Matter around us

Definition of Matter

➢ Matter

- Definition: Matter is anything that occupies space and has mass.

🧠 **Key Points :-**

- ***Matter is made up of tiny particles.***
- ***It can exist in different states (solid, liquid, gas).***
- ***It may or may not be visible to the naked eye.***

✅ Examples of Matter:

- Air, Water, Stone, Wood, Oxygen, Iron rod

❌ Non-examples (Not considered matter):

- Feelings like love, anger, Sound, Light, Heat, Thoughts

Characteristics of Particles of Matter

➢ Particles of matter are very small :-

- They are so tiny that we cannot see them with naked eyes.
- Example: A crystal of potassium permanganate can color a large amount of water.

➢ Particles of matter have spaces between them :-

- There are gaps between the particles, called inter-particle spaces.
- Example: Sugar dissolves in water because the particles of sugar occupy the spaces between water particles.

➢ Particles of matter are constantly moving :-

- They have kinetic energy and keep moving in all directions.
- Example: The fragrance of perfume spreads in a room without shaking the bottle.

➢ Particles of matter attract each other :-

- There is a force of attraction between particles that keeps them together.
- Example: Solids have the strongest force of attraction, while gases have the weakest.

States of Matter

- There are three main physical states of matter:

1. Solid :-
   - Has a fixed shape and fixed volume.
   - Particles are closely packed in a regular pattern.
   - Very strong force of attraction between particles.
   - Very little space between particles.
   - Particles vibrate in their fixed positions.
   - Examples: Stone, iron, wood, ice.
2. Liquid :-
   - Has a fixed volume but no fixed shape (takes shape of container).
   - Particles are less tightly packed compared to solids.
   - Moderate force of attraction between particles.
   - More space than solids.
   - Particles can slide past each other.
   - Can be slightly compressed.
   - Examples: Water, milk, oil, juice.
3. Gas :-
   - Has no fixed shape and no fixed volume.
   - Particles are very far apart.
   - Very weak force of attraction.
   - Maximum space between particles..
   - Particles move freely and rapidly in all directions.
   - Examples: Oxygen, carbon dioxide, hydrogen, air.

Characteristics of the Three States of Matter

Property	Solid	Liquid	Gas
Shape	Fixed	Not fixed (takes container's shape)	Not fixed
Volume	Fixed	Fixed	Not fixed
Compressibility	Negligible (almost not compressible)	Slightly compressible	Highly compressible
Inter-particles space	Very less	Moderate	Very large
Force of attraction	Strong	Moderate	Very week

Particles movement	Vibration at fixed position	Slide past each other	Move freely and rapidly
Rigidity	High	Low	No rigidity
Fluidity	Not fluid (can't flow)	Cannot flow	Can flow easily

Effect of Temperature on Matter

👉 What happens when we increase the temperature of matter?

➔ Particles gain kinetic energy

- When temperature increases, particles start moving faster.
- Their kinetic energy increases.

➔ Particles vibrate more strongly

- In solids, particles begin to vibrate more rapidly in their positions.
- In liquids and gases, they move more freely and with more energy.

➔ Inter-particle attraction decreases

- The increased motion weakens the force of attraction between particles.
- This can break the bonds between them.

➔ Change of state occurs

- If enough heat is supplied, matter can change its state:
    - Solid → Liquid (Melting)
    - Liquid → Gas (Boiling or Vaporization)

➔ Expansion takes place

- Most substances expand when heated due to increased particle movement.
- This is why metal wires expand in heat.

🔁 Summary:

Increasing temperature increases particle movement, weakens the attraction between them, and leads to change of state.

Change of State of Matter

- When a substance changes from one state (solid, liquid, gas) to another due to change in temperature or pressure, it is called change of state.

✅ 1. Melting (Solid → Liquid)

- When a solid is heated, it changes into liquid.
- This happens at a fixed temperature called melting point.
- During melting, particles gain energy and overcome the force of attraction.
- Example: Ice melts to form water at 0°C.

✅ 2. Boiling / Vaporization (Liquid → Gas)

- When a liquid is heated, it changes into gas.
- This occurs at a fixed temperature called boiling point.
- Particles gain more energy and completely break free from liquid state.
- Example: Water boils and forms steam at 100°C.
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✅ 3. Condensation (Gas → Liquid)

- When a gas is cooled, it changes into liquid.
- Particles lose energy and come closer.
- This is the reverse of vaporization.
- Example: Steam condenses to form water.

✅ 4. Freezing (Liquid → Solid)

- When a liquid is cooled, it changes into solid.
- Particles lose energy and settle into fixed positions.
- This occurs at the freezing point.
- Example: Water freezes to form ice at 0°C.

✅ 5. Sublimation (Solid → Gas and Gas → Solid)

- Some substances directly change from solid to gas and vice versa, without becoming liquid.
- This process is called sublimation.
- Examples: Camphor, naphthalene, dry ice.

Latent Heat

👉 Definition:

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

✅ 1. During change of state, temperature remains constant, even though heat is continuously supplied.

- Example: When ice melts at 0°C, it absorbs heat but stays at 0°C until all ice turns to water.

✅ 2. Types of Latent Heat:

a) Latent Heat of Fusion

- It is the heat energy required to change 1 kg of a solid into liquid at its melting point without temperature change.
- Example: Ice → Water at 0°C
- For ice, it is approximately 334 kJ/kg.

b) Latent Heat of Vaporization

- It is the heat energy required to change 1 kg of a liquid into gas at its boiling point without temperature change.
- Example: Water → Steam at 100°C
- For water, it is approximately 2260 kJ/kg.

🧠 **Key Point :-**

Latent heat is hidden heat – it is used to change the state, not the temperature.

Evaporation

👉 Definition:

- Evaporation is the process by which a liquid changes into vapour at any temperature below its boiling point.

✅ 1. It is a surface phenomenon

- Only particles at the surface of the liquid escape into air.

✅ 2. Takes place at all temperatures

- Unlike boiling, evaporation can occur even at room temperature.

✅ 3. Particles gain energy

- Some high-energy particles escape, leaving the rest cooler.

✅ 4. Evaporation causes cooling

- When fast-moving particles leave the surface, the average temperature of remaining particles decreases.
- Example:
    - Water cools in an earthen pot.
    - After applying alcohol or perfume, skin feels cool.

👉 Factors Affecting Evaporation :-

1. Surface Area

- Larger surface area → faster evaporation.
- Example: Wet clothes dry faster when spread out.

2. Temperature

- Higher temperature → faster evaporation.
- Example: Clothes dry faster in sunlight.

3. Humidity (Moisture in air)

- More humidity → slower evaporation.
- Example: Clothes dry slowly on a humid day.

4. Wind Speed

- Higher wind speed → faster evaporation.
- Example: Wet floors dry quickly under a fan.

Evaporation Causes Cooling

👉 Why does evaporation cause cooling?

- When a liquid evaporates, the particles with higher kinetic energy escape from the surface.
- As a result, the average kinetic energy of remaining particles decreases, which leads to a drop in temperature.
- This is why evaporation produces a cooling effect.

✅ Explanation:

- During evaporation, heat energy is taken from the surroundings or the surface of the liquid.
- This absorbed energy cools down the surrounding area.

✅ Everyday Examples:

- Sweating cools our body:
  Sweat absorbs heat from the skin and evaporates, making the body feel cool.
- Alcohol/Perfume feels cool:
  Alcohol evaporates quickly by absorbing heat from the skin.
- Water in an earthen pot (matka) remains cool:
  Water seeps out and evaporates from the surface, absorbing heat from the pot.
- Wet clothes dry and feel cool:
  The water evaporates and takes heat from clothes, making them cool to touch.

Temperature Scales and Conversion

✅ 1. Common Temperature Scales:

- Celsius (°C)
  - Freezing point of water = 0°C
  - Boiling point of water = 100°C
- Kelvin (K)
  - Freezing point of water = 273 K
  - Boiling point of water = 373 K

✅ 2. Why Kelvin Scale?

- Kelvin is the SI unit of temperature.
- It starts from absolute zero (0 K), where particle motion completely stops.

✅ 3. Conversion Formula:

- To convert Celsius to Kelvin:

  👉 K = °C + 273
- To convert Kelvin to Celsius:

  👉 °C = K – 273

✅ 4. Examples:

- 25°C = 25 + 273 = 298 K
- 300 K = 300 – 273 = 27°C

Melting Point and Boiling Point

✅ 1. Melting Point

- The temperature at which a solid changes into a liquid is called its melting point.
- At this temperature, both solid and liquid states exist in equilibrium.
- During melting, temperature remains constant until all solid is converted into liquid.
- Example:
  - Ice melts at 0°C or 273 K.

✅ 2. Boiling Point

- The temperature at which a liquid changes into gas is called its boiling point.
- At this temperature, the liquid boils throughout the entire volume (not just at the surface).
- During boiling, temperature remains constant until all liquid is converted into gas.
- Example:
  - Water boils at 100°C or 373 K.

🧠 **Key Point :-**

Melting and boiling points are fixed for pure substances and can be used to identify them.