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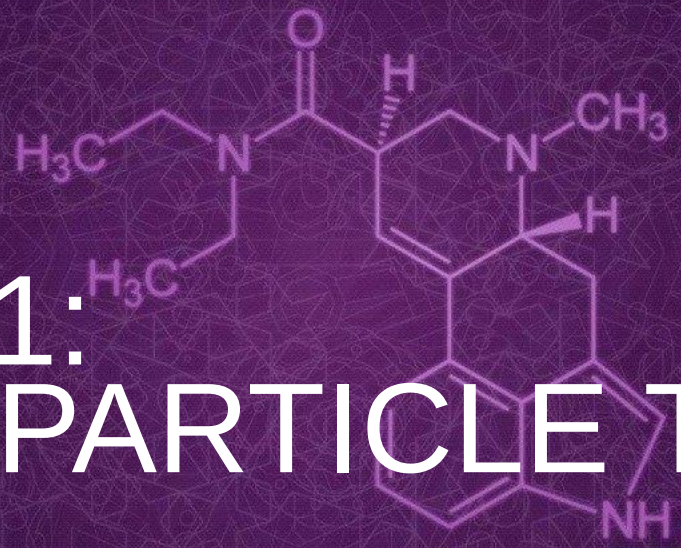


TOPIC 2.1: KINETIC PARTICLE THEORY

THE ABOUT

CHAPTER ANALYSIS

TIME

- Straight forward chapter
- 2 **key** concepts
- 1 **advanced** concepts

EXAM

- Usually tested in MCQs
  → 2009 (2), 2010(1), 2011 (2), 2012 (1), 2014 (1), 2016 (1), 2017 (1)
- Structured
  → 2010 (6 marks)

WEIGHTAGE

- Light overall weightage
- Constitute to **2.5%** of marks for past 5 year papers
- Less commonly tested in recent years

MUST KNOW

BASICS

Solid	Liquid	Gas
• Fixed volume • Fixed shape • Cannot be compressed • Does not flow	• Fixed volume • No fixed shape • Cannot be compressed • Flows easily	• No fixed volume • No fixed shape • Can be compressed easily • Flows in all direction

MUST KNOW

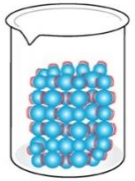
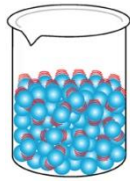
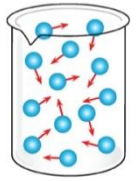
KINETIC PARTICLE THEORY OF MATTER

The theory states that:

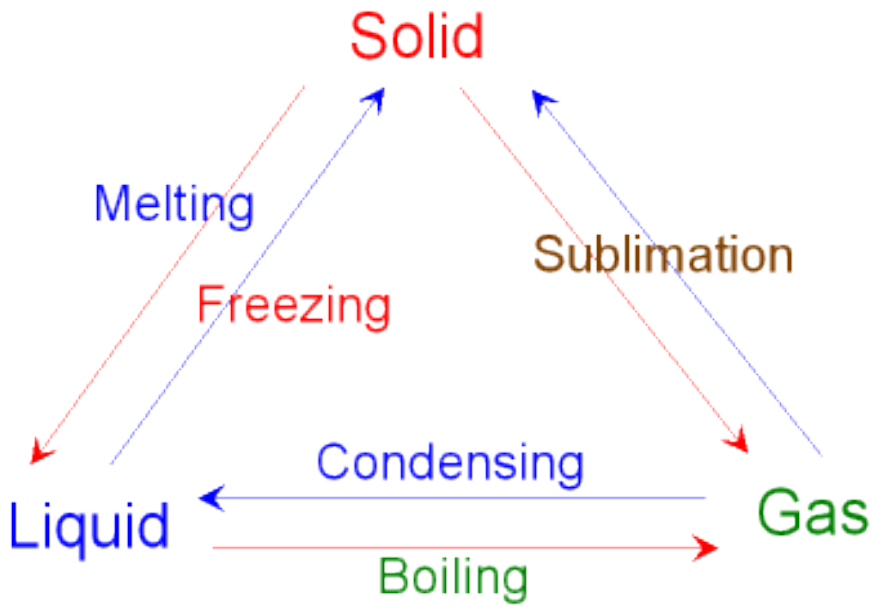
- all matter is made up of **particles** too small to be directly visible,
- there are **spaces between the particles** of matter whose magnitudes differ according to the state of matter, and
- the particles are in a constant state of **random motion** at varying speeds.

KEY CONCEPT

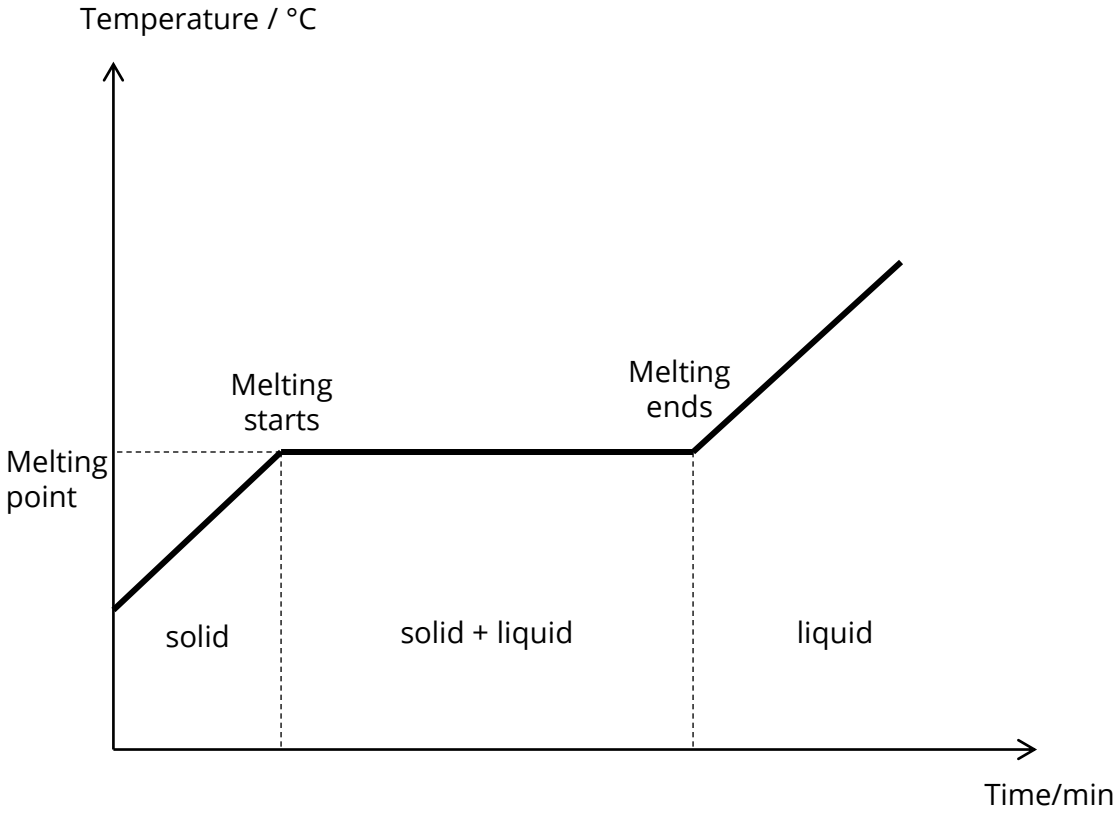
KINETIC PARTICLE THEORY OF MATTER

Physical Properties	Solid	Liquid	Gas
Particulate model of matter			
Arrangement	Closely packed in an orderly arrangement	Loosely packed in a disorderly arrangement	Far apart & random arrangement
Forces of attraction	Very strong attractive force	Strong attractive force	Weak attractive force
Density	Very high density	High density	Low density
Movement	Vibrate about fixed position	Sliding over one another freely	Move about randomly at high speed
Energy		Increasing energy →	

CHANGE IN STATE



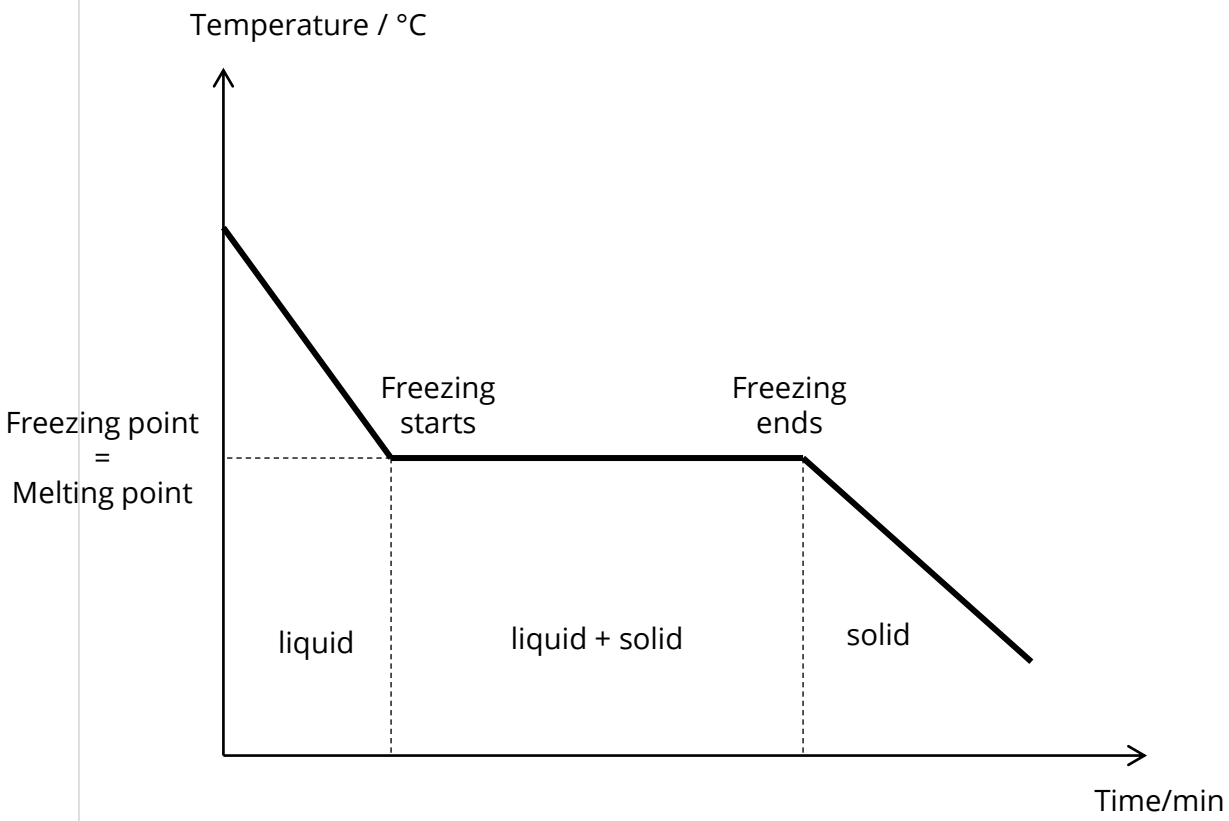
MELTING (SOLID TO LIQUID)



The temperature of the matter (solid) is a measure of the average kinetic energy the matter possesses.

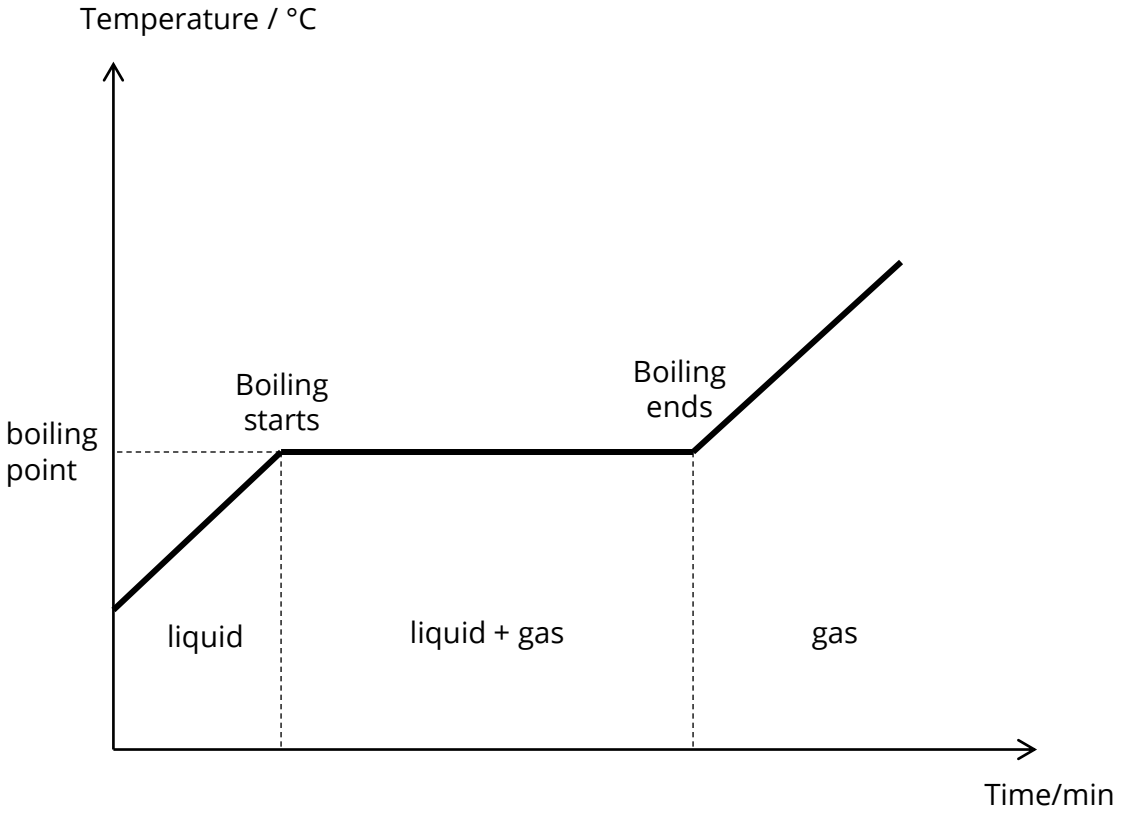
- During melting, the particles vibrate so violently that they have sufficient energy to overcome and **break free of the attractive forces** holding them in place.
- The **temperature remains constant** as the heat energy absorbed is not used to increase the particles' kinetic energy/temperature, but is used to overcome the forces of attraction between particles.
- A **mixture of solid and liquid** is present during this stage.

FREEZING (LIQUID TO SOLID)



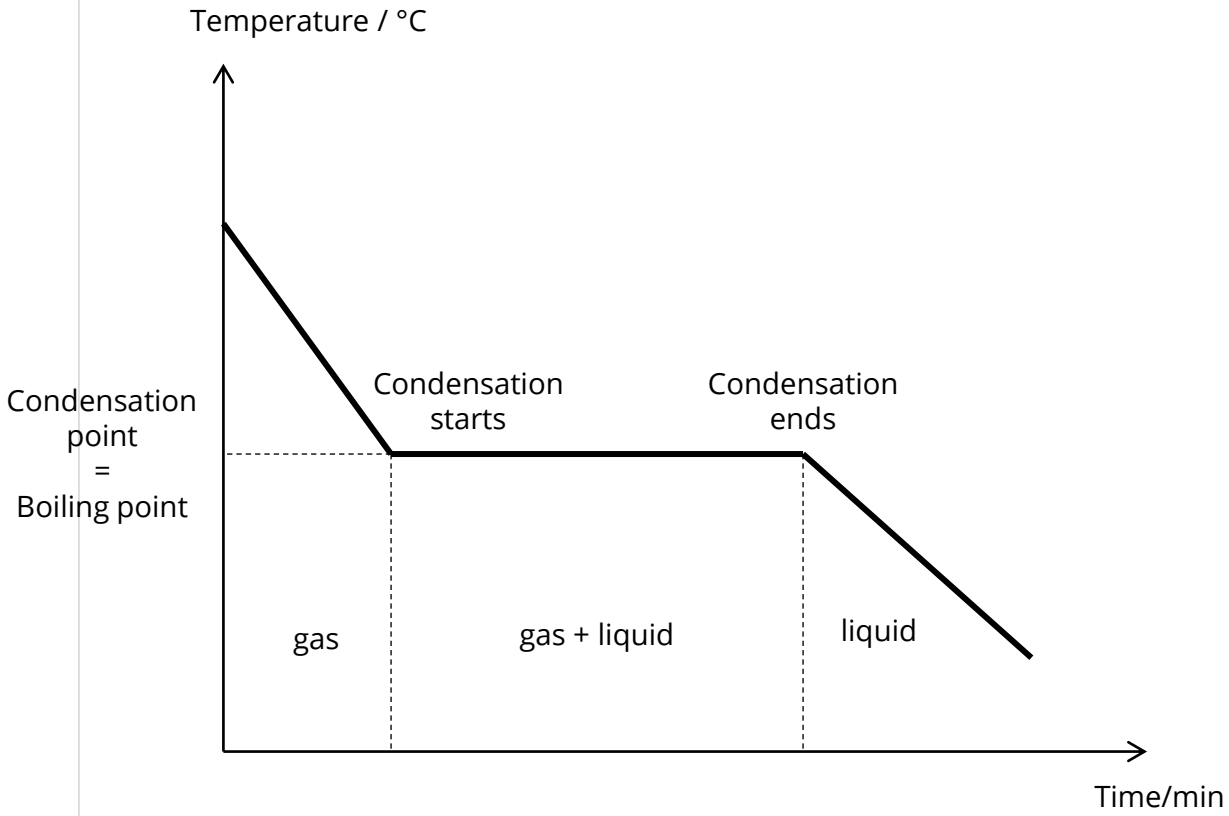
- At B, the particles have lost sufficient kinetic energy and freezing begins.
- The particles **no longer have the energy to overcome the forces of attraction** between themselves and **return to their fixed position.**
- Between B and C, the freezing process is taking place. The **temperature remains constant** because **heat energy is released and given out to the surroundings.** The release of heat energy balances the cooling effect and thus the temperature is constant.
- A mixture of solid and liquid is present during this stage.

BOILING (LIQUID TO GAS)



- At B, sufficient heat energy has been absorbed and boiling begins.
- During boiling, the particles have **gained sufficient energy to overcome the forces of attraction** between them and move even further apart.
- The **temperature remains constant**. The heat energy absorbed is not used to increase the particles' kinetic energy/temperature, but is used to overcome the forces of attraction between particles.
- A mixture of gas and liquid is present during this stage.

CONDENSATION (GAS TO LIQUID)



- At B, the particles have lost sufficient kinetic energy and condensation begins.
- During condensation, the particles **no longer have the energy to overcome the forces of attraction** between themselves and they come closer together.
- **Heat energy is released** and given out to the surroundings as particles slow down and come closer together. The **release of heat energy balances the cooling effect** and thus the **temperature remains constant.**
- A mixture of gas and liquid is present during this stage.

ADVANCED

SOLID TO GAS
SUBLIMATION
DEPOSITION

ADVANCED

SUBLIMATION & DEPOSITION

Common Substances

Iodine is a dark purple solid at room temperature. When heated with low heat, it undergoes sublimation and turns into violet gas.

Dry ice is often used as a cooling agent to maintain low temperatures. It is preferred over normal ice as it sublimes to give gaseous carbon dioxide, rather than water.

ADVANCED

SUBLIMATION & DEPOSITION

Mothballs are made of a chemical called naphthalene and sublime to produce gaseous fumes that repel household pests.

Reverse sublimation, also known as **deposition**, occurs when a gas enters the solid phase directly. During winter it snows, that's when a gas → solid.

KEY CONCEPT

GAS/LIQUID PARTICLES
DIFFUSION
MOVEMENT OF MOLECULES

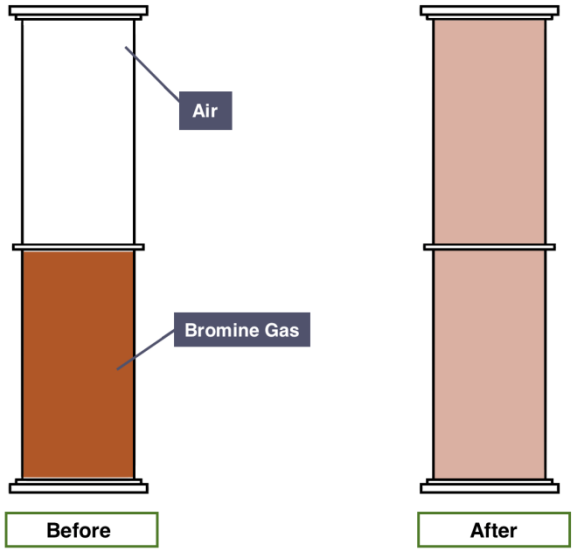
MUST KNOW

DIFFUSION

Diffusion is **the movement of molecules from a region of higher concentration to a region of lower concentration**. During diffusion, gas or liquid particles take up available space in a container through random motion, mixing thoroughly in the process.

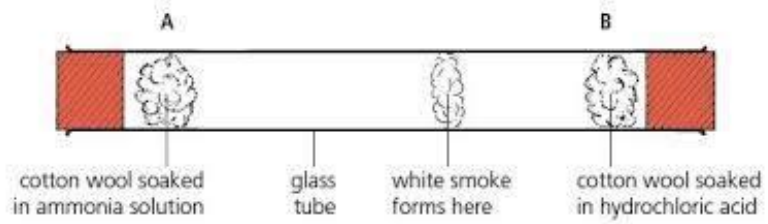
Diffusion in liquid

Diffusion in gas



KEY CONCEPT

things to note



→ *Heavier molecules moves slower. Hence, white precipitate forms nearer to the hydrochloric acid side.*

Higher temperature, faster rate of diffusion

With more kinetic energy, particles vibrate and move faster at higher temperatures. **The higher the temperature**, the greater the average kinetic energy, hence the faster the particles move.
This allows for **a faster rate of diffusion**.

Mass of particles

The greater the mass of the particles (Mr), the **slower the rate of diffusion**.

State of matter

The particles in a liquid are packed closer together than those in a gas. Hence the same particles diffuses slower in a liquid as compared to a gaseous medium.

Gaseous state diffuses faster than liquid state.

Concentration gradient

The greater the difference in the concentration level, the **steeper the concentration gradient, the faster the rate of diffusion.**

MCQ 1

Which of the following statement is **not explained the kinetic particle theory of matter**?

(A) Particles are always in constant random motion.
(B) Particles in solids, liquids and gases will move/vibrate at different speeds.
(C) Particles cannot be seen by the naked eye.
(D) Space between molecules only exist between particles of liquids and gases.

Answer: **D**

There is spacing in solid state as well even though the spacing is very little.

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