Unit 1

Unit 1: Matter – Its Nature and Behaviour

Introduction to Matter

Matter is defined as anything that has mass and occupies space. Everything we see, from air to water, is made up of matter.

States of Matter:

- **Solid**: Definite shape and volume.
- **Liquid**: Definite volume but takes the shape of the container.
- **Gas**: Neither definite shape nor volume, expands to fill its container.

Characteristics of Particles of Matter

1. **Particles of Matter are Very Small**: Particles of matter are too tiny to be seen by the naked eye. For example, when sugar dissolves in water, it appears to disappear, but the particles are still there.
2. **Particles of Matter are in Constant Motion**: The particles in all states of matter are constantly moving. The movement is least in solids, moderate in liquids, and maximum in gases.
3. **Particles of Matter have Spaces Between Them**: The space between particles is largest in gases, smaller in liquids, and smallest in solids. This is why gases can be easily compressed.
4. **Particles of Matter Attract Each Other**: The particles are held together by attractive forces, strongest in solids and weakest in gases.

States of Matter

1. **Solids**:
   - Have a definite shape and volume.
   - Particles are tightly packed.
   - Examples: Ice, wood.
2. **Liquids**:
   - Have a definite volume but no definite shape.
   - Particles are less tightly packed than in solids and can move past each other.
   - Examples: Water, oil.
3. **Gases**:
   - Neither definite shape nor volume.
   - Particles are spread out and move freely.
   - Examples: Oxygen, carbon dioxide.

Change of State of Matter

Matter can change from one state to another by altering temperature or pressure. These changes are **physical changes** and are **reversible**.

1. **Melting**: Solid to liquid (e.g., ice to water) at the **melting point**.
2. **Freezing**: Liquid to solid (e.g., water to ice) at the **freezing point**.
3. **Boiling**: Liquid to gas (e.g., water to steam) at the **boiling point**.
4. **Condensation**: Gas to liquid (e.g., steam to water).
5. **Sublimation**: Solid directly to gas (e.g., dry ice to carbon dioxide gas).

Latent Heat

Latent heat is the heat energy required to change the state of a substance without changing its temperature.

1. **Latent Heat of Fusion**: The heat energy required to convert 1 kg of solid into liquid without a change in temperature.
    - Example: Melting ice to water at 0°C.
2. **Latent Heat of Vaporization**: The heat energy required to convert 1 kg of liquid into gas without a change in temperature.
    - Example: Boiling water to steam at 100°C.

Diffusion

Diffusion is the movement of particles from an area of higher concentration to an area of lower concentration. Diffusion occurs faster in gases than in liquids and solids due to the larger spaces between particles.

- **Example**: When perfume is sprayed in a corner of a room, it spreads throughout the room.

Evaporation

Evaporation is the process by which a liquid turns into a gas below its boiling point. It occurs only at the surface of the liquid.

Factors affecting evaporation:

1. **Temperature**: Higher temperature increases the rate of evaporation.
2. **Surface Area**: Larger surface areas increase evaporation.
3. **Humidity**: Lower humidity increases evaporation.
4. **Wind Speed**: Higher wind speeds increase evaporation.

Plasma and Bose-Einstein Condensate

Besides the three common states of matter, two more states exist:

1. **Plasma**: A state of matter where gases are superheated and ionized (e.g., stars, neon lights).
2. **Bose-Einstein Condensate (BEC)**: A state of matter formed at extremely low temperatures where particles behave as a single entity.

Important Definitions

- **Boiling Point**: The temperature at which a liquid changes into gas.
- **Melting Point**: The temperature at which a solid changes into liquid.
- **Intermolecular Forces**: The forces of attraction between particles.