Solution and Solubility

1. What is a Solution?

A solution is a mixture of molecules that are evenly distributed.

It consists of:

- **Solute:** The substance that dissolves in the solution.
- **Solvent:** The substance in which the solute dissolves.

Example:

In a salt-water solution:

- Salt ⟶ Solute.
- Water ⟶ Solvent.
- Saltwater ⟶ Solution.

2. Water – The Universal Solvent

Water is called the universal solvent because:

- It can dissolve most substances.
- This is due to its polar nature (positive and negative charges).

Examples:

- Sugar, salt, and oxygen dissolve in water.
- Water dissolves many chemicals and minerals.

3. Soluble vs Insoluble Substances

Soluble Substances:

Substances that completely dissolve in a solvent.

Examples:

- Salt dissolving in water.
- Sugar dissolving in water.

Insoluble Substances:

Substances that do not dissolve in a solvent.

Examples:

- Chalk powder in water.
- Sand in water.

4. Types of Solutions

A. Solid in Liquid:

A solid (solute) dissolves in a liquid (solvent) to form a solution.

Examples:

- Salt-water solution.
- Sugar-water solution.
- Tea (sugar dissolves in water).

B. Liquid in Liquid:

A liquid (solute) dissolves in a liquid (solvent).

Examples:

- Orange juice mixed with water.
- Vinegar mixed with water.
- Alcohol in water (used in hand sanitizers).

C. Gas in Liquid:

A gas (solute) dissolves in a liquid (solvent).

Examples:

- Carbonated (fizzy) drinks: Carbon dioxide (CO_2) dissolves in water.
- Oxygen dissolved in water: Used by aquatic animals for breathing.

D. Gas in Gas:

A gas (solute) dissolves in another gas (solvent).

Examples:

- Room freshener sprayed in a room.
- **Air:** A mixture of gases like:

Oxygen, nitrogen, carbon dioxide, and argon.

5. Key Concepts

Concentration of Solution:

- The amount of solute dissolved in a solvent.
- Solutions can be:

Dilute: Small amount of solute.

Concentrated: Large amount of solute.

Saturation:

When no more solute can dissolve in the solvent, the solution becomes saturated.

Example: Adding sugar to tea – eventually, it stops dissolving.

Factors Affecting Solubility:

Temperature:

- Increasing temperature → increases solubility of solids.
- Decreasing temperature → increases solubility of gases.

Pressure:

- Increasing pressure → increases solubility of gases.

Example: CO_2 dissolves in fizzy drinks under high pressure.

- Agitation (Stirring): Stirring increases the rate of solubility.

6. Fun Facts About Solutions

i. Seawater – The Largest Solution on Earth:

- Seawater is a solution of salt and minerals dissolved in water.
- It also contains dissolved gases like oxygen and carbon dioxide.

ii. Oxygen in Water:

- Aquatic animals breathe oxygen dissolved in water.
- Colder water holds more dissolved oxygen.

iii. Soft Drinks:

- Carbonated drinks contain CO_2 gas dissolved under pressure.
- When the bottle is opened, the pressure decreases, and CO_2 escapes, forming bubbles.

iv. Air is a Gaseous Solution:

Air contains:

- 78% nitrogen,
- 21% oxygen,
- 1% other gases (argon, carbon dioxide, etc.).

v. Perfume Diffusion:

- When perfume is sprayed, it spreads through the air.
- This is an example of a gas-gas solution.

Key Takeaways

Solution Basics:

- **Solute:** The substance that dissolves.
- **Solvent:** The substance in which the solute dissolves.
- **Solution:** The uniform mixture formed.

Types of Solutions:

- **Solid in Liquid:** Salt in water.
- **Liquid in Liquid:** Alcohol in water.
- **Gas in Liquid:** CO_2 in soda.
- **Gas in Gas:** Air.

Solubility Factors:

- **Temperature:** Higher temperature increases solubility of solids but decreases solubility of gases.
- **Pressure:** Higher pressure increases solubility of gases.
- **Stirring:** Increases the rate of solubility.

Interesting Examples:

- **Carbonated drinks:** CO_2 dissolves under high pressure.
- **Air:** A mixture of gases.
- **Aquatic animals:** Breathe oxygen dissolved in water.