MATTER IN OUR SURROUNDING

CONTENTS

Matter

- Anything which occupies space and has mass is called matter.
- Food, water, air, clothes, table, chair, plants and trees.
- Indian philosophers said that all the matter living or non-living, was made up of five basic elements air, earth, fire, sky and water
- On the basis of its physical properties and on the basis of its chemical properties.
- On the basis of chemical properties the matter is classified as **elements, compounds** and **mixtures**.
- Everything around us is made of tiny pieces or particles. The particles make up matter are atoms or molecules.

Characteristics of particles of matter:

- The particles of matter are very, very small
- The particles of matter have spaces between them
- The particles of matter are constantly moving
- The particles of matter attract each other

Classification of matter

On the basis of physical states, all the matter can be classified into three groups.

1. Solids 2. liquids 3. Gases

Properties of solids

- Solids have a fixed shape and a fixed volume
- Solids cannot be compressed much.
- Solids have high densities. They are heavy
- Solids do not fill their container completely.
- Solids do not flow.

Ex. Ice, wood, coal, stone, iron, brick

Properties of liquid

- Liquids have a fixed volume but they have no fixed shape. Liquids take the shape of the vessel in which they are placed.
- Like solids, liquids cannot be compressed much.
- Liquids have moderate to high densities. They are usually less dense than solids.
- Liquids do not fill their container completely.
- Liquids generally flow easily.

Ex. Water, milk, fruit juice, ink, groundnut oil, kerosene etc.

Properties of gases

(1) Gases have neither a fixed shape nor a fixed volume. Gases acquire the shape and volume of the vessel in which they are kept.

(2) Gases can be compressed easily.

(3) Gases have very low densities. They are very. very light.

(4) Gases fill their container completely.

(5) Gases flow easily.

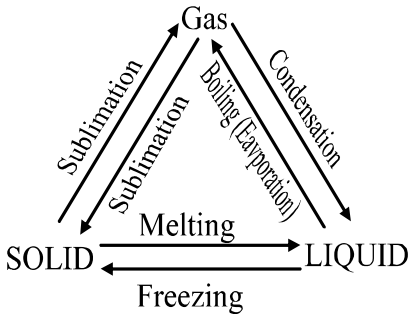
Ex. Air, oxygen, hydrogen, nitrogen

◈ Comparison of characteristic properties of solids, liquids and gases

	Property	Solids	Liquids	Gases
1	**Shape**	Definite	Take the shape of the container, but do not necessarily occupy all of it.	Take the shape of the container by occupying whole of the space available to them.
2	**Volume**	Definite	Definite	Take the volume of the container.
3	**Compressibility**	Almost nil	Almost nil	Very large
4	**Fluidity or Rigidity**	Rigid	Fluid	Fluid
5	**Density**	Large	Large	Very small
6	**Diffusion**	Generally do not diffuse	Diffuse slowly	Diffuse rapidly
7	**Free surfaces**	Any number of free surfaces	Only one free surface	No free surface.

➢ Change of state of matter

- 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 conditions 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**:**

(a) Solid **:** ice

(b) Liquid **:** water and

(c) 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.

$$\text{Ice} \underset{\text{Cool}}{\overset{\text{Heat}}{\rightleftharpoons}} \text{Water} \underset{\text{Cool}}{\overset{\text{Heat}}{\rightleftharpoons}} \text{Steam}$$

(Solid) (Liquid) (gas)

➢ Effect of temperature change

By increasing the temperature (by heating), a solid can be converted into liquid state; and the liquid can be converted into gaseous state (or vapour state). And by decreasing the temperature (by cooling), a gas can be converted into liquid state; and a liquid can be converted into solid state.

◈ Solid to liquid change : Melting

- **Defination** : The process in which a solid substance changes into a liquid on heating, is called melting (or fusion).
- **Melting point :** The temperature at which a solid substance melts and changes into a liquid at atmospheric pressure, is called melting point of the substance.

- Ice is a solid. In solids, the particles are tightly packed together. When we heat a solid, its particles become more energetic and kinetic energy of the particles increases. Due to the increase in kinetic energy, the particles start vibrating more strongly with greater speed. The energy supplied by heat overcomes the intermolecular forces of attraction between the particles. As a result, the particles leave their mean position and break away from each other. When this happens, the solid melts and a liquid is formed.

Ex. Melting point of ice = 0ºC

Melting point of wax = 63ºC

Melting point of iron = 1535ºC

The melting point of a solid is a measure of the force of attraction between its particles. Higher the melting point of a solid substance, greater will be the force of attraction between its particles.

◈ Liquid to gas change : Boiling (or vaporisation)

- **Defination** : The process in which a liquid substance changes into a gas rapidly on heating, is called boiling.
- **Boiling point :** The temperature at which a liquid boils and changes rapidly into a gas at atmospheric pressure, is called boiling point of the liquid.
- In a liquid most of the particles are close together. When we supply heat energy to the liquid, the particles of water start vibrating even faster. Some of the particles become so energetic that they can overcome the attractive forces of the particles around them. Therefore, they become free to move and escape from the liquid. When this happens, the liquid evaporates i.e., starts changing into gas.

Ex. Boiling point of water = 100ºC

Boiling point of alcohol = 78ºC

Boiling point of mercury = 357ºC

The boiling point of a liquid is a measure of the force of attraction between its particles. Higher the boiling point of a liquid, greater will be the force of attraction between its particles.

When a liquid is heated, the heat energy makes its particles move even faster. At the boiling point the particles of a liquid have sufficient kinetic energy to overcome the forces of attraction holding them together and separate into individual particles. And the liquid boils to form a gas.

◈ Gas to liquid change : Condensation

The process of changing a gas to a liquid by cooling, is called condensation. Condensation is the reverse of boiling.

◈ Liquid to solid change : Freezing

The process of changing a liquid into a solid by cooling, is called freezing. Freezing means solidification. Freezing is the reverse of melting. So, the freezing point of a liquid is the same as the melting point of its solid form.

Ex. Melting point of ice = 0ºC

Freezing poing of water = 0ºC

➢ Effect of change of pressure

- The three states of matter differ in the intermolecular forces and intermolecular distances between the constituent particles.
- Gases are compressible because on applying pressure, the space between the gaseous particles decreases. Therefore, gases can be compressed readily.
- When we apply pressure and reduce temperature the gases can be converted into liquids i.e., gases will be liquefied.
- The process of conversion of a gas into a liquid by increasing pressure or decreasing temperature is called **liquefication.**

A substance may exist in any of the three different states of matter depending upon the conditions of temperature and pressure.

(1) If the melting point of a substance is above the room temperature at the atmospheric pressure, it is said to be a solid.

(2) If the boiling point of a substance is above room temperature under atmospheric pressure, it is classified as liquid.

(3) If the boiling point of the substance is below the room temperature at the atmospheric pressure, it is called a gas.

➢ Latent heat

- **Defination :** The heat energy which has to be supplied to change the state of a substance is called its latent heat.
- Latent heat does not raise the temperature but latent heat has always to be supplied to change the state of a substance. The word 'latent' means 'hidden'
- Every substance has some forces of attraction between its particles which hold them together. Now, if a substance has to change its state, then it is necessary to break these forces of attraction between its particles. The latent heat does not increase the kinetic energy of the particles of the substance, the temperature of a substance does not rise during the change of state.

◈ **Latent heat is of two types**

- **Latent heat of fusion :** The heat required to convert a solid into the liquid state is called latent heat of fusion. In other words 'The latent heat of fusion of a solid is the quantity of heat in joules required to convert 1 kilogram of the solid to liquid, with out any change in temperature.

Ex. The latent heat of fusion of ice = 3.34×10^5 J/kg

- **Latent heat of vaporisation :** The heat required to convert a liquid into the vapour state is called latent heat of vaporisation.
- The other words 'The latent heat of vaporisation of a liquid is the quantity of heat in joules required to convert 1 kilogram of the liquid to vapour or gas, without any change in temperature.

Ex. Latent heat of vaporisation of water

$= 22.5 \times 10^5$ J/kg

➢ Sublimation

- **Defination :** The changing of a solid directly into vapours on heating, and of vapours into solid on cooling, is known as sublimation.
- Sublimation can be represented as:

$$\text{Solid} \underset{\text{Cooling}}{\overset{\text{Heating}}{\rightleftharpoons}} \text{Vapour (or Gas)}$$

- The solid substance which undergoes sublimation is said to 'sublime'. the solid obtained by cooling the vapours of the solid is called a 'sublimate'.

Ex. When solid ammonium chloride is heated, it directly changes into ammonium chloride vapour. And when hot Ammonium chloride vapour is cooled, it directly changes into solid ammonium chloride. Ammonium chloride, Iodine, Camphor, Naphthalene and Anthracene.

➢ Evaporation

- **Defination :** The process of change of a liquid into vapour at any temperature below its boiling point is called evaporation.

◈ **Factors affecting evaporation : –**

- **Temperature :** Rate of evaporation increase with increase in temperature. This is because with the increase in temperature more number of particles get enough kinetic energy to go into the vapour state.

Ex. Drying of clothes take place rapidly in summer than in winter

- **Surface Area :** The rate of evaporation increases on increasing the surface area of the liquid

Ex. If the same liquid is kept in a test tube and in a china dish, then the liquid kept in the china dish will evaporate more rapidly : Because more of its surface area is exposed to air.

- **Humidity :** Humidity is the amount of water vapour present in air. Air around us cannot hold more than a definite quantity of water vapour at a given temperature. If the amount of water in air is already large i.e., humidity is more, the rate of evaporation decreases. Thus, the rate of evaporation increases with decrease in humidity in the atmosphere.

Ex. Drying of clothes on a humid day.

- **Wind speed :** The rate of evaporation also increases with increase in speed of the wind. This is because with increase in speed of wind, the particles of water vapour move away with wind resulting decrease in the amount of vapour in the atmosphere.

Ex. Clothes dry faster on a windy day.

➢ Diffusion

- **Defination :** The spreading out and mixing of a substance with another substance due to the motion of its particles is called diffusion.
- Diffusion is a property of matter which is based on the motion of its particles.
- Diffusion is fastest in gases because the particles in gases move very rapidly. The diffusion is slowest in solids because the particles in solids do not move much.
- The rate of diffusion increases on increasing the temperature of the diffusing substance. This is because when the temperature of a substance is increased by heating, its particles gain kinetic energy and move more rapidly and this increase in the speed of the particles of a substance increases the rate of diffusion.

◈ Diffusion in gases

Diffusion in gases is very fast. This is because the particles in gases move very quickly in all directions.

Ex. When we light an incense stick (agarbatti) in a corner of our room, its fragrance spreads in the whole room very quickly. The fragrance of burning incense stick spreads all around due to the diffusion of its smoke into the air.

Ex. When someone opens a bottle of perfume in one corner of a room, its smell spreads in the whole room quickly. The smell of perfume spreads due to the diffusion of perfume vapours into air.

◈ Diffusion in liquids

Diffusion in liquids is slower than that in gases. This is because the particles in liquids move slower as compared to the particles in gases.

Ex. The spreading of purple colour of potassium permanganate into water, on its own, is due to the diffusion of potassium permanaganate particles into water

Ex. The spreading of blue colour of copper sulphate into water, on its own, is due to the diffusion of copper sulphate particles into water.

The rate of diffustion in liquids is much faster than that in solids because the patricles in a liquid move much more freely, and have greater spaces between them as compared to particles in the solids.

◈ Diffusion in solids

Diffusion in solids in a very, very slow process.

Ex. If we write something on a blackboard and leave it uncleaned for a considerable period of time we will find that it becomes quite difficult to clean the blackboard afterwards. This is due to the fact that some of the a particles of chalk have diffused into the surface of blackboard.

Ex. If two metal blocks are bound together tightly and kept undisturbed for a few years, then the particles of one metal are found to have diffused into the other metal.