

MATTER:-

Anything or everything which occupies space and has mass is called matter. This word is used to cover all the substances and the material from which the universe is made. For example, the air we breathe in, the food we eat, the clothes we wear, the houses where we live, the water which is most essential for every individual living being, clouds, stars and different planets; all represent matter.

CHARACTERISTICS OF PARTICULATE MATTER:-

The important characteristics of the particulate nature of matter may be summed up as follows:

1. Every matter is made up of particles.
2. The particles constituting a matter are very small in size.
3. The particles have empty or vacant spaces in them known as interparticle spaces.
4. Particles are not stationary and are in a state of motion.
5. Attractive forces are present in the particles of a substance. These are called interparticle forces.
6. The particle motion increases with the rise in temperature.

STATES OF MATTER:-

There are three states of matter i.e. a) The Solid State b) The Liquid State c) The Gaseous State.

The Solid State:- Solids are known for their hardness and rigid nature. The important characteristics of the solid state are listed below:

1. Solids have fixed shapes
2. Some solids can change their shape under force but regain the same when the applied force is removed.
3. Solids keep their volume which means that they have fixed volume.
4. Solids can be hardly compressed on applying pressure.
5. Solids have negligible kinetic energy of the particles.
6. Solids do not have the property of diffusion.

The Liquid State:- The important characteristics of the liquid state of a substance are listed.

1. Liquids do not have fixed shapes.
2. Liquids have fluidity and not rigidity.
3. Liquids occupy definite volume or keep their volume.
4. Liquids have lesser density as compared to solids.
5. The kinetic energy of the particles in the liquid state is more than in the solid state.
6. Particles in the liquid state can easily diffuse.

The Gaseous State:- The important properties of this state of matter are listed:

1. Gases do not have fixed shape.
2. Gases have maximum fluidity and least rigidity.
3. Gases do not keep their volume and are highly compressible.
4. Gases are generally very light.
5. The kinetic energy of the particles in the gaseous state is very high.
6. Gases exert pressure.
7. Gases diffuse very rapidly.

DIFFERENCE BETWEEN SOLID, LIQUID AND GAS:

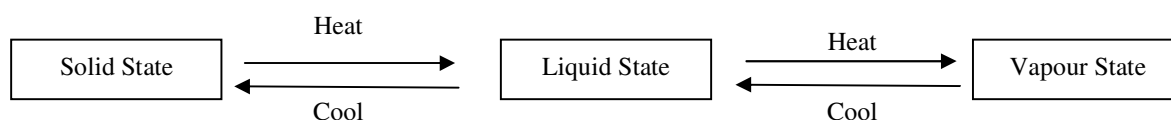
Solid	Liquid	Gas
1. Solids have a fixed volume and a definite shape.	Liquids have a fixed volume but have no definite shape. They take the shape of the container but they do not fill it.	Gases have neither a fixed shape nor a definite volume. They take the shape and volume of the vessel. They fill the container.
2. Solids are rigid and are not compressible	Like solids, liquids cannot be compressed much	Gases are easily compressible.
3. Solids have high densities. They are heavy.	Liquids have moderate to high densities. They are generally less dense than solids.	Gases have very low densities. They are very light.
4. Solids do not fill the container.	Liquids do not fill the container.	Gases fill the container completely.
5. Solids do not flow	Liquids generally flow easily.	Gases flow easily.
6. Solids do not diffuse.	Liquids can diffuse more than solids.	Gases have strong tendency for diffusion.
7. Solids stay where they are placed.	Liquids can be poured.	Gases spread out quickly.

CHANGE OF STATE:

A substance may exist in any of the three states of matter (i.e. solid, liquid or gas) depending upon the conditions of temperature and pressure. By changing the condition of temperature and pressure, a substance can be made to exist as solid, liquid or a gas. A solid on heating usually changes into a liquid which on further heating changes into gas. Similarly, a gas on cooling condenses into a liquid which on further cooling changes into a solid. The most familiar and common example is water. It exists in all the three states:

- Solid : ice
- Liquid : water and
- Gas : water vapour.

Ice is a solid state and may be melted to form water (liquid) which on further heating changes into steam (gas). These changes can also be reversed on cooling.

**SCALES OF MEASURING THE TEMPERATURE:**

There are three scales in which temperature can be measured. These are known as Celsius scale ($^{\circ}\text{C}$) Fahrenheit scale ($^{\circ}\text{F}$) and Kelvin scale (K).

- Thermometers with Celsius scale are calibrated from 0°C to 100°C .
- Thermometers with Fahrenheit scale are calibrated from 32°F to 212°F .
- Kelvin scale of temperature is S.I. scale and is very common these days. Temperature on this scale is shown by the sign K.

The different scales are related to each other as:

$$^{\circ}\text{F} = 9/5 (^{\circ}\text{C}) + 32^{\circ}$$

$$\text{K} = ^{\circ}\text{C} + 273$$

DEFINE THE TERMS:**DENSITY:**

The density of a solid may be defined as, "Mass occupied by a solid per unit volume and is obtained by dividing the mass of a particular solid by the volume occupied by that mass of the solid.

The unit of density is Kg/L or kg/dm^3 .

RIGIDITY:

It is the property by virtue of which a substance can retain its shape when a force is applied to it. Solids have the property of rigidity, whereas liquids and gases are not rigid.

COMPRESSIBILITY:

The particles of matter have spaces between them and they can be compressed (empty space is decreased) by applying force or pressure. Gases have high compressibility because of large empty spaces between the molecules of the gas. Solids and liquids are not compressed.

FLUIDITY:

This is the tendency of a substance to flow. Liquids and gases possess fluidity, whereas solids do not flow, they are rigid.

FILLING A GAS CONTAINER:

Gases have negligible forces of attraction between their molecules and therefore, they move in all directions with very high velocities and fill the container.

SHAPE:

The definite geometrical arrangement of constituents of a substance determines its shape. Solids have definite shapes whereas liquids take the shape of the container in which they are placed. Gases also do not have any shape.

KINETIC ENERGY:

The energy possessed by the particles due to their motion. Molecules of gases possess maximum kinetic energy and those of solids possess least kinetic energy. The kinetic energy of substances decreases as: gases>liquids>solids.

GAS PRESSURE:

Pressure of a gas is because of the hits which their particles record on the walls of the container. Since particles in a gas have high kinetic energy, they strike the walls of the container with the force. As a result, they exert pressure.

DIFFUSION OF GASES:

Since the interparticle spaces are very large and interparticle forces are quite weak, the particles of one gas can readily move into the empty spaces of another gas.

LATENT HEAT:

Latent heat is the energy required to change a solid into liquid. The word latent means hidden because this energy is hidden into the contents of the container.

LATENT HEAT OF FUSION:

Latent heat of fusion is defined as the amount of heat energy required to change 1 kg of a solid into a liquid at atmospheric pressure without any change in temperature at its melting point. Thus, the particles in water at 0°C (273 K) have more energy than the particles in ice at same temperature.

INTERMOLECULAR FORCES:

The particles of matter exert attractive forces upon one another. These forces are called intermolecular forces or interparticle forces. These are attractive forces and depend upon the nature of the particles. The stronger the forces of attraction, closer the particles are. When the intermolecular forces are very strong, the particles are packed close together and matter takes the solid form.

MELTING POINT:

The temperature at which a solid melts to become a liquid at the atmospheric pressure is called its melting point. Therefore, the melting point of a liquid is an indication of the strength of the intermolecular forces of attraction. The melting point of ice is 0°C. It may also be expressed as 273.16K or simply as 273 K. The process of melting is also called fusion.

BOILING POINT:

The temperature at which a liquid changes into a gas or vapour at the atmospheric pressure is called its boiling point. Boiling is a bulk phenomenon. In this process, the particles from the bulk of the liquid get enough energy to change into vapour state. For water, the boiling point is 100°C or 373 K.

SUBLIMATION:

Sublimation may be defined as the change of solid directly into the gaseous state without passing through the liquid state directly into the gaseous state without passing through the liquid state upon heating and back to the solid state when the temperature is lowered. Example: *Naphthalene, camphor, iodine, ammonium chloride are some common examples of the substances which undergo sublimation.*

EVAPORATION:

Evaporation may be defined as the phenomenon of change of liquid to the vapour state at any temperature below the boiling point of the liquid.

HEAT OF VAPORISATION:

Heat of vaporisation may be defined as the amount of heat energy that is needed to convert one kg of a liquid into its vapour state without any rise in temperature.

FACTORS AFFECTING EVAPORATION:

The evaporation of liquids is influenced by the following factors:

1. **Surface area available for evaporation:-** Evaporation is a surface phenomenon which means that only the particles or molecules of the liquid present on its surface change into vapours. Thus, greater the surface area of the liquid more will be the rate or extent of evaporation.
2. **Increase in temperature:-** The evaporation of water or of any other liquid becomes fast if the atmospheric temperature is high or we can say that the evaporation of a liquid is fast in summer as compared to winter. Actually, the increase in temperature also increases the kinetic energy of the particles or molecules of the liquid. They acquire greater tendency to change to the vapour state. As a result, the evaporation becomes fast.
3. **Decrease in humidity:** Humidity presents the amount of water vapours present in air. At a certain temperature or weather conditions, air around us can hold only a certain definite amount of water as vapours. In case, the humidity level or amount of water vapours. In case, the humidity level or amount of water vapours in air is already high, then the rate of evaporation decreases.
4. **Increase in the speed of wind:-** The speed of the wind around us has also some effect on evaporation of the liquid. We often notice that the wet clothes dry fast on a windy day. Actually, with the increase in wind speed,

the particles of water vapours present in air also move away and the air which replaces it, comparatively dry. This will enhance or increase the rate of evaporation.

5. Nature of the liquid:- Lesser the boiling point of a liquid, more is its tendency to change into vapours or to evaporate.

Difference between Boiling and Evaporation

Boiling	Evaporation
1. Boiling occurs only when the liquid is heated.	Evaporation of a liquid takes place of its own.
2. Boiling takes place at a specific temperature known as the boiling of the liquid.	Evaporation takes place at all temperatures.
3. Boiling occurs from the surface as well as from below the surface of the liquid.	Evaporation is a surface phenomenon and occurs only from the surface of the liquid.
4. No cooling is caused during boiling	Cooling is always caused during evaporation.

Why should we wear cotton clothes in summer?

During summer, we perspire more because of the mechanism of our body which keeps us cool. We know that during evaporation, the particles at the surface of the liquid gain energy from the surroundings or body surface and change into vapour. The heat energy equal to the latent heat of vaporisation is absorbed from the body leaving the body cool. Cotton, being a good absorber of water helps in absorbing the sweat and exposing it to the atmosphere for easy evaporation.

Why does a desert cooler cool better on a hot dry day?

On a hot dry day the humidity (amount of water vapour in air) is less and therefore, rate of evaporation is more. Since we know that evaporation causes cooling, therefore, as the rate of evaporation is more on a hot dry day, therefore, the desert cooler cools better.

How does the water kept in an earthen pot (matka) become cool during summer?

Earthen pot has many small pores. Water kept in earthen pot comes out from the pores during the summer and it evaporates. Since evaporation causes cooling, therefore, water kept in earthen pot becomes cold.

Why are we able to sip hot tea or milk faster from a saucer rather than a cup?

The surface area of hot tea or milk in a saucer is more than in a cup. Because of larger surface area, cooling will be more rapid in a saucer than in a cup. Hence we are able to sip hot tea or milk faster from a saucer rather than a cup.

Why is ice at 273 K more effective in cooling than water at the same temperature?

When ice (solid state) is to melt at 273 K, it takes up certain energy from the surrounding to overcome the attractive forces in the solid particles. As a result, the temperature of the surroundings gets lowered and cooling is noticed. However, water is already in the liquid state and has no tendency to change to the vapour state at this temperature. It will hardly take up any energy from the surroundings in order to change into the vapour state. Therefore, it will cause comparative less cooling.

What produces more severe burns, water or steam? Why?

Steam is formed when water at its boiling point temperature of 100°C (373 K) absorbs latent heat of vaporisation. On account of this, steam produces more severe burns on the skin as compared to boiling water.

Why does the temperature remain constant during the change of state?

Once the change of state of a substance begins or starts, the energy which is now supplied is being used up as latent heat. It means that it does not increase the kinetic energy of the particles and is used up only to bring about a change in state. Therefore, the temperature becomes constant.

Why does ice float on water?

In general, liquids have lower density than solids therefore, ice (solid form) is expected to be heavier than water (liquid state). However, ice has lower density than water because it has cage like structure. In this structure, a lot of vacant spaces are left when water molecules are linked in ice. The number of these vacant spaces are comparatively less in water and hence density of water is more than ice. Therefore, because of lower density of ice, it floats on water.