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### 1. Kinetic Particle Theory

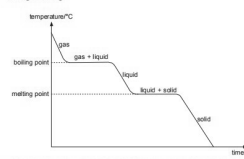
All matter is made of particles which are in constant random motion. This accounts for the properties of the three states of matter and the changes of states.

### 2. Properties of the Three States of Matter

Property	Solid	Liquid	Gas
Structure			
Packing of particles	Tightly packed. Arranged in an orderly manner.	Packed closely together, but not as tightly as in solids. No regular arrangement.	Spaced far apart from each other
Movement of particles	Can only vibrate about fixed positions	Particles slide past each other	Particles move freely at high speeds
Shape	Fixed shape	No fixed shape. Takes on the shape of the container it is in.	No fixed shape. Takes on the shape of the container it is in.
Volume	Fixed volume. Not easily compressed.	Fixed volume. Not easily compressed.	No fixed volume. Easily compressed.

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The following diagram shows the temperature change when a pure substance undergoes cooling.

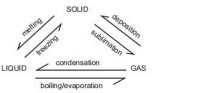


At parts where the graph falls, heat is given out from the substance to the surroundings and its temperature decreases. The graph becomes flat when the substance undergoes a change in state. The graph remains flat as the particles form bonds, producing heat which is given out to the surroundings.

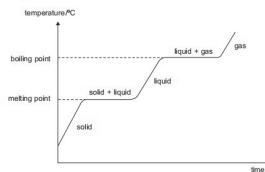
- Melting** : Occurs at the melting point. Particles absorb heat and vibrate more vigorously, allowing them to overcome the interparticle interactions holding them in fixed positions.
- Freezing** : Occurs at the melting point. Particles release heat and move more slowly. Interparticle interactions are formed and the particles are forced to be held in a fixed and orderly arrangement.
- Boiling** : Occurs at the boiling point. Particles absorb heat and gain more kinetic energy. The particles move fast enough to completely overcome the forces of attraction.
- Evaporation** : Occurs below the boiling point. Particles at the surface gain sufficient energy to escape into the surroundings.
- Condensation** : Occurs at the boiling point. Particles release heat and move more slowly. The forces of attraction are then able to hold the particles closely.

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### 3. Changes of State



The following diagram shows the temperature change when a substance undergoes changes in state.

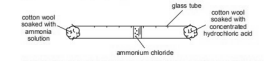


At parts where the graph rises, heat is supplied to the substance to raise its temperature. The graph becomes flat when the substance undergoes a change in state. The graph remains flat as heat is taken in to overcome the interactions between the particles.

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### 4. Diffusion

Particles of matter move from a region of higher concentration to a region of lower concentration. Particles with higher mass move more slowly than particles with lower mass. For example, ammonia diffuses at a higher rate than hydrogen chloride since it is lighter ( $M_r$  of ammonia = 17,  $M_r$  of hydrogen chloride = 36.5).



At higher temperature, the rate of diffusion is greater as the particles have more kinetic energy and can move faster.

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