

# Kinetic Particle Theory

## What is Kinetic Particle Theory?

Matter is defined as any substance that has **mass** and **volume**.

## Kinetic Particle Theory

The **kinetic particle theory** states that:

- All matter is composed of **tiny particles**
- that are in **a constant state of motion (have kinetic energy.)**

## Properties

Properties	Solid	Liquid	Gases
Forces of Attraction between particles	<b>Strong attractive forces</b> between particles	<b>Relatively strong attractive forces</b> between particles BUT weaker than those in solid.	<b>Weak forces of attraction between particles</b>

Properties	Solid	Liquid	Gases
Arrangement of Particles	<p>Particles are <b>orderly arranged</b> in a fixed position. Hence, they have a <b>fixed shape</b>. It has a <b>fixed volume as a solid cannot be compressed</b> since its particles are already very close to one another with very little space between the particles.</p>	<p>Particles are <b>NOT held in fixed positions</b>. They are arranged in a disorderly manner. Hence, they <b>DO NOT have a fixed shape</b>. Particles of a liquid are farther away from one another than a</p>	
<p>solid. However, they are <b>still packed quite closely together</b>. Hence, a liquid <b>cannot be compressed and has a fixed volume</b>.</p>	<p>Particles are <b>NOT held in fixed positions</b>. Particles are <b>spread far apart from one another</b>. Hence, they <b>DO NOT have a fixed shape</b>.</p>		
Movement of Particles	<p>Particles are <b>unable to move freely</b>.</p>	<p>Particles are <b>able to move freely and slide across one another</b>.</p>	<p>Particles <b>move rapidly in high speeds in any direction</b>.</p>

Properties	Solid	Liquid	Gases
Energy of Particles	Particles <b>vibrate about its fixed positions</b>	Particles of a liquid have <b>more kinetic energy than</b> particles of a solid in the same substance.	Particles have high kinetic energy.

## Changes in Temperature

### Heating and Cooling of Particles

Heating/Cooling	Change in distance between particles	Change in movement of particles	Change in arrangement of particles
Heating	Distance between particles increases and particles are further apart from one another	Vibrates faster and more vigorously	From sliding over one another within the liquid to free to move anywhere in the container
Cooling	Distance between particles decreases and particles get closer.	Vibrates slower and less vigorously	From sliding over one another within the liquid to vibrating at fixed positions

### Heating Curve

<b>States of Matter Present</b>	<b>Temperature (increasing, decreasing or remain constant)</b>	<b>Movement of Particles</b>	<b>Arrangement of Particles</b>	<b>Strength of Attractive Forces of Attraction Between Particles</b>
Solid	Increasing	Particles are gaining kinetic energy and vibrate faster	Particles are arranged in an orderly manner	Particles are close to one another with strong forces of attraction between them.
Solid and Liquid	Constant	Particles continue to vibrate, without increase in kinetic energy	Particles are starting to slide over one another	Energy is taken in to overcome the forces of attraction between particles
Liquid	Increasing	particles are gaining kinetic energy and vibrate faster	Particles are sliding over one another randomly	Strong forces of attraction between particles

States of Matter Present	Temperature (increasing, decreasing or remain constant)	Movement of Particles	Arrangement of Particles	Strength of Attractive Forces of Attraction Between Particles
Liquid and Gas	Constant	Particles continue to vibrate, without increase in kinetic energy	Particles moving further away in a random manner	Energy is taken in to overcome the forces of attraction
Gas	Increasing	Particles are gaining kinetic energy and vibrate faster. Particles travel at <b>high speeds</b>	Particles are very far away and free to move randomly	Weak forces of attraction

## Brownian Motion

The **kinetic model of matter** states that all matter is made up of a large number of small particles (e.g. atoms, molecules, ions) which are in **continuous and random motion**.

## Definition of Diffusion

Diffusion is the **movement of particles from a region of higher concentration to a region of lower concentration.**

## Factors affecting the rate of diffusion

### Temperature

- As temperature increases, the particles **move faster and spread through water more quickly.**
- The **higher the temperature, the faster the rate of diffusion.**

### Relative Molecular Mass

Since **ammonia particles have a smaller relative molecular mass,** they **move faster than hydrogen chloride particles.** The ammonia particles **move further along the tube than the hydrogen chloride particles** before the particles collide and react to form ammonium chloride

- The **greater the relative molecular mass of the molecule, the slower the rate of diffusion**

### Concentration

- The greater number of CO molecules means that there is a **higher statistical probability that the CO molecules will spread through the solution, increasing the diffusion rate.**

## Essential Questions

How does energy affect the arrangement and behaviour of the particles in matter?

- When **particles absorb energy in the form of heat, they move more quickly due to an increase in kinetic energy.**
- At temperatures when the substance is changing state, the **energy gained is**

**used to overcome forces of attraction, and the particles spread further apart and move more freely**, resulting in a more random arrangement.