure of Liquid Solutions
  - Raoult's Law
- Ideal and Non-ideal Solution
  - Ideal solution
  - Non-Ideal solution
- Colligative Properties and Determination of Molar Mass
  - Solution with positive deviation
  - Solutions with negative deviation
  - Relative lowering of vapour pressure
  - Limitations of Raoult's law
- Osmosis and osmotic pressure
  - Introduction of Osmosis and osmotic pressure
  - Osmosis
  - Reverse osmosis and water purification
  - Vant's Hoff's theory of dilute solution
  - Depression in freezing point
- Abnormal Molar Mass
- Solute Dissociation or ionization
- Osmotic Pressure of mixture of two solution

Saturated solution

The maximum quantity of solute, measured in grams, that can be dissolved in 100 g of a solvent at a specific temperature is known as the solubility of the solute. A solution exhibiting this maximum solubility is called a saturated solution.

Super saturated solution

A solution containing an excess amount of solute beyond the saturation point for a given quantity of solvent at a specific temperature is termed a supersaturated solution.

- It is unstable system.

Applications

Chemistry

Solutions serve as pivotal components in a myriad of chemical processes and reactions, encompassing dissolution, precipitation, and chromatography, among others.

Industry

Various industrial sectors heavily rely on solutions, evident in their utilization within pharmaceuticals, food processing, and manufacturing processes.

Everyday Life

Solutions permeate everyday life, finding application in commonplace scenarios ranging from beverages and personal care products to household cleaning agents

Solution And Its Type

Types of Solutions

S.No.	Solute	Solvent	Types of Solutions	Examples
Solid Solutions				
1	Solid	Solid	Solid in solid	All alloys like brass, bronze, an alloy of copper and gold, etc.
2	Liquid	Solid	Liquid in solid	Amalgam of mercury with Na, $CuSO_4.5H_2O$. $FeSO_4.7H_2O$

3	Gas	Solid	Gas in solid	Solution of H_2 in Pd, dissolved gases in minerals.
Liquid Solutions				
4	Solid	Liquid	Solid in liquid	Sugar solution, salt solution, I_2 in CCl_4
5	Liquid	Liquid	Liquid in liquid	Benzene in toluene, alcohol in water.
6	Gas	Liquid	Gas in liquid	CO_2 in water, NH_3 in water etc.
Gas In Liquid				
7	Solid	Gas	Solid in gas	Iodine vapours in air, camphor vapours in N_2.
8	Liquid	Gas	Liquid in gas	Water vapours in air, CHCl3 vapours in N_2.
9	Gas	Gas	Gas in gas	Air ($O2 + N_2$)

Note: The dissolution of a liquid in a gas or a solid in a gas is not feasible as the components cannot create a homogeneous mixture.

Properties of a Solution

(i) A solution is characterized by a single phase, making it a monophasic system.

(ii) Being uniform throughout, a solution exhibits consistent properties such as density, refractive index, etc.

(iii) The size of solute particles in a solution fall within the order of 10^{-7} - 10^{-8} cm.

(iv) Components of a solution are not easily separable through physical methods.

(v) The properties of a solution are reflective of its components; thus, the components retain their individual properties.

(vi) The composition of a solution is not fixed but can vary within specific limits.

(vii) Certain solution properties, including density, viscosity, surface tension, boiling point, and freezing point, vary with the solution's composition.