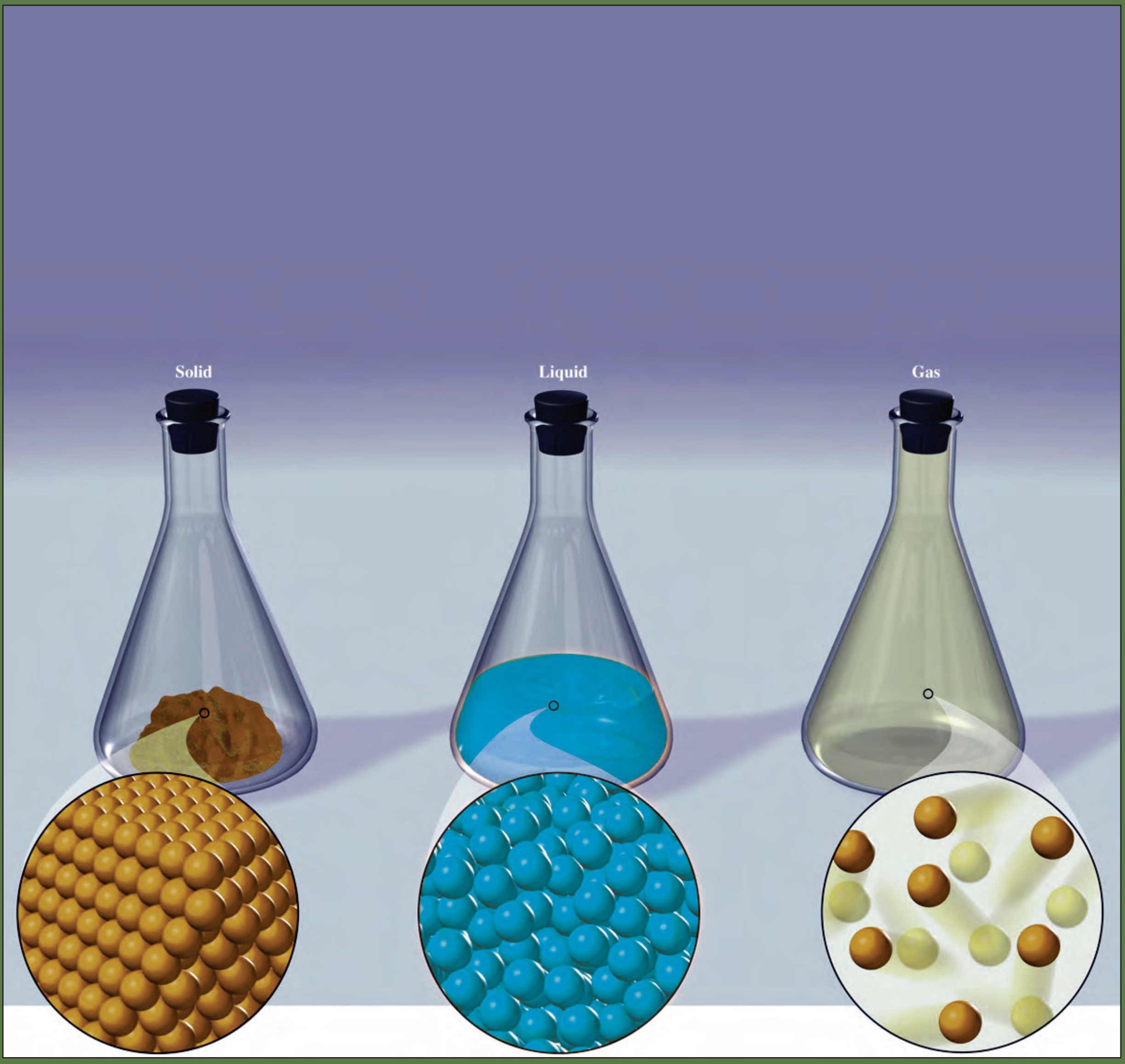
CHEMISTRY

CHAPTER 9



MATTER
IN OUR SURROUNDINGS

CHEMISTRY

We are surrounded by a number of objects. eg : iron, wood, water, air etc. We do not see air but we feel its presence. All these things occupy space and have mass. In the **World of Science, matter is anything that has mass and occupies space.** There are different kinds of matter. Here, we learn about matter based on its physical properties.

ACTIVITY 9.1

Look at your surroundings, observe and write the objects around you.

In your house	1.. 2.. 3..
In the play ground	1.. 2.. 3..
In your class room	1.. 2.. 3..

9.1. PHYSICAL NATURE OF MATTER

Let us perform an activity to learn about the nature of matter.

MORE TO KNOW

The size of the atoms and molecules of matter is very small, almost beyond our imagination. It is measured in nanometres (1nm = 10^{-9}m).

ACTIVITY 9.2

Let us take a small piece of chalk and powder it. We can see that the chalk powder consists of small particles. These particles are responsible for the formation of matter (chalk). **Matter is made up of tiny particles** known as atoms and molecules. Molecules are made up of atoms. Molecules and atoms are the building blocks of matter.

Fig.9.1-Chalk piece

Fig.9.2-Chalk powder

9.2. CHARACTERISTICS OF PARTICLES OF MATTER

ACTIVITY 9.3

- Take some water in a beaker.
- Mark the level of water. Add some sugar to the water and stir well.
- Do you observe any change in the water level?
- What does the solution taste like?
- What happened to the sugar?
- Where did it disappear?

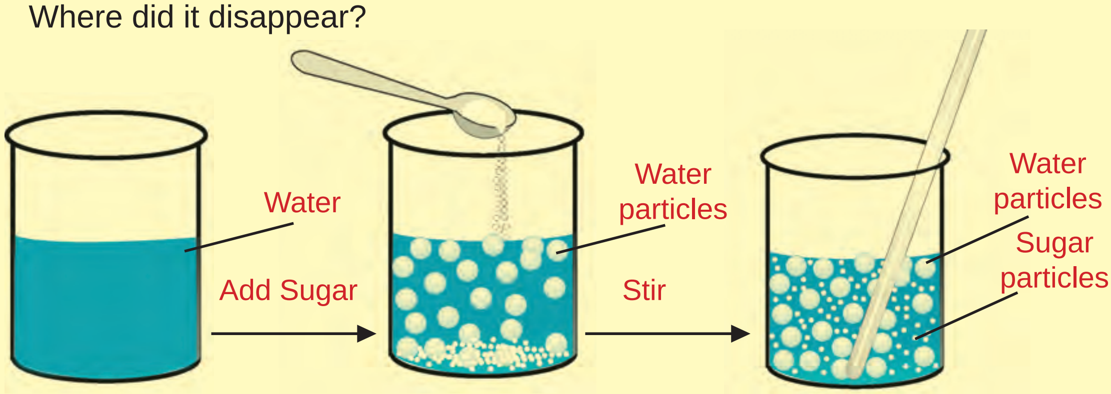


Fig.9.3-Particles of water and sugar are magnified million times.

From the above activity you can notice that there is no change in the water level but the taste is sweet. It indicates that the sugar is completely dissolved in water. When you dissolve sugar in water, the molecules of sugar occupy the space between molecules of water and get uniformly distributed in water. It is understood **that there exists a space between the molecules in matter.**

ACTIVITY 9.4

- Take a beaker with water
- Add a drop of blue ink slowly and carefully into the beaker.
- Leave it undisturbed in your classroom
- Record your observation

Fig.9.4-Diffusion of ink in water

From the above activity you can understand that **the molecules of matter continuously move and mix with each other.**

ACTIVITY 9.5

- Open a water tap.
- Try to break the stream of water with your fingers.
- Are you able to break the stream of water?
- What could be the reason behind the stream of water remaining together?

Fig.9.5-Stream of water remains together

The above activity shows that **molecules of matter have force of attraction between them.** This force binds the molecules together. Force of attraction between the molecules (Inter molecular forces) varies from one kind of matter to another. The structure and properties of matter – whether they are hard or soft, colored or transparent, liquid or gas- depends on the way in which the atoms and molecules are arranged.

9.3. STATES OF MATTER

Matter can exist in three physical states, i.e., solid, liquid and gas.

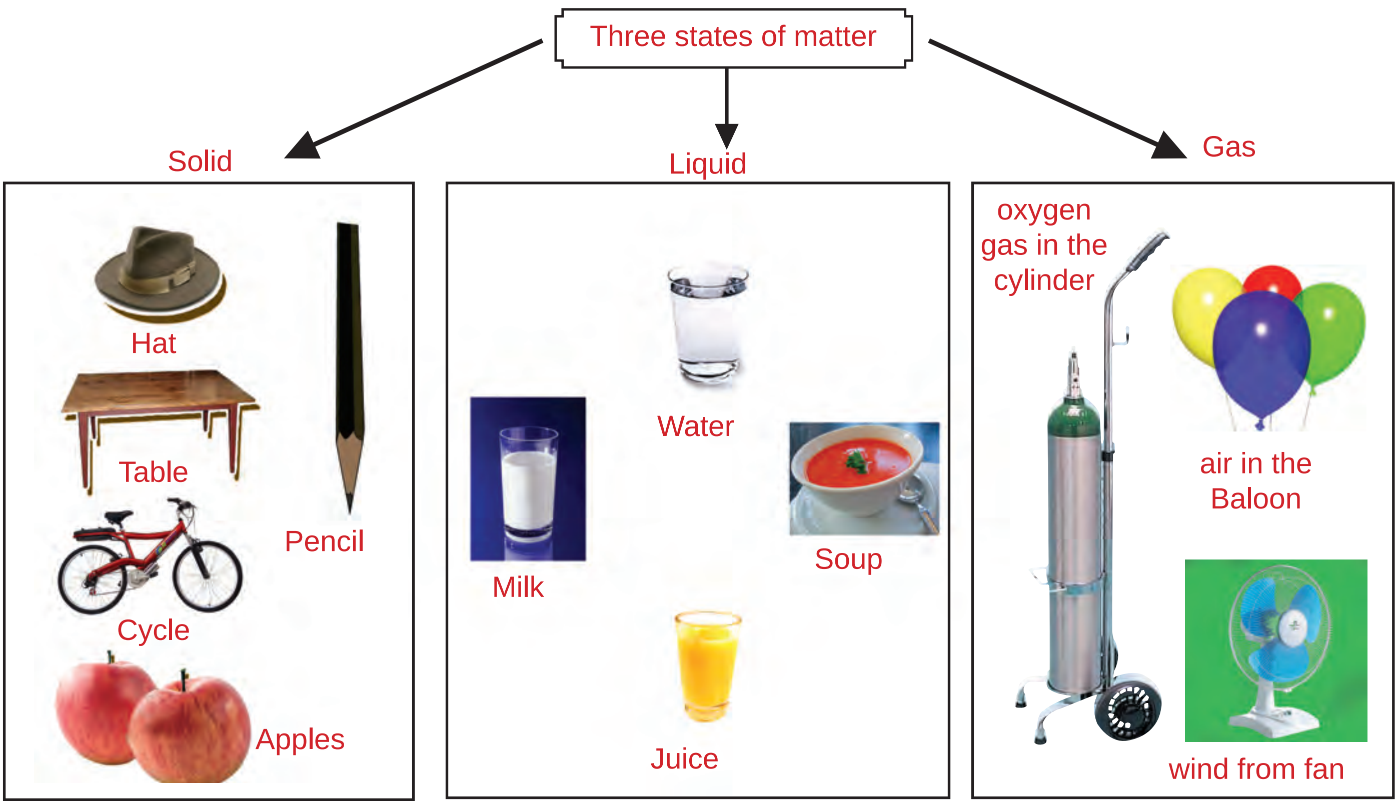


Fig.9.6-States of matter

Solid

Solids are characterized by definite shape, size and volume. In solids, the molecules are very closely arranged because the force of attraction between the molecules is very strong. They are incompressible. The following figures 9.7(a& b) are a few examples to show that matter exists in the solid state. Fig (9.8) shows how molecules are closely arranged in solids.

9.7.(a)

9.7.(b)

Fig. 9.7- Examples of matter in solid state

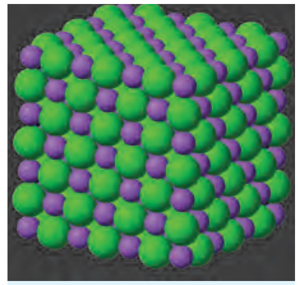


Fig.9.8
Close arrangement of molecules in solid

TO THINK...

Sponge is also a solid. Yet we are able to compress it. Why? Sponge has minute holes in which air is trapped. When we press it, the air is expelled and we are able to compress it.Solids may break under force. It is difficult to change their shape as they are highly incompressible.

Fig. 9.9. Sponge

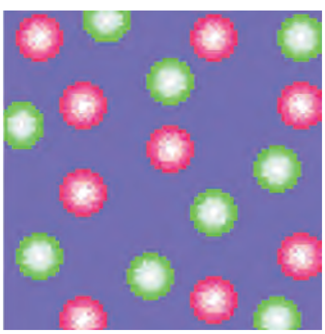


Fig.9.10
Plasma State

MORE TO KNOW

Matter exists in two more states.

Fourth State of Matter -Plasma- super heated gaseous State.

Fifth State of Matter -Bose-Einstein condensate – super cooled Solids.

Liquid

Liquids occupy definite volume but have no definite shape. It takes the shape of the container as shown in fig 9.11. Do you know why? The force of attraction between the molecules in a liquid is less when compared to solids, and these molecules are loosely packed. This allows the liquid to change its shape easily. They are negligibly compressible. A few examples for matter that exist in liquid state are water, oil, juice etc. From the fig 9.12 you can also see how the molecules are loosely arranged in liquids.

Fig. 9.11. Liquid take the shape of the container

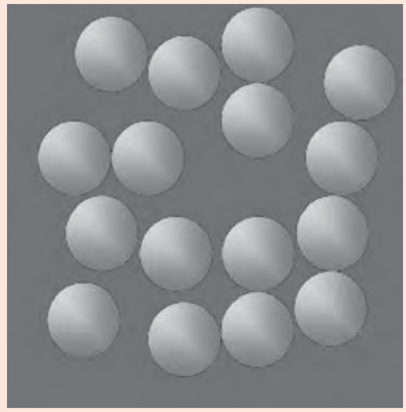


Fig 9.12. Loose arrangement of molecules in liquid

Gas

The atoms or molecules of matter that always occupies the whole of the space in which they are contained is called a **gas**, as shown in Fig 9.13 . It neither occupies a definite volume nor possesses a definite shape. The force of attraction between the molecules of a gas is negligibly small, because the molecules are very loosely packed as in Fig 9.14 . The molecules are distributed at random throughout the whole volume of the container. Gases are highly compressible when compared to solids and liquids. Gases will expand to fill the space of the container. The Liquefied Petroleum Gas (LPG) cylinder that we get in our home for cooking or the oxygen supplied to hospitals in cylinders are compressed gases. Compressed Natural Gas (CNG) is used as fuel these days in vehicles, too.

Fig 9.13. Gas filled baloon

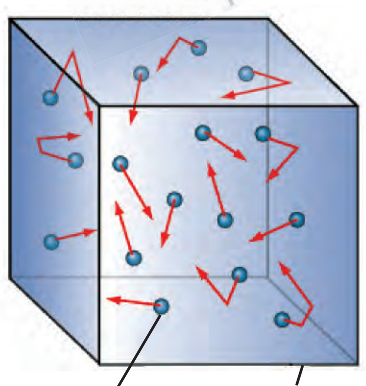


Fig 9.14. Very loose arrangement of molecules in gas

ACTIVITY 9.6

Take a cork ball and press it. Do you find any change in the size or shape. No,it cannot be compressed. You know well that solids are incompressible.

Let us compare the compressibility of liquids and gases using an activity.

Take two hypodermic syringes and label them 1 and 2.

1. Plaster the nozzle and seal it with a cork.
2. Remove the piston (Plunger) from the syringes.
3. Fill syringe-1 with water.
4. Do not add anything in syringe 2 (still it contains air).

Insert the piston back into the syringes. You may apply some Vaseline on the piston before inserting them into the syringes for smooth movement.Now try to compress by pushing the piston in each syringe. In the case of water (liquid) in syringe1 the piston moves just a little. But in the case of air in syringe2, the piston can be pushed completely.

This shows liquids can be compressed slightly, while gases can be compressed easily.

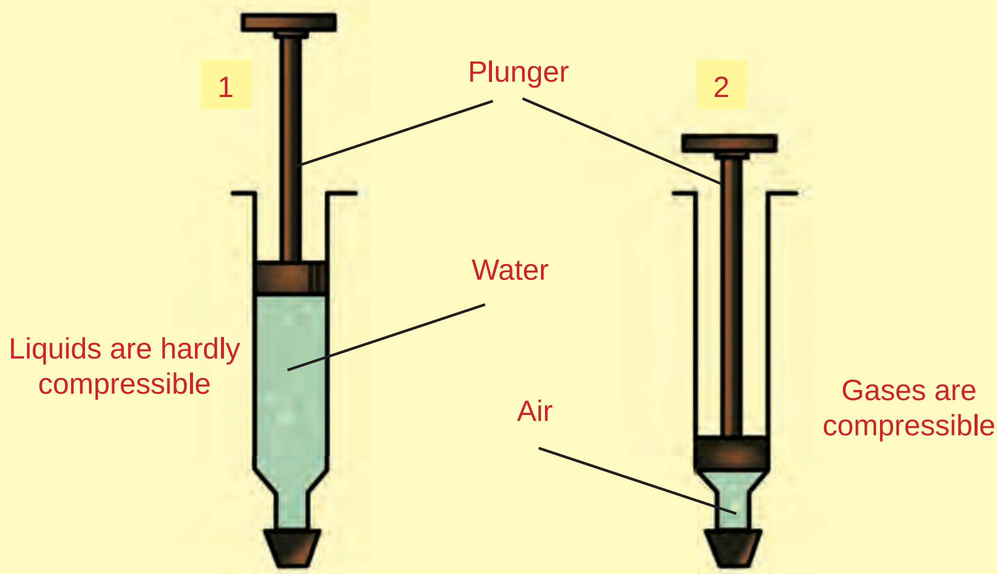


Fig. 9.15. Effect of pressure on liquid and air

MORE TO KNOW

Why does the smell of hot cooked food spread out easily?

Here the particles of the aroma of food mix with the particles of air in the kitchen and spread out from the kitchen very easily. This is due to

(i) The free particles or molecules of gas in aroma and air.

(ii) The high speed of the gaseous particles or molecules.

(iii) The large space between them.

So gases diffuse much faster than solids and liquids.

Properties of Solid, Liquid and Gas :

Table 9.1

S.No	SOLID	LIQUID	GAS
1	Have definite shape and volume	Have definite volume but no definite shape	Have neither definite shape nor definite volume
2	Cannot flow	Can flow from higher level to lower level	Can flow very easily and quickly
3	Intermolecular space is minimum	Intermolecular space is moderate	Intermolecular space is maximum
4	Intermolecular forces are maximum	Intermolecular forces are less	Intermolecular forces are negligible
5	They are incompressible	They are compressible to an extent	They are easily compressible

9.4 EFFECT OF TEMPERATURE ON SOLID, LIQUID AND GAS

Can you change the state of matter? i.e., from solid to liquid or from liquid to gas. Let us perform an activity to understand the effect of temperature on matter.

ACTIVITY 9.7

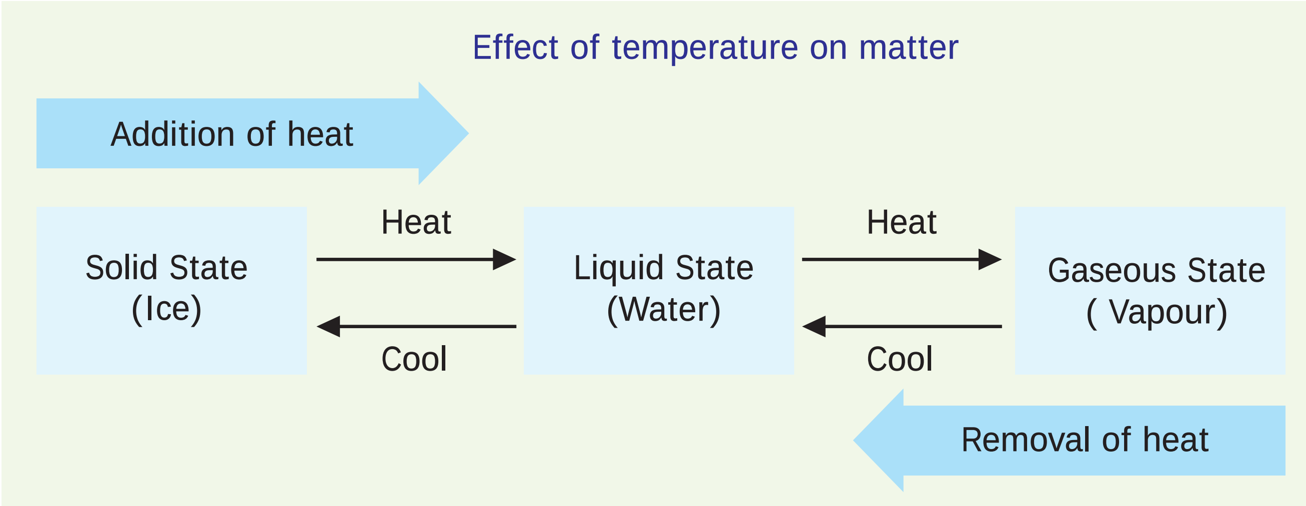
Take ice cubes in a container, heat the container and observe the changes.

Ice (Solid)

Water (Liquid)

Vapour (Gas)

Fig. 9.16. Effect of temperature on matter.



On varying the temperature, you can notice that matter will change from one state to another. For example ice (solid) in the container, on heating, becomes water (liquid) and on further heating, it changes into water vapour(gas).

Water can exist as three states of matter.

- Solid, as ice.
- Liquid, as water
- Gas, as water vapour.

What happens to the particles of matter during the change of states? How does this change of state take place? Don't we need answers to these questions?

On increasing the temperature of solids, the movement of the particles (molecules/atoms) increases. Due to the increase in movement, 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 in to a liquid. The temperature at which a solid melts to become a liquid is called its **melting point.**

When we supply heat energy to water, the particles (molecules or atoms) 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 between each other. At this temperature the liquid starts changing into gas. The temperature at which a liquid starts boiling is known as its **boiling point.**

Particles from the bulk of the liquid gain enough energy to change to the vapour state. So, we infer that one state of matter can be changed into another state by varying the temperature.

THINK AND ANSWER

Does coconut oil solidify during the winter season?

ACTIVITY 9.8

Magesh is interested in classifying the different states of matter shown in the box below. Shall we help Magesh to classify the objects below, depending on its state. Put the appropriate objects in the given table (Table 9.2).


Stone


Smoke from incense sticks


Water


Petrol


Oxygen inside the Cylinder


Iron Rod

Honey


Ice Cubes


Milk


Baloon

Table 9.2

Solid	Liquid	Gas

ACTIVITY 9.9

To check all whether solids change their state at the same temperature.

- Take ice, butter and wax.
- Put the ice into the pan. Heat it until the ice changes into water. Use the thermometer to measure the temperature at which it changes the state
- Continue this process for butter and wax.
- Note down the temperature at which the solid state is converted in to liquid state in the following table.

Table 9.3

S.No.	Solids	Temprature (^0C)
1.	Ice	
2.	Butter	
3.	Wax	

EVALUATION

1. Materials which are very familiar to Raveena are given below. Help her to classify them into solids, liquids and gas.

   bricks, kerosene, milk, coconut oil, air, book, table, oxygen, carbon dioxide

2. Give reason for the following observation.

   a) We can smell the jasmine flower while we are sitting several meters away.

   b) The level of water remains the same when a pinch of salt is dissolved in it.

3. Gas can be compressed into a smaller volume but a solid cannot be. Could you explain. Why?

4. Match the following:

a)	Liquid on heating	-	liquid
b)	Solid	-	easily compressible
c)	Atoms and molecules	-	becomes vapour
d)	Milk	-	cannot flow
e)	Gas	-	building blocks of matter

5. Choose the correct one from the answers given in brocket:

   a) The only substance which exists in all the three states of matter is __________ (water, stone, glass)

   b) The matter which has a negligible intermolecular space is__________ (solid, liquid, gas)

   c) 1 Nanometer is equal to __________

   (10^{-10}m, 10^{-9}m, 10^{-12}m)

6. Fill in the blanks:

   a) The force of attraction between the particles in gas is __________ (less / more) than that of a solid.

   b) __________ (Solid / Liquid) state has definite volume, but no definite shape.

7. Mohan went to a shop to buy milk. He took his bicycle to go to the shop. He saw that the air in the cycle tube was a very little. He took it to the cycle shop. The cycle mechanic used a compressor pump to inflate the cycle tube. Mohan had a doubt. “How does the compressor works?”. Help Mohan to find the answer.

8. On varying the temperature, you can notice the process that matter will change from one state to another. Name the process A, B, C and D.

$$\text{Ice} \underset{D}{\overset{A}{\rightleftarrows}} \text{Water} \underset{C}{\overset{B}{\rightleftarrows}} \text{Water Vapour}$$

9. Solids are incompressible. Sponge is also a solid. We are able to compress it. Could you explain. Why?

PROJECT

Collect 5 or 6 different types of used water bottles. Take a bucket of water. Fill it fully into different bottles one by one. Based on your observation, answer the following questions.

a) Does the volume remain the same?

b) Does the shape of the liquid remain same?

1 Litre 1 Litre 1 Litre 1 Litre 1 Litre

FURTHER REFERENCE

Books

1. Chemistry matters – Richard Hari, Oxford University press, New Delhi

2. Introductory Chemistry - M Katyal, Oxford University press, New Delhi

Websites

http://chemistry . about.com/od/everyday chemistry.in.everyday-life htm

http://www.classzone.com/books/earth-science/terc/content/visualizations

http://chemistry.about.com/library/btacid.quiz.htm

Places of scientific importance for visit:

Birla Planetorium, Guindy, Chennai.

CHEMISTRY

CHAPTER 10

MATTER

AND ITS NATURE

CHEMISTRY

Everyday we see a variety of changes. These changes may involve one or more substances. For example, ice melts, water changes into steam, sugar dissolves in water. Your mother makes curd from milk for your lunch. The milk is fermented to curd. A change is produced. A stretched rubber band also represents a change. Changes in matter occur under certain conditions. In this chapter, we shall perform some activities and closely examine the nature of these changes. Changes that take place around us are of two types

1. **Physical changes.**
2. **Chemical changes.**

10.1. PHYSICAL CHANGES

Fig. 10.1. Broken Pencil

ACTIVITY 10.1

Break a pencil into two pieces. Lay the pieces on a table so that the pieces acquire the shape of the original pencil. Obviously, you cannot join the pieces back to make the original piece, but, is there a change in the property of the pencil?

From the above activity, we can make out that the pencil underwent changes only in size.

ACTIVITY 10.2

Cut a piece of paper into four square pieces. Cut each square piece, further into four square pieces. Lay these pieces on the floor or table. So that the pieces acquire the shape of the original piece of paper.

Obviously, you cannot join the pieces back to make the original paper, but is there a change in the property of the paper?

You saw that the paper underwent change in size. It is a **physical change**.

Do you know that melting of ice cream is an example of a physical change?

Fig. 10.2. Melting of Ice cream

Fig. 10.3. Separation of Iron filings from sand using magnet

ACTIVITY 10.3

- Take a little sand and iron fillings in a tray. Mix them well. Observe, what has happened.
- Is there any new product formed? Can you separate the iron fillings from the sand?
- You would have noticed that new substances are not formed.
- To separate the fillings, move a magnet over the mixture. The fillings are easily attracted by the magnet while the sand remains on the tray.
- Collect the iron fillings in another tray.

We will find that there is no change in chemical composition and no new product is formed. It is only a **physical change**. So a physical change does not involve the formation of any new substance and it is readily reversible.

ACTIVITY 10.4

CRYSTALLISATION.

- Take a little amount of water in a china dish.
- Add sufficient amount of copper sulphate crystals to get a saturated solution. Add a few drops of acid (Hydrochloric acid- HCl) to this solution.
- Heat the solution till the crystals are completely dissolved. Allow the solution to cool and then filter.
- Continue to cool the filtered solution for some more time, without disturbing it. After some time, cystals are formed in the solution.

From this activity we can observe that the newly formed crystals have definite geometrical shapes and different sizes.

Crystals of the pure substance can be obtained from the solution. This process of obtaining crystals is known as **crystallization**.

Fig. 10.4. Crystallisation process

ACTIVITY 10.5

SUBLIMATION

- Take a small amount of camphor in a china dish.
- Invert a funnel over the dish.
- Close the stem of the funnel with a cotton plug. On heating it gently, camphor is converted to its vapour. Vapour of camphor gets condensed on the walls of the funnel.

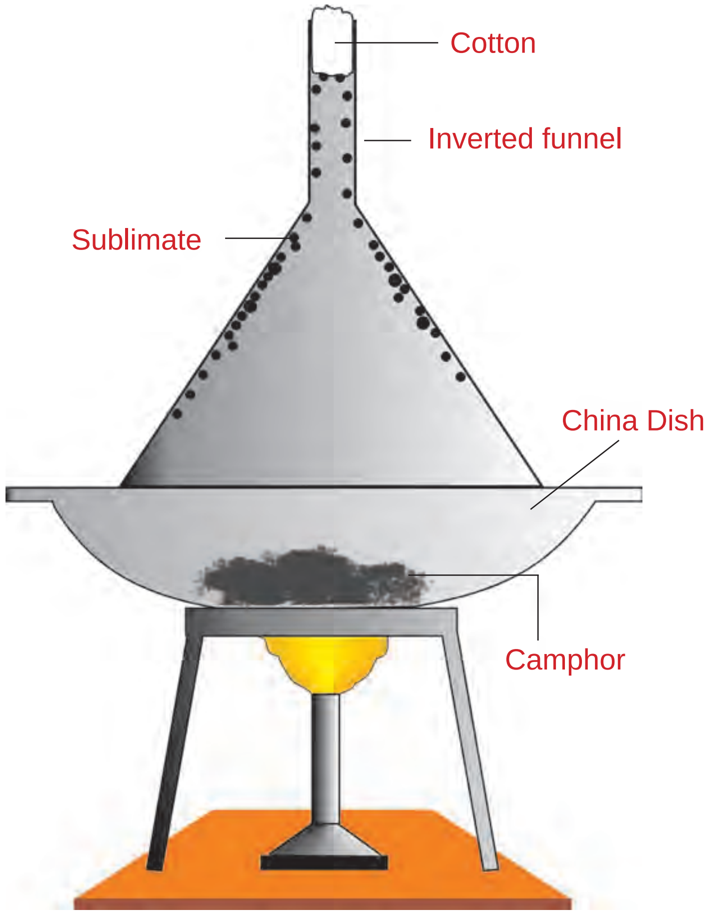


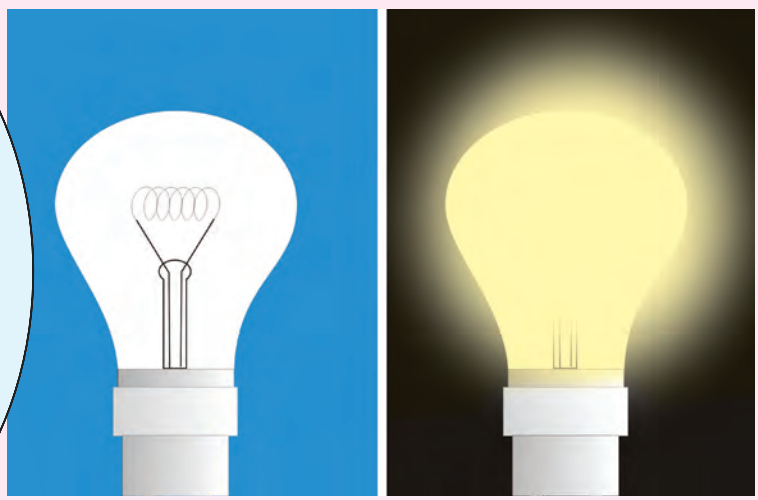
Fig. 10.5. Sublimation

From the above activity we observe that camphor changed its state and appearance.

We cannot recover the camphor in the same form, the physical appearance of the camphor has changed, but its chemical composition remains the same. This process of converting solid directly into its vapour state is known as **sublimation**.

TO THINK...

When an electric current is passed through the filament of a bulb, the filament starts glowing and there is a change in the appearence of the filament. When the current is cut OFF the glow of bulb stops and its original appearance is restored.



Bulb before switching ON

Glowing Bulb

Fig. 10.6.

ACTIVITY 10.6

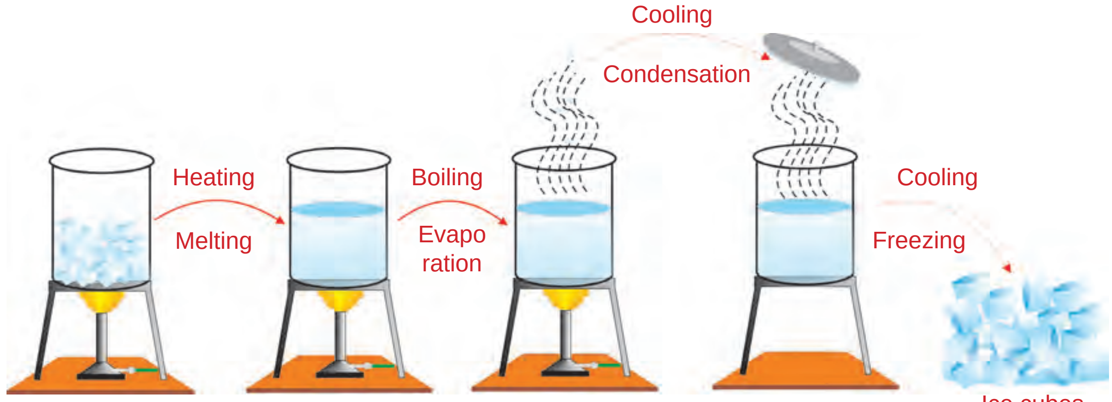


Fig. 10.7. Changes in the state of water due to heating and cooling

- Take some ice in a beaker and place it on a tripod stand and heat it with the help of a burner. What do you see? Ice melts to form water.
- Can we change this water to ice again? Suggest a method for it.
- Take some water in a beaker and boil it, what do you observe?
- Keep a plate inverted above the beaker.
- Do you see some water droplets condense on the inner surface of the plate and fall into the beaker?
- Water can be frozen into ice cubes.

From this activity, we see that water changed its state (from solid to liquid, liquid to gas and from gas to liquid) but the chemical composition is not changed. A solid can change into liquid on heating. For example, ice melts into water on being heated. This process is called **melting**.

If this liquid (water) continues to be heated, it changes into vapour. This process is called **evaporation**.

The vapour, when allowed to cool, condenses into its liquid state. This process is called **condensation**.

This water, when cooled further changes to ice. This process is called **freezing**.

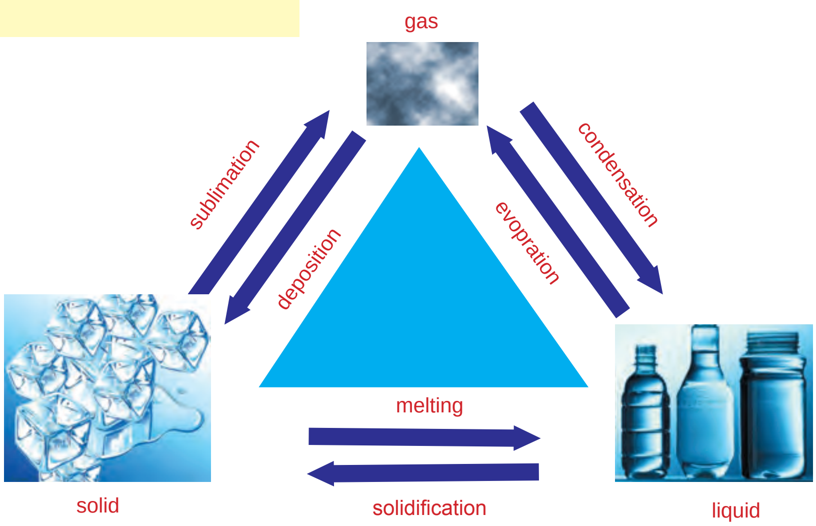


Fig. 10.8. Change of States

In all the above activities you can see that changes take place only in the physical properties of a substance, such as shape, size, colour and temperature. A physical change occurs when the substance changes its physical state but does not change its chemical composition. A change in which a substance undergoes changes only in its physical properties is called a **physical change**. A physical change is generally reversible and no new substance is formed.

10.2. CHEMICAL CHANGES:

You are quite familiar with the rusting of iron. If you leave an iron object such as bolt or iron rod in the open or in the rain, a reddish brown layer is deposited on its surface. **The layer thus formed is called rust and the process is called rusting**.

In the presence of moisture, iron reacts with oxygen present in air, to form hydrated 'iron oxide', known as **rust**. Oxygen and water are two essential ingredients for rusting of iron; absence of either or both of them can prevent rusting.

Fig.10.9(a)-rusted Nut

Fig.10.9(b) rusted vehicle

ACTIVITY 10.7

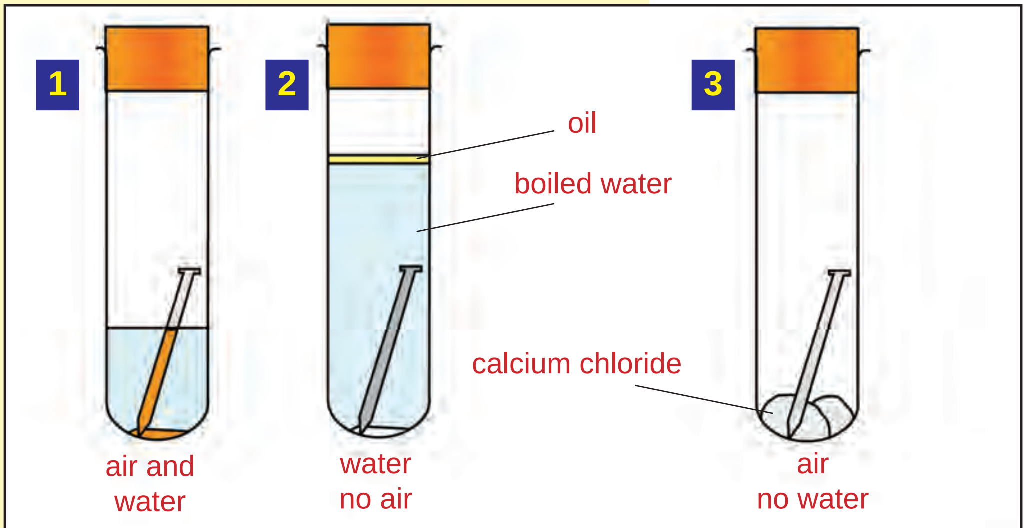


Fig. 10.10. Conditions required for rusting

- Take three test tubes and label them 1, 2 & 3.
- Place a clean iron nail in each of them.
- In test tube-1, pour a small amount of tap water.
- In test tube-2, add boiled distilled water containing no oxygen and add some vegetable oil to keep off the air.
- In test tube-3, add a small amount of calcium chloride (a dehydrating agent).
- Keep them undisturbed for three to four days and observe the nails in the test tube.

We notice that the nails in test tube-2 and-3 have not rusted while the nail in test tube-1 has rusted. From this activity you can infer that oxygen and water are essential for rusting.

Rust is a brittle substance that flakes off easily from the surface. Rust is different from the iron on which it gets deposited. (i.e.) a new substance is formed.

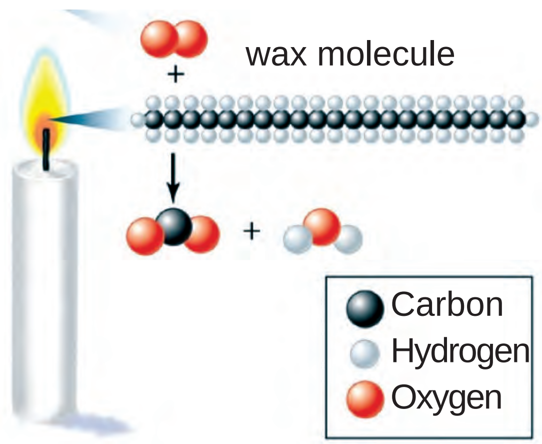


Fig. 10.11. Burning of candle

MORE TO KNOW

Burning of a candle is an example of a chemical change. Wax molecule is converted into carbondioxide and water molecules.

ACTIVITY 10.8

Take a fine strip of magnesium ribbon.

Bring the tip of the strip near a candle flame.

It burns with a brilliant white light and finally leaves behind a residue of powdered ash.

Does the ash look like the magnesium ribbon? No.

Fig. 10.12. Burning of magnesium ribbon

The change produced can be represented in the form of an equation

Magnesium + oxygen ⟶ Magnesium oxide

If you collect the ash and mix it well with a small amount of water, another new substance is formed.

Magnesium oxide + Water ⟶ Magnesium hydroxide

The property of magnesium hydroxide is different from that of Magnesium.

MORE TO KNOW

Phenolic compounds are responsible for the bright colours, aroma and flavour of many fruits and vegetables. They have been shown to reduce the risk of heart disease and certain types of cancer.

MORE TO KNOW

Vegetables and fruits turn brown on cutting due to the reaction between the phenolic compound in fruits and the oxygen in the air. Phenolic compound and oxygen react to form a brown pigment known as **melanin**.

TO THINK...

During Diwali, we are very happy to light fire crackers with our family members. The combination of colour and sound creates an exciting light show and we have a spectacular display. Do you ever think of what happens to the crackers after they are burnt completely? Similarly burning of paper or wood produces heat and light and finally you get a small amount of ash, (i.e.) a new substance is formed. In all these cases, we cannot get back the original substances. Say whether physical or chemical change has taken place.

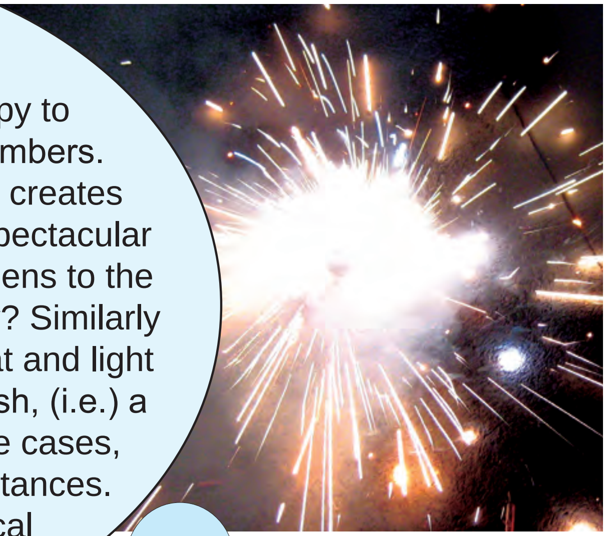


Fig. 10.13. bursting of crackers

ACTIVITY 10.9

Chemical Reaction of baking soda with lemon juice.

- Take a teaspoonful of lemon juice in a test tube. Add a pinch of baking soda to it.

We would hear a hissing sound and see bubbles of a gas coming out.

The gas evolved is carbon-di-oxide.

Lemon juice (citric acid) + Baking soda $\longrightarrow$ Carbon dioxide + Salt + Water

The sound produced is due to the evolution of gas (carbon di oxide) in this reaction.

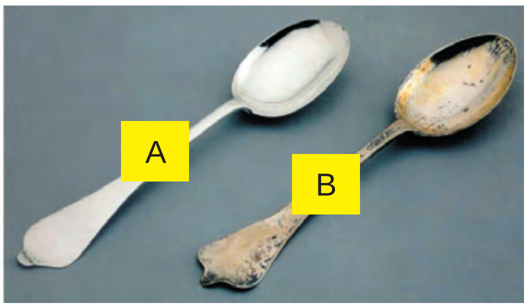


Fig. 10.14. Tarnishing silver Spoon

MORE TO KNOW

If you have any objects made from silver you know that the bright, shiny surface of silver gradually darkens and becomes less shiny. This discolouration is known as tarnishing. Look at the picture with two silver spoons ‘A’ and ‘B’. ‘A’ shines well but ‘B’ does not. What happens? Why does this discolouration occur? This happens because silver undergoes a reaction with sulphur contained in the air. You can use chemistry to reverse the tarnishing reaction, and make the silver shiny again.

ACTIVITY 10.10

Curdling of Milk:

- Boil the milk and cool to luke warm temperature
- Add a teaspoon of starter butter milk or curd into it. Keep it aside for a few hours.

Has any change occurred?

The milk changes to curd since both milk and curd have different properties. It is a **chemical change**.

Find out what happens if excess starter buttermilk or curd is added? What happen if the starter buttermilk or curd is added to milk at very high temperature?

Will the curd set faster when it placed outside or inside the refrigerator?

When a large quantity of starter curd / buttermilk is used

What happens to the taste of the curd. Find out the reason for your answer.

milk

curd

Fig. 10.15. curdling

In all the above activities, you can see that one or more new substances are formed. The properties of the new substances are not the same as that of the original one. These processes are also irreversible. This type of change is called a **chemical change**. A change in which one or more new substances are formed is called a chemical change. A complete and permanent change in the properties of the substance is produced. A Chemical change is also referred to as a **chemical reaction**.

Chemical changes are very important in our day- to- day life. A medicine is a product of chemical reaction. Useful materials like plastic, detergents, etc. are also produced by chemical reactions.

In addition to the new products formed, the following may also accompany a chemical change.

- Heat or light may be given off or absorbed
- Sound may be produced
- Colour change may take place
- A change in smell may take place.

AMAZING FACT!

Iron Pillar

In NewDelhi, near Qutub Minar, stands an iron pillar which is more than 7 meters tall and weighs more than 6000 kg. It was built 1600 years ago. Strangely, even after such a long period of time it has not rusted. Scientists from all over the world have examined its quality of rust resistance. It shows the advances India had made in metal technology as far back as 1600 years ago.

Fig. 10.16. Iron Pillar in Delhi

Fig. 10.17. Ship in Chennai Port

MORE TO KNOW

You know that ships are made of iron. A part of a ship always remains under water. Since the sea water contains a great amount of salt, the ship suffers a lot of damage from rusting in spite of being painted. These rusted parts need to be replaced every now and then. Imagine the loss of money!

10.2.1. DIFFERENCES BETWEEN PHYSICAL CHANGE AND CHEMICAL CHANGE

Table 10.1

S.No	Physical change	Chemical change
		
1	The physical changes are reversible	The chemical changes are irreversible
2	New subtances are not formed	New substances are formed
3	The molecular composition of the substance remains the same	The molecular composition of the substance also changes
4	No energy change involved	Energy change involved

Fig.10.18-Painted Window

MORE TO KNOW

Prevention of rusting can be done by

1. Applying oil, paint or grease.
2. Galvanisation (deposition of zinc over iron).
3. Chrome plating (deposition of chromium over iron).
4. Tinning (coating of tin over iron).

10.3. ACIDS, BASES AND SALTS

On Sunday, Keerthivasan's mother boiled an egg for his lunch. Since it was too hot, she took a bottle of water from the fridge, poured some into a bowl and placed the egg in it to cool. She went to the market and forgot all about the egg. When she came back and took the egg out of water, she was surprised to find that the hard shell of the egg had disappeared. She wondered what happened. She smelt the liquid and realized her mistake. She had poured vinegar into the bowl, instead of water. Can you say what would have happened? Perhaps you can do it at home with the help of your mother.

In our daily life we use a number of substances such as lemon, tamarind, tomato, common salt, sugar and vinegar. Do they all have the same taste? If you have not tasted any of these substances, taste it now and enter the result in table number 10.2

CAUTION !

1. Do not taste anything unless you are asked to.
2. Do not touch anything unless you are asked to.

Table 10.2

Substance	Taste (sweet/sour/bitter/any other)
Curd	
Orange juice	
Grapes	
Lemon Juice	
Tamarind	
Sugar	
Unripe Mango	
Goose berry (Nelli)	
Baking soda	
Vinegar	
Common salt	
Tomato	

You find that some of these substances taste sour, some taste bitter, and some taste sweet.

10.3.1 ACIDS,BASES AND SALTS USED IN OUR DAILY LIFE

During summer, when your grandmother prepares pickles (lime, mango, etc.), she adds vinegar to them. Did you ever ask her why she does that? If not, ask her now and find out the reason.

Curd, lemon juice, orange juice and vinegar taste sour. These substances taste sour because they contain acids. The chemical nature of such substances is acidic. The word acid comes from the Latin word 'acidus' which means sour. We come across many acids in our daily life.

In general, acids are chemical substances which contain replaceable hydrogen atoms. Acids can be classified into two categories namely organic acids and mineral acids or inorganic acids.

Organic acids

Acids which are obtained from animal and plant materials are called organic acids. Many such acids are found in nature. Lemon and orange contain citric acid. Hence they are called citrus fruits. Milk that has turned to curd tastes sour, contains an acid called Lactic acid. The acids found in food stuffs are weak. Soft drinks contain some carbonic acid which gives a tingling taste. Apple contains malic acid. Even the digestion of food in our body requires the presence of hydrochloric acid. Some common organic acids are shown in the Fig.10.19.

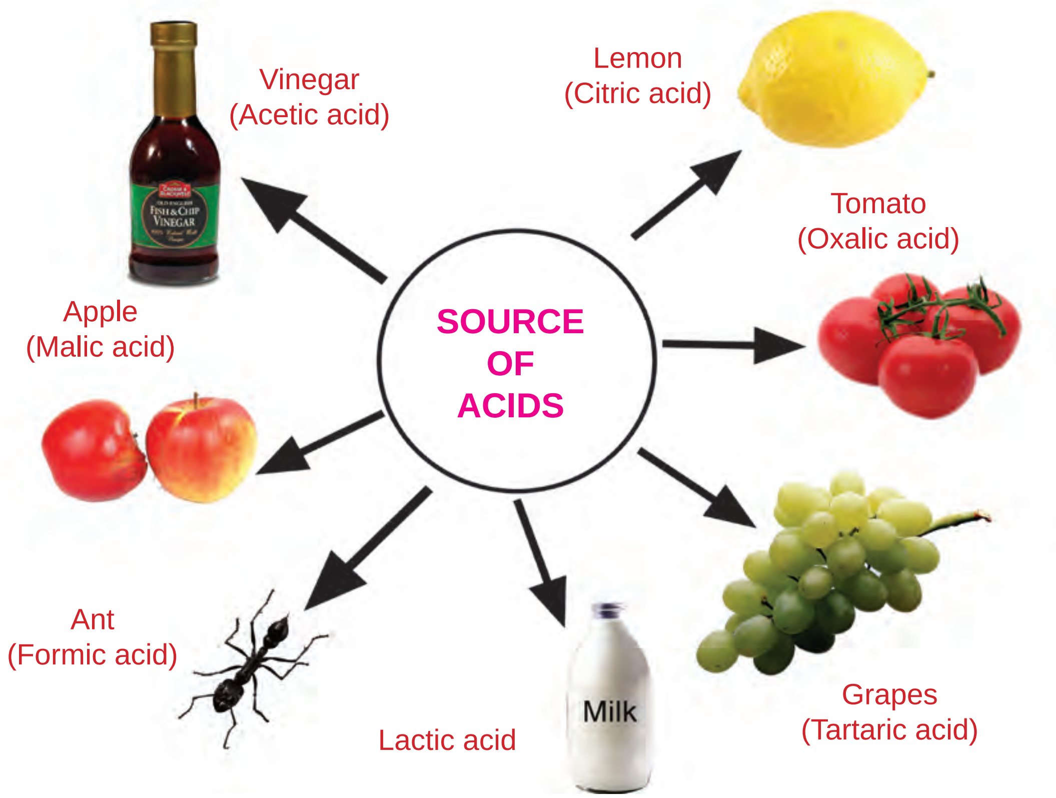


Fig. 10.19. Acids and their sources

Mineral acids

Acids that are obtained from minerals are called mineral acids or Inorganic acids. For example, Hydrochloric acid, Nitric acid, Sulphuric acid (Fig.10.20) which are commonly available in the laboratory. They must be used with a lot of care. They are corrosive. It means that they can eat away metal, skin and clothes. But they will not corrode glass and ceramics. Hence they are stored in glass bottles.

An acid is a substance which contains replaceable hydrogen ions.

Fig. 10.20. Mineral Acids in Laboratory

Find

Observe how copper and brass vessels are washed in your house. Why is tamarind used for washing them?

Bases and alkalis in our daily life

Substances such as baking soda, does not taste sour. It is bitter in taste. It shows that it has no acid in it. If you rub its solution with your fingers, it feels soapy. Substances like these which are bitter in taste and feel soapy on touching are known as bases. The nature of such substances is said to be basic. Bases are oxides or hydroxides of metal. They are chemically opposite to acids. Some bases like caustic soda [Sodium hydroxide] and caustic potash [Potassium hydroxide] are very corrosive.

Bases give hydroxyl ions when treated with water. Bases which are soluble in water are called Alkalis. The hydroxides of Calcium, Sodium and Potassium are examples of alkalis. They are water soluble bases. **All alkalis are bases, but not all bases are alkalis**. The word alkali is derived from the Arabic word alquili which means plant ashes. Ashes of plants are composed of mainly sodium and potassium carbonates.

Some common bases used in our daily life are given Table 10.3.

CAUTION !

Never taste or touch any unknown chemicals.

Table 10.3

No	Name	Other Name
1	Calcium oxide	Quick lime
2	Potassium hydroxide	Caustic potash
3	Calcium hydroxide	Slaked lime
4	Sodium hydroxide	Caustic soda
5	Magnesium hydroxide	Antacid

Table 10.4

Name of Base	Found in
Calcium hydroxide	Lime Water
Ammonium hydroxide	Window cleaner
Sodium hydroxide/ Potassium hydroxide	Soap
Magnesium hydroxide	Milk of magnesia

Test for identifying acids and bases

We should never touch or taste a substance to find out whether it is an acid or base because, both acids and bases are harmful and burn the skin. A safe way to find out is to use an indicator. Indicators are a group of compounds that change colour when added to solutions containing either acidic or basic substances. The common indicators used in the laboratory are litmus, methyl orange and phenolphthalein. Apart from these, there are some natural indicators like turmeric, red cabbage juice and beetroot juice.

Table 10.5

Indicator	Colour in Acid	Colour in base
Litmus	Red	Blue
Phenolphthalein	Colourless	pink
Turmeric	Yellow	Brick red
Beetroot juice	Pink	Pale yellow
Red cabbage juice	Pink/Red	green

10.3.2. NATURAL INDICATORS

Litmus: A natural dye

The most commonly used natural indicator is litmus. It is extracted from lichens (Fig. 10.21) and it has a purple colour when put in distilled water. When added to an acidic solution, it turns red and when added to a basic solution, it turns blue. It is available in the form of solution, or in the form of strips of paper known as litmus paper. Generally, it is available as red and blue litmus paper.

Fig. 10.21. Lichens

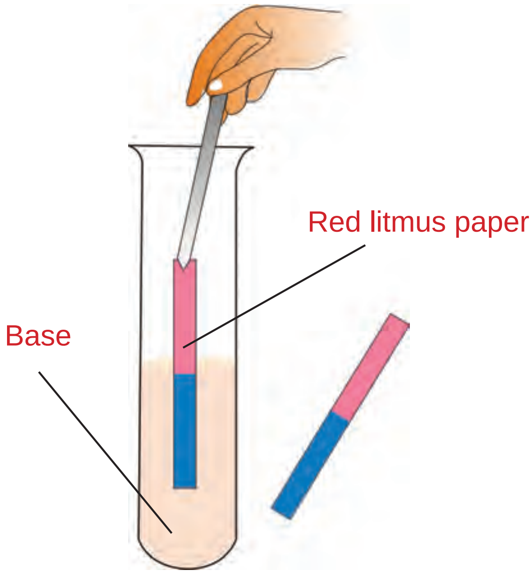


Fig. 10.22. Red litmus paper dipped in Base solution changes to blue

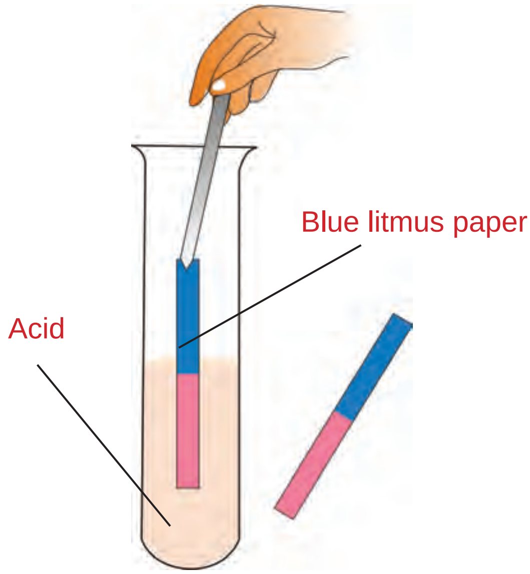


Fig. 10.23. Blue litmus paper dipped in Acid solution changes to red

Fig. 10.24. Students performing experiment

ACTIVITY 10.11

Add some water to orange juice in a test tube. Put a drop of the above solution on a strip of the red litmus paper with the help of a dropper. Is there any change in colour? Repeat the same exercise with the blue litmus paper.

Note down the change in colour. Perform the same activity with the following substances, and tabulate the results. If the solution does not change its colour to either red or blue on litmus paper, they are known as neutral solutions. These solutions are neither acidic nor basic.

Table 10.6

S.No	Test solution	Effect on red litmus paper	Effect on blue litmus paper	Inference
1	Tap Water			
2	Detergent solution			
3	Shampoo			
4	Common salt			
5	Sugar solution			
6	Lime water			
7	Washing Soda solution			
8	Vinegar			
9	Milk of Magnesia			
10	Aerated drink			

Turmeric as a natural indicator

ACTIVITY 10.12

Make your Own Greeting Card

- Take a tablespoon full of turmeric powder. Add a little water and make a paste. Deposit the turmeric paste on a plain paper and dry it. Draw the design in turmeric paper using soap solution. Dry it. Your greeting card is ready.
- Testing of solutions with turmeric paper.
- Cut thin strips of the turmeric yellow paper.
- Put a drop of soap solution on a strip of the turmeric paper.
- What do you observe?
- Similarly test the solutions listed in Table 10.7 on strips of the turmeric paper and note down your observations.

Fig. 10.25. Preparing Greeting card

Table 10.7

S.No	Test Solution	Effect on strips of turmeric paper	Remarks
1	Lemon juice		
2	Orange juice		
3	Vinegar		
4	Milk of Magnesia		
5	Baking soda solution		
6	Lime Water solution		
7	Sugar solution		
8	Common salt solution		

Coffee is brown and bitter in taste. Is it an acid or a base?

Don't give the answer without a test.

MORE TO KNOW

Cells in the human body contain acids.

DNA (deoxy ribonucleic acid) in cells controls the features of body such as appearance, colour, and height.

Proteins are body builders and they contain amino acids.

Fats contain fatty acids.

ACTIVITY 10.13

Prepare your own indicator

Take a red cabbage, beet root and some brightly coloured flowers such as hibiscus. Grind each one of the above items separately in a mortar. Mix acetone and ethanol to each. Filter and collect the filtrate in separate bottle. Your indicators are ready for tests with various solutions.

Fig. 10.26. Materials to prepare indicator

Properties of Acids

1. They have a sour taste.
2. Strong acids are corrosive in nature.
3. Hydrogen is the common element present in all acids. However, all compounds containing hydrogen are not acids. For instance ammonia, Methane and glucose are not acids.
4. They react with metals and produce hydrogen.

   Metal + Acids $\longrightarrow$ Salt + Hydrogen gas
5. Acids turn blue litmus to red.
6. The indicator phenolphthalein is colourless in acids
7. The indicator methyl orange is red in acids.
8. They are good conductors of electricity.

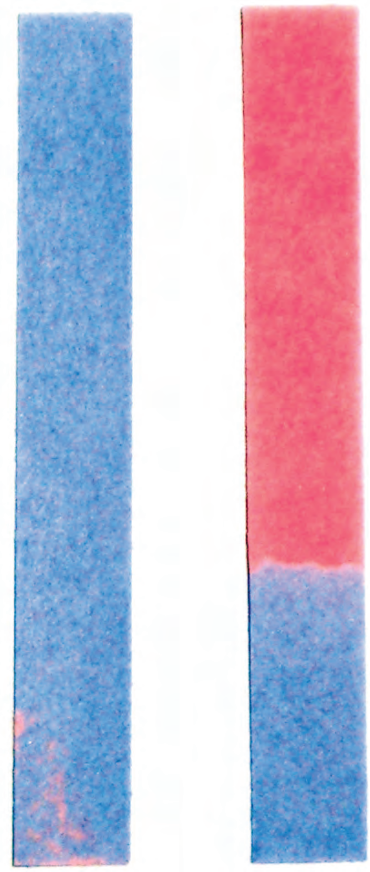


Fig.10.27-Litmus paper

MORE TO KNOW

Pink or blue? Hydrangea macrophylla, an ornamental plant, can blossom in different colours depending upon the nature of the soil. In acidic soil, the flower colour is blue, in basic soil pink, and in neutral soil white.

Fig. 10.28. Hydrangea macrophylla

Uses of Acids

Inorganic acids are used in:

1. Chemical laboratories as reagents.
2. Industries for manufacturing dyes, drugs, paints, perfumes, fertilizers and explosives.
3. The extraction of glue from bones and metals from its ore.
4. Preparation of gases like Carbondioxide, Hydrogen sulphide, Hydrogen, Sulphur dioxide etc.,
5. Refining petroleum.

Organic Acids like carboxylic acids are used:

- as food preservatives.
- as a source of vitamin C.
- for preparation of baking soda.
- to add flavour to food stuffs and drinks.

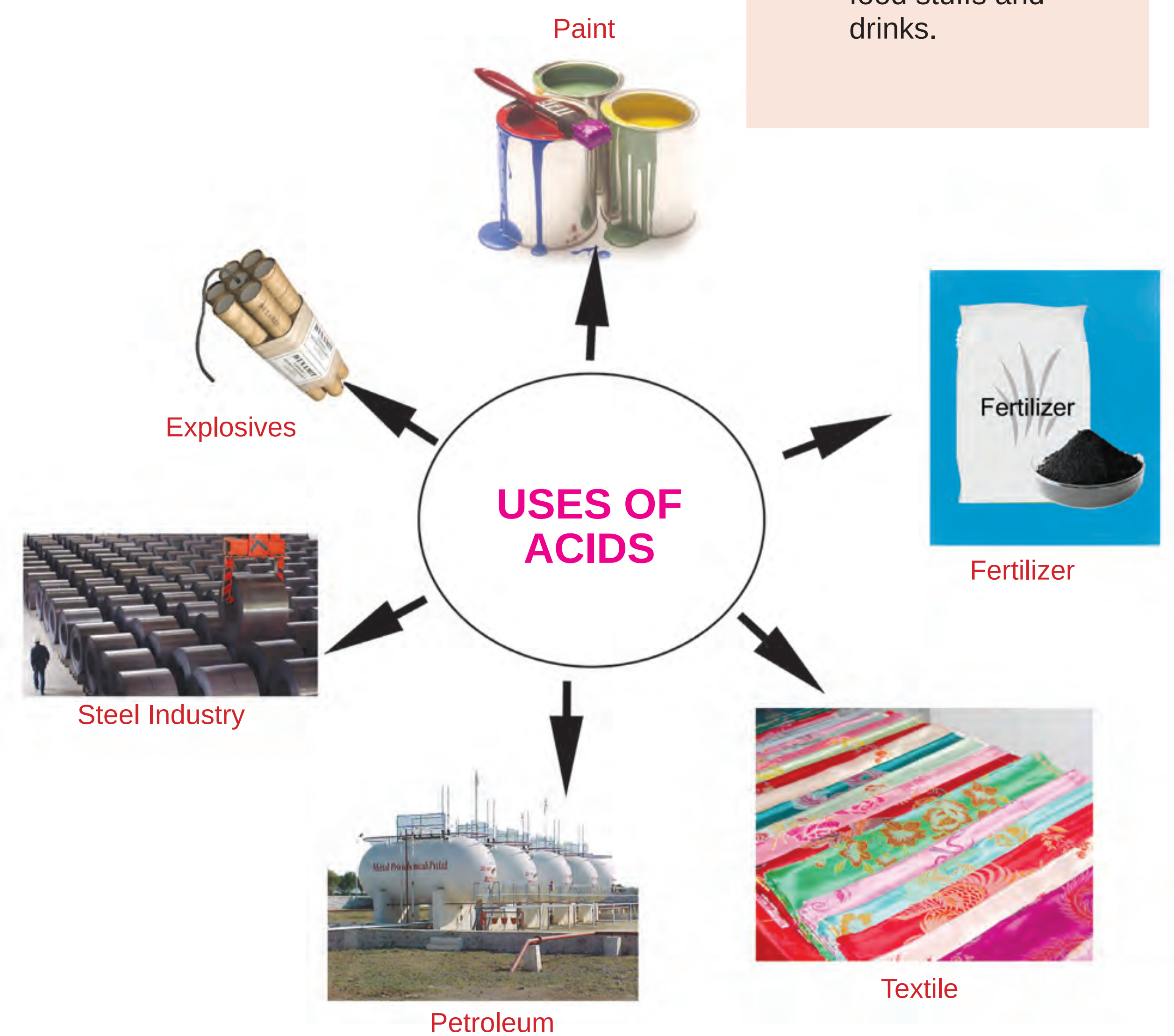


Fig. 10.29. Uses of Acids

Properties of Bases

1. Bases are bitter in taste.
2. Strong bases are highly corrosive in nature.
3. Generally they are good conductors of electricity
4. Basic solutions are soapy to touch.
5. Bases turn red litmus paper to blue.
6. Bases are compounds that contain hydroxyl group.

Uses of Bases

1. as a reagent in chemical laboratories.
2. in industries for manufacture of soap, textile, plastic.
3. for the refining of petroleum.
4. for manufacturing paper, pulp and medicine.
5. to remove grease and stains from clothes.

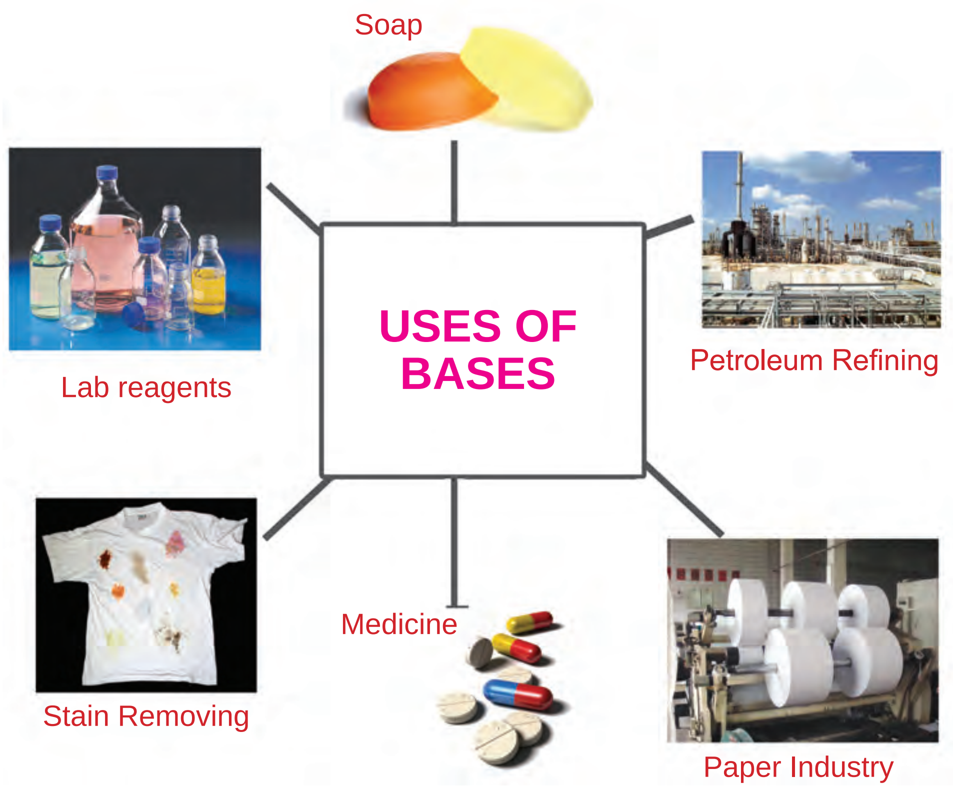


Fig. 10.30. Uses of Bases

ACTIVITY 10.14

Have a debate in your class about Acid rain and write briefly how it affects our environment.

Neutralisation

You have learnt that acids turn blue litmus to red and bases turn red litmus to blue; hence they have different chemical properties. What do you think that would happen when an acid is mixed with a base? Let us perform the following activity:

ACTIVITY 10.15

- Take a test tube and add 5ml of (caustic soda) sodium hydroxide into it.
- Add 2-3 drops of phenolphthalein in it and you can see that the solution becomes pink.
- Now add dilute hydrochloric acid slowly in drops and see what happens.
- The colour will disappear.
- This shows that the base is completely neutralised by the acid.

When an acidic solution is mixed with a basic solution, both solutions neutralise the effect of each other. When an acid solution and a base solution are mixed in suitable amount, both the acidic nature of the acid and basic nature of the base are destroyed. The resulting solution is neither acidic nor basic. Touch the test tube immediately after neutralisation. What do you observe? In the process of neutralisation, heat is always evolved or liberated. The evolved heat raises the temperature of the mixture.

In neutralisation reaction, a new substance is formed. It is known as salt. Salt may be acidic, basic or neutral in nature.

Neutralisation can be defined as the reaction between an acid and a base. In this process salt and water are produced with the evolution of heat.

Acid +Base $\longrightarrow$ Salt + Water & heat is evolved.

MORE TO KNOW

Sulphuric acid (H_2SO_4) is called as the king of chemicals, because of its industrial importance. The amount of sulphuric acid that a country uses indicates the economy of a country. The strongest acid in the world is the Fluorosulphuric acid ($HFSO_3$)

MORE TO KNOW

We know that even our stomach produces an acid. Once we start eating, acid is secreted in the stomach to start the digestion process. It is often not the food that we eat that causes acidity problems in the stomach, but an overproduction of this acid that is secreted. In fact, some food can help to reduce the acidity in the stomach by neutralising (reducing) some of the acidity. Milk is one of the most beneficial food items that helps in reducing the acidity in the stomach.

Salt

A salt is a substance formed by the neutralisation of an acid by a base.

Sodium hydroxide + Hydrochloric acid $\longrightarrow$ Sodium chloride + Water + Heat
(Base) (Acid) (Salt)

Table 10.8

Name of acid	Salt formed	Names of salts
HCl	Chloride	Sodium chloride, Copper chloride, Ferric chloride
HNO_3	Nitrate	Sodium nitrate, Copper nitrate, Ferric nitrate

Uses of Salt

Table 10.9

Name of Salt	Use
For the human body Calcium phosphate, Calcium lactate, Ferrous sulphate, Sodium chloride etc.	For the proper functioning of the human body.
For domestic purposes	
1. Sodium chloride	Used as a preservative. To add taste to our food
2. Sodium bicarbonate	In baking and in effervescent drinks.
3. Hydrated potassium aluminium sulphate	In the purification of water.
For Industrial Purpose	
1. Sodium carbonate	For the manufacture of washing powder.
2. Copper sulphate	As an insecticide.
3. Potassium nitrate	In the manufacture of gun powder.

10.3.3. NEUTRALIZATION IN EVERYDAY LIFE

Indigestion:

Our stomach contains hydrochloric acid. It helps us to digest food. More acid in the stomach will cause stomach upset or indigestion. Sometimes indigestion is painful. We take an antacid such as milk of magnesia to neutralise the excess acid.

Ant bite:

When an ant bites, it injects acidic liquid (Formic acid) into the skin. The effect of the acid can be neutralized by rubbing with moist baking soda or calamine solution (Zinc Carbonate).

Factory Wastes:

The wastes of many factories contain acids. If they are allowed to flow into the water bodies, the acids will kill fish and other organisms. The factory wastes are therefore neutralised by adding basic substances.

Soil treatment:

Excess use of chemical fertilizers, makes the soil acidic. When the soil is acidic, plants do not grow well. So it is treated with bases. If the soil is basic, organic matter releases acids, which neutralises the basic nature of soil.

Fill the Table yourself

Table 10.10

Acids	Bases
1. They have sour taste	
2.	They turn red litmus to blue
3. It contain hydrogen	
4.	Generally good conductors of electricity

EVALUATION

1. A physical change is generally reversible. Chemical change is irreversible. Classify the following changes as physical change and chemical change.

   a) Frying of egg b)Burning of petrol c) broken glass

   d) formation of curd from milk e) compression of spring

   f) photosynthesis g) digestion

2. Kumar kept the naphthalene balls in his bureau to keep away the insects. After some days, he found they had become very small. Give reason for the change. Name the phenomenon behind it.

3. Malarvizhi's father bought an apple. He cut it into small pieces and gave her. It changed to brown after some time. Seeing the brown colour, she asked her father how it happened. What will be the answer from her father?

4. Sting operations!

   Bee stings can be very painful. If a bee stings your friend, how would you help him?

   a) What substance will you rub on his hand?

   b) What chemical does that substance contain?

5. Give reason for

   a) Indigestion tablets contain a base. Why?

   b) Explain why rusting of iron objects is faster in coastal areas.

6. Anaerobic bacteria digest animal waste and produce biogas (Change A). The biogas is then burnt as fuel (change B). The following statements pertain to these changes. Choose the correct one.

   i) A- is a chemical change

   ii) B - is a chemical change

   iii) Both A and B are chemical changes

7. Burning of wood and cutting the wood into small pieces are two different types of changes. Give reason.

8. Match the following:

a)	Vinegar	quick lime
b)	Milk	acetic acid
c)	Tamarind	milk of magnesia
d)	Calcium oxide	tartaric acid
e)	Magnesium Hydroxide	lactic acid

9. Fill in the blanks:

   a) Acids have __________ (bitter / sour) taste.

   b) Burning of a candle is an example of __________ (Physical / chemical) change.

   c) Some commonly used natural indicators to identify acid and base are __________, __________.

10. Take a fresh iron nail and rusted iron nail. Beat them up with a harmer and check for your self which of the two is stronger? Why?

PROJECTS

1. Let us make a list of items that you find in your home, and classify them as acid, base or salt. You could organize your list according to the following categories:
   a) Bathroom items (soaps, detergents, disinfectants, etc.)
   b) Cosmetics (lotions, shampoos, etc.)
   c) Food items (pickle, lemon, ajinamoto, soda water.)
   d) Miscellaneous (car batteries, refrigerators, window cleaners, insect repellants, etc.)
2. Prepare a natural Indicator using red cabbage. Bring the different water samples (minimum 5 samples) in your area and test the sample using the indicator. Find out whether it is acidic, basic or neutral. Record your observations and tick (✓) the appropriate column in the table below. Discuss the results.

Water samples	Acid	Base	Neutral
Sample - 1			
Sample – 2			
Sample – 3			
Sample – 4			
Sample – 5			

After classifing the different samples, write down which of the samples you will use for (a) Drinking (b) Washing (c) Irrigation (d) Bathing.

FURTHER REFERENCE

Books

1) Introductory Chemistry - M Katyal, Oxford University press, New Delhi
2) Advanced Organic Chemistry – Bahl and Arun Bahl Johnson

Websites

http://chemistry.about.com/library/btacid.quiz.htm

http://www. chem4kids.com/files/read-acidbase.html

http://www funsci.com/fun3-en/acids/acids htm

CHAPTER 11

COMBUSTION AND FLAME

In the Stone Age, people never knew the use of fire. They used to eat raw food. It was by accident that they discovered that by rubbing two stones together they could produce fire. Later they used fire for cooking, getting light and for safeguarding their lives from animals. Fire is obtained by the rapid oxidation of a material in chemical process of combustion, releasing heat, light, and various other products.

Fig 11.1 (a)

Fig 11.1 (b)

Combustion is the burning of substances in air or oxygen to release heat and light. The substance that undergoes combustion is called **fuel**. Fuels are substances which, on combustion produce heat energy without producing undesirable by-products.

ACTIVITY 11.1

We use various kinds of fuel for various purposes at home, in industry and for running automobiles. Shall we name a few fuels?

1.

2.

3.

11.1. COMBUSTION AND ITS TYPE

There are many materials that can burn. They can be classified depending on their state. They may be solid e.g. cow dung, coal, firewood.Kerosene and petrol are liquid fuels. There are gases that can burn. e.g. coal gas, natural gas and bio gas. Recall the activity of burning of Magnesium ribbon in 10th unit. You learnt that magnesium burns to form magnesium oxide and produces heat and light. You can perform similar activity with a piece of charcoal. What do you observe? You will find that coal burns in air producing carbon dioxide, heat and light. A chemical process in which a substance reacts with oxygen to give off heat is called **combustion**. The substance that undergoes combustion is said to be **combustible**.

ACTIVITY 11.2

Are all substances around us combustible?

- Light the burner
- Using a pair of tongs, hold a piece of straw over the flame.
- What happens to the straw?
- Record the observation in the table given below
- Repeat the above procedure with other materials and record your observation in the table.
- If combustion takes place, mark the material combustible; otherwise, mark it non-combustible.

Table 11.1

Tick the appropriate column

Material	Combustible	Non-Combustible
Straw		
Wood		
Iron nail		
Kerosene oil		
Stone piece		
Charcoal		
Matchsticks		
Glass		

From the above activity, you infer that the substances like paper, straw, wood, matchsticks, etc. are combustible or inflammable. Substances like stone, glass, iron nails, etc. do not burn on being exposed to flame. Such substances are called **non-combustible** substances.

Let us investigate the conditions under which combustion take place.

Fig.11.2 combustable & Non-combustable things

ACTIVITY 11.3

Caution : Be careful while handling candle

- Fix a lighted candle on a table.

Case 1

- Put a glass chimney over the candle and rest it on a few wood blocks in such a way that air can enter the chimney.
- Observe what happens to the flame.

Case 2

- Now, remove the wooden blocks and let the chimney rest on the table.
- Again observe the flame.

Case 3

- Finally, put a glass plate over the chimney.
- Watch the flame again.
- What happens in the three cases?
- Does the flame flicker off?
- Does it flicker and give smoke?
- Does it burn unaffected?
- Can you infer anything at all about the role played by air in the process of burning?

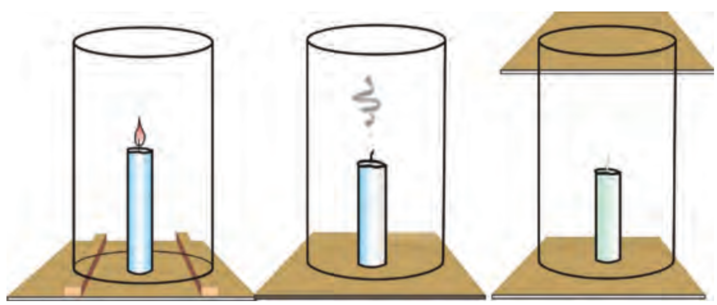
Condition necessary for combustion

Combustible substance

TO THINK

You might have heard that when the clothes of a person catch fire, the person is covered with a blanket to extinguish the fire. Can you guess why?

The candle burns freely in case (1) when air can enter the chimney from the bottom. In case (2), when air does not enter the chimney from the bottom, the flame flickers and produces smoke. In case (3) the flame finally goes off, because the air is not available. Therefore you can easily understand that for combustion, air is necessary.



Case 1 Case 2 Case 3

Fig 11.3 - Air is a essiential for burning

Ignition temperature

When a sparkler is lighted with a burning candle, it does not burn immediately. It takes some time and only when it attains a particular temperature, it starts burning.

A fuel has to be heated to a certain minimum temperature before it can catch fire. This temperature is different for different fuels. Some substances catch fire immediately, while some take a longer time. The lowest temperature at which a fuel catches fire is called its **ignition temperature**.You will understand the significance of ignition temperature upon doing the activity11.4.

ACTIVITY 11.4

1. Place a paper cup containing water on a flame.

2. The water will become hot, but the cup will not burn.

3. This is because the water takes away the heat from the cup and does not allow it to reach its ignition temperature.

Fig 11.4. Heating water in a paper cup

Now, we can easily understand why fire is extinguished by water, and a log of wood takes a longer time to start burning than wood shavings, when heated in a flame. When water is poured over a burning substance, it absorbs heat from the substance. As a result the temperature of the substance falls below the ignition temperature, and it stops burning

A log of wood has a huge mass. So, when we heat it with a flame, the heat received by the log is dissipated through its bulk mass. And the log takes a long time to attain the ignition temperature. On the other hand, wood shavings, having a smaller mass, attain the ignition temperature more readily. So, a large piece of wood takes a longer time than wood shavings to start burning.

Types of combustion

Combustion can be of different types. It can be spontaneous, rapid, slow or incomplete.

Spontaneous combustion

Some combustion reactions take place without the application of heat energy. When white phosphorus is exposed to air at room temperature, it catches fire immediately; even without being lit by a match stick. This type of combustion reaction that occurs without the help of any external heat is called **spontaneous combustion**.

Rapid combustion

Bring a burning match stick or gas lighter near a gas stove in the kitchen. Turn on the knob of the stove. What do you observe ? The gas burns rapidly. Such combustion is known as **rapid combustion**. Bursting of fire crackers, burning of camphor. Magnesium wire in air, gas in a burner and kerosene in a stove are good examples of rapid combustion.

Fig 11.5. Burning of Magnesium wire.

Slow combustion

Combustion that takes place at a very slow rate is called **slow combustion**. During this type of combustion low heat and light are produced. Food oxidized in our body to release energy is an example of slow combustion.

$$\text{Glucose + Oxygen} \longrightarrow \text{Carbon dioxide + water + energy}$$

Incomplete combustion

Combustion takes place in the presence of oxygen. If the supply of oxygen is insufficient, then combustion will be incomplete. This is called **incomplete combustion**. Carbon forms carbon monoxide when it undergoes incomplete combustion.

$$\text{Carbon + Oxygen} \longrightarrow \text{carbon monoxide}$$

MORE TO KNOW

Rusting of iron is another good example of slow combustion. During rusting, iron is oxidised and energy is released, but the process is very slow. So we cannot see, how it happens?

Fig 11.6. Rusting of iron

11.2. FIRE CONTROL

Heat energy in the form of fire plays an important role in our daily life. Unfortunately, fire has an enormous destructive quality, if it is not controlled properly. We read in the newspaper about devastation by fire leading to loss of life and property. Thus, it is important to know not only the methods of controlling fire, but also different means of putting out fires when they get out of control.

Fig 11.7-Fire Control

Fire can be controlled and extinguished by

1. Removing any combustible materials near the region of fire.
2. Cutting off the supply of air by using sand or blanket.
3. Bringing down the ignition temperature by using water.

Usually sand and water are thrown on burning matter to extinguish fire. Sand reduces the supply of air and cools it. **Water should not be used for oil fire**. Oil being lighter, floats, spreads and causes severe damage. So, oil fire should be extinguished by using substances called foamite. For fires caused by electrical appliances or installations, solid carbon dioxide or carbon tetrachloride should be used. The risk of electrical shock is too great, if water is used.

Fire Extinguishers

All of us are familiar with fire extinguishers, the red painted steel containers kept in factories, hospitals, schools, theatres, business places, etc. In the event of a fire breaking out, fire extinguishers can be used to put out the fire.

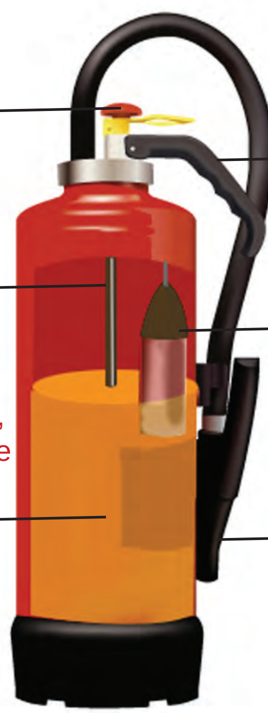


Fig 11.8. Fire Extinguishers

11.3. FLAME AND ITS STRUCTURE

Observe an LPG flame. Can you tell the colour of the flame? What is the colour of a candle flame? Recall your experience of burning a magnesium ribbon, if you do not have experience of burning, some items given in the table 11.2. You can do that now.

On burning the following materials, is flame formed? Record your observations.

MORE TO KNOW

Incase of emergency we should call...

101 - Fire Service

108 - Free Ambulance Service

Table 11.2

Tick the appropriate column

Sl.no	Material	Forms flame	Does not form flame
1	Candle		
2	Magnesium		
3	Camphor		
4	Kerosene		
5	Charcoal		

Different parts of a candle flame are shown in the figure

Zone of non-combustion: This is the dark zone that lies around the wick. It contains unburnt gas particles. No combustion takes place here as no oxygen is available.

Zone of partial combustion: In this zone, the hydrocarbons present in the oil gas decompose into free carbon and hydrogen. The unburnt carbon particles impart a pale yellow colour to the flame. This is the luminous part of the flame.

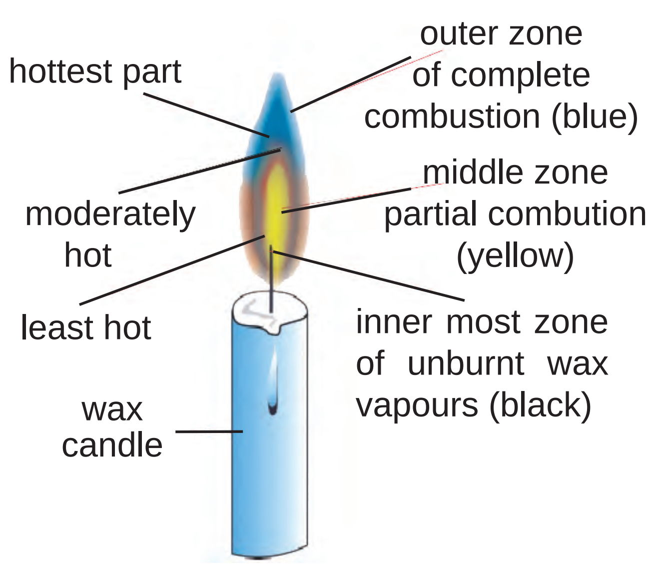


Fig 11.9. Structure of candle flame

Zone of complete combustion (blue) This is the non-luminous thin zone of the flame. It is the outermost hottest region in the flame that is invisible. Here, carbon and hydrogen are completely oxidized to Carbondioxide and water vapour.

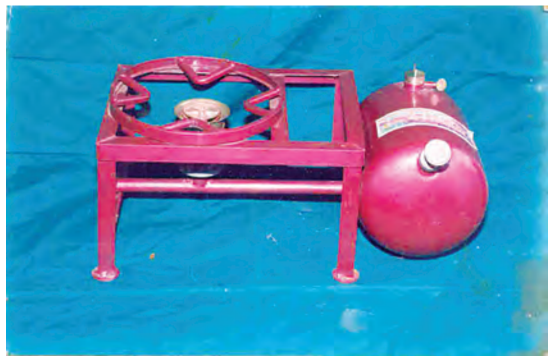
Carbon + Oxygen $\longrightarrow$ Carbonmonoxide (blue flame)

Carbonmonoxide + Oxygen $\longrightarrow$ Carbondioxide + Water (vapour)

11.4. EFFICIENCY OF FUELS

Any substance that can be burnt or otherwise consumed to produce heat energy is called a fuel. Wood, natural gas, petrol, kerosene, diesel, coal, and LPG are commonly used as fuels

We use fuels to run all forms of modern transportation like automobiles, trains, buses, ships, and aero planes. Fuels are an important source of energy for many industries. Thermal power stations depend heavily on fuels for generating electricity. We also use fuels for domestic purposes, e.g., cooking.



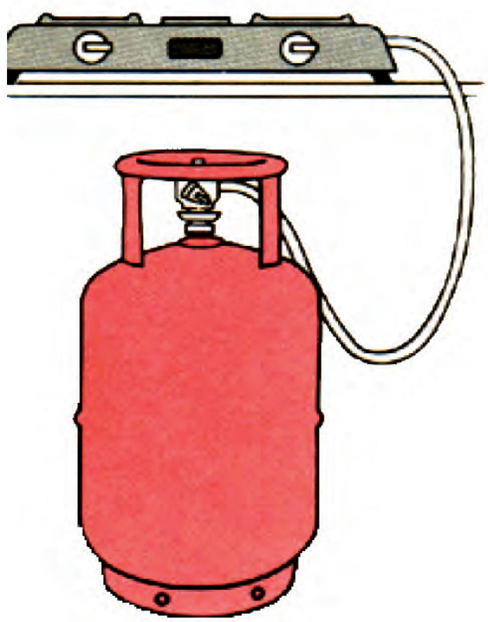


Fig 11.10. Different type of fuel usage

Characteristics of a Good Fuel

We know that a large number of substances burn to produce heat energy. But not all of these substances can be used as fuel. The good characteristics of a fuel are as follows:

1. It should be cheap and readily available.
2. It should be easy to store, transport and handle.
3. It should not produce toxic fumes or smoke or other harmful products on combustion.
4. The amount of soot or ash left behind should be minimum.
5. It should have a high calorific value.
6. It should have a low ignition temperature.

Calorific Value

The main constituents of fuels are hydrocarbons. During combustion, these hydrocarbons get oxidized to form carbon dioxide and water. Heat is evolved in this process (exothermic process).

hydrocarbon + Oxygen $\longrightarrow$ carbon dioxide + water + Heat energy

Fuel

The nature of the fuel can be determined by the amount of heat energy evolved. The higher the heat energy evolved, the better is the fuel.

The amount of heat energy liberated when 1 kg of the fuel is burnt completely in oxygen is called the **calorific value** of the fuel. The calorific values of some common fuels are given in Table 11.3.

Table 11.3

Calorific value of some fuels

Fuel	Calorific value (Kcal/Kg)
Wood	4000
Coal	7000
Coke	8000
Kerosene	10,300
Petrol	11,500
Natural gas	8000-12,000
Water gas	3000-6000
Hydrogen	34,000
Methane	13,340

Types of Fuels

There are three types of fuels. They are solid, liquid, and gaseous fuels.

Solid Fuels

Coal, wood, charcoal, coke, and paraffin are some commonly used solid fuels. The drawbacks of solid fuels are as follows:

1. They have a high ignition temperature.
2. They produce a large amount of residue (soot, ash) after combustion.
3. Their calorific value is low.

Liquid Fuels

Petrol, kerosene, and diesel are some commonly used liquid fuels which are obtained from petroleum (an oily mixture of hydrocarbons in its crude form). Ethyl alcohol is also a liquid fuel. Locomotives, buses, and lorries use diesel as the fuel.

Gaseous Fuels

Gases such as methane, carbon monoxide and hydrogen are combustible. Natural gas, producer gas, coal gas, water gas, LPG (liquefied petroleum gas), and biogas (gobar gas) are other examples of gaseous fuels.Gaseous fuels are preferred over solid and liquid fuels because of the following advantages.

- They have a low ignition temperature.
- They burn completely (complete combustion) and leave no residue (soot, ash, smoke).
- They are easy and safe to handle, transport, and store.
- They have a high calorific value.
- They are cheap.

Natural gas

Natural gas is obtained from petroleum wells. It contains a mixture of hydrocarbons (methane and ethane). It is one of the cheapest available gaseous fuels.

Producer gas, coal gas and water gas

Producer gas, coal gas, and water gas are important gaseous fuels used in industries. All three are obtained from coal or coke.

LPG (Liquefied Petroleum Gas)

It is the most widely used gaseous fuel for cooking. LPG is a mixture of propane (15%) and butane (85%) liquefied under pressure. It has a high calorific value. A small amount of ethyl mercaptan, an inert gas with a characteristic odour, is added to LPG to detect any leak.

Biogas (Gobar gas)

Gobar gas contains a mixture of methane and ethane and is a very cheap form of gaseous fuel.Gobar gas is becoming increasingly popular in villages, where cattle can be maintained in large numbers. It is also comparatively less expensive.

Fig.11.11-Biogas (Gobar gas) plant

11.5. FUELS AND ENVIRONMENT

The increasing fuel consumption has harmful effects on the environment.

1. Carbon fuels like wood, coal, petroleum release unburnt carbon particles. These fine particles are dangerous pollutants causing respiratory diseases such as asthma.

2. Incomplete combustion of these fuels gives carbon monoxide gas. It is a very poisonous gas. It is dangerous to burn coal in a closed room. Because the carbon monoxide gas produced can kill persons sleeping in that room.

3. Combustion of most fuels releases carbon dioxide in the environment. Increased concentration of carbon dioxide in the air is believed to cause global warming.

4. Burning of coal and diesel releases sulphur dioxide. It is an extremely suffocating and corrosive gas. Moreover, petrol engines give off gaseous oxides of nitrogen. Oxides of sulphur and nitrogen dissolve in rain water and form acids.

Acid rain formation

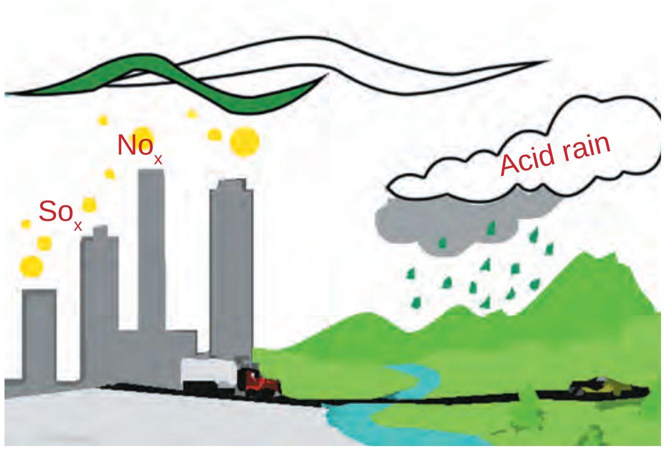


Fig 11.12. Acid Rain Formation

Such rain is called **Acid Rain**. It is very harmful for crops, buildings and soil.

The use of diesel and petrol as fuels in automobiles is being replaced by CNG (Compressed Natural Gas), because CNG produces harmful products in very small quantities. CNG is a cleaner fuel.

ACTIVITY 11.5

Classify the following as solid, liquid and gaseous fuels: Petrol, coal, wood, oil, rubbish, natural gas, LPG, coke, water gas, charcoal, kerosene.

GLOBAL WARMING

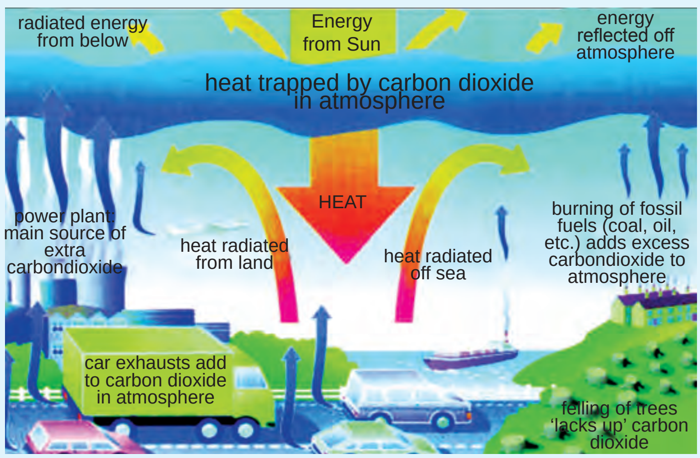


Fig 11.13. Global warming

It is the rise in temperature of the atmosphere of the earth. This results, among other things, in the melting of polar glaciers, which leads to a rise in the sea level, causing floods in the coastal areas. Low lying coastal areas may even be permanently submerged.

EVALUATION

1. Sharmila is familiar with the following substances. Help her to classify them into combustible and non-combustible.

   dry leaves, petrol, rubber tube, chalk, paper

2. Oil fire should be controlled by using foamite. Water should not be used to control oil fire. Could you explain. Why?

3. Give reason.

   Water is not used to control fire involving electrical equipments.

4. Match the following:

1) Oxides of sulphur and Nitrogen	-	Luminous flame
2) Biogas	-	Non- Luminous flame
3) Ethyl alcohol	-	Acid rain
4) Yellow colour flame	-	Gaseous fuel
5) Blue colour flame	-	Liquid fuel

5. Fill in the blanks:

   a) The substance that undergoes combustion is called _________. (Combustible / Non-Combustible)

   b) The lowest temperature at which fuel catches fire is called ________ (Body temperature / Ignition temperature)

   c) ___________ (Water / foamite) is used to extinguish oil fire.

   d) The amount of heat energy liberated by heating 1 kg of fuel is called ______. (Calorific value / Flame)

6. Magesh and Keerthivasan were doing an experiment in which water was to be heated in a beaker. Magesh kept the beaker near the wick in the yellow region of the flame. Keerthivasan kept the beaker in the outer most blue region of the flame. Whose water will get heated faster?

7. How would you put out the fire in each of the following cases? Justify the method chosen.

   1) A pane of hot oil catches fire.
   2) A cotton pillow catches fire.
   3) A wooden door is on fire.
   4) An electric fire.

PROJECT.

1) Survey 5 houses in your area. Find the number of house holds using LPG, Kerosene, electricity, wood, biogas and cattle dung as fuel and tick (✓)the appropriate column in the table below.

Name of the householder : Door No. :

Characteristics of fuels		Types of fuels					
		LPG	Kerosene	Electricity	Wood	Biogas	Cattle dung
Smoke produced	High						
	Moderate						
	Low						
Residue formed	High						
	Moderate						
	Low						
Time taken to cook the food	Long						
	Moderate						
	Less						
Cost of the fuel	Costly						
	Moderate						
	Less						

Based on your observations and data provided by the households.

Which of these fuels would you choose for your home? Why?

FURTHER REFERENCE

Books

1. Chemistry Facts, Patterns and Principles - Kneen, Rogers and Simpson (ELBS), The language book society
2. Frame work of Science – Paddy Gennom, Oxford University press, New Delhi

Websites

http://www.einstrumentsgroup.com

http://www.en.wikipedia.org/wiki/combsustion

http://www.chem.csustan.edu./consumer/fuels

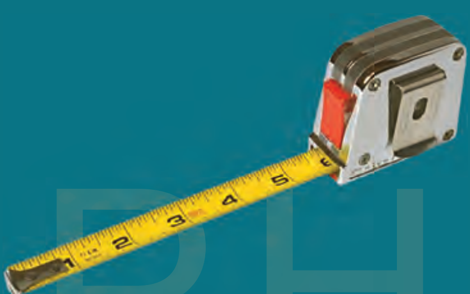
Places of scientific importance for visit:

1. Murugappa chettiyar Research Centre, Tharamani, Chennai.
2. A Fire and Rescue station.

PHYSICS

CHAPTER 12

MEASUREMENT



PHYSICS

Fig. 12.1.

Arun and his father went to see a plot of land they wanted to buy. The owner of the land gave the size of the plot in square feet. Arun's father asked the owner to give the size of the plot in square metre. Arun knew that length is measured in metre. He was confused with the terms square metre and square feet. Let us help him to understand.

The measure of a surface is known as area. **Area is the extent of plane surface occupied.** The area of the plot of land is got by multiplying the length of one side by the length of the other side.

Area = length x length.

The unit of area will be

metre x metre = $(\text{metre})^2$ read as square metre and written as m^2.

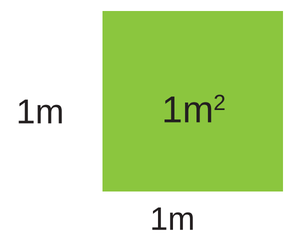
12.1. DERIVED QUANTITIES

Quantities got by the multiplication or division of fundamental physical quantities like length, mass and time are called **derived quantities**.

As area is got by using the fundamental physical quantity - length, it is known as derived quantity.

Volume and density are some other derived quantities.

One square metre is the area enclosed inside a square of side 1m



The area of a surface is $10m^2$ means that it is equivalent to 10 squares each of side of 1m

Breadth, height, depth, distance, thickness, radius, diameter are all different measures of length.

Other units of measurement

Sl.No.	Units of length	Units of area
1.	centimetre (cm)	square centimetre (cm^2)
2.	millimetre (mm)	square millimetre (mm^2)
3.	feet (ft)	square feet (ft^2)

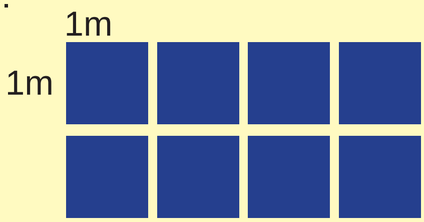
Area of agricultural fields is measured in acre and hectare

1 Acre = 4000 m^2 = 100 cent

1 hectare = 2.47 acre

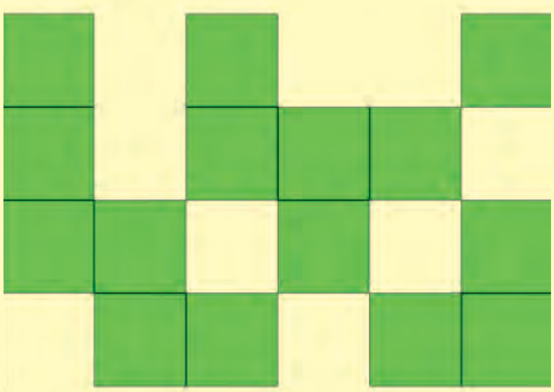
ACTIVITY 12.1

Let us find the area of the given figure.



ACTIVITY 12.2

Let us find the area of the given figure (coloured portion) in cm^2 and mm^2. The side of each small square is 1cm.



ACTIVITY 12.3

Name the unit convenient to measure the area of these surfaces we see in everyday life [mm^2, cm^2, m^2, ft^2, acre].

Sl. No.	Surface	Unit of area
1	Teacher's table top	
2	Black board	
3	Science text book	
4	Measuring scale	
5	Eraser	
6	Class room	
7	Play ground	
8	Agricultural land	

MORE TO KNOW

A metre is much longer than a foot. Do you know how many feet make a metre?

1 metre = 3.28 feet

So, 1 m^2 = 10.76 ft^2

SELF CHECK

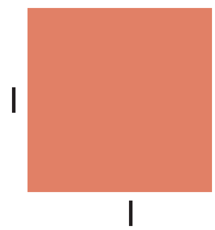
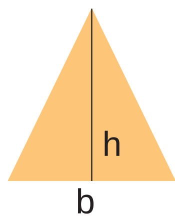
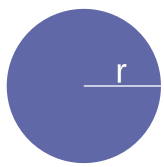
1cm^2 = ------------- mm^2

1 m^2 = --------------- cm^2

REMEMBER

Even though the area is given in square metre, the surface need not be square in shape.

The surfaces need not be a rectangle or square always. We use the following formulae to calculate the area of some regular objects. (i.e.) objects which have definite geometric shape.

S.No.	Shape	Figure	Area	Formula
1.	Square		length x length	l^2
2.	Rectangle		length x breadth	l b
3.	Triangle		½ x base x height	$\frac{1}{2}$ bh
4.	Circle		π x radius x radius	πr^2 $\pi = \frac{22}{7}$ or 3.14

ACTIVITY 12.4

- Take a graph sheet and draw a square of any size in it and find its area in square millimetre (mm^2) and in square centimetre (cm^2).
- Repeat the activity by drawing a rectangle.
- Verify your answer by using the formula.

Let us try the method of measuring the area of irregular objects (i.e) objects which do not have regular geometric shape .

We can use a graph sheet to measure their area.

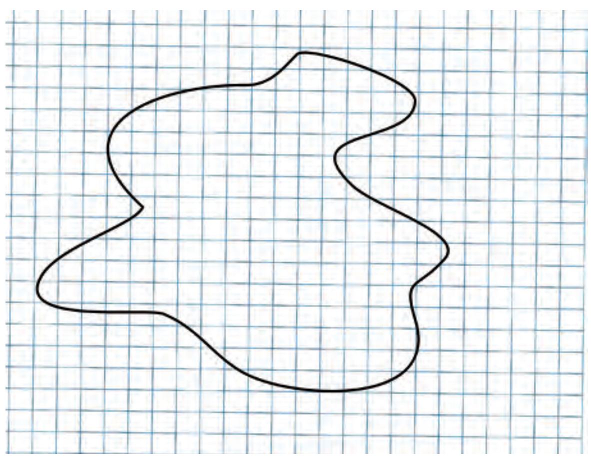


Fig. 12.2.

ACTIVITY 12.5

Let us take an object having irregular shape like a broken glass or a broken tile and measure its area.

Follow the steps given below:

1) Place the object on a graph sheet and draw the outline (like shown in figure 12.2).
2) Count the number of small squares enclosed within the outline. If more than half a square is inside the boundary, count it as one otherwise neglect it.
3) Each small square of the graph sheet has a side of 1mm or area $1mm^2$.
4) Area of the irregular object = Number of squares counted X 1 mm^2

The area of the irregular object } = ------mm^2.
= ------ cm^2.

EXPERIMENT

1) Repeat the procedure to find the area of a leaf.
2) Draw squares of the area of one square metre and one square foot. Compare the two areas.

TO THINK

How would you find the surface area of

(a) a banana and

(b) your palm?

Volume

Kumar's family lives in a small house. They have no cupboard to keep their clothes. Kumar asked his father to buy a cup-board. His father refused to buy it as the cupboard would occupy considerable space in the house.

The space occupied by a body is called its volume.

ACTIVITY 12.6

Shall we observe the following figures of the objects and get an idea about their size and volume?

Bicycle

Nail

Pen

Motorcycle

Chair

Bench

Bus

Write the names of the objects in the increasing order of size. From your observation answer the following questions.

1) Which object is the smallest and which is the biggest in size?

2) Which object occupies the minimum space and which the maximum space?

3) What do you infer from the above?

[Objects of smaller size occupy less volume and objects of larger size occupy more volume]

Shall we calculate the volume of regular objects ?

Volume of some regular objects is obtained by multiplying the base area by their height.

Volume = base area x height

Can you tell the unit with which volume is measured?

It is, $m^2 \times m = m^3$ which is known as cubic metre.

The volume may also be expressed with different units depending upon the unit of measurement.

Unit of length	Unit of volume
milli metre (mm)	cubic millimetre (mm^3)
centimetre (cm)	cubic centimetre (cm^3)

The volume of an object is $10m^3$ means that it is equivalent to 10 cubes each of side 1m.

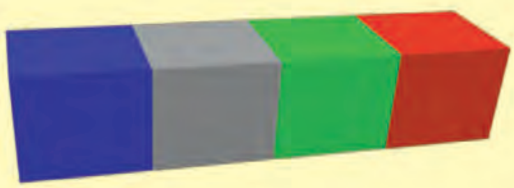
One cubic metre is the volume of a cube of side 1m.

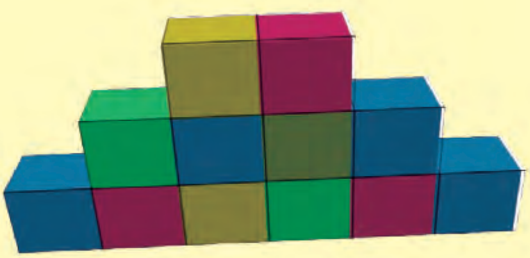
$1m^3$

ACTIVITY 12.7

Let us calculate the volume of the objects shown below:

The side of each small cube is 1 cm in length.



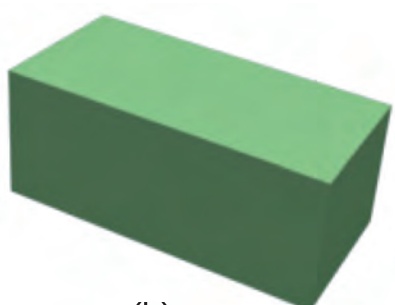


ACTIVITY 12.8

1. How many small cubes make the big cube shown in the picture ?
2. If the side of each small cube is 1 cm in length, find the total volume of the big cube.

Using the concepts discussed so far, try to write the names of the given shapes and the formula for calculating their volume.

(a)



(b)

(c)

Measuring liquids

Fig. 12.3

Your mother asks you to get milk from the milkman. When you buy milk from the milkman, he will give it to you in litres (i.e) volume of liquid is measured in litres.

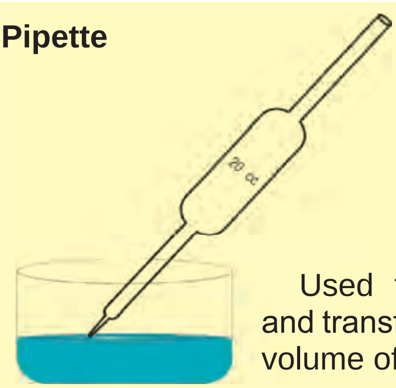
What is the meaning of 1 litre?

1 litre = 1000 cm^3.

One cubic centimetre is otherwise known as 1 millilitre written as ml.

What are the different vessels used to measure the volume of liquids?

Pipette



Used to measure and transfer a definite volume of liquid.

Fig 12.4

Measuring cylinder

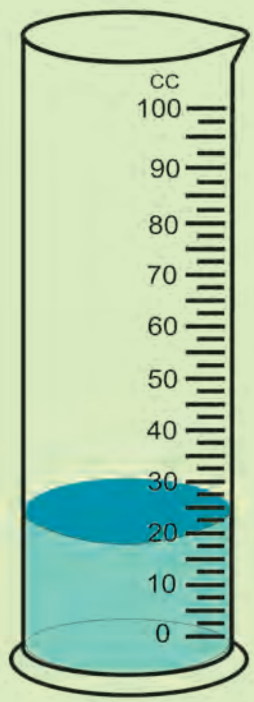


Fig 12.5

Used to measure the volume of liquid.

Burette

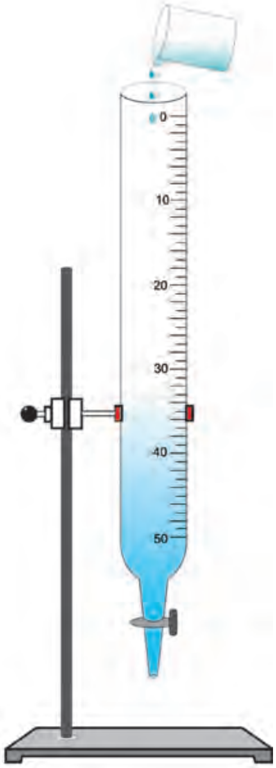


Fig 12.6

Used to make a small fixed volume of liquid to flow.

Measuring flask

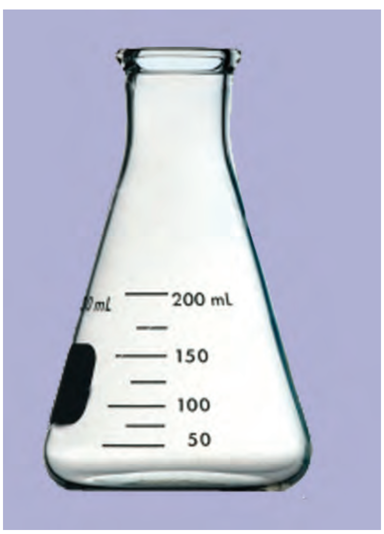
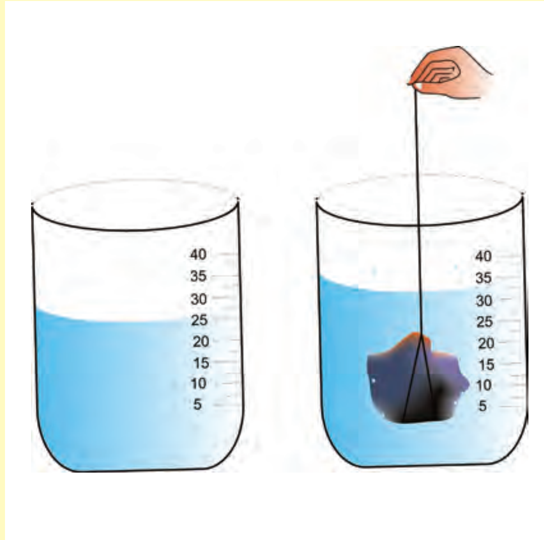


Fig 12.7

Designed to hold a fixed volume.

ACTIVITY 12.9



Let us find the volume of a stone using a measuring cylinder.

Follow the steps given below.

1) Pour water in the measuring cylinder up to a certain level.
2) Note the initial level of water.
3) Tie the stone by means of a thread.
4) Lower the stone into the water so that it is completely immersed without touching the sides.
5) Note the final level of water.
6) The difference between the final and initial levels gives the volume of the stone.

MORE TO KNOW

How will you express volume of water stored in a dam or reservoir?

Thousand million cubic feet (tMc).

Density

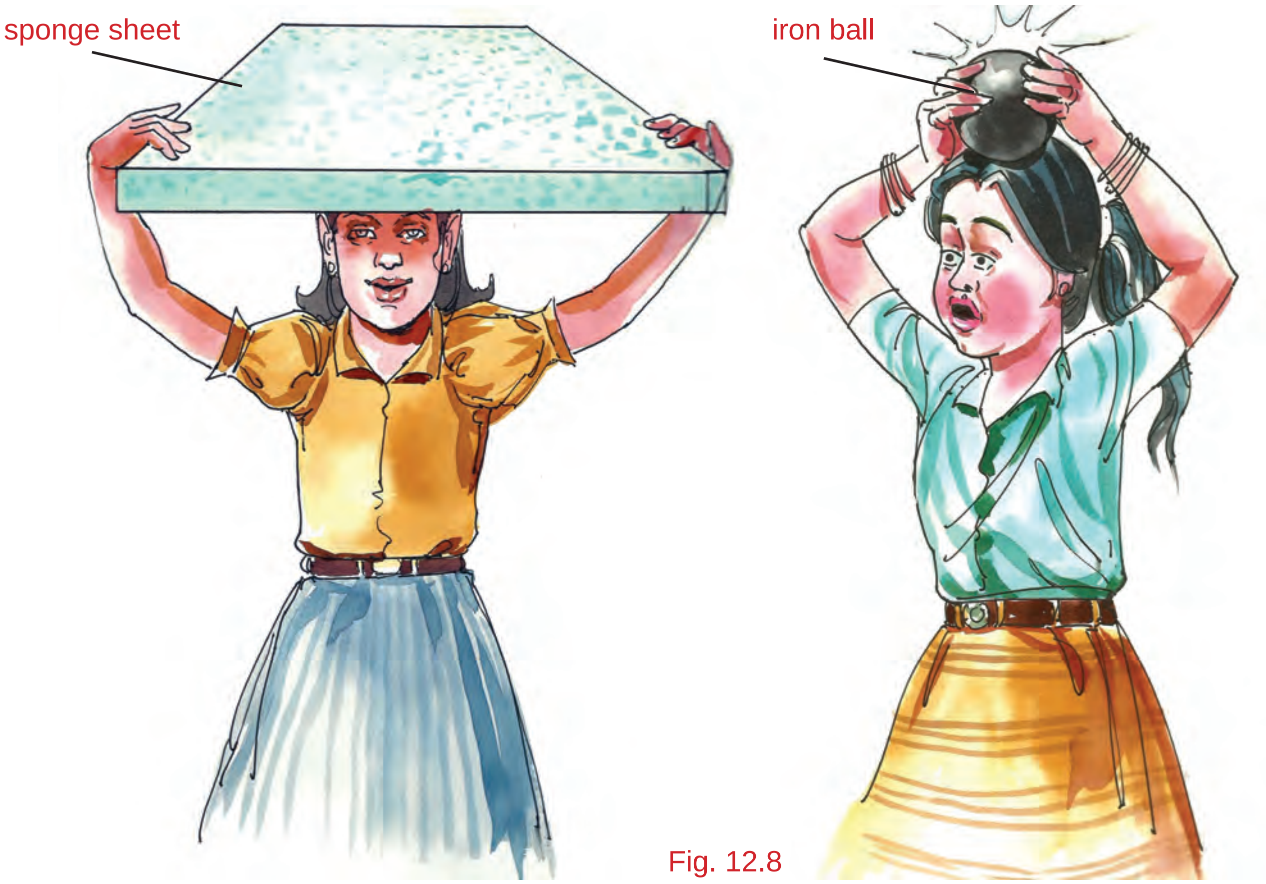


Fig. 12.8

Radha　　　　Seetha

Have a look at the pictures. Who is happier ? Radha or Seetha ?

Definitely Seetha will not be happy as her load (iron ball) is heavier, while Radha will be happy as her load (sponge sheet) is lighter.

The lightness or heaviness of a body is due to density. If more mass is packed into the same volume, it has greater density. So, the iron ball will have more mass than the sponge of same size. Therefore iron has more density.

Density is the mass of unit volume of the substance.

$$\text{Density} = \frac{\text{mass}}{\text{volume}}$$

The unit of density is kg /m^3.

ACTIVITY 12.10

Let us take three balls (spheres) of the same size but made of different materials like cork (cricket ball), iron (shot put) and rubber (bouncing ball) Hold them separately in your hand. Arrange them according to the descending order of their mass.

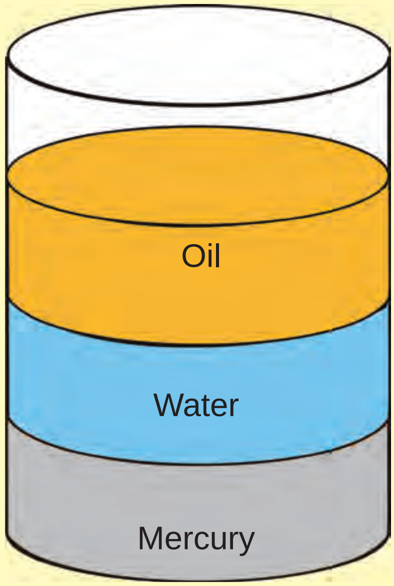
1.

2.

3.

We see that the iron ball has more mass when compared to cork and rubber. It shows that iron has greater density.

ACTIVITY 12.11



Observe the diagram

Let us identify the following :

(i) The liquid denser than water is ....

(ii) The liquid lighter than water is ....

If a substance is lighter than water, it will float; but if it is heavier than water, it will sink.

MORE TO KNOW

Density of water is 1000 kg/m^3. This means that water taken in a tank of length 1m, breadth 1m and height 1m, has a mass of 1000kg.

If the same tank is filled with mercury it will have a mass of 13,600 kg. So mercury is 13.6 times denser than water.

SELF CHECK

1) Density of steel is 7800 kg/m^3. Will it float or sink in mercury?

2) Give the mass of water contained in a tank of length 5m, breadth 3m and height 2m.

TO THINK

A balloon filled with air does not fly whereas a balloon filled with helium can fly. Why?

Hot air ballon

Why does this hot air balloon fly?

12.2. MEASUREMENT OF TIME

Why do we need to measure time?

We need to measure time for many reasons –to know when to go to school, when to take food, when to watch TV and when to sleep . The earlier clocks like the sundial , water clock and hour glass were not very accurate. There was the need to have more accurate and precise instruments . The earliest pendulum clocks which had weights and a swinging pendulum satisfied this need.

Simple pendulum

Fig 12.9. swing

Have you been on a swing? The back and forth motion of the swing is an example of oscillatory motion. You can observe the same in pendulum clocks, which work on the principle of the simple pendulum.

A simple pendulum is a small metallic ball (bob) suspended from a rigid stand by an inelastic thread. When the bob is pulled gently to one side and released, it moves to and fro. One complete to and fro motion is called one **oscillation.** i.e. from one end (extreme) to the other end and back. The time taken to complete one oscillation is called **time period**.

The distance between the point of suspension and the centre of the bob is called **length of the pendulum**.

Amplitude is the distance upto which the bob is pulled from the position of rest.

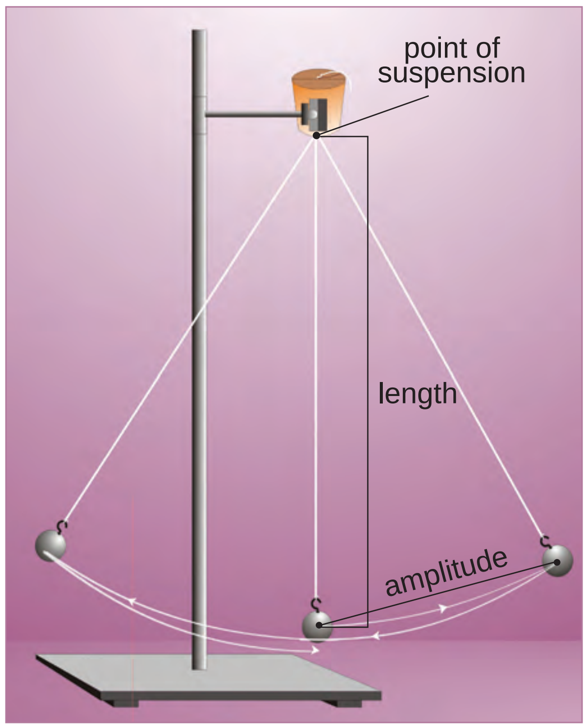
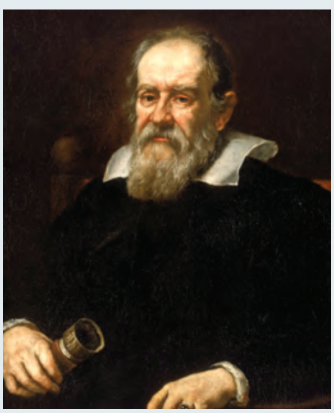


Fig 12.10. Simple pendulum

A story is told of Galileo. He went to a church in Pisa (in Italy). He noticed that a lamp suspended from the roof by a long chain was swinging periodically. Using his pulse beats he found that the time of swing of the lamp remained constant even as the swinging decreased. His keen observation made him understand the importance of the constant time of the swing.



Galileo

Before he died in 1642, he made plans for the construction of a pendulum clock; but the first successful pendulum clock was constructed by the Dutch scientist Christian Huygens only in 1657.

ACTIVITY 12.12

1. Set up a simple pendulum in your class room with a thread of length 60cm.
2. Set the bob into oscillations
3. Note the time taken for 20 oscillations in seconds.
4. Time period = Time for one oscillation = $\dfrac{\text{time taken for 20 oscillations}}{20}$

EXPERIMENT

Repeat the above experiment using

(i) bobs of different sizes without changing length of the pendulum.

(ii) threads of length of 80 cm and 100cm.

(iii) various amplitudes.

Do you notice any change in the time period?

In the first and third cases you will find no change in the time period

But in the second case the time period increases with increase in length. So we infer that **time period of a simple pendulum depends on the length of the pendulum and is independent of mass of the bob and the amplitude.**

12.3. ASTRONOMICAL DISTANCES

Meera and Sundar were very excited as their uncle had joined ISRO (Indian Space Research Organisation). They were eagerly anticipating a visit to his new work place to see rockets and satellites. Let us listen to a conversation between Meera, Sundar and their uncle.

Meera : Uncle, will you become an astronaut?

Uncle : No, Meera, I will be joining a team responsible for the launch of rockets.

Sundar : Rockets rise many thousands of kilometre in the sky, don't they?

Uncle : Yes, indeed they do. These rockets send satellites into orbits and spacecraft on their journey into outer space. A spacecraft travels lakhs and lakhs of kilometres in space. Do you realise that in order to express huge distances other units of measurement are required?

Meera &
Sundar : What are these units? Do tell us!

Uncle : Now you see, to measure very long distances like the distance of the sun, other stars and different planets from the earth we use convenient units like **astronomical unit** and **light year**.

Astronomical Unit is the average distance between the earth and the sun.

1 Astronomical Unit = 150 million kilometre (15 crore km).

Light year is the distance travelled by light in vacuum in one year.

1 Light year = 9.46×10^{12} km (9,46,000 crore kilometres).

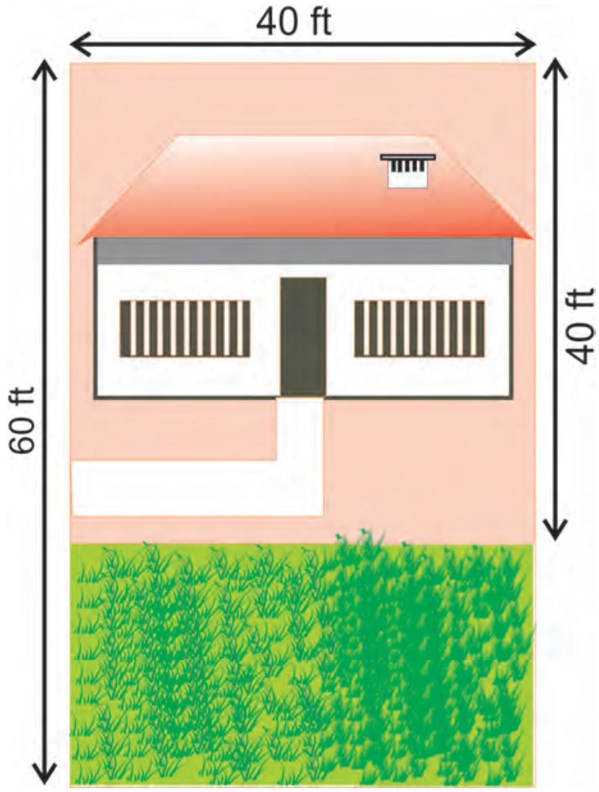
MORE TO KNOW

Light travels distance of 3 lakh km in one second.

Imagine this boy is travelling at the speed of light . He can travel around the world seven and a half times in one second. He would take eight minute, and twenty seconds to reach the earth from the sun . A racing car travelling at 1,000 kilometres per hour would take 17 years to complete the same journey.

EVALUATION

1. Ananth's father had a rectangular plot of length 60 feet and breadth 40 feet. He built a house in the plot and in the remaining area he planted a garden as shown.

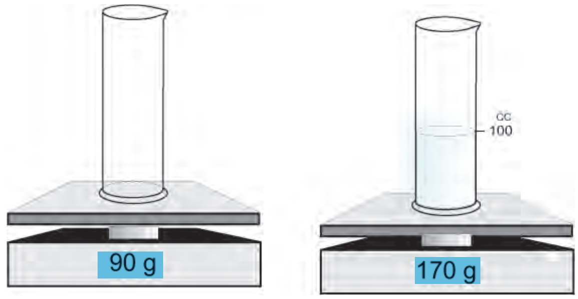


Can you help Ananth to find out the area of his garden.

2. 'Density is the lightness or heaviness of a substance.

Kamala wanted to know whether water or coconut oil had lesser density. Her sister Mala asked her to bring a cup of water and some coconut oil. How did Mala clear Kamala's doubt?

3. Observe the given picture and note

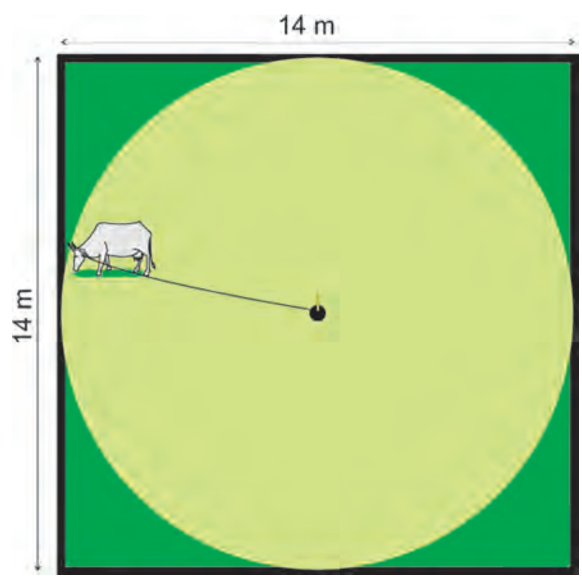


(i) Mass of the liquid ---------- gm

(ii) Volume of the liquid ---------- cc

(iii) Density of the liquid ---------- g/cc

4. Farmer Kandasamy had a square fenced field in which he allowed his cow to graze. He tied his cow to a stake at the centre of the plot by a rope of length 7 m.



Farmer Kandasamy's son Raju was amused to see that the cow grazed over a large circle of grass but left grass at the corners untouched. How did Raju find out how much land was not grazed?

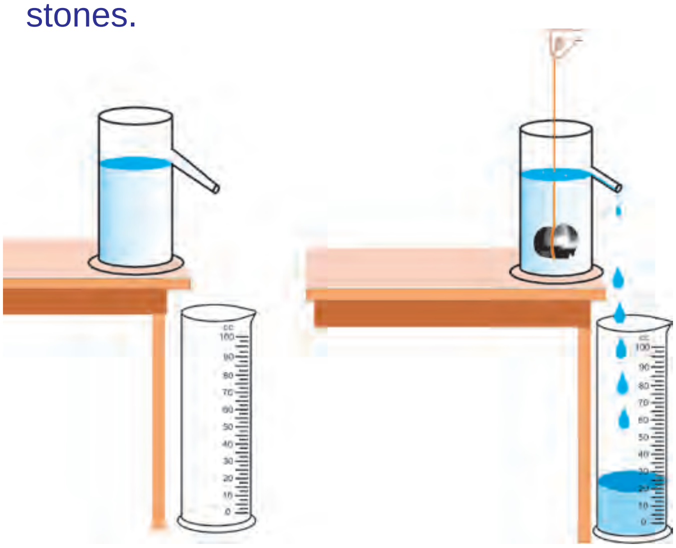
PROJECTS

1. Take a vessel with water and a 25ml graduated beaker. Distribute the water by giving 100ml, 125ml, 175 ml and 200 ml respectively to each of your four friends with the help of the beaker. How many times did you use the beaker for each friend?

2. Use a stop clock and determine how many times the following activities can be repeated in a span of one minute.

S.No.	Activity	Number of repetitions in one minute.
1.	Your friend inhales and exhales	
2.	The heart beat of your friend	
3.	Your friend blinking his eyes	

3. Using an overflow jar and a measuring cylinder find the volume of different stones.



Record Your observations:

Stone	Volume
1.	
2.	
3.	

FURTHER REFERENCE

Books

1. Frame work of Science - Paddy Gannon, Oxford University Press, New Delhi

Websites

http://www.kidastronomy.com

http://www.bbc.co.uk/schools/ks3bitesize/phys/html

CHAPTER 13

MOTION

13.1. SPEED

Two of the most exciting events in any sports meet is the 100m dash and 4x100m relay. Though all athletes run the same distance, the athlete who runs the distance in the shortest time will be the winner. In other words, the athlete who has the highest speed or is the fastest will win.

The most obvious feature of an object in motion is speed. It is a measure of how fast or slow an object is moving.

Fig 13.1

MORE TO KNOW

Usain Bolt won the 100m in 9.6 seconds and 200m in 19.19 second at the Beijing Olympics in 2008. He also won the 4 x 100m relay along with his team mates. His high speed made the media call him **'Lightning Bolt'**.

ACTIVITY 13.1

Let us observe a car, a cycle and a bullock-cart as they move on the road. Which of these takes the shortest time to cover a certain distance?

The car travels the fastest as it takes least time. The bullock-cart is the slowest as it takes longest time. The cycle has a speed between that of the car and the bullock-cart.

A fast moving object has high speed and a slow moving object has slow speed.

Now, what about an aeroplane?

Car

Bullock cart

Cycle

13.2. WHAT IS SPEED?

Speed of a body is the distance travelled by the body in one second.

$$\text{SPEED} = \frac{\text{DISTANCE TRAVELLED}}{\text{TIME TAKEN}}$$

Distance travelled is measured in metre and time in second

Therefore, the unit of speed is metre / second . [m / s].

It can also be expressed in kilometre / hour [km / h]

What do you mean by saying the speed of a car is 50 km/h?

It means that the car travels a distance of 50 km in one hour.

1 km = 1000m and 1 hour = 60x60 s

$$\text{So, } 1 \text{ km/h} = \frac{1000 \text{ m}}{60 \times 60 \text{ s}}$$

$$= \frac{5}{18} \text{ m/s}$$

Example :

a) $2 \text{ km/h} = 2 \times \frac{5}{18} \text{ m/s}$

b) $3 \text{ km/h} = 3 \times \frac{5}{18} \text{ m/s}$

If you know the speed of an object, you can find out the distance covered by it in a given time. All you have to do is multiply the speed and time.

Distance covered = Speed x Time

ACTIVITY 13.2

Let us give a cricket ball to a group of four friends and ask them each to throw the cricket ball from a given point. Mark the point up to which each of them throws the ball.

Measure the distance thrown and discuss the speed of the ball.

SELF CHECK

a) 36 km/h = ______ m/s

b) 72 km/h = ______ m/s

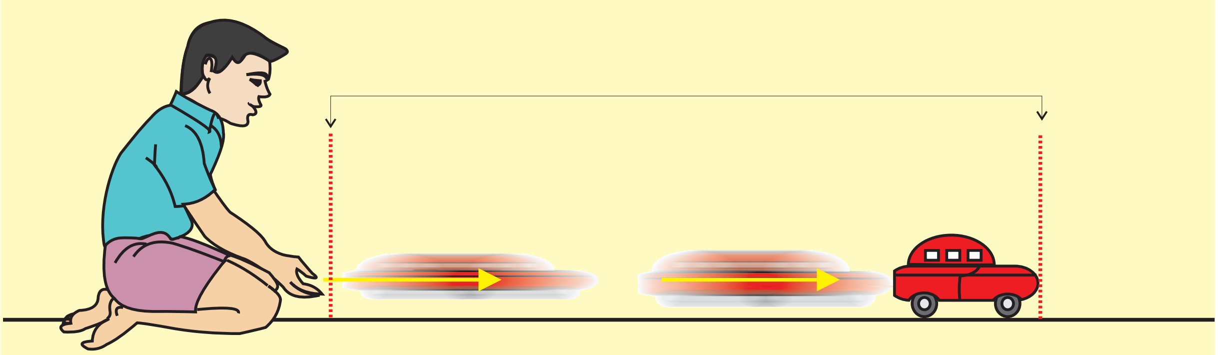
c) 180 km/h = ______ m/s

d) 15m/s = ______ km / h

e) 25m/s = ______ km / h

f) 35m/s = ______ Km/ h

ACTIVITY 13.3



Let us organise a toy car race to understand the concept of speed. Divide the class into 5 groups. Draw a line at the starting point .

One from each group should roll the toy car along the ground. Another should note the time from the instant the car crosses the line to the instant it stops. Measure the distance. Calculate the speed of each car and record it.

S.No	Group	Distance travelled by the car	Time taken	Speed
1	I			
2	II			
3	III			
4	IV			
5	V			

Find

1) Which group was the fastest?

2) Which group was the slowest?

Variable Speed

The speed of a bus during a journey may vary. When the bus is nearing a bus stop, its speed decreases.

On the highways the bus travels with greater speed. But in a city or town it travels with less speed due to heavy traffic.

The bus has different speeds at different times. So we say that it has **variable speed.**

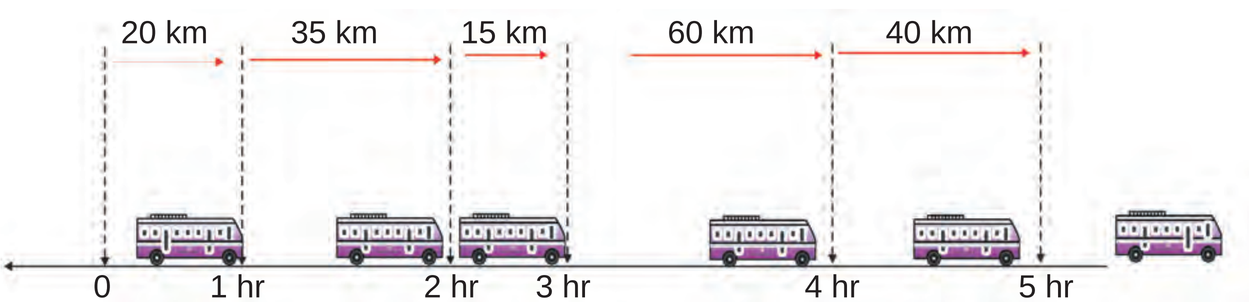


Fig 13.2. Variable speed

For such bodies, we can calculate the average speed:

$$\text{Average speed} = \frac{\text{Total distance travelled}}{\text{Total time taken}}$$

If a body moves with the same speed at all times we say that it has **uniform speed.**

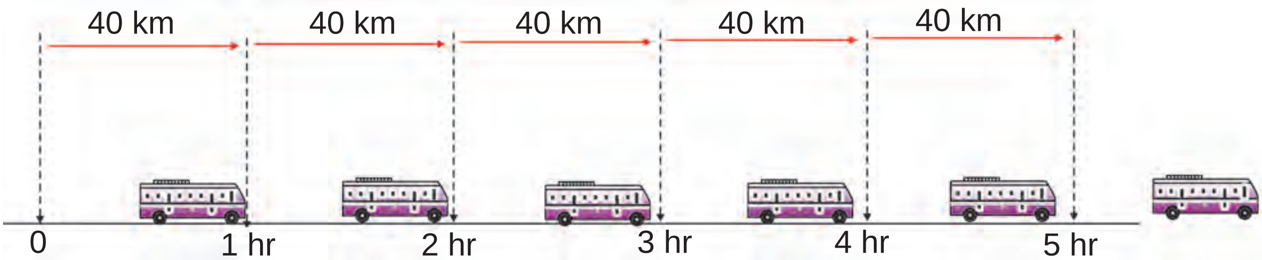


Fig 13.3. Uniform speed

Graphical representation

Have you seen a graph shown on your television screen while watching a cricket match?

It gives you an idea of the runs scored and also compares the performances of two teams.

Why is graphical representation used?

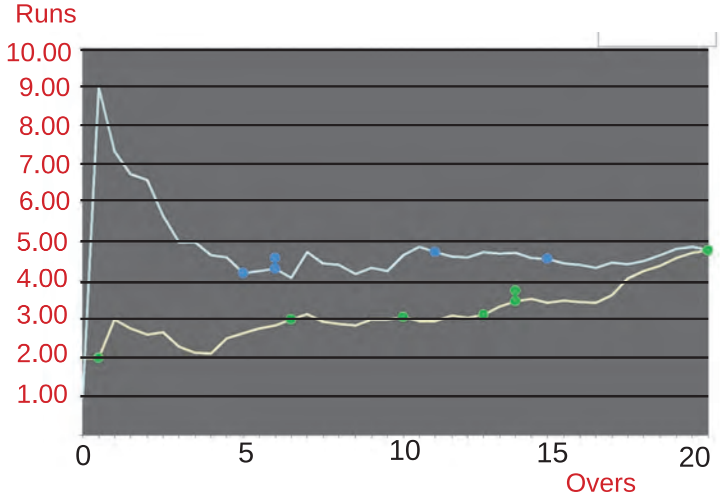


Fig 13.4. Graphical representation

When you are given a set of numbers which are relative to one another, it may not give you a clear idea of the relationship between them.

If the same numbers are represented on a graph, it gives a beautiful visual representation and therefore a clearer idea of the relation.

Hence, change of distance with time may be represented by a distance - time graph.

Science today

Have you noticed a meter fitted in the front of a scooter or a motorcycle?

Such meters can be found on the dashboard of cars, buses etc,. This meter has provision to measure both speed and distance. One of the meters has km/h written. This is a **speedometer**. It gives the speed of the vehicle every instant in km/h. There is another meter also which measures the total distance covered by the vehicle in metre. This is called an **Odometer**.

Speedometer with odometer

13.3. DISTANCE – TIME GRAPH

Rajesh was travelling with his father in their car from Erode to Coimbatore. He kept himself busy by noting the distance travelled by the car every 5 minutes.

This is what he noted in the first 30 minutes.

S.No	Time in minutes	Distance in km
1	0	0
2	5	5
3	10	10
4	15	15
5	20	20
6	25	25
7	30	30

You can make a graphical representation of his observations:

Follow these simple steps.

Taking axes and scale:

Take a graph sheet and draw two lines perpendicular to each other.

Mark the horizontal line as OX(x-axis) and the vertical line as OY (y-axis).

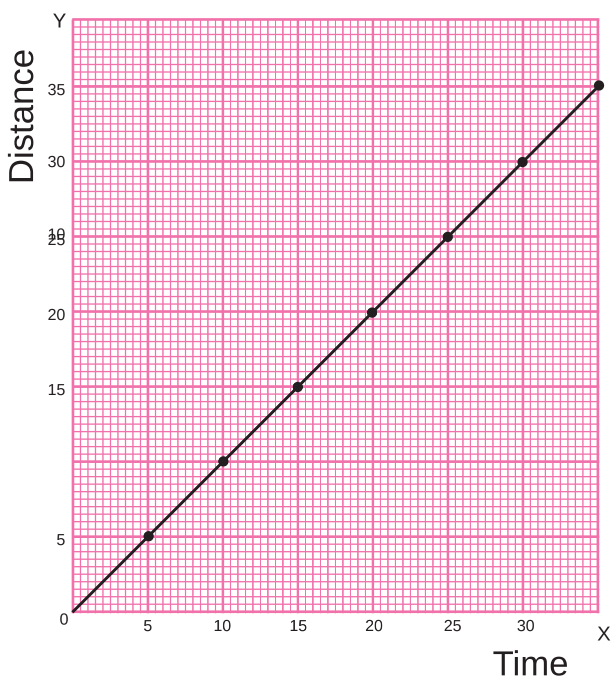


Fig 13.5. Distance Time Graph

Time is taken on the X-axis and distance on the Y-axis.

Choose scales to represent distance and time.

For example, the scales could be

X-axis : 1 cm = 5 minutes

Y-axis : 1 cm = 5 km

Plotting the graph :

Mark the values on the axes for time and distance according to the scales you have chosen.

According to the values noted, mark the points on the graph sheet. Join the points. You will get a straight line.

For uniform speed, the distance time graph is always a straight line.

For variable speed, it could be of any shape.

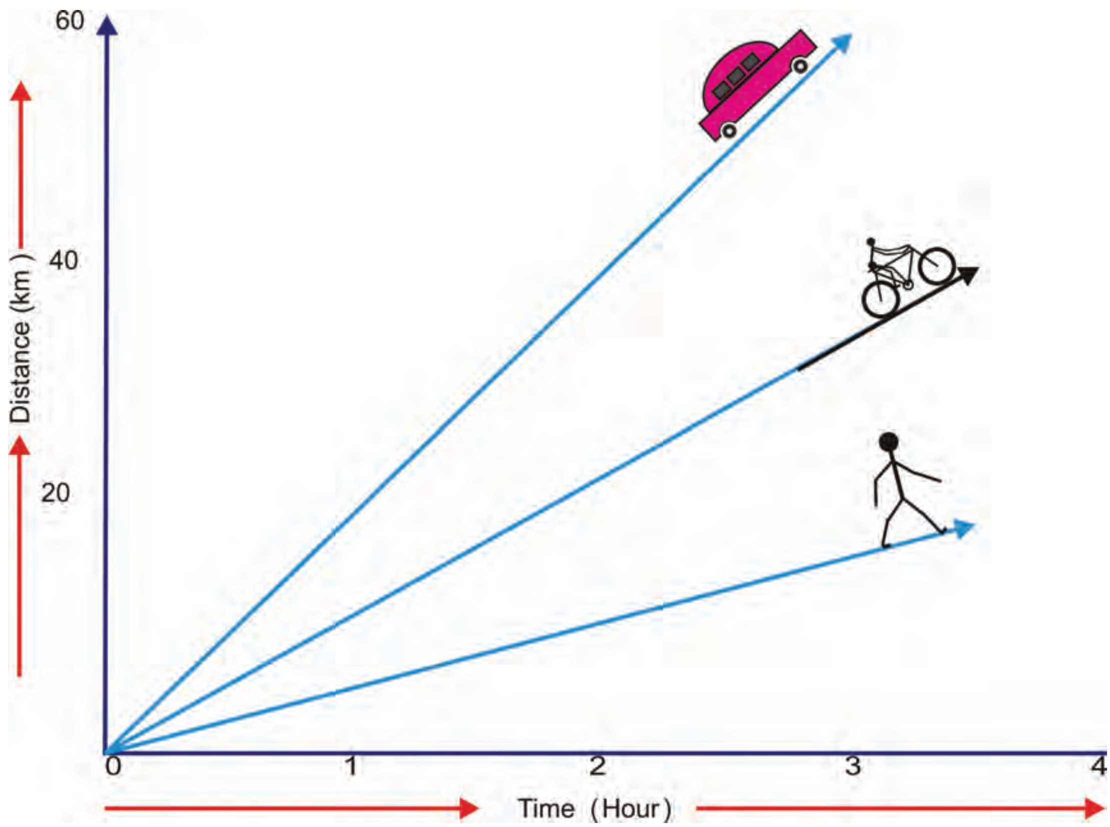


Fig 13.6

Greater the speed, steeper will be the graph.

ACTIVITY 13.4

Three cars, A, B and C travel from Madurai to Salem. The time taken and the distance covered are given in the table below.

S.No	Time taken in hours	Distance travelled in km		
		Car A	Car B	Car C
1	1	20	50	40
2	2	40	100	80
3	3	60	150	120
4	4	80	200	160
5	5	100	250	200

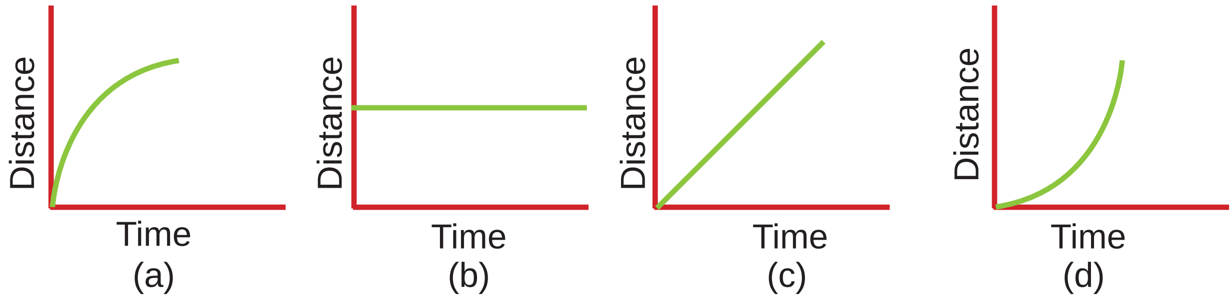
Plot the distance- time graph for the three cars in the same graph sheet.

a) What do you infer?

b) Which car had the maximum speed?

SELF CHECK

What do the following graphs represent?



(a) and (d) represent variable speed. (b) represents an object at rest.

(c) represents uniform speed.

13.4. VELOCITY

Every day when you go to school from your house,you could take path 1 or path 2 or path 3. Do these paths have the same distance? No, the distance is not the same; it varies with the path taken.

Imagine that you travel from your house to school in a straight line.

Fig 13.7.

This will be the shortest distance between them, called **displacement**. In the picture, it is represented by a dotted line.

Displacement is the shortest distance between two points.

MORE TO KNOW

Anemometer is a device used for measuring wind speed. It has aluminium cups which turn on a spindle. As the wind speed increases the cups rotate faster.

Velocity is the displacement of a body in one second.

$$\text{VELOCITY} = \frac{\text{DISPLACEMENT}}{\text{TIME TAKEN}}$$

Its unit is m / s.

Velocity is nothing but speed in a definite direction.

13.5. ACCELERATION

Do you ride a bicycle to school? If you are late, what would you do?

Obviously, you would pedal faster to reach school on time. In other words, you would increase your velocity or accelerate.

So, acceleration is the measure of change in velocity.

Acceleration is the change of velocity in one second.

$$\text{Acceleration} = \frac{\text{Change in velocity}}{\text{Time taken}}$$

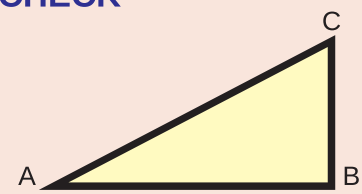
Its unit is m / s^2.

If a car has an acceleration of 5 m/s^2 every second its velocity increases by 5 m/s.

If the velocity of a moving body decreases, we say that it has negative acceleration or retardation or deceleration.

Example : A train slowing down to stop at a station.

SELF CHECK



Suresh walks from point A to B and then again from B to C.

a) What is the distance he has travelled?

b) What is the displacement?

Acceleration due to gravity

Let us see what happens when a ball is thrown up vertically?

As it rises, its velocity gradually decreases till it becomes zero ie., the ball is retarded. As the ball falls down its velocity gradually increases ie., it is accelerated.

The retardation or acceleration is due to the earth's gravitational force. It is known as acceleration due to gravity. It has an average value of 9.8 m/s^2 and is represented as g.

$g = 9.8 m/s^2$

This means that the velocity of a body decreases by 9.8 m/s every second when it is thrown up and the velocity increases by 9.8 m/s every second when it falls down.

To Think

A marble and a big stone are dropped simultaneously from a particular height. Which will reach the ground first?

13.6. SCIENCE TODAY - ADVENTURE SPORTS

Have you ever dreamed of flying like a bird or gazed up at flying birds and longed to join them.

1. Hang gliding

Hang gliding is a sport in which a pilot flies a light un-motorized aircraft called a hang glider launched by foot.

Most modern hang gliders are made of aluminium alloy. The pilot is safe inside a harness suspended from the frame of the glider.

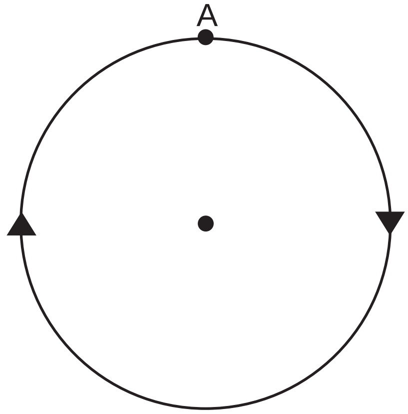
2. Para-gliding

Para-gliding is the latest aero sport. A para-glider is a non-motorised, foot launched inflatable wing, easy to transport, launch and land. It is basically a parachute made of special nylon or polyester fabric. The pilot is clipped to a harness in a comfortable sitting position. A para-glider is much lighter than a hang glider and easier to operate.

Yelagiri in Vellore district of Tamil Nadu is a hill station with gentle slopes ideal for para-gliding. Tamil Nadu Tourism holds a para-gliding festival at Yelagiri in August- September every year.

EVALUATION

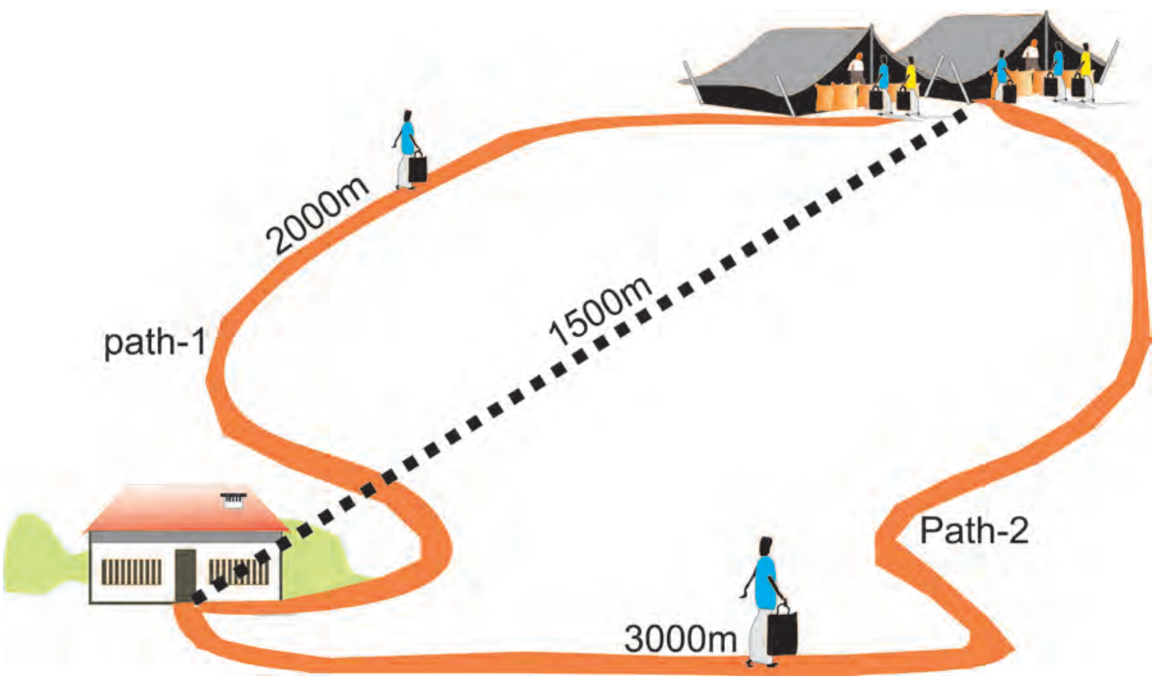
1. Selvi goes for a morning walk in the park near her house. She starts from point 'A', walks a circular path of radius 7m and returns to the same point 'A'.



(i) What is her displacement?

(ii) Find the distance she has walked.

2. Mani and Shankar walk from their home to the market in 20 minutes, Mani takes path 1 while Shankar takes path 2.



(i) What do you infer about their speeds?

(ii) Who has the greater velocity? Why?

3. Raju is travelling in a train moving at a speed of 72 km/h. In order to stop the train, the driver decreases the speed. The rate of decrease in speed of the moving body is known as deceleration.

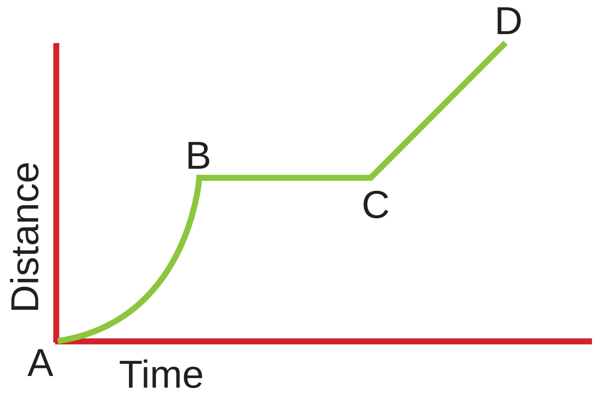
If the decleration of the train is $10 m/s^2$, how much time will it take to come to a stop?

4. The given graph depicts the motion of a bus. Interpret the motion the bus.

a) AB represents ---------------

b) BC represents ---------------

c) CD represents ---------------



PROJECTS

1. Take a graph sheet. Draw a distance – time graph with the data given below.

Time (minute)	10	15	20	25	30
Distance (km)	10	20	30	40	50

2. Conduct a race and find who is the fastest among your friends.
   Make 4 friends run a distance of 50 m one by one and note the time taken by each. Complete the given table.

S.No.	Name of the friend	Time taken (second)	Speed (m/s)
1. 2. 3. 4.			

FURTHER REFERENCE

Books

1. Physics for higher Tier - Stephen people, Oxford University Press, New Delhi.

2. Fundamentals of Physics - Halliday, Resnick and Walker, Wiley India Pvt.Ltd.

Websites

http://www.sciencemadeeasy.com

CHAPTER 14

ELECTRICITY AND HEAT

Muthu's father sprang a pleasant surprise one morning.

Father : Hurry up, children! get ready. We are going to visit the Indira Gandhi Centre for Atomic Research at Kalpakkam.

Muthu : Don't we have a nuclear reactor at Kalpakkam?

Father: Yes. Last holiday, I had taken you to Mettur Dam and the hydroelectric power station there. The holiday before we visited Ennore Thermal Power Plant. So, this time I have decided to take you to yet another place from where we get electricity.

In these days, it is almost impossible to carry on with our daily lives without the use of electricity. From homes to big industries we all depend on electricity to make our task easier and life more comfortable.

eg : to light our homes, to operate motors, lifts, to take water from a well, bore well, sump and etc.,

From where do we get electricity?

A power station provides electricity. However the supply of electricity may fail or it may not be available in some places. In such situations a torch is sometimes used for providing light.

Switch on a torch. What happens ?

You will see that the bulb glows. Why does the bulb glow ?

It glows because the electric energy stored in the electric cells is converted into light energy by the bulb.

Fig 14.1.Torch

INTERESTING FACT :

Tamilnadu Leads

Wind energy is an important free, renewable, clean and non-polluting energy source. In a wind farm, huge wind mills convert wind energy into electric energy. Tamil Nadu is the No.1 state in India with the highest wind power generating capacity of about 5,000 MW. Most wind farms are in Thoothukudi, Kanyakumari and Thirunelveli Districts of Tamilnadu.

The first electric cell was developed by an Italian scientist Luigi Galvani and then improved by Alessandro Volta. It has been further developed into the modern day cell or torch battery. Now, we also have rechargeable alkali cells and solar cells. Solar cells convert lightenergy into electric energy.

Luigi Galvani

ACTIVITY 14.1

Let us observe the given pictures and group them as given in the table below.


Refrigerator


Television


Cellphone


Wall clock


Microwave Oven


Electric Train


Calculator


Wrist watch


Computer


Electric Toy

S.NO	APPLIANCES/DEVICES THAT RUN ON BATTERY	APPLIANCES/DEVICES THAT RUN ON ELECTRIC POWER

14.1. ELECTRIC CELL

Fig 14.2

An electric cell is a device which converts chemical energy into electric energy.

The cell has two different metal plates – one is the positive terminal and the other is the negative terminal. These plates are kept inside a chemical called electrolyte.

The cell is a source of electric current. Electric current is the flow of electrons or charge.

14.2. WHAT IS AN ELECTRIC CIRCUIT ?

An electric circuit is the closed path along which electric current flows from the positive terminal to the negative terminal of the battery.

A circuit with a cell and a bulb is given here:

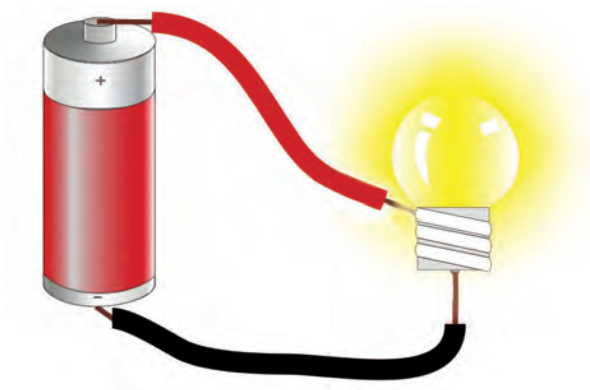


Fig 14.3

A circuit generally has:

a) a source of electric current - **a cell or battery**.

b) **connecting wires** for carrying current.

c) a device which uses the electricity - a **bulb.**

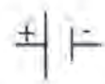
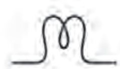
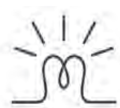
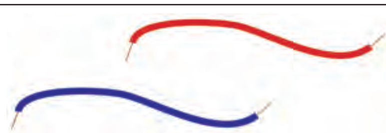
d) **a key or a switch** – This may be connected anywhere along the circuit to stop or allow the flow of current. When the current flows. the circuit is said to be closed. When the current does not flow, the circuit is said to be open.

Why symbols?

If you were to describe an electric circuit to someone, it is likely that you would want to draw it. It takes time to draw a circuit, because people might draw batteries, bulbs, etc., in different ways. This could be very confusing. This can be overcome if we use standard symbols to draw a circuit.

14.3. SYMBOLS OF ELECTRIC COMPONENTS

The given table shows the symbols of electric components commonly used in electric circuits.

S.No.	Name of the component	Picture	Sym bol	Explanation
1.	Cell			Longer line denotes the positive terminal and shorter line denotes the negative terminal.
2.	Battery			Two or more cells joined together form a battery
3	Switch (Key)			Switch is OFF– circuit is OPEN
				Switch is ON– circuit is CLOSED
4.	Bulb			Bulb does not glow
				Bulb glows
5.	Connecting Wire			connecting different components

14.4. ELECTRIC SWITCH

What is used to turn the lights or fan ON and OFF ?

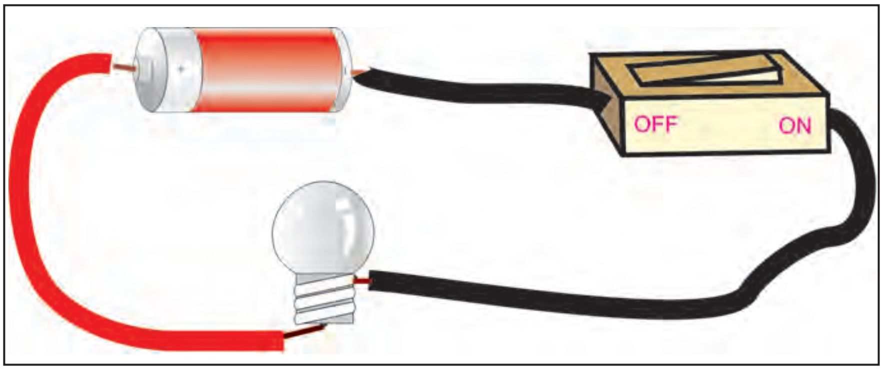
The device used is called a **switch.**

An electric switch is a device that opens or closes an electric circuit.

When the switch (key) K is closed, the circuit is complete; current flows through the circuit and the bulb glows.

When the switch (key) K is open, the circuit is not complete; current does not flow through the circuit and the bulb does not glow.

A circuit with the switch in the OFF position



Circuit with symbols (OFF position)

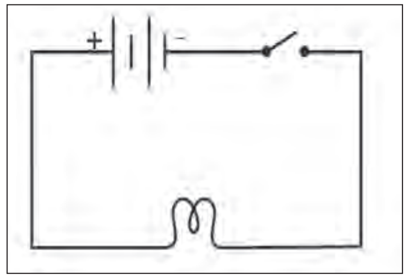
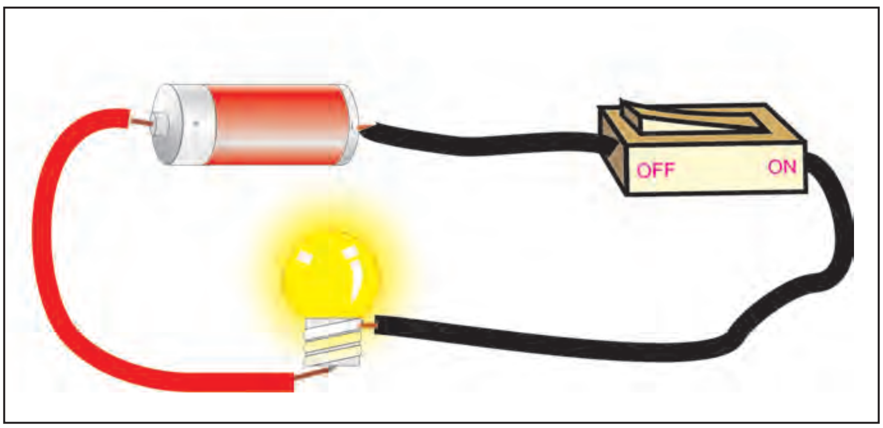


Fig 14.4

A circuit with the switch in the ON position



Circuit with symbols (ON position)

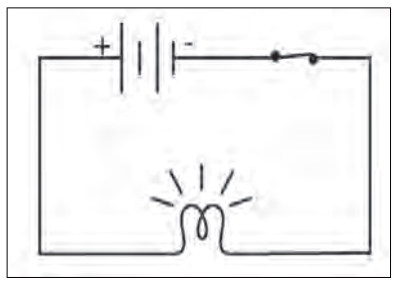


Fig 14.5

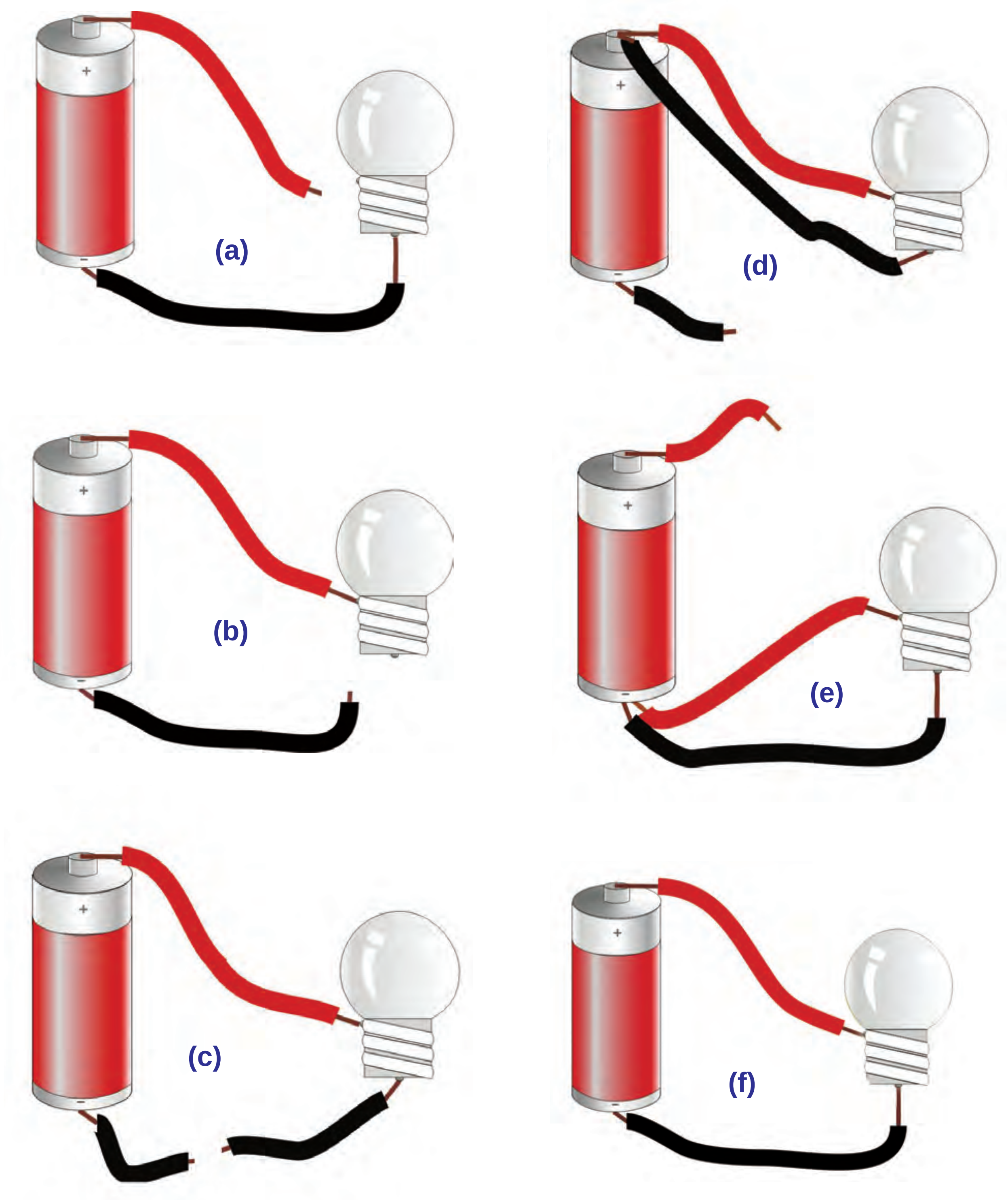
MORE TO KNOW

Inside the bulb there is a thin coil of wire made of tungsten, called filament. It gets heated and glows when the current flows. Here electric energy is converted into light energy.

ACTIVITY 14.2

Let us note the different ways the cell is connected to the bulb.

Identify the cases in which the bulb will glow. Can you tell why ?

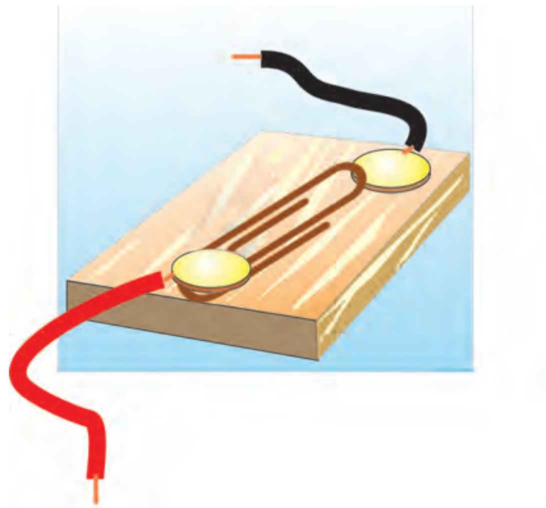


ACTIVITY 14.3

We can make a simple switch for your experiments. We will need

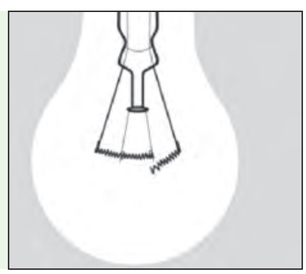
- a small block of soft wood.
- a paperclip.
- two metal drawing (board) pins.
- 3 pieces of insulated wire.
- a small bulb with holder and
- a battery.

1. Attach a piece of wire to each board pin. Push one pin into the flat side of the wood.
2. Push the second pin through the end loop of the paper clip and into the board. The drawing pins should be about 1cm apart.
3. To test the switch, connect the free end of one of the wires to the positive terminal of the battery.
4. Use the free wire to connect the negative terminal of the battery to the bulb holder.
5. Connect the free wire on the switch to the free screw on the bulb holder.
6. When the paper clip is turned to touch both board pins, the bulb glows. The switch is ready. Try it.



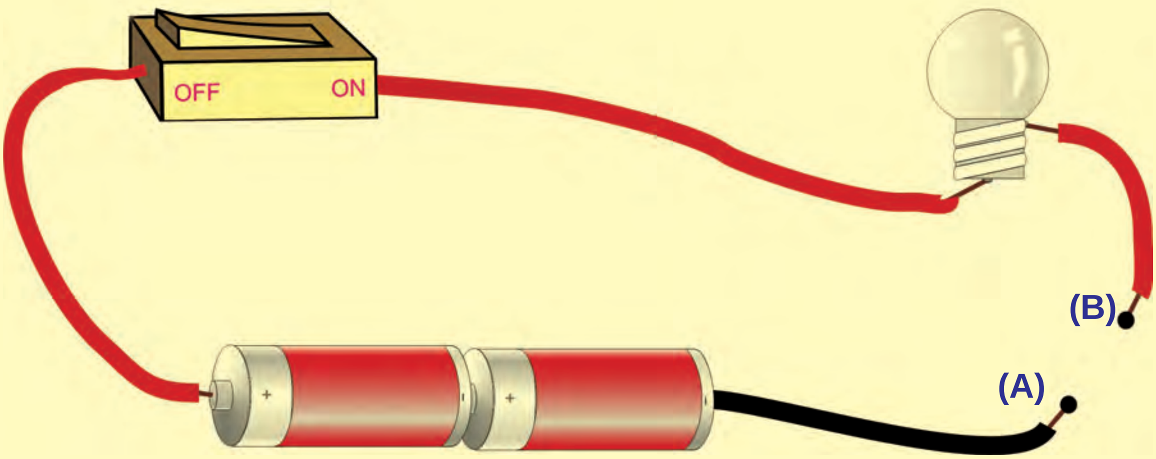
To Think...

If the filament inside the bulb is broken will the bulb glow? Why?



ACTIVITY 14.4

We need a battery, a key, a small bulb, a plastic scale, a wooden scale, a copper wire, metal key, metal safety pin and a glass rod.



Let us connect the circuit as shown in the figure with the help of connecting wires. Connect different materials between the points A and B one by one. Check if the bulb glows when key K is closed. Record the observation with a tick mark (✓) in the proper box.

S.No.	OBJECT	BULB GLOWS	BULB DOES NOT GLOW
1.	Metal key		
2.	Wooden scale		
3.	Plastic scale		
4.	Metal safety pin		
5.	Copper wire		
6.	Glass rod		

What do you understand from the above activity?

The above activity shows that the bulb glows or current flows in the circuit only when certain objects like copper wire, metal safety pin and a metal key are connected.

Current does not flow through wood, plastic and glass rod. Based on this property, we can classify materials as conductors and insulators.

Electric eel

MORE TO KNOW

Electric eel is an electric fish. It is capable of generating powerful electric shocks for hunting its prey and for self defense.

Electric eel lives in the fresh water of the Amazon and Orinoco river basins in South America.

14.5. CONDUCTORS AND INSULATORS

CONDUCTORS: The materials which allow electric current to pass through them.

Examples: All metals like Copper, Iron, Silver and Human body.

Copper wire

INSULATORS: The materials which do not allow electric current to pass through them.

Examples: Plastic, Wood, Rubber and Glass.

Wood

Fig 14.6. Conductor and insulator

To Think...

Why do electricians wear rubber gloves and shoes while at work?

Electrician gloves

14.6. HEATING EFFECT OF CURRENT

Can we see the flow of electric current?

Flow of electric current in a wire is not visible but we can only see and feel the effects of the flow of current.

ACTIVITY 14.5

Let us connect a thin wire between the two terminals of a battery. After a few seconds, touch it.

What do you feel? Is it not hot? Yes. It is. Can you explain the reason?

Shall we name a few appliances that work on the heating effect of current?

Electric kettle

Used for boiling water to make tea or coffee .

Electric bulb

The filament of the bulb is heated when current flows and becomes white hot to emit brilliant light.

Electric iron

Used for ironing or pressing clothes.

Electric toaster

Used to toast bread.

All heating appliances have a wire which produces heat when current is passed. It is known as heating element. This is the most important part of a heating appliance.

It is a coil of wire made of a special material called nichrome which becomes very hot when current is passed. This heat is used to cook food (as in an electric stove), heat water (as in an electric kettle, electric heater) etc.,

MORE TO KNOW

Nichrome consists mainly of nickel and chromium.

14.7. MAGNETIC EFFECT OF CURRENT

In the year 1820 a Danish scientist Christian Oersted was giving a lecture in a class room. He noticed that a magnetic needle kept on the table was not pointing in the North-South direction. He was surprised. On looking closely he found that the needle was kept near a wire carrying current. When he took the needle away from the wire, it started pointing in the North-South direction. He brought the needle near the wire once again and noticed that it deflected. So he concluded that there is a magnetic field around a wire carrying current.

Christian Oersted

Fig 14.7.

Magnetic compass

The picture shows a compass which has a magnetic needle pivoted at its centre.

The pivoted magnetic needle will always point in the North-South direction.

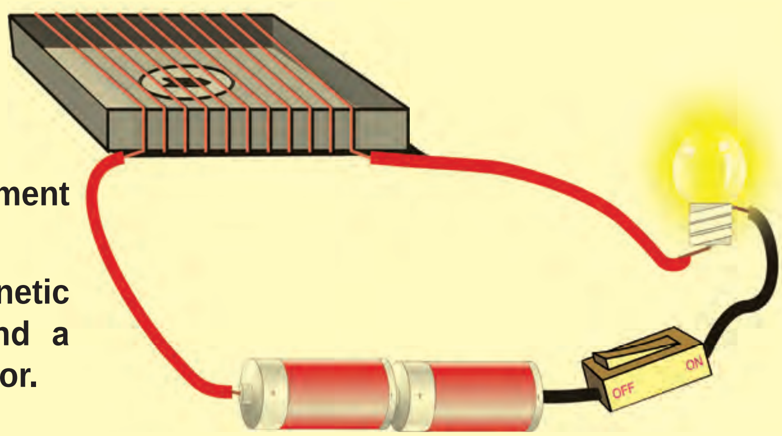
ACTIVITY 14.6

Let us take an empty match box. Place a small compass needle inside the match box tray. Wind an electric wire a few times around the tray. Now connect the free ends of the wire to an battery through a switch as shown in the diagram.

Keep the switch in the off position. Bring a bar magnet near the compass needle. Note that the needle gets deflected. When you remove the magnet, the needle will come back to its original position.

Keep the switch in the ON position. Does the compass needle deflect? Yes, it does. Move the switch to the OFF position. Does the compass needle come back to its initial position?

Yes, it does.



What does this experiment indicate?

It indicates that a magnetic field is produced around a current carrying conductor.

14.8. ELECTROMAGNET

Are magnets and electricity related?

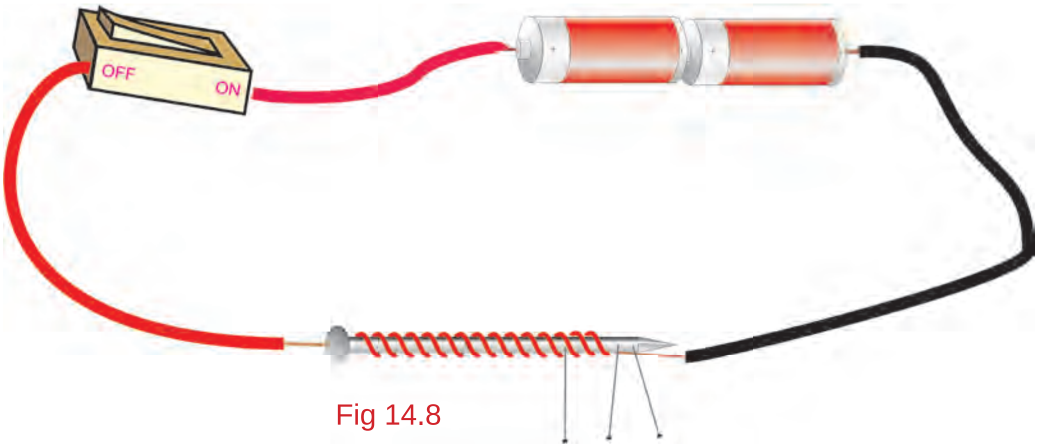


Fig 14.8

MORE TO KNOW

Huge electromagnets are used to remove iron scraps in the scrap yard.

ACTIVITY 14.7

Wind a copper wire around an iron nail. Connect the ends of the wire to a battery through a key. Close the key.

Bring some pins near the nail. What happens?

Now open the key and again bring the pins.

What happens ? What do you infer ?

A material that becomes a magnet when current is passed is called an electromagnet.

Electromagnets are used in many appliances like electric motor, Telegraph, Telephones, Electric bell, etc.

Many toys have electromagnets inside.

Doctors use small electromagnets to take out tiny pieces of magnetic materials that have accidentally entered the eye.

14.9. ELECTRIC BELL

Have you visited any friend's house recently? How did you let him know of your arrival?

Did you knock at the door or ring a bell ? Wasn't it much easier to ring the bell?

The picture of an electric bell is shown:

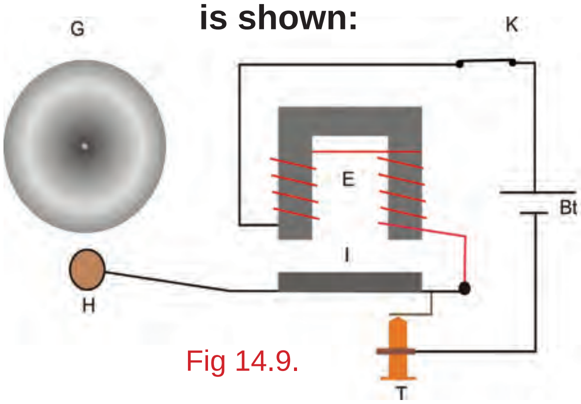


Fig 14.9.

Bt- Battery **T**-Terminal **H**-Hammer **G**-Gong **I**-Ironstrip **E**-Electromagnet **K**-Key

Working

When the key is closed current flows through the coil and the electromagnet is magnetised.

It pulls the iron strip and the hammer strikes the gong of the bell to produce a sound.

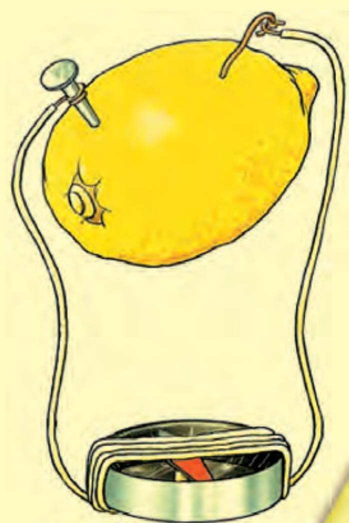
Now the circuit breaks and the current stops flowing through the coil. The electromagnet is no longer magnetized and the iron strip comes back to its original position. It touches the contact terminal again, completing the circuit and the process gets repeated. The hammer keeps on striking the gong producing a ringing noise.

EXPERIMENT

An electric lemon cell:

We will need a lemon, a piece of copper wire about 5 cm long, a 1m long plastic coated wire, a nail and a compass.

1. Press the lemon on a table to make it juicy inside.
2. Wind the plastic coated wire round the compass several times.
3. Twist one end of plastic coated wire around the copper wire. Now push the copper wire into the lemon.
4. Wind the other free end of the wire around the nail. Push the nail into the lemon at a distance of 3 cm from the copper wire.



Look at the compass needle. Has it moved? The copper wire acts as the positive terminal, the nail as the negative terminal and the lemon juice as the electrolyte. Try using a root vegetable like potato or beetroot instead of a lemon.

Does this produce electricity too?

14.10. HEAT

Dip a steel spoon into a pan of boiling water. What do we notice? After a few minutes the steel spoon becomes too hot to hold. What happened? The boiling water has transferred its heat energy to the spoon. When we touch ice, we feel cold. Here, the heat energy is transferred from our body to the ice.

So the energy which can be transferred from a hotter body to a colder body and which produces a sensation of hotness or coldness is called heat.

14.10.1. SOURCES OF HEAT:

1. The sun

The sun gives us light. Does it also give us heat?

1. Let us keep a metal piece in the sun light. Touch the metal piece after a few minutes. Do we feel any change ? Yes, it has become hot.

2. Shall we stand in the sun for some time. Touch the head. Won't we feel hot? Yes, we do.

3. Will we be able to walk bare footed at midday? It may be uncomfortable because the ground is hot.

So we understand that the sun gives out heat besides light.

Fig 14.10. Sun

Fig 14.11. Coal fire

2. Combustion

Burning of coal, kerosene etc., produces heat.

These are called **fossil fuels** since they are made from the remains of plants and animals that died millions of years ago and where buried deep inside the earth.

MORE TO KNOW

The sun gives us 3.8×10^{26} joule of heat energy per second. This energy is produced by nuclear fusion.

The sun is the prime source of heat energy without which life would be impossible on the earth.

Now a days solar energy is used in solar cookers and solar heaters.

joule is the unit used to measure energy.

3. Friction

The weather becomes very cold in winter. If we rub our hands together, they become warm. The faster we rub, the hotter it becomes. Rubbing two things together produces heat due to friction.

The ancient man used friction to produce a spark. Sometimes they rubbed two flint stones to make a fire.

Fig 14.12. Producing spark

Fig 14.13. Forest fire

4. Electric current

When electric current flows through a conductor heat energy is produced, as in a water heater, iron box, electric kettle etc.

Fig 14.14. Electric kettle

ACTIVITY 14.8

Let us name the source of heat energy in the given cases:

1. Forest fires
2. Burning of paper.
3. Hair drier.
4. Shooting star.
5. Hot tyre of a moving vehicle
6. Drying of clothes.

14.10.2. HOT AND COLD OBJECTS

ACTIVITY 14.9

Let us take three large bowls. Fill one with ice cold water, the other with hot water and the third with tap water.

Put one hand in ice cold water and the other in hot water for a few minutes.

Take out and plunge both in tap water

Is the tap water hot or cold ? What does this experiment say about judging heat ?

Heat energy is not visible but can be felt.

14.10.3. HEAT AND TEMPERATURE

Sense of touch cannot tell us accurately the amount of heat energy possessed by a body. To measure the heat energy we use the physical quantity, namely temperature. **Temperature measures the degree of hotness or coldness of a body.**

Thermometer

Since the sensation of hotness or coldness is relative, we use thermometers to measure the temperature. On what basis is a thermometer constructed?

ACTIVITY 14.10

1. Put some ink into a glass bottle and fill with water.
2. Close the bottle tightly with a one hole cork. A narrow glass tube inserted.
3. Keep the bottle in a pan of boiling water. See the coloured water in the glass tube rise up.
4. Why does the level in the glass tube rise? Note that the water gets heated and expands to rise up in the glass tube.
5. The rise in the level is the measure of temperature.
6. What happens when the water in the bottle cools?

The water level in the glass tube goes down.

What is inferred from this?

Liquids expand on heating and contract on cooling.

This principle is used in the construction of thermometer.

Almost all television channels end their news broadcast with maximum and minimum temperature recorded in major cities for the day. In some channels the term Celsius is used while some other channels use the term Fahrenheit. What is the difference? Both Celsius and Fahrenheit are valid terms used in the measurement of temperature.

Thermometers have two different scales to measure temperature.

a) Centigrade or Celsius scale.

b) Fahrenheit scale.

Thermometers have two fixed points based on which graduations are marked.

These are called upper fixed point and lower fixed point. The distance between these two fixed points is divided into an equal number of degrees.

The lower fixed point is the **melting point of pure ice**.

The upper fixed point is the **boiling point of water**.

TEMPERA-TURE SCALES	UPPER FIXED POINT	LOWER FIXED POINT	NUMBER OF DIVI-SIONS
CELSIUS	100^0 C	0^0 C	100
FAHREN-HEIT	212^0 F	32^0 F	180

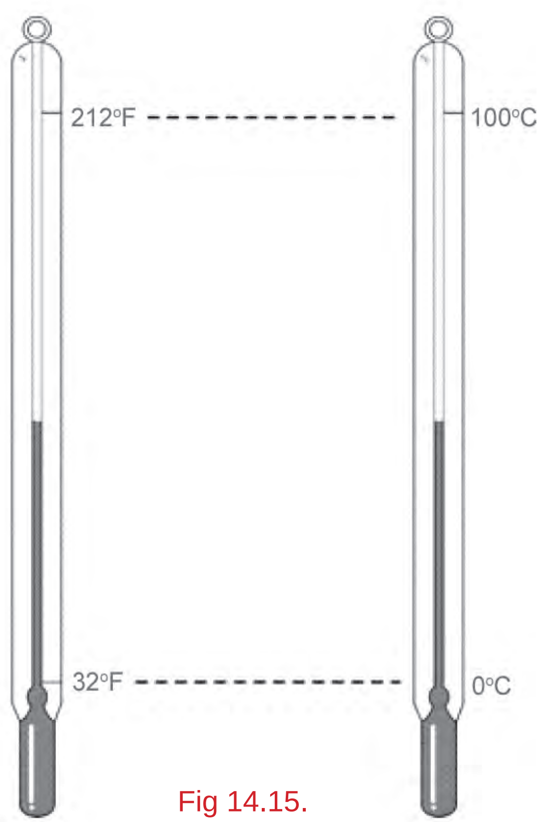


Fig 14.15.

MORE TO KNOW

The SI unit of temperature is kelvin. This is also known as absolute scale of temperature.

To convert Celsius into Fahrenheit we use the relation

$$\frac{C}{100} = \frac{(F-32)}{180}$$

'C' : Reading as shown by the Celsius thermometer.

'F' : Reading as shown by the Fahrenheit thermometer.

Self Check:

(i) 86^0F = ----- ^{0}C

(ii) 122^0F = ----- ^{0}C

(iii) ----- ^{0}F = 37^0C

(iv) ----- ^{0}F = 70^0C

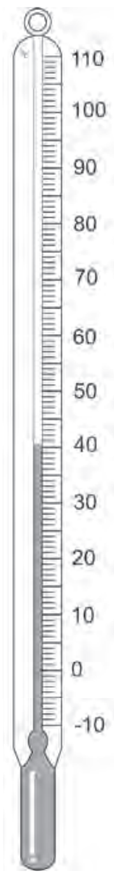
Most thermometers use mercury because

1. It is opaque and shiny.
2. Does not stick to glass.
3. It is a good conductor of heat.
4. It shows large expansion for small temperature changes.
5. It expands uniformly.

In some thermometers ALCOHOL is used.

14.10.4. MEASURING TEMPERATURE

Laboratory thermometer



The laboratory thermometer consists of a thick walled glass tube enclosing a fine uniform bore capillary tube. There is a cylindrical bulb at one end. The bulb and a part of the stem are filled with mercury, The top end is sealed after removing air. The graduations are marked from -10^0 C to 110^0 C

When the bulb is immersed in hot water, the mercury in the bulb expands and rises up in the capillary tube. The level of mercury in the tube gives the temperature of the hot water.

Fig 14.16

When we are sick, we visit a doctor. The first thing the doctor would have done is to take the body temperature. He would have done so with the help of a clinical thermometer. Shall we learn the construction of a clinical thermometer?

Clinical thermometer

It consists of a thick walled glass tube marked in degrees enclosing a capillary tube of fine bore. There is a cylindrical bulb at one end. Air is removed from the tube and the other end is sealed. The bulb and a part of the stem are filled with mercury. There is a constriction X just above the bulb which prevents the mercury from flowing back into the bulb. The reading of the mercury level gives the temperature of the patient. The thermometer is marked from 35^0 C to 42^0 C. The normal body temperature is 36.9^0C (98.4^0F). It is used to measure the temperature of the human body .

Clinical thermometers are available with Fahrenheit markings. They are also available with both Celsius and Fahrenheit markings.

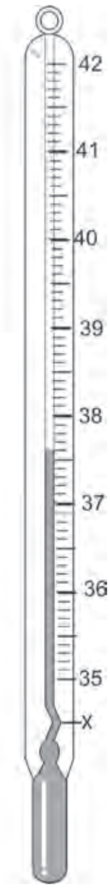


Fig 14.17

MORE TO KNOW

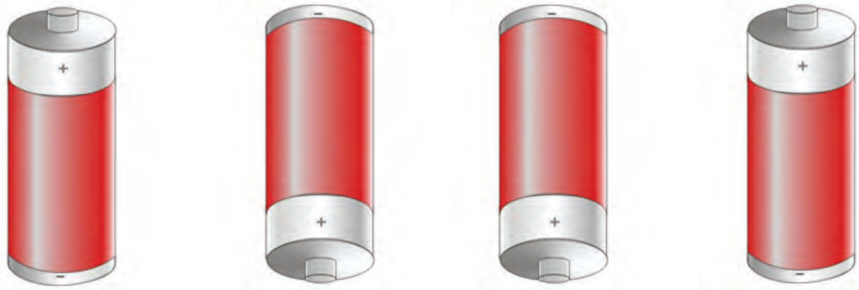
Now a days the digital thermometer is in use. The digital thermometer is an electronic device containing no glass or mercury. It is unbreakable and safe to use.

It beeps one minute after it has been kept under the arm or in the mouth of the patient.

The temperature can be read from the numerical display.

EVALUATION

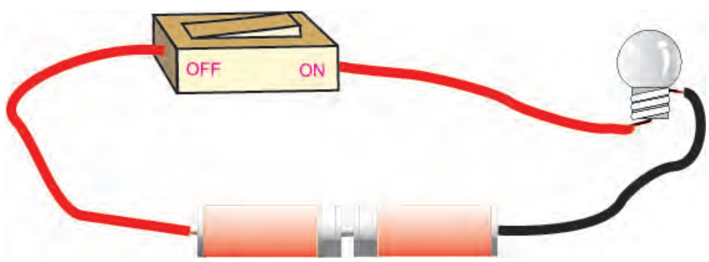
1.



By drawing lines, show how these four cells may be connected to form a battery.

2. The symbols of electric components are given. Use some of them to make a circuit so that the bulb glows.

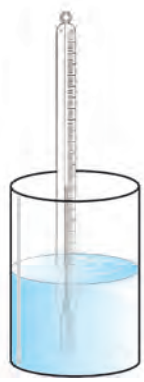
3. Observe the circuit given.



Identify the changes required to make the bulb glow. Draw the correct circuit using symbols.

4. Arun at the doctor's clinic

Muthu in the laboratory



One of them is correct and the other is wrong. Explain.

PROJECTS

1. You are provided with three cells, and a bulb. Connect to form a circuit with one cell. Repeat using two cells and three cells. See the variation in the glow of the bulb and record your observations by writing bright, brighter or brightest in the table.

Number of cells used	Nature of glow
One	
Two	
Three	

2. Take water in a metal container. Keep the bulb of the thermometer inside the water for two minutes at 10 AM and measure the temperature. Keep the container in the sunlight for 20 minutes and again measure the temperature. Repeat at 12 noon and 2 pm. Record your observations.

Time	Temperature inside the class room (^oC)	Temperature after keeping in sunlight (^oC)
10 am		
12 noon		
2 pm		

3. You are supplied with a long iron nail, a long insulated copper wire, 3 Battery cells and a box of steel pins.

Make an electromagnet with 50 turns and connect it to a cell. Bring the box of pins near it. Count the number of pins attracted by the electromagnet. Repeat the experiment by using two and three cells

Enter your observations in the table.

Number of cells	Number of pins attracted
One	
Two	
Three	

FURTHER REFERENCE

Books

1. Know about Science - Electricity - Anju Chawla, Dreamland Publication

Websites

http://www.howstuffworks.com

http://www.dmoz.org/kidandteens/schooltime/science.com

CHAPTER 15

LIGHT

Fig 15.1.

Look at the picture of the city taken at night. Can you imagine how the city will look if all the lights were turned off? Would you be able to see anything?

Can we see objects when there is no light? We cannot see any object when there is no light.

What is light and darkness?

Light is a form of energy that gives us the sensation of vision. The absence of light causes darkness. To see objects, our eye should receive light from it.

15.1. REFLECTION

When light falls on a transparent material like clear glass it passes through it. However, when it falls on opaque objects like table, chair, etc., some of it bounces back.

This bouncing back of light from a surface is called reflection.

A story of the dog and the bone.

One day a dog with a bone in it's mouth was crossing a bridge. Suddenly it looked down into the water and saw another dog carrying a big bone in its mouth. The greedy dog wanted the second bone also.

Thinking that it would frighten the other dog and get another bone, it barked loudly. Alas! The bone fell into the water and greedy dog lost it's own bone.

What do you think the dog saw in the water?

The dog thought that there was another dog but what it saw was it's own image reflected in the water.

Fig 15.2.

ACTIVITY 15.1


Tajmahal


Candle

Let us observe the pictures given.

We see an exact replica of the object known as its image.

What causes the image?

Reflection of light produces the image.


Swan

15.2. MIRROR

What is a mirror ?

A plane mirror is used by us every day for looking at our own image while combing our hair or washing our face. We can see our image in a mirror; but not in a plane glass sheet or in a piece of wood or a stone. Why?

This is because most of the light falling on a mirror is reflected, but other objects do not reflect as much light.

A mirror is a shining surface which reflects almost all the light falling on it.

Most mirrors are made of glass. A mirror that is flat is called a plane mirror.

ACTIVITY 15.2

Do all objects reflect the same amount of light ?

Check using a piece of glass, a mirror and a white paper.

Hold the objects so that sunlight falls on them and project the reflected light on a wall. Record your observation for each object.

What difference do you see? Discuss.

ACTIVITY 15.3

Let us investigate the nature of image formed by a plane mirror.

1. Keep a candle in front of the plane mirror.
2. Observe the image of the candle in the mirror.
3. Place a screen behind the mirror.
4. Can we get this image on a screen?

No, We can not get the image.

Such an image which cannot be got on a screen is called a virtual image.

A virtual image is always erect.

The image formed by a plane mirror is always virtual and erect.

ACTIVITY 15.4

1. Shall we stand in front of a mirror and observe our image. Is it bigger or smaller?

2. Gradually move away from the mirror. What happens to the size of the image? Does it change?

The size of the image remains unchanged.

The size of the image formed by a plane mirror is always equal to the size of the object.

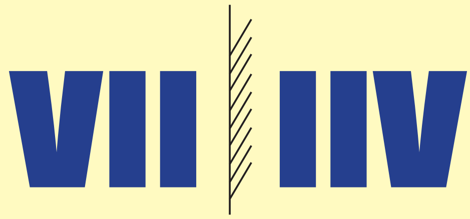
HAVE FUN

How will you see your cat hiding in the next room without entering the room?

Just hold a mirror at the doorway. Look! Your cat can be seen inside the mirror.

ACTIVITY 15.5

1. Let us take a thick white paper and write VII
2. Keep it in front of a mirror.
3. It appears as IIV in the mirror.
4. There is a side to side inversion.



5. Now stand in front of the mirror and touch your nose with your right hand. What do you see in the mirror?
6. Your image appears in the mirror; but touching the nose with the left hand.

You will find that in the mirror right appears as left and left appears as right. This property is known as **lateral inversion.**

7. Does the image appear upside down? No! the image is erect.

The image formed by a plane mirror is always laterally inverted.

Have you ever noticed strange letters in front of an ambulance?

Actually it is nothing but the word AMBULANCE written such that drivers in vehicles ahead can read the word properly in their rear view mirrors.

Fig 15.3. Ambulance

ACTIVITY 15.6

(i) TƎIUϘ ꟼƎƎꓘ

(ii) ИWOD TIƧ ƎƧAƎJꟼ

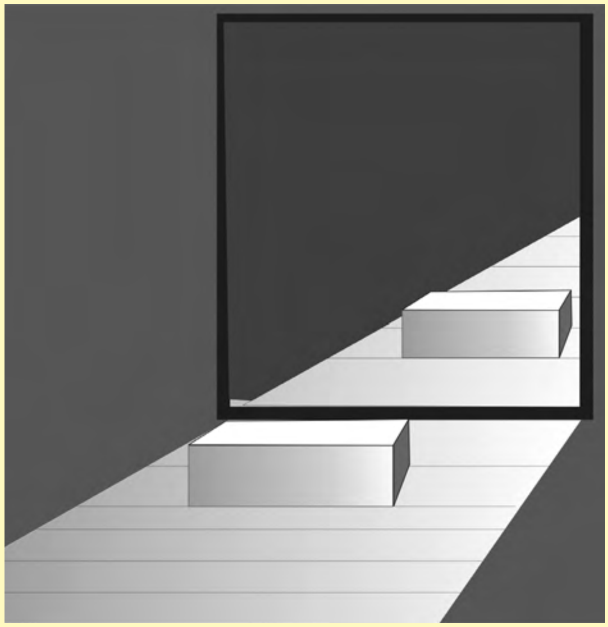
1. What do these mirror messages say?
2. Write your own mirror messages.

MORE TO KNOW

To see the full size image the mirror should be at least half your height.

ACTIVITY 15.7

1. Place a strip of plane mirror on a line on the graph sheet.
2. The image of the graph sheet is seen inside the mirror.
3. Place an eraser or sharpener at the boundary of the second line.
4. Note the position of the image inside the mirror.
5. Repeat by placing the eraser at different positions and observe the image position each time.
6. Is there any relation between distance of the image from the mirror and that of the object in front of it?



The image is formed at the same distance behind the mirror as the object is in front of it.

15.3. SPHERICAL MIRRORS

Kannan and Kamala were waiting for their dinner. Kannan lifted up his new steel plate and saw his image in it. He told Kamala, “I can see my image due to reflection formed on the plate. We learnt this in our class today”.

Kamala took up a new steel spoon and said “Look Kannan. I can also see my image. This spoon also acts as a mirror”.

So mirrors need not necessarily be plane. Curved surfaces can also act as mirrors.

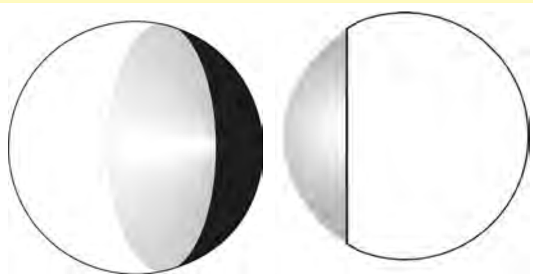
Look at your reflection in a polished steel spoon. Do both surfaces of the spoon give the same kind of image?

ACTIVITY 15.8

Provide students with samples of different kinds of mirrors and instruct them to examine the surfaces.

They will recognize that some mirrors have a plane reflecting surface, some others have a bulged reflecting surface and some have hollow reflecting surfaces.

The mirror with the bulged reflecting surface is called a convex mirror and the mirror with the hollow reflecting surface is called a concave mirror. These are known as curved mirrors.



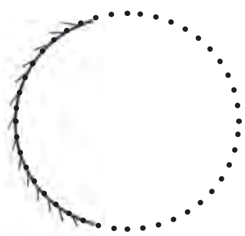
Concave mirror Convex mirror

Fig 15.4.

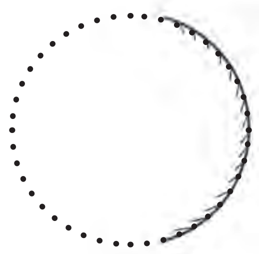
Representation of mirrors in diagrams

Fig 15.5.

Concave mirror



Convex mirror



Self check

Let us complete the spheres with curved mirrors b & c forming a part of it.

Any curved surface is a part of a sphere. Hence convex and concave mirrors are referred to as spherical mirrors

Self Check

Let us take a rubber ball and cut a portion of the ball with a knife. The inner surface of the cut portion is concave while the outer surface is convex.

Are you now convinced that concave and convex mirrors are a part of the sphere?

What happens when light falls on spherical mirrors?

Concave mirror makes the light to meet at a point after reflection (converges) and convex mirror diverges the light.

ACTIVITY 15.9

Let us hold a concave mirror facing the sun. Try to focus the light reflected by the mirror on a sheet of paper. Adjust the paper till you get a sharp bright spot on it. The bright spot is, in fact, the image of the sun.

The image formed on the paper or screen is called a real image.

Virtual images cannot be formed on the screen.

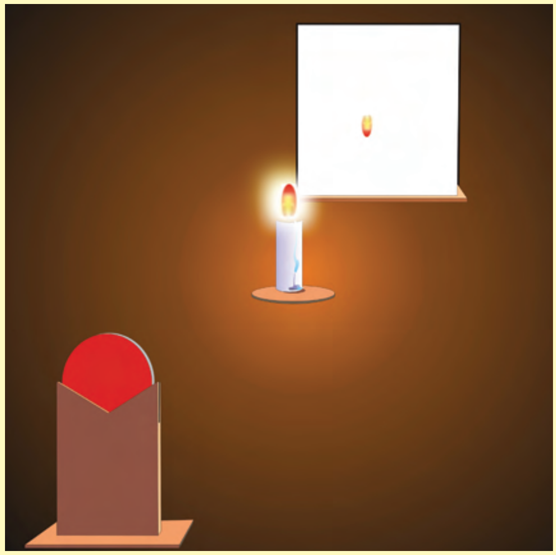
MORE TO KNOW

Mirrors are used in lighthouses. They reflect light a long way to help ships at sea.

ACTIVITY 15.10

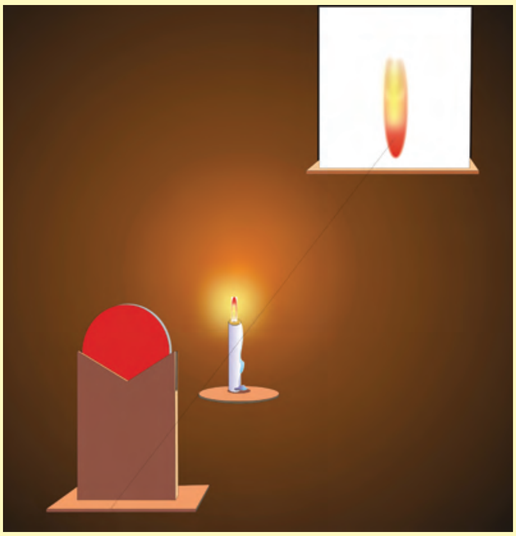
Let us try to obtain the image of a candle flame formed by a concave mirror on a screen.

Let us fix the concave mirror on a stand and place it on the table. Paste a piece of white paper on a cardboard of size 15cm X 20cm. This will act as a screen.



Keep a lighted candle on the table at a distance of 50 cm from the mirror. Move the screen till a sharp image is obtained.

Is the image real or virtual? Is it bigger, smaller or of the same size as the flame?



Now move the candle towards the mirror and place it at different distances from the mirror. In each case try to obtain the image on the screen.

Record your observations.

We see that the image formed by a concave mirror on the screen is a real and inverted image. It may be smaller or larger or of the same size as the object.

When the object is placed very close to the concave mirror, an erect and enlarged virtual image is formed inside the mirror.

ACTIVITY 15.11

Let us fix the convex mirror on a stand and place it on the table. Keep a lighted candle in front of the mirror. Try to get an image on the screen. Is it possible?

It is not possible to get an image on the screen. The convex mirror diverges the light. Therefore a virtual image, smaller than the object is seen inside the mirror.

What do you understand?

Convex mirrors form only virtual images that are diminished in size.

Uses of spherical mirrors:

Used as reflectors in car headlamps and telescopes.

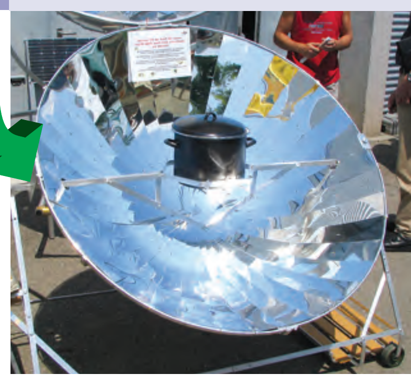
Used as shaving mirrors

CONCAVE MIRROR

CONCAVE MIRROR

Used by Dentists and ENT doctors to focus light on parts to be examined examined.

Used in solar cookers to converge the sunlight on food to be cooked .



CONVEX MIRROR

Used as rear view mirrors in automobiles since it has a wide field of view.

Used to watch over a large area.

15.4. SUN LIGHT – WHITE OR COLOURED?

Fig 15.6.

Have you seen the rainbow in the sky? The rainbow is seen as a large arc in the sky with many colours only when it rains.

The rainbow is a spectacular demonstration of white light as a combination of many colours.

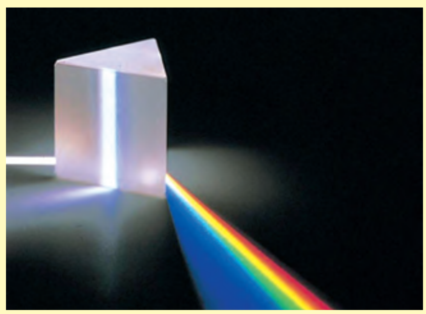
Rainbows occur when sun light from behind the observer falls on water droplets. So, we infer that sun light consists of many colours.

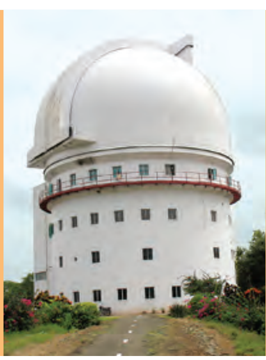
ACTIVITY 15.12

Let us take a glass prism. With the help of a mirror reflect a beam of sun light on one face of the prism.

The light coming out of the other face is made to fall on a white screen or wall.

We see colours similar to those of the rainbow. This proves that sun light consists of many colours.





Interesting Fact:

Kavalur observatory located in Javadu Hills (Vellore Dist) in Tamil Nadu has one of the largest reflector telescope in Asia.

How many colours are present?

When observed carefully, there are seven colours, though it may not be easy to distinguish all of them.

The colours are Violet, Indigo, Blue, Green, Yellow, Orange and Red represented as **VIBGYOR.**

What is dispersion?

You have observed that white light is made up of seven colours, it is possible to split it in to its constituent colours. Thus, the splitting up of white light into its seven constituent colours is called dispersion.

This band of colours is called a spectrum.

Can these colours be mixed to give white light?

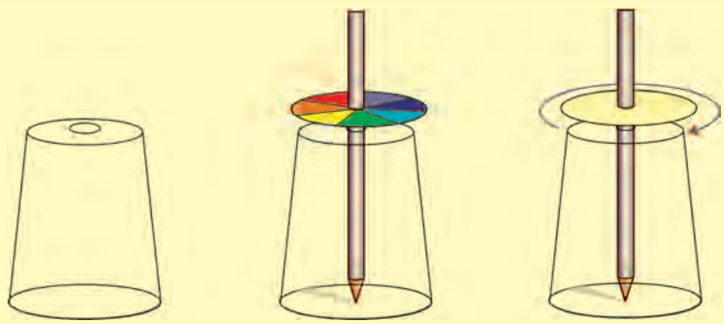
Yes, this can be done with the help of Newton's disc.

Newton's disc is a circular disc with segments painted in the seven colours of the spectrum. The disc is supported on a stand. It is provided with a handle to rotate the disc.

When the disc is rotated fast, the colours disappear and the disc appears almost white.

Fig 14.7. Newton's disc

EXPERIMENT



Let us make a Newton's disc.

1. Cut out a disc from white cardboard.
2. Using a protractor, divide the disc into seven equal sections.
3. Paint or colour each section with any one of the seven colours of the spectrum.
4. Make a hole in the centre of the disc. Push a long pencil or long knitting needle through it.
5. Spin the disc as fast as you can.When the disc spins very quickly the colours merge. We see only white.

EVALUATION

1. Write five English letters that appear the same even after lateral inversion. (Example : H)

2. A boy stands 1m in front of a mirror. He moves 50cm forward towards the mirror. What is the distance between the boy and his image?

3. Imagine that you are standing in front of a mirror in a dark room. You want to use a torch light to see your image in the mirror. Suggest a method to use it properly.

4. Write your name along with the names of 3 friends on a separate sheet of paper. Observe the images inside a plane mirror. How many letters are laterally inverted? How many are vertically inverted?

5. Identify the nature of the mirrors by observing the image formed by them.

(a) ---------------------

(b) ---------------------

(c) ---------------------

PROJECT

1. Hold a concave mirror towards a distant object. Adjust the position of the concave mirror till a clear and well defined image is obtained on the wall or a screen. Measure the distance from the concave mirror and the wall or screen. Repeat for different objects and record your observations.

Object	Distance

This is called **'focal length of the mirror'.**

FURTHER REFERENCE

Books

1. Young Scientist Vol-4 - World Book. Inc

Websites

http://www.arvindgupta.toys.com

http://www.dmoz.org/kidandteens/schooltime/science.com