



CHAPTER – 1

Nature of Matter

If we look around us, we see a large variety of things with different shapes, sizes, textures and colours. These include books, pens, tables, chairs, water, plants, animals etc. The food we eat, the clothes we wear, the paper on which we write, the air we breathe – each thing is matter. Ordinarily, we call the things around us matter, but in scientific language, "*matter is defined as anything that occupies space, has mass and can be felt by one or more of our senses*".

Heat, light, electricity, magnetism and sound are not considered to be matter because they have no mass nor do they occupy space.

1.1. Classification of matter:

Depending upon the nature of the components, we can classify matter into different types.

Activity 1.1.

Let the class be divided into Groups A, B, C, D and E.

Let Group A take a beaker containing 50 mL of water,

Group B dissolve 50 mL of water and 0.1 g crystals of copper sulphate or potassium permanganate or any other soluble coloured substance in a beaker.

Group C take 50 mL water and 0.2 g of the same substance in another beaker.

Let group D and E take different amounts of the above substance or common salt and dry sand and mix the components to form a mixture.

Report the observations on the uniformity and texture.

Group A has a pure substance which has a uniform composition throughout.

Groups B and C have obtained a mixture but having uniform composition throughout as in A.

Matters such as in groups A, B and C are said to be *homogeneous*. In groups B and C, we get mixtures in which the substances are completely mixed together and are indistinguishable from one another. They have no visible boundaries of separation between the various components. i.e. they are also homogeneous. Some other examples of such mixtures are salt dissolved in water, and sugar dissolved in water. A mixture of glycerine and water is a homogeneous mixture. Homogeneous mixtures are also called *solutions*. Unpolluted air is also a homogeneous mixture of gases like nitrogen, oxygen, water vapour, carbon dioxide etc. Two or more melted metals also can form homogeneous solutions. When solidified, they remain homogeneous. Such homogeneous mixtures of two or more metals are called *alloys*. A familiar example of alloy is **brass** which is a homogeneous mixture of zinc and copper.

Though both groups B and C have obtained a homogeneous mixture (solution) of two substances, but the intensity of colour of the mixtures is different. This shows that a homogeneous mixture can have a variable composition.

Matters which have uniform composition throughout are called homogeneous matters.

Groups D and E have obtained mixtures, which contain physically distinct parts and have non-uniform compositions. **Matter consisting of two or more components which are unevenly distributed are called heterogeneous matter.**

Heterogeneous matters have visible boundaries of separation between the various components. Mixtures of chalk and water, kerosene and water, air containing dust particles or smoke are examples of heterogeneous matters (mixtures). Muddy river water is also a heterogeneous mixture.

Matter may also be classified as solids, liquids and gases. Substances like wood, iron, steel, sand etc. are solids. Substances like water, milk, fruit juice, petrol, glycerine etc. are liquids. Substances like oxygen, nitrogen, carbon dioxide, water vapour (steam) etc. are gases.

Questions:

1. Define matter. Give four examples of matter.
2. Which of the following are matters?
Book, chair, heat, smell, pen, hot tea, light, electric bulb.
3. List the points of difference between homogeneous and heterogeneous matters.

1.2. Is matter composed of particles?

In man's search for knowledge, one of the questions he has asked is : *what is matter made of ? What makes one matter different from others?*

For a long time, two ideas prevailed regarding the nature of matter. One idea was that matter is *continuous* like a block of wood or rubber. A second idea was that matter is composed of *particles* that are indivisible. Fig. 1.1 illustrates what a piece of material would look like under the extremely high-powered viewing device.

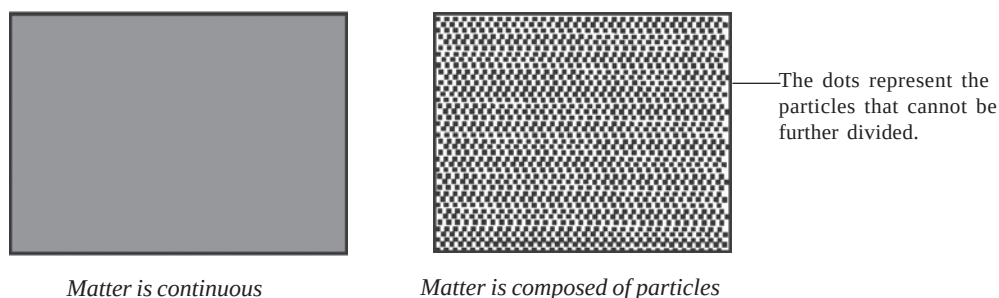


Fig. 1.1

One way of trying to decide between the above alternatives is to find out which idea can best explain experimental results. Let us perform the following experiment to *prove whether is matter continuous or particulate?*

Activity 1.2.

Take a 100 mL beaker or cylinder. Fill half of it with water and mark the level of water. Dissolve some salt or sugar by stirring with a glass rod. Observe any change in water level. Does the level of water change? What has happened to the salt? Where has it gone?

We can answer these questions if we use the idea that matter is made up of particles. When sugar is dissolved in water, it breaks down into very fine particles. These particles of sugar go into the spaces between the particles of water. Hence there is no change in the volume of water on dissolving sugar in it.

1.3. How small are the particles of matter?

Activity 1.3.

Take 2-3 crystals (0.10 g) of potassium permanganate and dissolve it in 100 mL of water. Stir the mixture with a glass rod to ensure that the solution is homogeneous. Using a pipette or measuring cylinder, remove 10 mL of this solution and put it into another beaker containing 90 mL water to make 100 mL solution. The colour of the solution will become lighter. Keep diluting the solution like this 5 to 8 times till you can detect any pink colour (Fig.1.2).

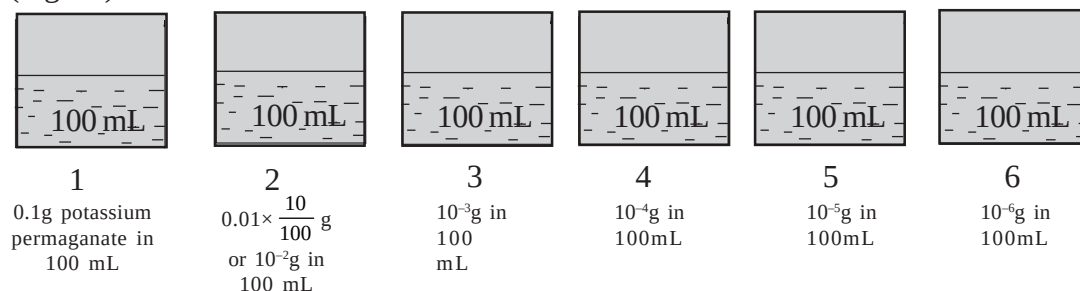


Fig. 1.2.

In the first beaker, in 100 mL of the solution there is $0.1 \times \frac{10}{100}$ or .01 of 10^{-2} g of potassium permanganate. What fraction of a gram of potassium permanganate is there in 1 mL of the diluted solution which you can detect the faint pink colour?

Potassium permanganate can obviously be spread out a great extent. If matter were continuous, an explanation would be that it is extremely *elastic*. If matter is particulate, it is necessary to imagine the particles of solid being separated and spread out in the water. Also, since the smallest amount of potassium permanganate that can be detected in the above experiment is about 10^{-6} g, this may be the maximum mass of any particles that do exist.

So we conclude that there must be millions of tiny particles in just one crystal of potassium permanganate, which keep on dissociating themselves into smaller and smaller particles. Till a stage is reached when the particles cannot be divided further.

The same activity can be done using a few drops of ink instead of potassium permanganate. The colour can be detected even on repeated dilution.

The particles of matter are very small. They are too small to be visible even under powerful microscope.

1.4. Particles of matter have space between them:

In activities 1.2 and 1.3 we have observed that particles of sugar, salt or potassium permanganate got evenly distributed in water. When a solid is dissolved in a liquid, generally there is no change in the volume of the liquid. The fact that there is no change in volume on dissolving sugar or salt in water tells us that there are spaces between the particles of water.

1.5. Particles of matter are continuously moving:

Activity 1.4.

- * Put an incense stick in a corner of the classroom. How close do you have to go near it so as to get its smell?
- * Now light the incense stick. Can you get the smell even from a distance?

When we light an incense stick in one corner of a room, its fragrance spreads in the whole room quickly. How does it happen?

Activity 1.5.

- * Take two glasses or beakers filled with water.
- * Put a drop of blue or red ink slowly and carefully along the sides of the first beaker and glycerine or honey (or any other thick liquid) in the same way in the second beaker.
- * Leave them undisturbed on the table.
- * How long it takes for the ink and the glycerine to spread evenly in the water?
- * Record your observations.
- * Carry out the experiment in hot water and observe the difference.

Activity 1.6.

- * Drop a crystal of potassium permanganate or any other soluble coloured salt into a glass of hot water and another containing cold water.
- * What difference do you observe regarding the distribution of the substances in hot and cold water?

In the above activities we observe that particles of matter intermix on their own with each other. They do so by getting into the spaces between the particles. *The intermixing of particles of two or more different types of matter on their own is called diffusion.*

We observe that diffusion becomes faster on heating. Why does this happen?

Particles of matter in solution are continuously moving, that is, they possess kinetic energy. As the temperature rises, particles move faster. We say that with increase in temperature, kinetic energy of particles also increases. And due to faster movements, they mix into each other more quickly.

1.6. Particles of matter attract each other:

Activity 1.7.

- * Take a piece of chalk, a brick and an iron nail.
- * Try to break them by hammering or cutting.
- * Which of them is difficult to break, that is, the particles are held together by stronger force?

There are some forces of attraction between the particles of matter which binds them together. The strength of the force of attraction is different in particles of different kinds of matter. We can move our hand through air very easily because the particles of air are far apart from one another and also the force of attraction between the particles of air is very, very small. It is negligible. We can also move our hand through water in fairly easily because the force of attraction between the particles of water is also small. But we cannot move our hand through a solid body. The force of attraction in a solid is very strong.

Questions

1. Describe what happens when sugar is dissolved in water and there is no increase in volume?
2. Even one or two crystals of potassium permanganate can impart colour to a large volume of water. Which characteristic of matter is illustrated by this observation?
3. What are the characteristics of the particles of matter?

1.7. What are the different states of matter?

If we look around us, we can see that matter exists in three different states — *solid*, *liquid* and *gas*. Can the idea of particles explain these three states of matter?

Let us observe some of their general properties.

Activity 1.8.

Observe a brick, a piece of wood, book, pencil, salt or sugar on a plate. Keep them at different places. Do you notice any change in their shapes? Try compressing them by applying force. What happens when they are hammered, pulled or dropped. Are you able to compress them? We can observe that all these have definite shapes, distinct boundaries and fixed volumes (Fig.1.3). They have negligible compressibility. Solids may break under force but it is difficult to change their shapes. They are rigid.

Let us consider the following.

A rubber band change its shape on stretching but regains the same shape when the force is removed. When excessive force is applied it breaks.

We find that a sponge can be compressed. A sponge has many small holes in which air is trapped. When we press it, the air is expelled out and we are able to compress it.



Fig. 1.3 . This block of wood is a solid. It has a definite shape and volume.

Activity 1.9.

* Recall activities 1.2 and 1.3, 1.4. where we saw that solids and liquids can diffuse into liquids. Gases from the atmosphere also diffuse and dissolve in water. The aquatic animals can breathe under water due to the presence of dissolved oxygen in water.

Thus we may conclude that solids, liquids and gases can diffuse into liquids. The rate of diffusion of liquids is higher than that of solids. This is due to the fact that in the liquid state, particles move freely and have greater space between each other as compared to particles in the solid state.

Activity 1.10.

Water, milk, fruit juice, kerosene, petrol etc. are some of the common liquids. Measure 50 mL of a liquid and transfer it into different containers one by one.

Does the shape of the liquid remain the same?

Pour the liquid from one container into another. Does it flow easily?

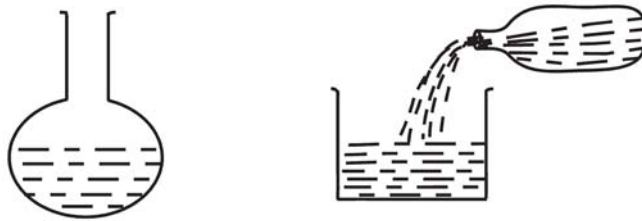


Fig. 1.4. Water is a liquid. It flows easily. It has no definite shape but has definite volume. It takes the shape of container.

We observe that liquids have no fixed shape but have a fixed volume. They take up the shape of the container in which they are kept (Fig. 1.4). Liquids flow and change shape, so they are not rigid and can be called fluid.

Activity 1.11.

Arrange three 100 mL syringes.

Remove the pistons from all the syringes.

Apply some vaseline on the pistons for their smooth movement.

Close the nozzles of the syringes by rubber corks (as shown in Fig. 1.2)

Fill water in the first and pieces of chalk or other solids (common salt or sugar may be used) in the second.

Leave the third syringe unfilled.

Insert the pistons back into the syringes.

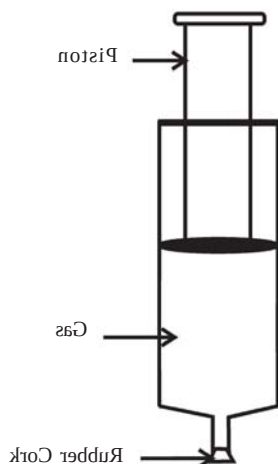


Fig. 1.2.

Now, try to compress the content by pushing the piston in each syringe.

What do you observe?

In which case was the piston easily pushed in?

We find that the piston of the third syringe containing air moves down considerably when pushed in. However, the pistons in the first and second syringes do not move down when we try to compress them.

We have observed that *gases are highly compressible* as compared to solids and liquids.

Due to high compressibility, fairly large mass of a gas can be put in a small metal cylinder by compression.

The liquefied petroleum gas (LPG) cylinder (Fig.1.6) that we use in our homes for cooking is a compressed form of the gas.

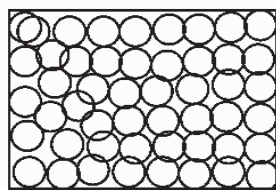
Suppose we have some cooking gas in a cylinder. If we open the cylinder, we will soon smell the gas all over the room. We sometimes come to know what is being cooked in the kitchen without even entering there, by the smell that reaches us. *How does the smell reach us?*



Fig. 1.6. Cooking gas (LPG).

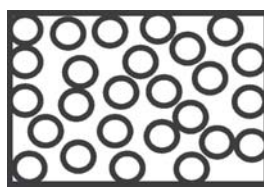
This suggests that particles of the gas in the cylinder and aroma of the food mix with particles of air, spread from the kitchen, reach us and even farther away. The smell of gas reaches us in seconds. This shows that gases diffuse rapidly and occupies the entire space available to it.

The idea that matter is composed of particles can be used to explain the characteristics of solid, liquid and gas. Fig 1.7 illustrates the arrangement of particles in solid, liquid and gas.



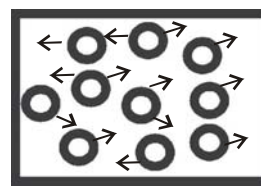
SOLID

Particles are arranged in a regular way, close together and held in position. The only motion possible is vibration about their fixed positions



LIQUID

Particles still close to each other, but can move in between one another.



GAS

Particles are much more widely separated, and are moving more rapidly than in a liquid.

Fig. 1.7. Arrangement of particles in solid, liquid and gases.

Let us answer these:

1. When a bottle of perfume was opened in a room, we can smell it even from a considerable distance. Why ?

2. What is diffusion? Give one example of diffusion of gases in a liquid.
3. Give reasons:
 - (a) A gas fills completely all the space available to it.
 - (b) A book should be called a solid.
 - (c) A gas exerts pressure on the walls of a container.

1.8. Can matter change its state?

We all know that water exist as a solid in the form of ice, as liquid water, and as a gas in the form of steam (water vapour).

We like to know how does this change of state take place? What happens inside the matter during this change of matter? What happens to the particles of matter during the change of states?

To answer these questions, let us perform the following experiments:

Activity 1.7.

- * Take some crushed ice in a beaker and suspend a thermometer in it (Fig 1.8).
- * Note the temperature of ice.
- * Start heating the beaker on a low flame.
- * Note the temperature when the ice starts melting
- * Keep on recording the temperature of melting ice on the thermometer every minute.
- * Note the temperature when all the ice has converted into water.
- * Why the temperature remains constant when the ice is melting?
- * When all the ice has melted, *put a glass rod in the beaker and heat while stirring till the water starts boiling.*
- * Note the temperature carefully till most of the water has vaporised.
- * Record your observations.
- * Why does the temperature remain constant when the water is boiling?

Ice is solid, so the particles of ice are held together by strong force of attraction. On increasing the temperature of solids, the energy of the particles increases. Due to increase in energy, the particles start vibrating more vigorously. A stage is reached when the energy supplied by heat overcomes the forces of attraction between the particles. The particles become somewhat loose, leave their fixed positions and start moving more freely. Thus 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.* The melting point of ice is 0°C (273.16 K). The process of melting, that is, change of solid state into liquid state is also known as fusion.

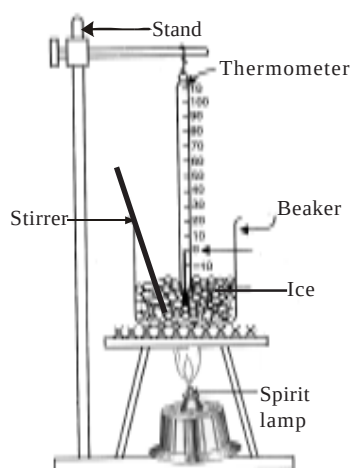


Fig. 1.8. Conversion of ice to water.

The melting point of a solid is an indication of the strength 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. For example, the melting point of iron is very high (1535°C). It tells us that the force of attraction between the particles of iron is very strong.

We have observed that the temperature of ice does not change after the melting point is reached, till all the ice melts. This happens even though we continue to heat the beaker, that is, we continue to supply heat. The 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 in the substance undergoing change and is known as the *latent heat*. The word latent means hidden.

The amount of heat energy required to change 1kg of solid into liquid at its melting point is known as the latent heat of fusion. It has been found by experiments that 3.34×10^5 joules of heat are required to change 1 kilogram of ice to water at its melting point, 0°C . So, the latent heat of fusion of ice is 3.34×10^5 joules per kg. It, therefore follows that particles in water at 0°C (273 K) have more energy than the particles in ice at the same temperature.

Thus we conclude that when a solid melts, its temperature remains the same.

Why we feel cold when we hold a piece of ice in our hand? The piece of ice in our hand starts melting slowly. During the process, ice takes the latent heat required for melting from our hand. Our hand loses heat to ice and we feel it cold.

When a solid melts, it absorbs heat to form liquid. The reverse of this is also true. That is, when a liquid freezes to form a solid, an equal amount of heat is given out. For example, when ice melts at 0°C , it absorbs latent heat of fusion to form water. When water freezes at 0°C to form ice, it gives out the same amount of heat.

We have also observed that the temperature of boiling water does not rise even though we continue heating the beaker (Fig.1.9). Why is it so?

When we supply heat energy to water, particles start moving even faster. At a certain temperature, a stage is reached when the particles have energy to overcome (or break) the forces of attraction between water particles. At this temperature the liquid start changing into gas (vapour).

The temperature at which a liquid starts boiling at the atmospheric pressure is called its boiling point. Boiling is a bulk phenomenon, particles from the bulk of the liquid gain enough energy to change into the vapour state. For water this temperature is 100°C (373 K) at one atmospheric pressure. At higher pressure its boiling point is above 100°C .

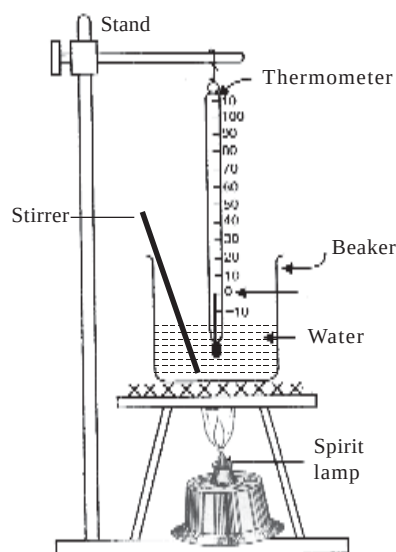


Fig. 1.9 Conversion of water to water vapour

The heat which is going into boiling water but does not increase its temperature is the energy required to change the state of water from liquid state to gaseous state. This is known as *latent heat of vaporization* of water. So can you define the *latent heat of vaporisation* in the same way we have defined the *latent heat of fusion* ?

The latent heat of vaporisation of a liquid is the quantity of heat required to change 1kg of the liquid to vapour at its boiling point. Thus, particles in steam, that is, water vapour at 100°C (373 K) have more energy than water at the same temperature. This is because particles in steam have absorbed extra energy in the form of latent heat of vaporisation.

When water changes into steam, it absorbs latent heat, and when steam condenses to form water, an equal amount of latent heat is given out.

Wax too shows changes in state similar to those shown by water. Let us observe lighting of a candle (Fig.1.10).

On heating, solid wax (paraffin) melts into liquid wax, which on further heating, is converted into vapours of wax. When we light the candle, the wax around the wick melts. The molten wax rises up the wick and is converted into wax vapour. The wax vapour mixes with oxygen in air and burns [Fig.1.10 A]. In a lighted candle, we can see the solid and liquid states of the wax. We can also see thick white smokes rising from the wick for some time after the candle is put off [Fig.1.10 B]. This is due to condensation of wax vapours.

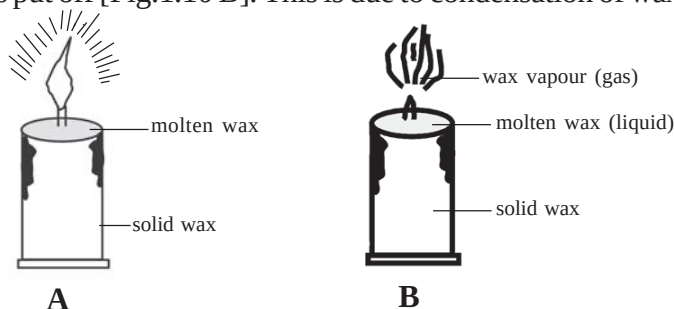


Fig 1.10. Changes in the state of wax.

So, we can infer that the state of matter can be changed into another state by changing the temperature.



Normally, a solid on heating changes into liquid state. The liquid state on further heating changes into gaseous state. Reverse happens when gaseous state is cooled. However, there are solids which on heating directly change into gaseous state, without changing into liquid state and vice versa.

Let us answer these:

1. Why is heat energy needed to melt a solid?
2. Why is temperature remain the same when ice is melted even though we supply heat continuously?
3. Steam and boiling water have the same temperature. But steam cause more severe burns than boiling water. Why?
4. For any substance, why does the temperature remain constant during the change of state?

1.9. Sublimation:

Activity 1.12

- * Take some ammonium chloride (or camphor) in a china dish and place the china dish on a tripod stand (Fig. 1.11).
- * Cover the china dish with an inverted glass funnel.
- * Put a loose cotton plug in the upper, open end of the china dish. Now heat the china dish slowly, and observe.

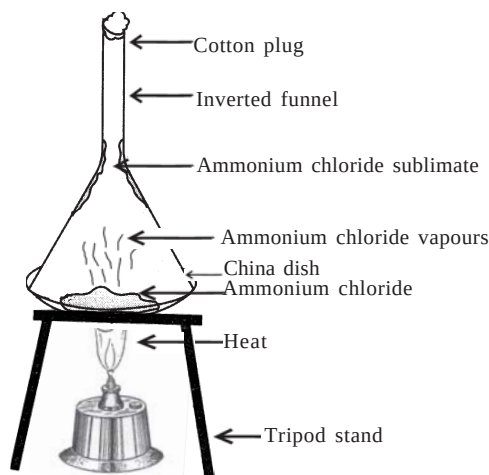
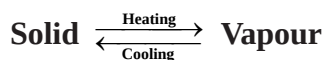


Fig. 1.11. Sublimation of ammonium chloride.

It is observed that the vapours of ammonium chloride rise up and get converted into solid ammonium chloride on coming in contact with the cold, inner walls of the funnel.

The process of changing a solid directly into gaseous state on heating without changing into liquid state and of vapours into solid on cooling, is called sublimation.



The solid particles formed when the gaseous state of a substance directly changes into solid state is called *sublimate*.

Sublimation occurs in only a few substances. The common substances which undergo sublimation are iodine, camphor, naphthalene and anthracene. In many households, small naphthalene balls are kept along with woollen and silk clothes, etc., to protect them from the attack of moths and other insects. These naphthalene balls disappear with time without leaving any residue. Where did it go ?

Let us answer these.

1. What is sublimation? Name two substances which undergo sublimation.
2. Name one property which is shown by ammonium chloride but not by sodium chloride.
3. Explain why naphthalene balls kept inside our cupboard disappear over a period of time?

1.10. Can we change the physical state of matter by changing pressure?

We have already learnt that the distances between the constituent particles in solids, liquids and gases are different. In gases, the particles are far apart. What will happen if we put pressure and compress a gas enclosed in a cylinder? Will the particles come closer? Can increasing or decreasing the pressure change the state of matter?

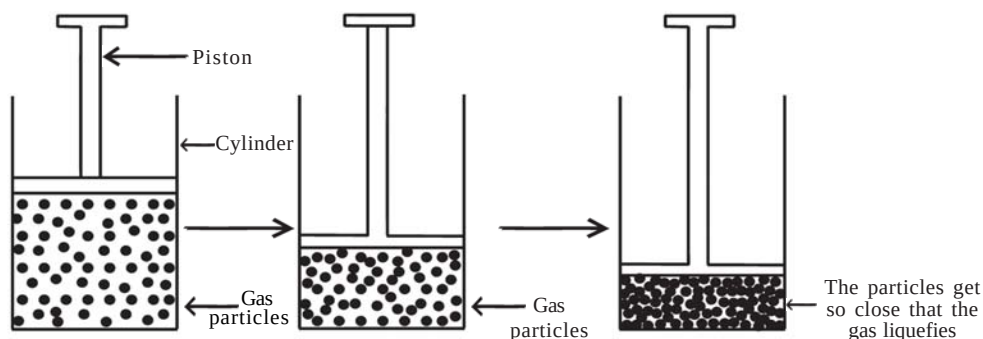


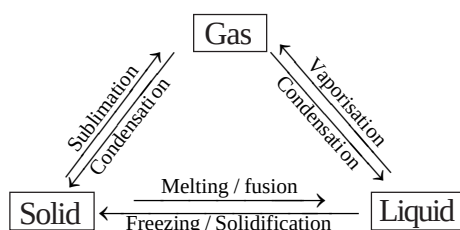
Fig. 1.12. By applying pressure, particles of matter can be brought close together.

When a high pressure is applied to a gas, it gets compressed into a small volume. This is because there was a lot of space between the particles of a gas. When compressed, the particles get so close together that they may liquefy. However, when a gas is compressed too much, then heat is produced due to compression. So, while applying pressure, it is necessary to cool them to take away the heat produced during compression. Cooling lowers the temperature of the compressed gas and helps in liquefying.

Thus, we conclude that *gases can be liquefied by applying pressure and lowering temperature*.

Carbon dioxide and ammonia gas can be liquefied by applying high pressure and lowering the temperature. Solid carbon dioxide is stored under high pressure. It gets converted directly to gaseous state on decrease of pressure to atmospheric pressure without coming into liquid state. For this reason, solid carbon dioxide is also known as dry ice.

Thus, we can say that pressure and temperature determine the state of a substance, whether it will be solid, liquid or gas. The following diagram shows inter conversion of solid, liquid and gas.



It should be noted that all substances cannot be changed from one state to the other. It is because many substances undergo decomposition when strongly heated. For example, sugar in the solid state cannot be changed into liquid sugar because, on heating, it undergoes decomposition. The decomposed substance is not sugar.

Let us answer these.

1. What is dry ice? Why is it so called?
2. How does applying pressure help in the liquefaction of a gas?
3. Suggest a method to liquefy atmospheric gases.

1.11. Evaporation:

Whether heat or change of pressure is always required for changing the state of matter?

We have observed that water, when left uncovered, dries up. Wet clothes also dry up due to changing of water into water vapour. How does these happen?

We know that particles of matter are always moving and not at rest. At a given temperature in any gas, liquid or solid, there are particles with different amounts of kinetic energy. In the case of liquids, a small fraction of particles at the surface, having higher kinetic energy, are able to break away from the forces of attraction of other particles and escape in the form of vapour. This *phenomenon of change of a liquid into vapours (gas) below its boiling point is called evaporation.*

1.11.1. Factors affecting evaporation:

Using our common experience, let us find out in which of the following situations, evaporation will be quicker?

- (i) Keeping 5 mL of water in a test tube near the window or under a fan.
- (ii) Keeping 5 mL of water in an open dish near the window or under a fan.
- (iii) Repeating of the above steps on a sunny day and on a rainy day.

We can infer that the rate of evaporation increases mainly on the following factors:

(i) Increase of surface area:

If the surface area of a liquid exposed to the air is increased, the rate of evaporation increases. For example, while putting wet clothes for drying up we spread them out. Can you say why we are able to sip hot tea faster from a saucer than from a cup?

(ii) Increase of temperature:

With the increase of temperature, more particles of the liquid get enough kinetic energy to go into the vapour state (gaseous state). In other words, the rate of evaporation of a liquid increases with rise in temperature and becomes maximum at its boiling point.

(iii) Decrease in humidity:

The amount of water vapours present in air is termed *humidity*. When the amount of water vapours present in air is small, the air appears to be *dry* and we say that humidity is low. On the other hand, when the amount of water vapours in the air is large, the air appears to be *damp* and we say that the humidity is high.

The air around us cannot hold more than a definite amount of water vapour at a given temperature. If the amount of water vapour in air is already high, the rate of evaporation decreases and vice versa.

When the humidity of air is low, then the rate of evaporation is high, and water evaporates more readily and we feel cool and comfortable. During summer, the humidity of air increases. People sweat a lot in such weather. But the sweat from our bodies does not evaporate readily due to high humidity of air. Such weather becomes damp and we feel hot and uncomfortable. This type of weather is experienced during cloudy days.

(iv) Increase in wind speed:

It is a common observation 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 surroundings. This increases the rate of evaporation of water.

1.11.2. Evaporation cause cooling:

When we put a little spirit (or petrol) at the back of our hand and wave it around, the spirit evaporates rapidly and our hand feels cold. When spirit changes into vapour, it takes the latent heat of vaporisation from our hand. The hand loses heat and gets cooled. In open vessels, 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 makes the surroundings cold.

During hot summer days, we use earthen pots (called chaphu) to get cold water. The earthen pot has a large number of extremely small pores in its walls. Some of the water continuously keeps seeping through these pores to the outside of the pot. This water evaporates continuously and takes away the latent heat of vaporisation from the earthen pot and the remaining water. The remaining water loses heat and gets cooled.

On a hot day or after doing some physical exercise, our body temperature tends to rise. At this time, our sweat glands give out moisture or sweat on our skin. When the sweat evaporates, it takes the latent heat of vaporisation from our body and keep our body cool. Perspiration (or sweating) is our body's mechanism to keep us cool.

Cotton clothes in hot summer days helps us to keep cool and comfortable. During summer, we perspire more because of the body's mechanism to keep us cool. Cotton, being a good absorber of water helps in absorbing the sweat and exposes it in air for easy evaporation. The evaporation of this sweat cools our body. A fan also increases the rate of evaporation of moisture or sweat from our body and makes us cool and comfortable.

During hot summer days, people sprinkle water on the floor or open ground. Water evaporates by taking the large latent heat of vaporisation from the ground and surrounding air. By losing heat, the place becomes cool and comfortable.

Cite some more examples of cooling due to evaporation from your daily life experiences.

Let us answer these:

1. Why does we perspire on a hot day?
2. How does the water kept in an earthen pot becomes cool during summer?
3. Why are we able to sip hot tea or milk faster from a saucer rather than from a cup?

4. Why do people prefer to use cotton clothes in summer? Why we feel cool and comfortable under a tree than under a roof on a sunny day ?
5. What are the factors which affect evaporation?

SUMMARY

- * Matter is anything that occupies space, and has mass.
- * Matter is made up of particles.
- * Matter which has uniform composition throughout is homogeneous and that which consists of two or more components and unevenly distributed is heterogeneous.
- * Matter exist in three states — solid, liquid and gas.
- * The spaces in between the constituent particles and kinetic energy of the particles are minimum in case of solids, intermediate in liquids and maximum in gases.
- * In solids, particles are arranged in a regular way, in case of liquids the particles can slip and slide over each other while for gases, particles move randomly, there is no order.
- * The three states of matter are interconvertible.
- * The state of matter can be changed by changing temperature and/or by changing the pressure.
- * Latent heat of fusion is the amount of heat energy required to change 1 kg of solid into liquid at its melting point.
- * Latent heat of vaporisation is the heat energy required to change 1 kg of a liquid to vapour at atmospheric pressure at its boiling point.
- * Sublimation is the change of a solid directly into vapour on heating without changing into liquid state and vice versa.
- * Boiling is a bulk phenomenon. Particles from the bulk of the liquid gain energy and change into vapour state.
- * Evaporation is a surface phenomenon. Particles from the liquid surface gain enough energy to overcome the forces of attraction present in the liquid and change into the vapour state.
- * The rate of evaporation depends upon the surface area exposed to the atmosphere, the temperature, the humidity and the wind speed.
- * Evaporation causes cooling.

EXERCISES

1. *Define matter. Give four examples of matter?*
2. *Light and sound are not considered to be matter, why?*
3. *Give two processes which provide the best evidence for the motion of particles in matter.*
4. *When we dive in water, we cut through water easily. Which property of matter is shown by this observation?*
5. *Why do gases have neither a fixed shape nor a fixed volume?*
6. *Why do solids, liquids and gases differ in shape and volume?*
7. *Name two gases which are available in compressed form.*
8. *What is diffusion? Give one example.*
9. *What is meant by latent heat of fusion of a solid? How much is the latent heat of fusion of ice?*
10. *Define the term "latent heat of vaporization" of a liquid.*
11. *Define (a) melting point and (b) boiling point of a substance.*
12. *State the various factors which affects evaporation.*
13. *How does evaporation results in cooling effect?*
14. *What are the conditions necessary to liquefy gases?*