9th CHEMISTRY

CHAPTER 1- MATTER IN OUR SURROUNDINGS

MATTER

Anything which occupies space , has mass and can be felt by our one or more five senses is known as matter. E.g. air, water, iron etc.

Classification of Matter

Matter can be classified on the basis of their physical and chemical properties as –

(a) Based on physical properties matter can be classified into three types
   a. Solid
   b. Liquid
   c. Gases

(b) Based on chemical properties matter can be classified into three types
   a. Elements
   b. Compounds
   c. Mixture

Note :

In this chapter we shall study about matter based on their physical properties.

Physical Nature of Matter

Matter is made up of very-very small particles.

Activity: To show that matter is made up of particles.

When 20-30g of salt (or sugar) is added to 500 ml of water in a beaker. We see salt (or sugar) dissolves and disappears in water.

This dissolving of salt (or sugar) in water can be explained on the fact that matter is made up of particles as- the water and salt (or sugar) both are made up of particles, the particles of salt get into the spaces between particles of water.

Activity 2: to show that particles of matter is very-very small.

We take 2 or 3 crystals of potassium permanganate and dissolve them in 100 ml of clear water in a beaker; we will get deep purple color solution.

Now we take 10ml of this solution and put into 90 ml of clear water in 2nd beaker, we see that solution in 2nd beaker is again of purple colour but slightly lighter.

Now we take 10 ml of solution from 2nd beaker and put into 90ml of clear water in 3rd beaker, we see that solution in 3rd beaker is again of purple colour but more lighter.

If we repeat the above steps 5 to 8 times we see that the colour of solution becomes very light, but the purple colour is still visible.

This experiment shows that 2 or 3 crystal of potassium permanganate can colour a very large volume of water.

So, we conclude that just a single crystal of potassium permanganate is made up of millions of tiny particles, which keep on dividing themselves into smaller and smaller particles and impart colour to such large volume of water.

If we take 2ml or dettol instead of potassium permanganate we can detect smell even in very dilute solution.

Characteristics of Particles of Matter

1. Particles of matter have space between them.
2. Particles of matter are in continuous motion
3. Particles of matter attract each other.

1. Particles of matter have space between them.

To show that particles of matter have space between them we take 100ml of water in a beaker, then we add 50g salt into it and stir with glass rod. After dissolving salt in water, we note that volume of solution has not increased (i.e. remains 100 ml)

This is due to the fact that there are spaces between particles of water. The particles of salt get into the spaces between particles of water.

2. Particles of matter are in continuous motion

To show that the particles of matter are in continuous motion we can perform the following activities/experiments-

(i) If we light an incense stick in one corner of our class room, then after 1 or 2 minute we can get its smell in whole room. It is due to the fact that the particles of air as well as gases produced by incense stick are in continuous motion. So, the smell get spreads in the whole room.

(ii) If we put a drop of blue ink in a beaker filled with water and leave it undisturbed. We note that the water in whole beaker turns blue. It is due to the fact that the particles of water as well as ink are in continuous motion. So blue colour of ink spreads in whole beaker.

(iii) If we drop a crystal of copper sulphate into a beaker of hot water and another crystal in another beaker containing cold water. We allow the crystal to settle at the bottom. We observe that blue colour of copper sulphate spread quickly in hot water and that will take some time in cold water.

This is due to the fact that, the moving particles of a matter contains kinetic energy. As temperature rises the kinetic energy of particles increases and particles move faster and colour of in spread more quickly.

Note

1. The intermixing of particles of two different types of matter on their own is known as diffusion.
2. The rate of diffusion increases with rise in temperature.

3. Particles of matter attract each other

There is a force of attraction between the particles of matter; this can be explained on the basis of following activities-

Take a piece of chalk, a rubber band and an iron nail. If we try to break them by our hands, we note that it is very easy to break a piece of chalk, it requires more force to break the rubber band. But the iron nail almost does not break even when large force is applied.

This is due to the fact that particles of matter have force acting between them. This force keeps the particles together. The strength of this force varies from one kind of matter to another.

In the above activity, strength of this force is very low between the particles of chalk and that is higher in rubber and highest in iron.

NCERT QUESTIONS

1. Which of the following are matter?
Chair, air, love, smell, hate, almonds, thought, cold, cold-drink, smell of perfume.

Ans: Chair, air, almonds, cold-drink

2. Give reasons for the following observation: The smell of hot sizzling food reaches you several metres away, but to get the smell from cold food you have to go close.
Ans: We get smell when some gas releases from food and diffuses into air. When food is hot, its temperature is high. So, rate of diffusion is faster than that at low temperature (i.e. when food is cold). So we get smell of hot food.

3. A diver is able to cut through water in a swimming pool. Which property of matter does this observation show?
Ans: A diver is able to cut through water in a swimming pool because; the force of attraction between the particles of water is week.

4. What are the characteristics of the particles of matter?
Ans:

1. Particles of matter are very-very small.
2. Particles of matter have space between them.
3. Particles of matter are in continuous motion
4. Particles of matter attract each other.

States of Matter

Matter can exist in three states –

1. Solids
2. Liquids
3. Gases.

1. The Solid State

The state of matter which has fixed shape, size and volume is called solid. E.g. iron, wood, diamond etc. are solids.

Properties of Solids:

1. Solids have a definite shape, size and volume.
2. Solids have distinct boundaries.
3. Solids have negligible compressibility.
4. Solids can not diffuse into other solids.
5. Solids do not fill container completely in which it is kept.
6. Solids have high density.

Q. A rubber band can change its shape on stretching. Is it solid?

Ans: yes, a rubber band is considered a solid because a rubber band changes shape under force and regain the same shape when the force is removed. If excessive force is applied, it breaks.

Q. Sugar or salt when kept in different vessels take the shape of vessel. Are they solid?

Ans: As the shape of each individual sugar or salt crystal remains fixed whatever we put it in a plate or in a vessel. So, sugar and salt are solids.

Q. Sponge can be compressed. Is it a solid?

Ans – Compressibility of a sponge is due to holes in it, in which air is trapped. When we press a sponge, the air comes out and we are able to compress it. So, sponge is a solid.

2. The Liquid State

Liquids: The state of matter which has fixed volume but no fixed shape and size is known as liquid. e.g. water, oil, mercury etc.

Properties of Liquids

1. They take up the shape of container in which they are kept. So, they have no fixed shape and size.
2. Liquids are not rigid and can flow easily.
3. Solids, liquids and gases can diffuse into liquids.
4. The force of attraction between the particles of liquids is less than that in solid and more than that in gases.

Q. How aquatic animals breathe under water?

Ans- As we know that all living creatures need to breathe for survival. The aquatic animals can breathe under water due the presence of dissolved oxygen in water.

Q. Rate of diffusion of liquids is higher than that that of solids. Why?

This is due to the fact that in liquids, particles has less force of attraction and greater space between them as compared to particles in solids.

3. The Gaseous State

The state of matter which has no fixed shape, size or volume is known as gases. E.g hydrogen, oxygen, carbondioxide etc.

Properties of Gases:

1. Gases fill the container in which it is kept.
2. Gases has high compressibility.
3. They exert pressure on the walls of container.
4. They can flow easily.
5. They have very weak force of attraction and larger distance between their particles.

Q. Smell of hot cooked food reaches us in seconds. Why?

Ans: The speed of particles of gases is very high and there is large space and weak force of attraction between them. So, rate of diffusion of one gas into another gas is very fast. Also, this rate of diffusion increase when temperature is high i.e. food is hot. Due to this property of diffusion of gases the smell of hot cooked food reaches to us in second.

Q. By which property of gases large volume of gas can be compressed into small cylinder?

Ans: This is due to high compressibility of gases.

Q. What is LPG & CNG.

LPG – LPG means Liquefied Petroleum Gas – It is used in home as cooking gas.

CNG – CNG means Compressed Natural Gas – It is used as fuel in vehicles.

NCERT QUESTIONS

1. *The mass per unit volume of a substance is called density. (density = mass/volume). Arrange the following in order of increasing density – air, exhaust from chimneys, honey, water, chalk, cotton and iron.*

Ans. Air, exhaust from chimneys, water, honey, cotton, chalk, iron.

2. *Tabulate the differences in the characteristics of states of matter.*

	Solids	Liquids	Gases
1.	They have fixed shape, size and volume	They have fixed volume but no fixed shape and size.	They have no fixed shape size and volume.
2.	Highly rigid	Not rigid	Not rigid

3.	Not compressible	More compressible than solids and less compressible than gases	Highly compressile
4.	Do not fill a container completely in which it is kept	Do not fill a container completely in which it is kept	Fill a container completely in which it is kept
5.	Kinetic energy of particles of solid is very low.	Kinetic energy of particles of liquids is more than solids but less than gases	Particles of gases have high kinetic energy.
6.	Density of solid is very high	Density of particles of liquids is more than solids but less than gases	Density of gases is very low.

3. Give reasons
(a) A gas fills completely the vessel in which it is kept.
(b) A gas exerts pressure on the walls of the container.
(c) A wooden table should be called a solid.
(d) We can easily move our hand in air but to do the same through a solid block of wood we need a karate expert
Ans:

(a) A gas fills completely the vessel in which is kept. Because, its particles are held by weak interparticles forces, therefore, can move freely within the container and fill it.

(b) The particles of a gas moves randomly with a high speed. Due to this random motion, the particles hit each other and also with the walls of container. So force is exerted by gas particles on the walls of container. This force per unit area is the pressure exerted by the gas jon walls jof container.

(c) A wooden table has fixed shape, size and volume. So, it is called a solid.

(d) The force of attraction between the particles of air (gas) is very weak. So they are quite far from each other. Therefore, we can easily move our hand in air. On the other hand, the force of attraction between the particles of wood (solid) is very high and they are close to each other . Hence it is not easy to move our hand through wood and we need cerate expert.

(e) Water molecules in ice are arranged in special case like structure due to which there is a lot of space between the particles of ice. So, it has lower density than that of water. Therefore, ice floats over water.

CHANGE IN STATES OF MATTER

state of matter can be changed into another state by changing the temperature as explained below:

On increasing the temperature of solids, the kinetic energy of the particles increases. Due to the increase in kinetic energy, the particles start vibrating with greater speed. The energy supplied by heat

overcomes the forces of attraction between the particles. The particles leave their fixed positions and start moving more freely. A stage is reached when the solid melts and is converted to a liquid. The temperature at which a solid melts to become a liquid at the atmospheric pressure is called its melting point.
When we supply heat energy to water, particles start moving even faster. At a certain temperature, a point is reached when the particles have enough energy to break free from the forces of attraction of each other. At this temperature the liquid starts changing into gas. The temperature at which a liquid starts boiling at the atmospheric pressure is known as its boiling point.

Melting point:

The temperature at which a solid melts to become a liquid at the atmospheric pressure is called its melting point.

The melting point of a solid is an indication of the strength of the force of attraction between its particles.

The melting point of ice is 273.16 K.

The process of melting, that is, change of solid state into liquid state is also known as *fusion*

Q. When a solid melts, its temperature remains the same, so where does the heat energy go?

As we know that the temperature of the system does not change after the melting point is reached, till all the ice melts. This happens even though we continue to supply heat. *This heat gets used up in changing the state by overcoming the forces of attraction between the particles*. As this heat energy is absorbed by ice without showing any rise in temperature, it is considered that it gets hidden into the contents of the beaker and is known as the latent heat.

Latent heat of fusion

The amount of heat energy that is required to change 1 kg of a solid into liquid at atmospheric pressure at its melting point is known as the latent heat of fusion.

So, particles in water at 0^0 C (273 K) have more energy as compared to particles in ice at the same temperature.

Latent heat of vaporization

The amount of heat energy that is required to change 1 kg of a liquid into gas at atmospheric pressure at its boiling point is known as the latent heat of vaporization.

Sublimation

A change of state directly from solid to gas without changing into liquid state (or vice versa) is called sublimation

If we heat some crushed camphor or ammonium chloride in a china dish and put an inverted funnel over the china dish. Also put a cotton plug on the stem of the funnel. We see that solid ammonium chloride is converted into its vapours.

Ammonium chloride appears to sublime because of undergoing chemical reactions or decomposition i.e. ammonium chloride when heated decomposes into hydrogen chloride and ammonia.

Change in states of matter by changing pressure

As we know that the difference in various states of matter is due to the difference in the distances between the constituent particles. If we start putting pressure and compress a gas enclosed in a cylinder, the particles of the gas come close to each other and it convert into liquid. Similarly carbon dioxide can be converted into dry ice (solid CO_2) by increasing pressure. Therefore, state of matter can be changed into other state by changing pressure.

Condensation

A change of state from gas into liquid state is called condensation.

Solidification

A change of state from liquid into solid state is called solidification.

Fusion

A change of state from solid into liquid state is called condensation.

Evaporation

In the liquids, some particles at the surface, having higher kinetic energy, break away from the forces of attraction of other particles and gets converted into vapour. *This phenomenon of change of a liquid into vapours at any temperature below its boiling point is called evaporation.*

Factors Affecting Evaporation

the rate of evaporation increases with–

1. An increase of surface area: We know that evaporation is a surface phenomenon. If the surface area is increased, the rate of evaporation increases. For example, while putting clothes for drying up we spread them out.
2. An increase of temperature: With the increase of temperature, more number of particles get enough kinetic energy to go into the vapour state.
3. A decrease in humidity: Humidity is the amount of water vapour present in air. The air around us cannot hold more than a definite amount of water vapour at a given temperature. If the amount of water in air is already high, the rate of evaporation decreases.
4. An increase in wind speed: As we see that clothes dry faster on a windy day. With the increase in wind speed, the particles of water vapour move away with the wind, decreasing the amount of water vapour in the surrounding.

Evaporation cause cooling

In an open vessel, the liquid keeps on evaporating. The particles of liquid absorb energy from the surrounding to regain the energy lost during evaporation. This absorption of energy from the surroundings make the surroundings cold.

e.g. 1. when we pour some acetone (nail polish remover) on our palm, The particles gain energy from your palm or surroundings and evaporate causing the palm to feel cool.

2. After a hot sunny day, people sprinkle water on the roof or open ground because the large latent heat of vaporisation of water helps to cool the hot surface.

Q. Why should we wear cotton clothes in summer?

In summer, we perspire more because of the mechanism of our body which keeps us cool. We know evaporation cause cooling i.e. 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.

Q. Why do we see water droplets on the outer surface of a glass containing ice-cold water?

If we take some ice-cold water in a glass. Soon we will see water droplets on the outer surface of the glass. The water vapour present in air, on coming in contact with the cold glass of water, loses energy and gets converted to liquid state, which we see as water droplets.