Characteristics of Particles of Matter

Particles of matter are moving continuously, that is to say, they possess what we call kinetic energy. Particulate matter moves faster as temperature rises. So, the particles' kinetic energy also increases with temperature rise.

States of Matter

We can see that in three different states – solid, liquid and gas – matter exists around us. These states of matter arise because of the variation in the characteristics of the material particles.

THE SOLID STATE

Objects such as a pen, a book, a needle, and a piece of a wooden stick, all of which have a definite shape, distinct boundaries, and fixed volumes, which means they have insignificant compressibility. Solids continue to retain their shape when they are exposed to an outside force. Solids may break under force, but their shape is difficult to change, so they are stiff.

Now consider the example of a rubber band, sugar, salt and sponge, all these can be extended, they 're solid so they can take the form of a container that's held in or can be compressed.

- A rubber band changes shape under tension, and when the force is removed, it regains the same form. This breaks when excessive force is applied.
- Whether we take it on our hand, put it in a plate or in a jar, the shape of each individual sugar or salt crystal remains fixed.
- A sponge has minute holes in which the air is stuck; the air is released as we press it out so we can compress it.

THE LIQUID STATE

The atmospheric gases diffuse and dissolve in water. These gases, especially Carbon dioxide and Oxygen, are necessary for aquatic animals and plants to live. To live, all living beings must breathe. Because of the availability of dissolved oxygen in the water, marine animals can breathe underwater.

So, we can conclude that solids, liquids, and gasses can spread into liquids. We observe that the liquids do not have a fixed form but a fixed volume. They take on the shape of the container that holds them in. Liquids flow and shape change, so they're not stiff but can be called fluids. The atmospheric gases diffuse and dissolve in water. These gases, especially oxygen and carbon dioxide, are necessary for aquatic animals and plants to live.

So, we can conclude that solids, liquids, and gasses can spread into liquids. The rate of liquid diffusion exceeds that of solids. This is because particles move freely in the liquid state and have greater space between each other as compared to solid-state particles.

THE GASEOUS STATE

Compared with solids and liquids, gases are extremely compressible, as observed. Compressed gas is the liquefied petroleum gas (LPG) cylinder we get into our home for cooking or the oxygen supplied to cylindrical hospitals. These days compressed natural gas (CNG) is used in automobiles as fuel.

Because of its high compressibility, huge quantities of a gas can be compressed to a small container and easily transported. By the smell that reaches our nostrils, we come to know what's being cooked in the kitchen without even getting into there. Food aroma particles mix with air particles spread out from

the kitchen, reach us and even further away. The odour of hot cooked food hits us in seconds; compare this with the rate of solid and liquid diffusion.

Gases show the property of diffusing rapidly into other gases due to high particle velocity and large space between them. At high speed, the particles move about randomly in the gaseous state. The particles strike each other and also the container walls because of this random movement. The pressure exerted by the gas is due to that force exerted on the container 's walls by gas particles per unit area.

Change in the State of Matter

Water can exist in 3 states of matter–

- solid in form of ice,
- liquid, as the familiar water, and
- gas, as water vapour.

Let us now see the effect of change of temperature.

EFFECT OF CHANGE OF TEMPERATURE

The kinetic energy of the particles increases when the temperature of the solids increases. The particles start vibrating with greater speed due to the increase in kinetic energy. The heat-fueled energy overcomes the attraction forces between the particles. The particles leave their stationary positions and start moving freely.

When the solid melts, a stage is reached and converted into a liquid. The temperature at which a solid at atmospheric pressure melts to become a liquid is called its melting point.

A solid's melting point is an indication of the force of attraction that exists between its particles. The melting point is **273.16 K * for ice**. The melting process, that is, the transformation of a solid-state into a liquid state is also known as fusion. During the melting experiment, the system temperature does not change after reaching the melting point until all the ice melts. This happens even though we are continuing to heat the beaker; that is, we are continuing to provide heat. This heat gets used up by overcoming the forces of attraction between the particles to change the state. Since ice absorbs this heat energy without showing any rise in temperature, it is considered to get hidden in the beaker 's contents and is known as latent heat.

The term latent stands for concealed or hidden. The amount of heat energy needed to convert 1 kg of a solid into liquid at its melting point at atmospheric pressure is known as the latent fusion heat. Thus, particles in 00 C (273 K) water have more energy than particles in ice at the same temperature. Particles start moving even faster when we transfer heat energy to water. A point is reached at a certain temperature when the particles have enough energy to break free from each other's effects of attraction. At this temperature, the liquid starts to turn into steam.

The temperature at which a liquid at the atmospheric pressure starts to boil is known as its **boiling point**. **Boiling is a bulk phenomenon**—particles from the bulk of the liquid gain enough energy to transform into a state of vapour. So, by changing the temperature, we infer that the state of matter can be changed into a different state. We discovered that on heat application substances around us move from solid to liquid and from liquid to gas. But there are some, change directly from solid-state to a gaseous state and vice versa without transforming into liquid condition. A change of state directly from solid to gas without changing into liquid state is called **sublimation** (or vice versa).

EFFECT OF CHANGE OF PRESSURE

Gasses can be liquefied using pressure and temperature reduction. On the decrease in pressure to 1 atmosphere *, solid CO2 is converted directly to the gaseous state without entering the liquid state. This is why dry ice is also known as solid carbon dioxide. So, we can say that pressure and temperature determine a substance's state, whether it is solid, liquid or gas.

Evaporation

There are particles with varying amounts of kinetic energy at a given temperature in any gas, liquid or solid. In the case of liquids, with higher kinetic energy, a small fraction of particles on the surface will break free from the attraction forces of other particles and be transformed into vapour. This phenomenon of changing a liquid into vapours under its boiling point at any temperature is called evaporation.

FACTORS AFFECTING EVAPORATION

As observed that the rate of evaporation increases with–

1. an increase of surface area
2. an increase of temperature
3. a decrease in humidity
4. an increase in wind speed