Chapter 1: Kinetic Particle Theory

- The **kinetic particle theory** states that all matter is made up of tiny particles and that these particles are in constant motion.

Characteristic	Solid	Liquid	Gas
Arrangement of particles	• Orderly • Closely packed	• Disorderly • Less closely packed than in a solid	• Disorderly • Very far apart
Attractive forces between particles	• Very strong	• Strong	• Very weak
Kinetic energy of particles	• Very low	• Low	• High
Motion of particles.	• Vibrate and rotate about in their fix positions	• Move freely throughout the liquid	• Move about rapidly in any direction

Melting

- Melting is the process by which a substance changes from a solid to a liquid.
- The temperature at which a solid becomes a liquid is called its melting point.
- Different substances have different melting points.
- During melting, the temperature of the substance remains the same.

❖ What happens to the particles of a solid that is heated until it melts?

1	2	3
• Heat energy is absorbed by the particles of the solid. • The heat energy is converted into kinetic energy. • The particles start to vibrate faster in their fixed position.	• When the temperature is high enough, the vibrations of the particles become sufficient to overcome the forces of attraction between them. • The particles begin to break away from their fixed positions.	• The particles are no longer in their fixed positions. • The substance is now a liquid. • The particles can move freely throughout the liquid.

Freezing

- Freezing is the process by which a substance changes from a liquid to a solid.
- The temperature at which a liquid becomes a solid is called its freezing point.
- A pure substance melts and freezes at the same temperature.
- During freezing, the temperature of the substance remains the same.

❖ What happens to the particles of a liquid that is cooled until it freezes?

1	2	3
• Energy is given out by the particles of the liquid. • The particles lose kinetic energy and begin to move more slowly.	• When the temperature is low enough, the particles no longer have enough energy to move freely. • The particles start to settle into fixed positions.	• All the particles have settled into fixed positions. • The substance is now a solid. • The particles can only vibrate about in their fixed positions.

Boiling

- Boiling is the process by which a substance changes from a liquid to a gas at the boiling temperature of the substance.
- The temperature at which a liquid boils is called its boiling point.
- Different substances have different boiling points.
- During boiling, the temperature of the substance remains the same.

❖ What happens to the particles of a liquid that is heated until it boils?

1	2	3
• Heat energy is absorbed by the particles of the liquid. • The heat energy is converted into kinetic energy. • The particles start to move faster as the temperature rises.	• When the temperature is high enough, the particles have enough energy to overcome the forces of attraction holding them together.	• The particles are now spread far apart. • The substance is now a gas. • The particles can move about rapidly in any direction.

❖ What do you observe when a liquid boils?

➢ When a liquid boils, bubbles of gas are seen. These bubbles are formed when the liquid changes to gas. They also consist of other gases dissolved in the liquid. The bubbles rise to the surface and escape into the air.

Evaporation

- Evaporation is the process by which a liquid changes to a gas at temperatures lower than its boiling point.
- Evaporation occurs because some particles have enough energy to escape as a gas from the surface of the liquid.
- Liquids that evaporate quickly at room temperature are called volatile liquids. They usually have boiling points just above room temperature. e.g. petrol and perfumes.

❖ In what way is evaporation different from boiling?

Boiling	Evaporation
Occurs only at boiling point	Occurs only at temperatures below boiling point
Occurs throughout the liquid	Occurs only at the surface of the liquid
Occurs rapidly	Occurs slowly

Condensation

- Condensation is the process by which a gas changes to a liquid.
- When water vapour touches a cold surface, condensation occurs and liquid water is obtained.

❖ What happens to the particles of a gas when gas condenses?

➢ Think of condensation as the reverse of boiling. Heat energy is given out by gas particles during condensation. As the temperature drops, the gas particles lose energy and move more slowly. Eventually, the movement of particles becomes slow enough for the gas to change to a liquid.

Sublimation

- Sublimation is the process by which a solid changes directly to a gas without going through the liquid state.
- Substances that sublime may also change directly from a gas to a solid without going through the liquid state. This process is called deposition.

❖ Why do solids sublime?

➢ Sublimation occurs because particles at the surface of the solid have enough energy to break away from the solid and escape as a gas. Ammonium chloride and iodine are two other examples of solids that sublime.

❖ In what way is sublimation useful?

➢ Dry ice is used for industrial refrigeration and transporting frozen food. It is especially good for refrigerating food such as ice-cream and meat because it keeps them very cold and it changes directly to a gas without leaving any liquid behind.

Diffusion of gases

- Diffusion is the movement of particles from a region of higher concentration to a region of lower concentration.
- The rate at which a gas diffuses depends upon its **relative molecular mass**.
- The **relative molecular mass** of a gas is related to the mass of the particles of the gas.
- Example of diffusion of gases: Aroma from perfumes spreading in a room.

➢ Gases with lower relative molecular masses diffuse faster then those with higher relative molecular masses.

Diffusion of liquids

- The rate of diffusion of liquids is much lower than that in gases.
- The higher the temperature, the higher the rate of diffusion. This is because the particles gain more energy as the temperature increases. They can move faster and this increases the rate of diffusion.
- Example of diffusion of liquids: Colour from tea spreading in a solution.