05

Properties, uses and interactions of substances

By the end of this Chapter, you will be competent to...

- classify substances using different criteria.
- investigate the interactions of various substances with water, acids and bases.
- use concepts of relative density in everyday life.
- use the heating effect of substances productively.
- investigate the chemical changes in substances due to heat.
- investigate the nature and effects of static electricity.
- select suitable substances to manipulate electricity to suit our needs.
- build up simple electrical circuits.
- identify the chemical nature of substances used in daily life.

5.1 Classifying substances using different criteria

We come across many substances in our daily life. Our environment as well as our bodies and bodies of other organisms too are made up of a variety of substances.

Let us try to classify these substances using different criteria.

5.1.1 Classifying substances according to their physical state

Consider liquid water, ice and water vapour. You already know that these represent various states in which water exists. Ice is water in the solid state, liquid water and water vapour are the liquid and gaseous states of water respectively.

Substances in the solid state are hard, they have a definite shape, cannot be compressed by an external force. Therefore they have a definite volume. Things such as stones and wood can be classified as the things in the solid state.

There are several specific features in the substances in the liquid state.They flow easily, hence have no definite shape. They take the shape of the vessel holding them. (Fig.5.1) Liquids too cannot be compressed by an external force. Hence liquid has a definite volume. Things like water, coconut oil and diesel show these properties, hence these can be classified as the things in the liquid state. Substances in the gaseous state also can flow like liquids. Hence have no definite shape. Gases can be compressed by an outside force. Therefore their volume is not definite and would always take the volume of the vessel holding it. (Fig.5.2) Oxygen, nitrogen, water vapour and air show the above properties.

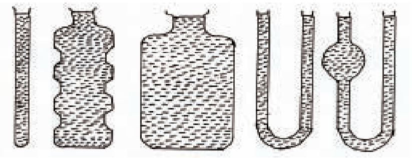


Fig.5.1 - Liquids take the shape of the vessel

Fig.5.2 - A gas (iodine vapour) takes the volume of the vessel

They can be classified as in the gaseous state.

Substances can be classified as solids liquids and gases according to the state they exist.

Now, let us summarise the properties of substances in the three states of matter in Table 5.1.

Solids	**Liquids**	**Gases**
Hard.	Not hard.	Not hard
Has a definite shape.	Has a flowing nature.Hence no definite shape. Takes the shape of the vessel.	Has a flowing nature. Hence no definite shape. Takes the shape of the vessel.
Cannot be compressed by external force. Hence fixed volume.	Cannot be compressed by an external force.Hence fixed volume.	Can be compressed by external force.No fixed volume. Takes the volume of the vessel.

Table 5.1 Properties of solids, liquids and gases

Assignment 5.1

Classify the following substances on the basis of their physical state using the properties given in the above table. Kerosene oil, LPgas, eraser, iron nail, milk, petrol, air, plate, bottle, carbondioxide, paint brush, spoon

5.1.2 Classifying substances according to their composition

Many of the substances around us can be considered as mixtures of pure substances.

An important property of mixtures is that their composition can vary. According to their composition mixtures can be homogeneous or heterogeneous.

Homogeneous mixture

In this type of mixture, the appearance throughout the liquid is the same and the composition in the entire mixture is the same. Examples are salt solution, sugar solution and air. Composition and appearance throughout the liquid is the same.

Heterogeneous mixture

In this type of mixture , the appearance, composition and properties are different from place to place. Here it is possible to identify the components individually. Examples of heterogeneous mixtures are sand and water, sand and iron powder. The components in such a mixture can be separated by physical methods.

Pure substances

A substance which has a definite composition is a pure substance. You already know that salt solution is a homogeneous mixture. The pure substances in it namely, salt and water can be separated by physical methods to get pure salt and water. Salt and water have a definite composition of their own, therefore they are pure substances.

Assignment 5.2

Identify the components of the mixtures given below.
Air, unpolished rice, salt water, river water, brass.

Elements and compounds

Substances with a definite composition can be further classified as elements and compounds.

Compounds

A compound is a pure substance, hence has a definite composition and made-up of several elements. Also, a compound can be separated into the elements of which it is made. Example, water can be separated into hydrogen and oxygen of which it is made. Common salt (sodium chloride) can be separated into elements, sodium and chlorine by chemical methods. Therefore water, salt, glucose and potassium permanganate are compounds.

Elements

Elements are those substances which cannot be broken down further. Hydrogen, sodium, carbon, mercury, copper are elements.

Assignment 5.3

Find out some compounds in your home and state the elements that they are made.

5.1.3 Metals and Non-metals

Metals

Most metals are solids. They have a shiny surface. They can be hammered into shapes (malleable). They can be drawn into wires(ductile).They make a ringing noise when you strike them (sonorous). Most of those have high melting points and boiling points. They are good conductors of heat and electricity. Gold, silver, copper, iron, aluminium are examples of metals.

Non-metals

Non-metals do not have shiny surfaces. They cannot be hammered nor drawn into wires. They break up into pieces if you try to hammer them (brittle). Compared to metals they have low melting and boiling points. Their ability to conduct heat and electricity are weak. (Except Carbon), sulphur, phosphorus, nitrogen show the above properties- hence non-metals.

5.2 Interactions of various substances with water, acids and bases

5.2.1 Interactions with water

If you were to be asked what the most commonly used liquid in your daily life, the answer would be invariably ‘water’. Water is needed for drinking, bathing, washing, cooking, watering plants and also in various industies (Fig.5.3). The reason for such a wide scale usage is because of its solvent property. Many solids, liquids and even gases dissolve easily in water. Some substances have water in them. Also, some substances react chemically with water. Let us consider some such properties of water.

Fig.5.3 -Uses of water

Solvent property of water

Activity 5.1

- Place a few test tubes on a test tube rack, and fill 1/3 of each with water.
- Take equal quantity of the followings:
  sugar, salt, urea, sand, wheat flour, baking soda, condys, copper sulphate, soap, washing blue, kerosene oil, coconut oil, lacquer, clay, paraffin.
- Put each of them respietively and separately into the test tubes and shake well. You will observe that some will dissolve and some will not.
- Record your observations in a table.

According to the above activity,

- Condys, copper sulphate, sugar, salt, and urea will dissolve well in water to form a clear solution.

- Kerosene oil, coconut oil, sand, washing blue, calcium carbonate, lacquer, and paraffin will not dissolve in water.
- Clay and soap will form a turbid solution when shaken.

Therefore we can conclude that certain substances dissolve in water to give a clear liquid, while some others show no reaction with water.

Assignment 5.4

Find out the instances where the solvent property of water is used in daily life.

Find out suitable solvents for insoluble substances such as kerosene oil, coconut oil, lacquer, polystyrene and polishes.

When any substance dissolves in water, the particles spread out evenly in the water. Hence the solution is clear, and has the same appearance and composition throughout the solution.

Let us examine another way in which substances interact with water. Certain substances which form crystals enclose a certain amount of water particles in them. This is called hydration. Compounds made by hydration are called hydrates. When a hydrated substance is heated strongly, water in it is removed and it becomes anhydrous. Examples of some hydrated compounds are hydrated copper sulphate, hydrated calcium chloride, hydrated sodium carbonate.

Activity 5.2

- Put some blue copper sulphate crystals into a boiling tube and heat.
- Note the colour change of the crystals.
- Add some water again to the product and observe.

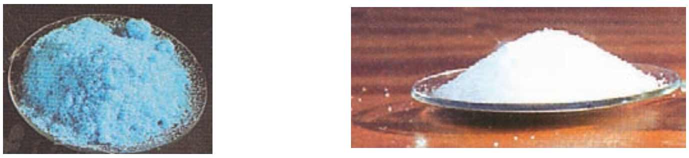


Fig. 5.4 - Copper sulphate , before heating and after heating

Now you have seen that the blue copper sulphate crystals turned into a white powder on heating. (Fig.5.4).If you add water to this it will turn blue again.

$$\begin{array}{c}\text{Hydrated copper sulphate}\\ \text{(Blue)}\end{array} \xrightleftharpoons[\text{add water}]{\text{heating}} \begin{array}{c}\text{Anhydrous copper sulphate}\\ \text{(White)}\end{array}$$

This shows that the blue colour of the copper sulphate crystals was due to the water particles in it.

Do you know?

In the laboratory anhydrous copper sulphate is used to identify water. Its colour will change from white to blue.

Anhydrous calcium chloride can absorb the water vapour of the air. Hence it is used for removing water vapour from gases.

Substances that react chemically with water

Certain substances react chemically with water and form new substances. Certain metals, non-metals and gases react with water in this manner.

Activity 5.3

Find samples of sodium, magnesium, zinc, iron, copper and aluminium.

Take some small **beakers** with the same volume of water. Put a tiny piece of **sodium** (about a grain of rice) and other metals to the water and observe what happens. (This activity should be done with the guidance of the teacher, since sodium reacts violently with water).

Sodium reacts violently with water. It makes a hissing sound, rushes around the water surface and turns into a small ball.

Advice!

Sodium, reacts with water very rapidly. As well, this activity should be conducted only under your teacher's guidance. Be careful not to touch the mettle and put only a tiny peice into water.

Magnesium, zinc, copper, iron, aluminium do not react with cold water. But if you carefully heat the beakers, magnesium will react slowly and gas bubbles will evolve. If this gas is collected in a small test tube and tested with lighted splint it will go "pop" showing that the gas evolved is hydrogen. Accordingly, sodium, potassium and calcium react with cold water. Magnesium reacts only with warm water. Copper, iron, aluminium and zinc do not react with cold or hot water.

Reaction of water with quick lime

Take a little quick lime to a beaker and add a little amount of cold water little by little carefully. There will be bubbling, a gas will be given off, and the beaker will get hot.
This shows that there is a chemical reaction taking place.

Do you know?

Quick lime is calcium oxide
Quick lime reacts with water and gives calcium hydroxide (slaked lime) which is a basic substance.
Slaked lime used in construction work is prepared by adding water to quick lime in this manner.

Reaction of calcium carbide with water

When water is added to calcium carbide, a reaction takes place and a gas called acetylene is produced. Acetylene is mainly used in producing the oxy- acetylene flame which was used in welding purposes. Acetylene gas is also used to speed – up the ripening process of fruits. (Fig 5.5)

Advice!

Reaction between quick lime and water gives off a lot of heat

Fig. 5.5

Oxy-acetylene flame

5.2.2 Reactions of various substances with acids

1. Acid - metal reactions

Certain metals react with acids. To find out the metals which react with acids, conduct the following activity.

Activity 5.4

Take a number of test tubes and place them on a test tube rack. Add equal quantities of dilute hydrochloric acid to each.

Add small pieces of magnesium, zinc, iron, aluminium, copper and tin to each test tube and observe.

Tabulate your observations.

According to the above activity

- Magnesium, aluminium, zinc, iron and tin react with dilute hydrochloric acid and give off hydrogen gas.
- Copper does not give any reaction with dilute acids.

Advice!

Sodium, potassium and calcium reacts with acids very rapidly. **Hence avoid putting these metals to acids.**

2. Acid - carbonate reactions

Coral, snail shells and egg shells are made up of calcium carbonate. If you place a little of each of these in a test tube and add a little dilute acid to each, bubbles of a gas will be produced and the particular material will gradually dissolve away. The gas given off is carbondioxide.

This shows that the carbonate in the above substances reacted chemically with the acid.

Do you know?

Marble too contains calcium carbonate. Hence acid rain will damages statue and buildings made of marble.
e.g.- Taj Mahal

3. Acid - base reactions

Acid react chemically with basic substances.Here the acidic property of the acid is neutralized by the basic property of the base and a neutral salt is formed.

Example: Hydrochloric acid reacts with sodium hydroxide which is a base. Then both get neutralized to form sodium chloride and water.

Acid + Base $\longrightarrow$ Salt + water

Activity 5.5

Take 25 ml of sodium hydroxide solution into a small beaker. Add a few drops of phenolphthalein indicator to it. (Phenolphthalein goes pink in a basic medium and colourless in acidic medium)

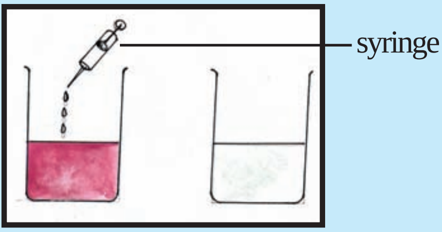


Fig. 5.6 - Neutralisation reaction of acid - base

Take some dil. hydrochloric acid to a syringe and add it to the sodium hydroxide drop by drop. Stop adding any more acid when the pink colour of the solution disappears. Now heat the product and allow it to vapourise. Record your results.

Here, the sodium hydroxide in the beaker has got neutralized by the acid. A neutral salt, sodium chloride has been formed. When it is vapourised crystals of common salt remains. Hence in an acid–base neutralization, salts are formed.

Assignment 5.5

Collect information regarding the use of acid-base reactions in daily life and record them.

5.2.3 Reactions of various substances with bases

You may have seen a rubber balloon being filled with air and fly up. Do you know what substances that were used to prepare hydrogen? You can try this out.

Activity 5.6

Put some caustic soda, pieces of aluminium and water into a bottle. Fix a balloon to the mouth of the bottle. Place the bottle in a vessel of cold water to prevent the bottle getting too hot by the reaction. The balloon will gradually get filled with gas. When it is filled you can tie the mouth of the balloon and fly it up.

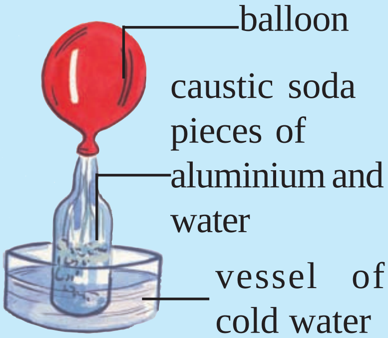


Fig. 5.6 Reaction of aluminium with caustic soda

Caustic soda reacts with aluminium metal and gives off hydrogen. Hydrogen is lighter than air, hence rises up. Metals such as tin, zinc also react with bases in a similar way. They react with acids also.

We often come across instances where water reacts with acids and bases. Some of them are useful to us and some are not so useful.

5.3 Phenomena regarding relative density

We know that certain objects float on water and some sink in water. In order to find out whether an object will float or sink, we can compare its density with the density of water.

5.3.1 Relative Density

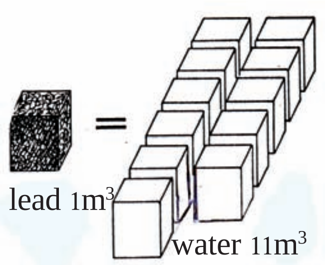


fig. 5.8 - Comparison of the density of water with that of

Relative density of a substance is the density of the substance relative to that of water.

You already know that the density of water is 1000 kgm^{-3}. Density of lead is 11000 kgm^{-3}.

That means density of lead is 11 times that of water.(Fig 5.8) Therefore, relative density of lead is 11. We can use the following relationship to find the relative density of a substance.

$$\text{Relative density} = \frac{\text{Density of the substance}}{\text{Density of water}}$$

According to the above relationship, let us find the relative density of petrol.

Solved problem:

Density of petrol is 800 kgm^{-3}. Find the relative density of petrol.

$$\text{Relative density of petrol} = \frac{\text{Density of petrol}}{\text{Density of water}}$$

$$= \frac{800 \text{ kgm}^{-3}}{1000 \text{ kgm}^{-3}}$$

$$= 0.8$$

Therefore, relative density of petrol is 0.8. Since relative density is a relative number which has no units.

Let us see how substances behave when put in water.

Activity 5.7

Put some pieces of iron, lead, glass, candle wax, cork and light wood into the water vessel and observe.

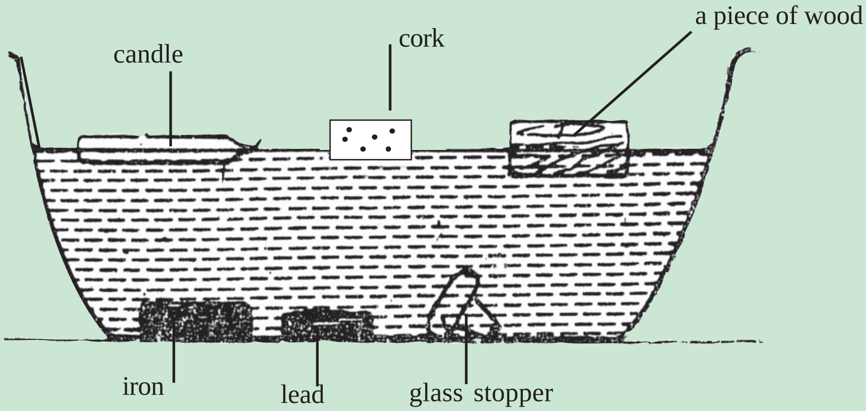


Fig 5.9 - How various substances behave in water

Substance	Relative density
1. Water	1.0
2. Iron	7.9
3. Lead	11.0
4. Candle wax	0.9
5. Glass	2.6
6 Cork	0.26
7. Mahogany	0.85

Table 5.2 - Relative density of certain substances

You will see that candle wax, cork, light wood float on water, while iron, lead and glass sink in water. The relative densities of the above substances are given in Table 5.2. Compare your observations with this data. Substances with relative density more than 1 will sink and those less than 1 will float.

5.3.2 Immersing floating and half immersing

Let us perform following activity to investigate above phenomenon.

Activity 5.8

- Take a glass vessel and pour about 1/3 water into it.
- Carefully put an egg into it. Observe what happens.
- Keep on adding table salt into the water and observe the position of the egg.
- Add more salt and observe the position of the egg.

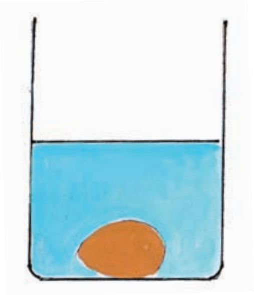


Fig 5.11

Egg is sunk

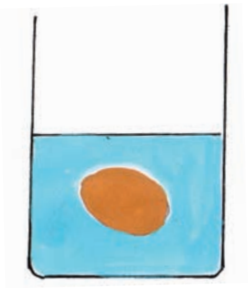


Fig. 5.12

Egg is immersed

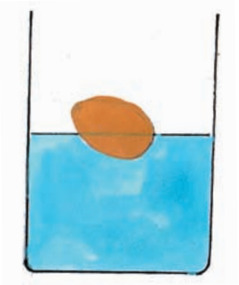


Fig 5.13

Egg is floating on the surface

As in Fig 5.11, the egg is at the bottom of the vessel, and as we go on adding salt, it comes up and begin to float in water. When we add more salt, it floats on the surface of the salt solution. (Fig.5.13)

These observations can be explained on the basis of relative density. At first the relative density of the egg was greater than that of water, hence the egg went down. As salt was being added to the water, the relative density of the solution increased and later it becomes equal. Now the egg is submerged and floating (Fig 5.12). With more salt being added the relative density of the solution becomes more than that of the egg. The egg then floats on the water. (Fig 5.13)

5.3.3 Upthrust

When you got into a swimming pool or a lake you may have got a feeling of lightness of your body. How does this happen? The following activity will clarify this.

Activity 5.9

Tie an object by a piece of thread and weigh it as shown in the Figure 5.8.

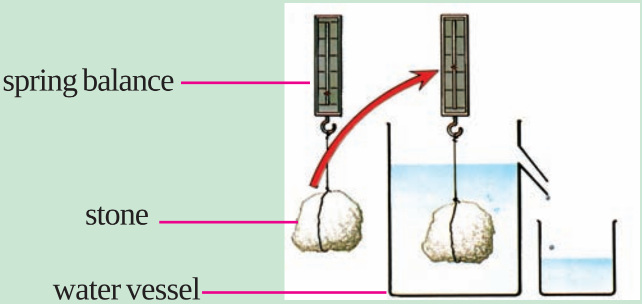


Fig 5.8 -Upthrust on an object

Now slowly lower it into a beaker of water and weigh it again. You will see that the weight indicated in the scale,

When the object is in water the weight is less than that when it is outside. Here the water seems to exert some force upwards on the object. This force exerted on objects immersed in water is known as **upthrust**.

Gases too exert a similar upthrust on objects.

Do you know?

- You have already heard of submarines.
- Submarines can go over the water as well as under the water.
- When a submarine wants to come up to the surface, it replaces the water in the tanks with air.
- Then the upthrust increases and the submarine comes up.
- When it wants to go under water, it fills the tanks again with water.

5.4 Chemical changes in substances due to heat

Heat causes many chemical changes in substances. In a chemical change the products formed are totally different to the substances used at first (reactants). **Combustion**, **thermal decomposition** and **thermal degradation** are examples for some of these chemical changes.

5.4.1 Combustion / Burning

Combustion is the burning of some substance. Here the burning substance undergoes some chemical reaction with oxygen. Let us see the conditions needed for combustion.

Conditions needed for combustion

It was a rainy day with strong winds. Sunil was doing his home work, but the lights went off. He lit a candle. He saw that the candle too was getting blown off by the wind.

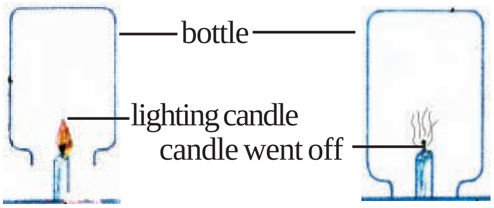


Fig 5.14

He quickly covered the candle with a glass bottle nearby. The flame started going down and finally went off. He opened the bottle, lit the candle again and closed it (Fig 5.14). Immediately the candle went off again. To find the answers to this let us do the following activity.

Activity 5.10

Find a wide beaker in which a tall glass can be kept.Fix a candle at its bottom and half fill it with water. Light the candle and invert the tall glass over it. (Fig 5.15). Observe what happens.

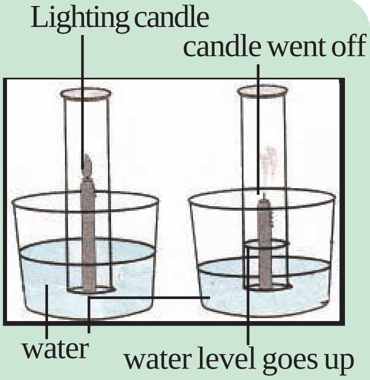


Fig 5.15 - Covering a lighted candle with a vessel

You will see that the candle goes off, and water rises up in the tall glass. Water entering the glass shows that some portion of the air inside the glass was removed, and the water took its place. This shows that the candle burnt some part of the air.

Activity 5.11

(This Activity should be done only under the guidance of your teacher)

- Find samples of combustible substances such as kerosene oil, petrol,wine spirit, coconut shells, wax, wood splints.
- Place each separately inside bottle tops.
- Hold each top to the flame, one by one using a pair of tongs.
- Find the time taken for each to catch fire.

Petrol and wine spirit will catch fire as soon as they are taken close to the flame. Kerosene oil caught fire after a little heating. Wax took longer. Wood and coconut shells took a much longer time. This shows that substances need certain temperatures to start burning. The minimum temperature to which a certain substance should be warmed up to be taken place the combustion is the ignition temperature of that substance.

Accordingly, for any substance to burn not only should there be oxygen, but the burning material should be at the ignition temperature. Table 5.3 gives the ignition temperatures of certain substances.

Substance	Ignition temperature ^{0}C
petrol	49
kerosene oil	95
ethyl alcohol	79.9
Sugar	385

Table 5.3- Ignition temperature of some substances

Do you know?

Ignition temperature of substances which evaporate easily are very low. Examples are petrol. wine spirit and thinner. This is why a little kerosene oil is added to start off a wood fire.

Products of combustion

Let us do the following activity to identify the products of combustion.

Activity 5.12

Light a candle and close it with an empty jam bottle as in Fig 5.16. When the candle goes off, remove the jam bottle and add some lime water into it and close the bottle. Shake the bottle and observe.

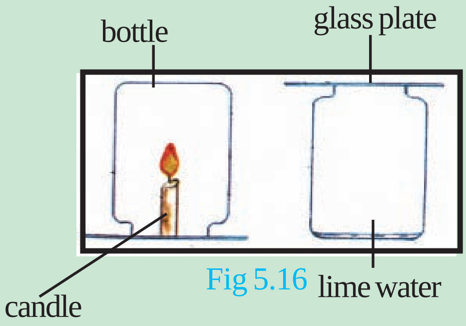


Fig 5.16

You will see that the lime water turns milky. Carbondioxide turns lime water milky. So we see that carbondioxide is produced in combustion.

Are there any other products of burning?

Activity 5.13

Take a dry jam bottle.

Light a candle inside it. Close the mouth of the bottle with a glass cover.After the candle goes off, remove the cover.Light the candle again and repeat the previous step again. Now place some anhydrous copper sulphate on the spot above the flame and observe.

The copper sulphate goes blue, showing that water had been formed during combustion.

We now see that the main products of combustion are carbondioxide and water vapour.

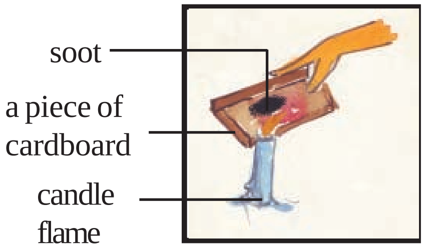


Fig 5.17 - Soot as a byproduct of burning

Burning sometimes produces soot too.

If you place a cardboard over a candle flame, a ring of soot will be formed on it. Soot is carbon, so carbon is a by-product of burning. (Fig. 5.17)

We can see that a candle flame produces light. We can also feel the heat produced. This shows that burning produces light energy and heat energy too. We can get a blue flame or a yellow flame from a Bunsen burner or a gas stove. Have you observed the difference between the two flames? We can get a yellow flame from the Bunsen burner by closing the air vents at the base of the burner. (Fig. 5.18). This flame has soot. It is because there is no sufficient air for burning.If we open the air vents we get a blue flame. This has no soot, because now there is sufficient air for burning. Which flame gives more heat? Let us do the following activity to find out.

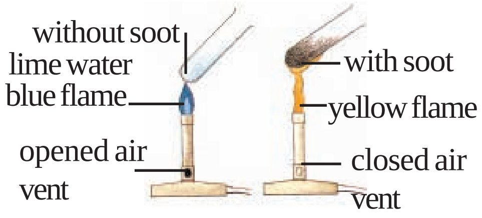


Fig. 5.18- How to get a blue flame and a yellow flame from a bunsen burner.

Activity 5.14

Take equal quantities of water into two similar boiling tubes. Place one over a blue flame and the other over a yellow flame. Note the time taken for the water to boil in each case.

The water heated by the blue flame boiled faster than that heated by the yellow flame. This shows that the blue flame gives a stronger heat.

Fuels

Fuels are substances which are burnt to get heat energy or light energy.Some common fuels in our country are wood, L.P gas, petrol. kerosene oil, diesel, coconut oil and wine spirits.

Do you know?

- In the past, trains were run by energy from coal.(Fig5.19).
- The energy source for the power station at Norochcholai is coal.

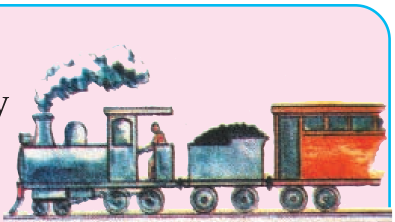


Fig. 5.19
A coal powered train

Assignment 5.6

Discuss with your group members, identify and record the fuels that are used; in generating electricity; in vehicles; in lighting lamps, baking bread.

Manipulating combustion effectively

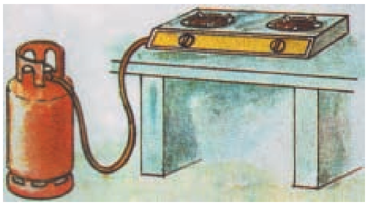


Fig 5.20 - A gas cooker

We already know that blue flame is the best for producing heat. Hence it is important to get a soot- less, blue flame for our cooking. In most houses gas cookers are used for cooking purposes. In order to get the highest efficiency from our gas cookers ;

- We must be sure that the air vents are sufficiently open.
- Any soot collected should be removed.

In order to improve the efficiency of a three-stone firewood hearth, the improved double - burner hearth could be used.

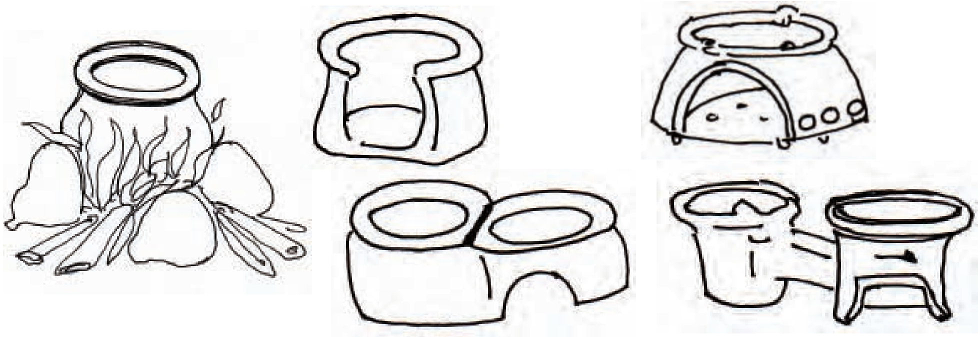


Fig 5.21 -Traditional three stone hearth and improved hearths

You cannot get a blue flame from wood. Yet if we can take measures such as stacking up the wood enabling to get sufficient air, drying the wood well, splitting the wood into small pieces we can make the use of wood more productive.

Dangers of combustion

Combustion can cause problems too. Bush- fires, houses and other materials catching fire are some such problems. These can be controlled by removing one or more of the factors which promote burning. There are many ways, such as ;

- Spraying water over the fire. This prevents the burning substance reaching the ignition temperature. (except in an oil related fire)
- Covering the burning material with gunny bags etc, which cuts off the oxygen supply to the fire and prevents further contact with air.
- Putting sand over a fire caused by oil can be effective as it not only cuts off air but also prevents the fuel reaching the ignition temperature.

5.4.2. Thermal decomposition

Thermal decomposition is the breaking down of any compound chemically, by the heat.

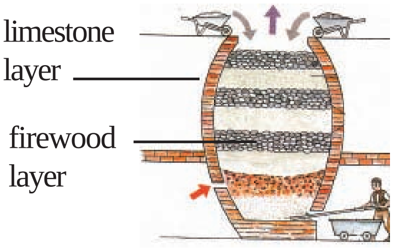


Fig 5.22 Thermal decomposition of limestone

In the production of quick lime a thermal decomposition takes place. Coral or sea shells are used in lime kilns to make quick lime.The intense heat produced by the burning wood decomposes the coral to form quick lime. Carbondioxide is formed as a by-product. This is released to the surroundings. Let us try out an experiment to observe an incident of thermal decomposition.

Activity 5.15

- Take a little condys(potassium permanganate) to a boiling tube.
- Hold it by a holder and heat it over a flame.
- Test the gas coming out with a burning splint.
- Place the remainder in the boiling tube on a piece of paper and observe.

Fig.5.23 - Heating condis

When the burning splint is held near the boiling tube, it burns brightly. The substance left in the boiling tube is very different from the original. Therefore we see that condys has undergone thermal decomposition on heating to form oxygen gas and another product.

5.4.3 Thermal degradation

You have often seen the paint on the walls exposed to direct sunlight gets discoloured or the splitting of a PVC tube when exposed. These are due to chemical changes caused by exposure to heat of the sunlight. Such changes are called thermal degradations.Some examples observed by a set of pupils are stated below:

Objects that are observed	Observation
1. Old PVC gutter and a new PVC gutter.	Colour of the old gutter has faded. Its malleability decreases and brittleness increases.
2.An old, coloured dress which was exposed to sunlight very often.	Colour has faded in the dress. But colour of the inner seam has not faded.
3.The paint layer that has been applied on an outer wall.	Colour has faded.
4.A polypropylene rice bag exposed to sunlight for a long time and a new one.	The old bag is broken into small pieces while the new one is not.
5.A coloured poster pasted on a wall long ago.	Colours become very pale and the paper is faded and become brittle.

These show that most substances when exposed to sunlight for a long time undergo chemical changes due to thermal degradation.

It seems as if thermal degradation is a disadvantage to us. If so what can we do to reduce thermal degradation? Not drying our clothes in strong sunlight, putting up sun shades, bamboo curtains in areas of the house where direct sunlight falls and painting the outer walls of houses with paints that are not affected by the heat of the sun are some steps you can take. The weather-shield and weather coat paints in the market are some paints that could be used. Polythene too undergoes thermal decomposition. This is an advantage to us, but the polythene type has to be specially made for this.

5 . 5 Thermal properties of substances and their usages

The changes and the behaviours shown by a substance due to heat is called the thermal property of that substance. Transmission of heat through substances, changes in the length and breadth of materials, change of state of substances are some thermal properties. Let us study some such properties and their uses.

Transmission of heat

Fig 5.24-Hot tea stirred with a metal spoon

If you put sugar into a hot cup of tea and stir it with a metal spoon, the upper end of the spoon will get hot.That is why the heat of the hot tea is transmitted up to your hand, along.(Fig 5.24).

Heat travelling from one place to another is called transmission of heat. Heat is transmitted in three ways, namely ;

1. Conduction 2. Convection 3. Radiation

1. Conduction

Let us observe conduction by an experiment.

Activity 5.16

Take a metal rod, about 20cm long. Fix some drops of wax at 4 cm intervals along the rod. Fix a pin to each of the wax drops. Hold and heat one end of the rod over the flame. Observe the wax drops.

Fig 5.25

You would have seen how the drops of wax fell off, one by one starting from the flame end. The wax melted because heat was transmitted to them.

The particles in the metal rod in contact with the flame, gets heat from the flame and passes it down to the next ones, and so on till it reaches your hand. Such a transmission of heat from one end of a metal to the other end without a movement of particles is called conduction. (Fig 5.26)

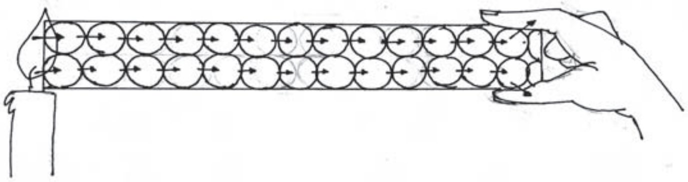


Fig 5.26 How heat travels from one particle to another in a metal

Do you know?

All metals conduct heat well. They are called conductors. Substances which do not conduct heat are called insulators. Glass, wood, cork, plastic, cloth, clay, ceramics, air, water, wool and polystyrene are insulators.

2. Convection

Let us conduct an activity to see how heat is transmitted through a liquid or a gas.

Activity 5.17

Fill a large beaker with water and place a crystal of condys at the bottom. Place the beaker on a tripod (Fig 5.27).Heat it and observe. In this activity, you will see that the purple colour of the condys spreads upwards as rays, and as they reach the wall of the beaker turn downwards and travel down. This happens because the water particles at the bottom got heated, got lighter and travelled upwards. The heavier, cold particles at the top go down to take their place.

Fig 5.27 - Convection currents in a liquid

These currents of water that get heated and go up, and the cold currents that come down are called convection currents. Due to these currents the water in the beaker gradually gets heated up. Here the particles themselves moved and transmitted the heat.
Let us see how heat transmits in a gas.

Activity 5.18

As shown in Fig 5.28 , place a lighted candle on a glass sheet and place a chimney over it. Place a T shaped Bristol board at the open end so that it gets divided into two sections.Bring a lighted joss stick close to the mouth of the section away from the candle. Observe what happens.

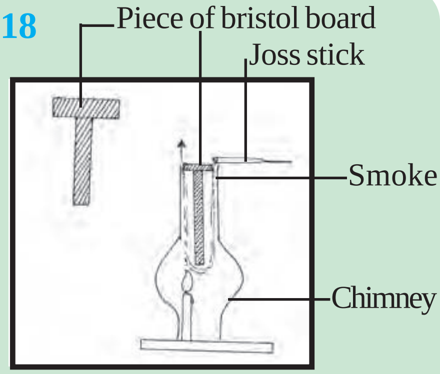


Fig 5.28

As heated air goes up through the section above candle, cold air comes down the other section. Smoke from the joss stick also travels along with the cold air and sets up a convection current. So, heat travels through a gas by convection currents.

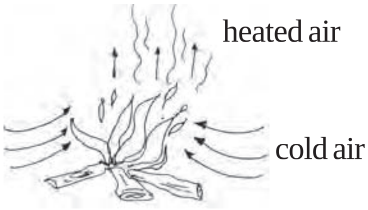


Fig 5.29- Convection currents

Convection currents near a fire can be easily felt. Here the heated air goes up and the colder air at the top comes down to take its place.(Fig.5.29).

3. Radiation

When we are near a fire we feel the heat. This occurs through another method of heat transmission called **radiation**. Radiation does not need a medium.Even when there is a medium, transmission takes place without the participation of the particles of the medium. Heat from the sun to the earth, travels through space which is a vacuum by radiation.

White or shiny smooth surfaces radiate heat easily, hence they absorb very little heat.

Do you know?

Since Sri Lanka is a country that gets sunlight well, the most suitable colour to paint our outer walls are light colours. Light colours absorb little heat of the sun, therefore prevents too much heating inside the house. White coloured clothes are best for those who were playing or working outdoors. Since white colour absorbs little heat, the discomfort to the body is less.

Changes in solids, liquids and gases due to heat

Change of state

You already know that substances can exist in three states, those are solids, liquids and gases. Any substance is capable of changing one state to another and it happens due to providing heat or removing heat. Example: If heat is given to a block of ice, it melts and becomes liquid water. If more heat is given, water becomes water vapour which is a gas.

$$\begin{tikzcd} \text{Ice (solid state)} \arrow[r, shift left, "\text{Heat given}"] & \text{Water (liquid state)} \arrow[l, shift left, "\text{cooling}"] \arrow[r, shift left, "\text{Heat given}"] & \text{Water vapour (gaseous state)} \arrow[l, shift left, "\text{cooling}"] \end{tikzcd}$$

Let us conduct the following activity to study more about changing the state of materials.

Activity 5.19

Take some samples of solids such as jak gum, Bee's wax, sugar, naphthalene balls, iodine, Camphor pellets and some liquids such as coconut oil, kerosene oil, water.Place each of them separately in bottle lids.Place all these over a metal plate and heat it over a flame.

Fig 5.30- Heating different solids and liquids

Observe the changes of each.

In this activity you will see that most of the solids used changed from the solid state to the liquid state, while those in the liquid state changed to the gaseous state.

Solid wax $\xrightarrow{\text{Heat}}$ **Liquid wax** $\xrightarrow{\text{Heat}}$ **Wax vapour**

But the iodine (solid) and naphthalene (solid) did not turn into a liquid but straight away became gases. The changes which took place can be stated in the following way:

Iodine $\xrightarrow{\text{Heat}}$ **Iodine vapour**

Camphor pellets $\xrightarrow{\text{Heat}}$ **Camphor gas**

A solid substance becoming a gas straight away without becoming a liquid is called sublimation. This happens only in certain substances.

Melting point and freezing point

How does a solid become a liquid? It happens at a definite temperature. Let us find out more things about it.

Activity 5.20

As shown in the Fig 5.31, place the bulb of a thermometer in the dissolving ice and note the temperature.

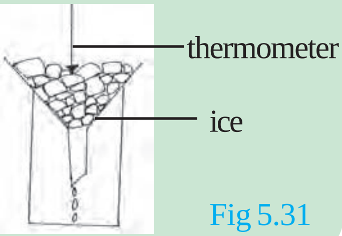


Fig 5.31

You will see that the ice becomes water at O^{0}C. This constant temperature is the melting point of ice. The opposite reaction to this, is that the temperature at which liquid water becomes ice is called the freezing point of ice. It too takes place at O^{0}C.

So the definite temperature at which a solid becomes a liquid is its melting point. The constant temperature at which a liquid becomes a solid is its freezing point. For any substance the melting point and freezing point are the same. Table 5.4 indicates the melting points of certain substances.

Substance	Melting point (^{0}C)
Ice	0
Paraffin wax	60
Sulphur	132
Lead	317
Iron	1539

Table 5.4 - Melting points of some substances

Boiling point

A liquid becoming a gas also happens at a definite temperature. This temperature is known as the boiling point. Let us find the boiling point of water.

Activity 5.21

Take some water to a boiling tube.Fix a thermometer in it as in Fig 5.32.Heat till the water boils. Note the temperature.

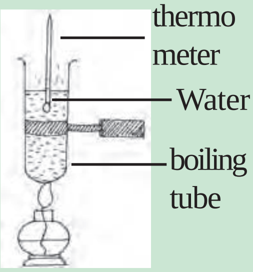


Fig. 5.32

When water is boiling the thermometer will show a temperature of 100^{0}C.This is the boiling point of water.

Substance	Boiling point ^{0}C
Water	100
Alcohol	77
Sulphur	444
Paraffin wax	80
Lead	1744
Iron	2900

Table 5.5 - Boiling points of some substances

Expansion of substances on heating

You may have often seen how a metal lid that cannot be opened, is easily opened by heating it a little over a flame. This is because , on heating the lid becomes slightly bigger. This effect of getting bigger on heating occurring in solids, liquids and gases is called **expansion**.

➢ Expansion of solids

Let us conduct the following activity to study the expansion of solids.

Activity 5.22

Make a loop out of wire just enough to hold a glass marble.Hold the wire loop to the yellow flame and heat.Now place the marble over the loop.Record your results.

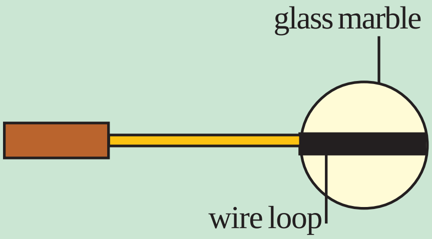


Fig 5.33 - Expansion of a solid

Here it will be seen that when the wire loop is heated, the ball goes through it easily. This is because the wire loop expanded on heating.

Let us study the linear expansion of a wire on heating.

➢ Expansion of liquids

Let us conduct the following activity to study expansion of liquids.

Activity 5.24

Insert an empty ballpoint pen tube through the cork of a bottle.
Fill the bottle with coloured water, and place the bottle in a bowl of hot water.
Observe what happens.

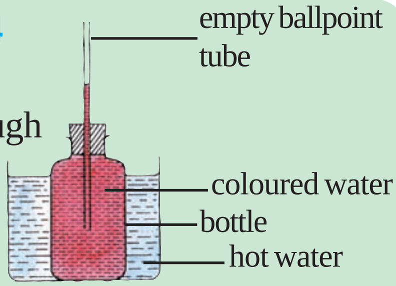


Fig 5.35 - Expansion of a liquid

Here the level of water in the pen goes up. It is because the volume of water has increased on heating. Therefore liquids too expand on heating.

➢ Expansion of gases

Let us study the expansion of gases on heating.

Activity 5.24

Insert an empty ballpoint pen tube through the cork of an empty bottle. Introduce a bubble of coloured water into it. Now hold the bottle between your two palms and warm it up. Note what happens to the bubble of coloured water.

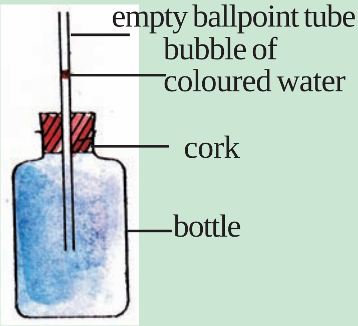


Fig 5.35 - Expansion of gas

The heat provided by the palms caused the drop of water to move up. The air inside the bottle has expanded and pushes the water bubble upwards. So we see that gases too expands on heating.

5.6 Static electric charges

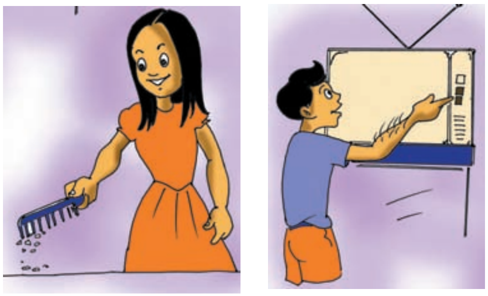


Fig. 5.37 - How the light substances get attracted to a rubbed comb and the hair gets drawn towards the TV screen.

You may have already experienced how little bits of paper, light feathers and styrofoam get attracted to combs after combing dry hair. After ironing some dress if you raise it up, the dress tends to cling on to the hairs of your skin.Similarly if you switch off the TV and bring your hand close to the screen, the hair gets drawn towards the screen. The ability to attract light objects by the comb, (Fig. 5.37) ironed dress and TV screen was because they were charged. These charges which were gathered due to rubbing are called **electro static charges**.

Activity 5.25

Rub a glass rod with a piece of silk cloth and test whether they are charged by holding them near light objects.

Rub an ebonite rod with a piece of flannel cloth and test whether they are charged by holding them near light objects.

Rub objects such as ballpoint caps, PVC pipes, Perspex , drinking straws and test whether they can attract light objects.

Important: For experiments on static electricity, the material take for rubbing must be free of any moisture. So dry them in the sun before the activity.

In all of the above instances, the material used for rubbing as well as the one that was rubbed were able to attract light objects to them. That is materials got charged by rubbing.

5. 6.1 Types of electrostatic charges

There are two kinds of electrostatic charges, the positive and the negative charges.The glass rubbed with silk got a positive charge while the ebonite rubbed with wool got a negative charge. When two substances are rubbed together, the type of charge that one substance gets is opposite to that got by the other.

Table 5.6 shows the manner in which each pair get charged.

Pair of substances used	**Substance getting negative charge**	**Substance getting Positive charge**
1. Glass and silk	Silk	Glass
2. Ebonite and wool	Ebonite	Wool(flannel)
3. Perspex and silk	Silk	Perspex
4. Polythene and wool	Polythene	Wool(flannel)
5. Cellulose acetate and polythene	Polythene	Cellulose acetate

Table 5.6

How did each of these get a positive or negative charge? Let us find out. The negative electrons in the glass rod goes to the silk cloth on rubbing. Therefore, glass gets a positive charge while silk gets a negative charge. (Fig 5.38)

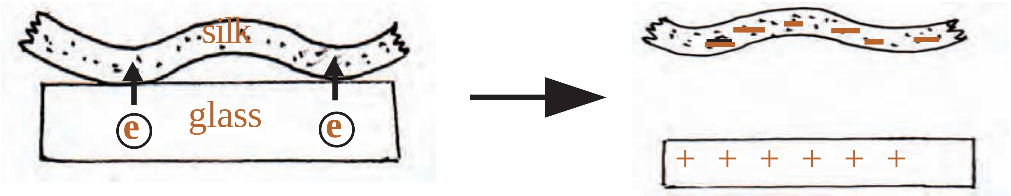


Fig 5.38 How glass and silk get charges on rubbing

The negative electrons in the flannel cloth goes to the ebonite on rubbing. Therefore flannel gets a positive charge while ebonite rod gets a negative charge (Fig 5.39).

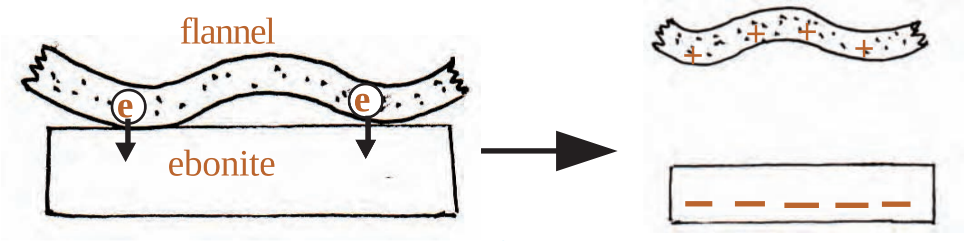


Fig 5.39 - How ebonite and flannel get charges on rubbing

Now you can explain how each of the other pairs get the charges.

A positively charged glass rod is attracted to a negatively charged ebonite rod. Two positively charged glass rods or two negatively charged ebonite rods repel each other. That is, like charges repel and unlike charges attract.

If we touch a charged object, the charges on it travel to our body. As a result the object loses the charge. When a charged object is left in the open for sometime, the particles of air in the atmosphere removes the charge, hence the object gradually loses charge.

Assignment 5.7

Let us use static electricity for fun! Charge some coloured balloons by rubbing with flannel cloth, and set them on to the ceiling or wall.(Fig 5.40)

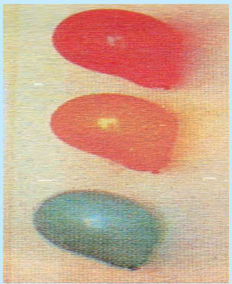


Fig 5.40 - Charged balloons on a wall

Let us find out some instances where static electricity is effective.

Lightening and thunder

Fig 5.41-Lightening

Just before a rain, the sky gets full of dark rain clouds. You can see lightning as well. The clouds get charged with static electricity when dry air currents move speedily across the rain clouds, rubbing against them. The upper part of the cloud gets positively charged while the lower part becomes negatively charged. When a large amount of such charges collect, the opposite charges get discharged. We see this as a lightning. Lightning can take place in three ways.

- Between the opposite charges in the same cloud
- Between two oppositely charged clouds
- Between a charged cloud and opposite charges on the ground
- Between a charged cloud and a normal cloud

At one such discharge a current of a voltage as high as 100 million volts can be generated. Hence during lightning a huge spark can occur. The heat produced at the same time causes a sudden expansion at the air. It brings about a huge noise with an explosion which we call thunder.

Assignment 5.7

Thunder and lightning takes place at the same time. Yet we see lightning first and hear the thunder a few minutes later. Find out the reasons for this.

Lightning from a charged cloud reaches the earth along the shortest route. Hence, very often naval vessels, tall buildings and transmission towers are ideal routes. When a charged cloud of high voltage floats over a tall building, the charges can travel to the earth along the building. The heat generated by the large current can damage the building.

Lightning conductors

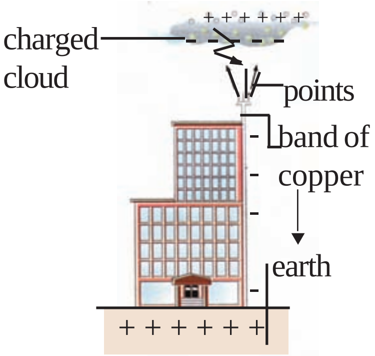


Fig. 5.4.2 - Lightning conductor

In order to prevent damages by lightning, tall buildings have **lightning conductors** fixed to their roofs. A lightning conductor is a metal rod with points at the top. It is fixed to the earth by a thick band of copper (earthed). This provides an easy route for the charges to flow to the earth. When a charged cloud goes over the conductor, opposite charges get collected at the top of the conductor. The charges on the cloud travel straight to the earth along the metal conductors. This prevents damage to buildings and transmission towers.

Uses of static electricity

The flash bulbs in photocopy machines and flash cameras use static electricity.

Prevention of accidents due to lightning

We often hear of various damages caused to life and property due to lightning. It is important to prevent them before they occur. Some suggestions to prevent accidents due to lightning are given below.

- Fix lightning conductors to tall buildings.
- Avoid riding bicycles, being out in the open, bathing, being in open water, and standing under tall trees.
- Avoid using telephones and electrical appliances in heavy rainy instances.
- Disconnect the TV antenna and put the cables outside.
- Be away from metal fences, metal antenna posts and barbed wire fences.

5.7 Current electricity

You may have already experienced that, some substances around us allow the flow of electricity through them while some substances do not allow the flow of electricity through them.

Electric conductors and insulators

Let us try to identify substances which allow electricity to flow through.

Activity 5.26

Set up an equipment as shown in the Fig 5.43. Break one wire in two and leave a space between. Fix two crocodile clips to the two free ends at A and B.Now place each of the substances given below to A and B and observe whether the bulbs glow.

Substances:

Iron nail, Copper wire, Piece of polythene, Piece of graphite / pencil lead, Rubber band, Piece of ceramic, Styrofoam, Glass rod, Lead wire, Plastic, rod from a dry cell, Piece of Aluminium (antenna rod)

Record your observations.

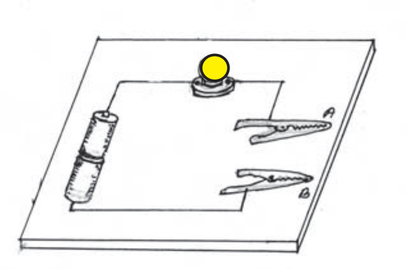


Fig 5.43

You may notice that some among those substances when fixed between A & B , the bulb get lighted while others not. According to these observations we can group those substances into two categories.

Conductors and insulators

Substances which allow electricity to flow are called **conductors** and those that do not are called **insulators**. Metals are good conductors. Non-metals are very often insulators, yet graphite (a type of carbon) which is a non-metal is a good conductor.

Conductors	Non conductors
Iron nail	Polythene
Copper wire	Rubber
Piece of Aluminium	Glass
Graphite	Ceramic
Lead wire	Styrofoam
Carbon rod	Plastic

Do you know?

- The reason for electricity to flow through conductors is because they have free electrons.
- The reason for electricity not to flow through non-conductors is because they do not have free electrons.

Semi conductors

Silicon and **germanium are** elements which show properties between conductors and non-conductors. Since they have only a few free electrons at room temperature, the flow of electricity along them is very weak. Hence they are called **semi-conductors**. The amount of free electrons can be increased by adding certain special elements to them. Then their conductivity increases. Yet the flow of electricity is only in one direction. Such conductors are used to make electronic components such as diodes, transistors, LED etc.

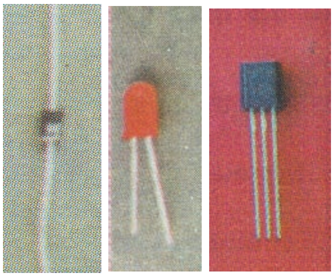


Fig. 5.44 - a diode,LED and A transistor

Fig 5.44 shows some such components.

Activity 5.27

Again Set up the circuit as in Activity 5.26. Connect the two terminals of the LED to points A and B. See whether the bulb lights up. Now change the terminals in the reverse direction and see whether the bulb glows.

Repeat the above with a diode.

You will find out that the bulb glows only when the LED bulb or the diode is connected in a certain direction.**The reason for this is because, in a diode or LED bulb, electricity flows only in one direction.**

Uses of conductors, insulators and semi-conductors

Conductors, insulators and semi-conductors are used in manipulating the electric current. The parts through which electricity has to pass through in electrical equipment and electronic components are made up of conductors. But these are covered over by non-conducting materials in order to protect the users from coming into contact with the current. Fig 5.45 shows how conductors and non-conductors are used in an electric bulb and a plug. Now you will understand why in electric cables, insulating tapes are wound round the places where the outer insulation has got damaged. Semi conductors are used in components where current has to flow only in one direction.

Fig. 5.45 - Conductors and non-conductors are used in an electric bulb and a plug

e.g. Powerpacks where AC current is converted to DC current have diodes with semi-conductors.In radio circuits, television and mobile phones circuits semi conductors been used.

Electrical resistors

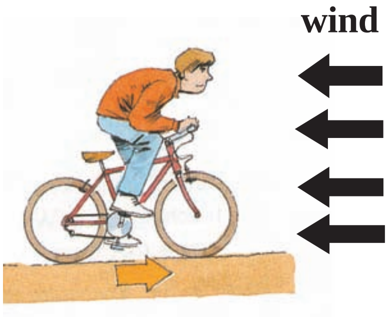


Fig. 5.46 -Riding a bicycle with difficult due to the resistance of the wind

When you are riding a bicycle and if there is a strong blowing against your direction as in Fig 5.46, it becomes difficult for you to proceed. The reason is the resistance of the wind against your motion. In a similar way, current passing through a conductor too is subject to resistance by the conductor itself. This is called electrical resistance.

Let us try to understand more about resistance.

Activity 5.28

Take two torch batteries, conducting wires, a nichrome wire about 40 cm long and a torch bulb.Connect the circuit as in Fig 5.47.Connect terminal A to different places(at 10 cm, 20 cm, 30 cm, 40 cm) along the nichrome wire and observe the glow in the bulb.

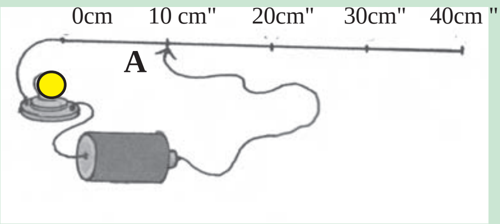


Fig 5.47

When you select a longer length of the nichrome wire the glow in the bulb decreases. This shows that as the wire gets longer less current flows through it. The reduction of glow shows that resistance increases with the length of the wire.

Resistance of a conductor changes with the length, diameter, type of wire as well as temperature. When the temperature decreases the resistance of the conductor decreases. This property is used in making **super conductors.**

Super conductors

Artificial substances have been prepared which are completely free of resistance at very low temperatures. Such resistance free substances are called super conductors.Scientists are taking great efforts to make substances which act as super conductors at room temperatures. If it is successful, waste of energy due to resistance in transmission can be prevented. Also the efficiency of computer chips, motors and dynamos can be increased by using super conductors.

Uses of resistors

Some uses of resistors are given below:

- In radio and television circuits resistors are incorporated to control current.
- In heating appliances such as heaters and hotplates, coils with high resistance wires such as nichrome is used. In electric bulbs high resistance wires of tungsten are used.
- In electric fans the regulator which controls the speed of the fan, resistors which can increase or decrease the current are used.

Do you know?

Being concerned about the insulation of conductors can prevent a lot of accidents due to electricity.

It is very dangerous to use electrical appliances which have damaged insulation.

5.8 Sources of electricity

Can you recall an incident where the electricity supply was cut off in your home. You could not listen to the radio, iron your clothes, read a book or watch the television ? Today electricity has become such an important aspect in our lives.

So let us find out how electricity is produced and how the circuits are set to make it flow.

5.8.1 Electric sources

The electricity needed to light a torch is obtained from cells. Electricity for houses or factories are from generators. In motors it is from dynamos. You may be familiar with the bicycle dynamo. Cells, dynamos which generate electricity are called sources of electricity. Fig. 5.48 gives some such sources.

Fig 5.48 - Some sources of electricity

5.8.2 Let us build some simple electric circuits.

Can you recall how you lit a bulb using an electric cell and a piece of wire. Fig 5.49 shows one way in which they can be connected. You have built a simple electric circuit. Current from the cell goes along the wire across the bulb and lights it up. **A closed system where electricity flows from an electric source is called an electric circuit.**

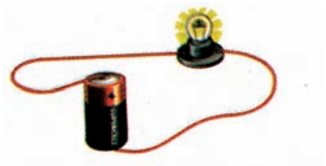


Fig. 5.49 - How to light a bulb using an electric cell

In the above circuit if you need to switch off the bulb you will have to remove the connecting wires. Without doing so, we can put out the bulb by connecting a switch to the circuit.

Let us see how a switch is incorporated into the simple circuit.

Activity 5.29

Use the following items and build a circuit as in Fig 5.50. An electric cell, bulb holder, torch bulb, switch and some wire. Observe what happens when you put the switch on and off.

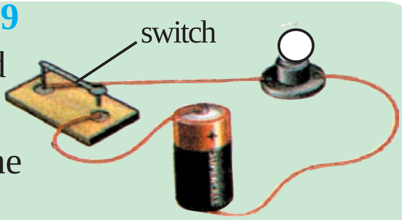


Fig 5.50 -A simple circuit with a switch

Here the bulb glows when the switch is closed and the bulb goes off when the switch is open. When the switch is closed the circuit is completed and the bulb glows. When the switch is opened the circuit is broken and the bulb goes off.

Compare the circuit you made with that of Fig 5.49.

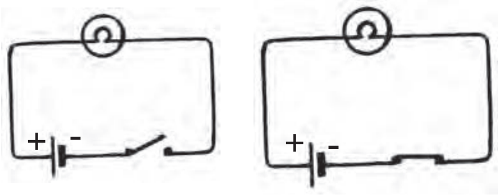
Drawing circuit diagrams

Fig 5.50 shows a simple electric circuit.It is not easy to draw cells, switches, bulbs etc. Instead of drawing pictures of these, standard symbols are used. Such an illustration is called a circuit diagram. Table 5.7 shows some standard symbols used for this.

Appliance	Symbol
1. Conductor	
2. Electric cell	
3. Bulb	 Or 
4. Switch(open)	
5. Switch(closed)	
6. Ammeter	
7. Voltmeter	
8. Resistor	 Or 
9. Motor	
10. LED	

Table 5.7 - Standard symbols used for circuit diagrams

The circuit diagram in Fig 5.51 shows a circuit with a cell, bulb and a switch. A indicates the switch in the open position and B when it is in the closed position.



A - open circuit

B - closed circuit

Fig 5.51 - Circuit diagram with open and closed circuits

Let us do the following activity to see how many cells and bulbs could be included in a circuit.

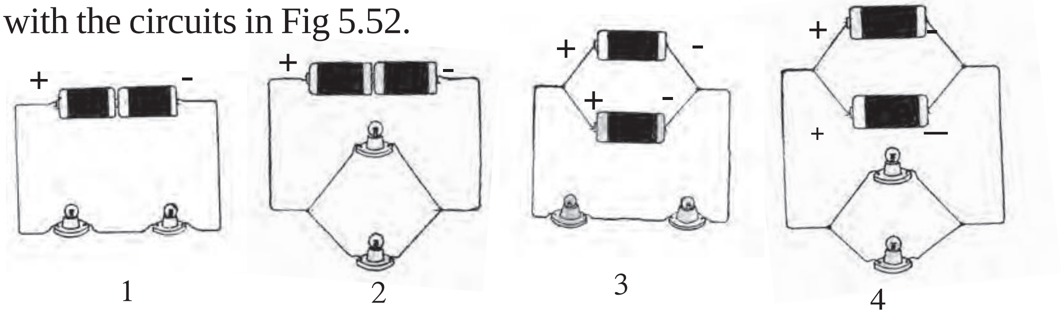
Activity 5.30

Connect the two cells, two torch bulbs, two holders and the wires given to you in any way you like and put up as many circuits as you can.(You must change only the way you connect the two bulbs and the two cells).

Draw each of the circuits on paper, and draw the circuit diagrams for each.

Note the circuit which gives the brightest light.

You would have noticed that you can connect the two bulbs and two switches in two ways. Compare the circuits you have made with the circuits in Fig 5.52.



5.52 - Different ways in which two bulbs and two cells can be connected

The above circuits can be denoted by the following circuit diagrams.(5.53) Compare with the ones you made.

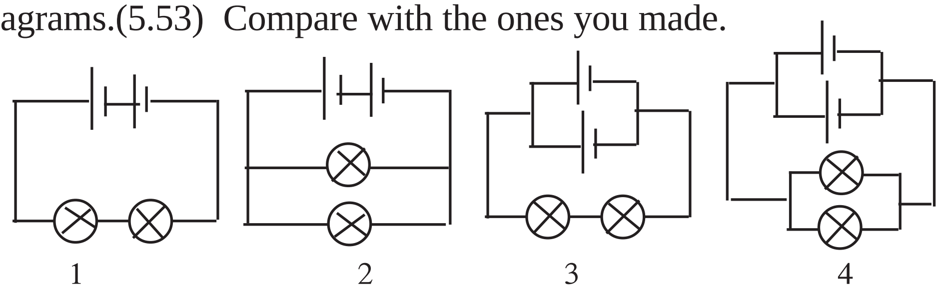


Fig 5.53 - Circuit diagrams

Measuring current and voltage difference

Fig 5.54 - positive and negative terminals

Take a cell and observe the positive and the negative marked at the two ends. In every cell, the two terminals positive and negative are marked. (Fig 5.54)

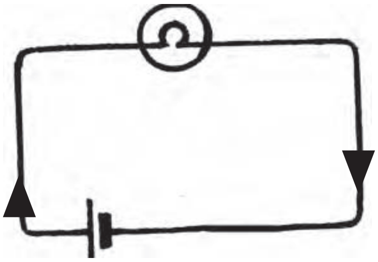


Fig 5.55 - Direction of flow of current

When a cell is connected to a circuit current flows from the positive terminal to the negative terminal. We can denote this in a circuit diagram as in Fig 5.55.

The current flowing in a circuit can be measured. An instrument called the **ammeter** is used for this. Unit for measuring current is **ampere** (A). Current flows from the positive terminal to the negative terminal because of a potential difference or pressure between the two ends. If the potential difference is high, a bigger current will flow while if it is small a lesser current will flow. Potential difference is measured using a **voltmeter** and the units of measurement are **volts** (V).

Fig 5.56 - Ammeter and Voltmeter used in laboratories

In the ammeter as well as in the voltmeter there are two terminals, marked positive and negative for connecting to the circuit. Positive end is marked in red and negative end is marked in black. When connecting wires the positive and the negative must be connected correctly. If the terminals are changed the electric meter may get damaged. Identify the manner in which an ammeter and a voltmeter should be connected to a circuit from the circuit diagram given below. The ammeter should be connected along with the other component but the voltmeter should be connected outside the circuit which has the component whose potential difference needs to be measured. (Fig 5.57).

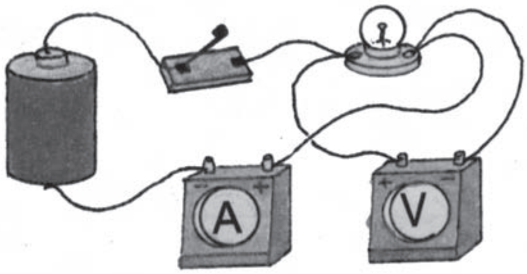


Fig 5.57- How a voltmeter and an ammeter are connected in a circuit

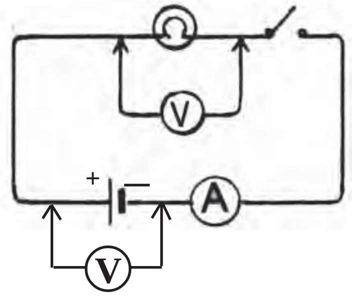


Fig 5.58- Circuit diagram to show how ammeter and a voltmeter are connected in a circuit

The potential difference between the two ends of any component of a circuit can be measured. The voltmeter is used to measure the potential difference between the two ends of a bulb.(Fig 5.58). The dotted line indicates how a voltmeter is fixed to measure the potential difference between the two ends of a battery.

Assignment 5.10

Observe the manner in which the cells and the bulb are connected in a torch.

Draw the circuit diagram for the circuit in the torch.

5.9 Chemical nature of substances that are in day-to-day use.

5.9.1 Household chemicals

We use many chemicals in our daily life. For cooking we use vinegar, goraka, salt, cloves, tamarind, fruit juices, sugar and in our washing and bathing we use soap, shampoo, washing powder or liquids and many other chemicals.

Lime juice, vinegar, goraka and tamarind are all sour. Salt has another taste. If you happen to taste soap or chunam (used in betel) accidentally, even you may have got such an unpleasant taste. It is dangerous to taste unknown chemicals. So now we see that the chemicals used at home have a variety of properties.

In laboratories there are many non - dangerous ways to identify chemicals. Use of litmus paper is one such method. Let us find out how litmus can be used to identify chemicals in the laboratory.

Activity 5.32

Take three beakers. Put lime juice or vinegar into one beaker, soap solution into the second and table salt to the third beaker. Put a piece of red litmus and blue litmus to each, and observe the colour differences in the three beakers.

You may have seen that lime juice or vinegar turned blue litmus into red. Red litmus did not change colour. Soap solution turned red litmus to blue. Blue litmus did not change the colour. Salt solution did not change the colours of any.

The above observations show us a special property about litmus, that is Vinegar turns blue litmus red, Soap solution turns red litmus and blue Salt does not change the colour of red or blue litmus. Acidic substances can change blue litmus red. Therefore vinegar is an acidic substance.

Basic substances can change red litmus blue. Therefore soap solution is a basic substance. Neutral substances do not change the colour of litmus. Therefore salt is a neutral substance. So we can identify the acidic, basic and neutral substances in our house using litmus.

Activity 5.33

Find samples of different chemicals used at home. (sugar, cloves, tamarind, tomato, washing powder, shampoo, slakedlime, baking soda, water etc)

Make solutions of each, put them into test tubes, label them and keep them on a rack.

Put a piece of red litmus, a piece of blue litmus to each and observe the colour changes in each.

Group the substances as acidic, basic, or neutral according to your observations.

Now you should be able to identify the acidic, basic and neutral substances in your home.

Acidic substances

Substances which turn blue litmus red are acidic substances. The acidic nature is because of some acid in them. Acids are sour to the taste. So lime juice, vinegar, goraka, spoilt milk are all acidic substances. A list of some acidic substances in the home and the acid they contain are given in Table 5.8

Hydrochloric acid, sulphuric acid, nitric acid are some acids you come across in the laboratory.

Acidic substance	Acid in it
lime	citric acid
vinegar	acetic acid
tea	tanic acid
fermented milk	lactic acid
grapes	tataric acid

Table 5.8 - some acidic substances and acids in it

Basic substances

Substances which turn red litmus into blue are basic substances. Their basic property is because of the bases in them. They are soapy to the touch. Also strong bases are corrosive. Soap, ash, lime water, washing powder are basic substances around the house.

Sodium hydroxide, potassium hydroxide, ammonium hydroxide and calcium hydroxide (lime water) are bases we come across in the laboratory.

Do you know?

Litmus paper changes colour only when they are moist.

Neutral substances

These substances do not change the colour of any kind of litmus. They do not show acidic or basic properties. Sugar, salt, pure water are neutral substances.

Indicators

Substances such as litmus which are used to identify acidic or basic substances are called indicators. Litmus is made from the juice of a plant called 'lichens'. Phenolphthalein, methyl orange, pH paper are some other indicators used in the lab oratory.Table 5.9 shows the changes shown by these indicators in acidic or basic media.

Indicator	Colour in acidic medium	Colour in basic medium
Litmus	Red	Blue
Phenolphthalein	Colourless	Red
Methyl orange	Red	Yellow
pH paper	Range of red	Range of blues

Fig. 5.9 - Colours of some indicators in acidic/basic media

Plant chemicals which change colour in acidic or basic media are found in our environment too. Red hibiscus, blue katarolu, turmeric, arecanut, banana inflorescence are some such substances. You can prepare some indictors from these and test out the substances at home for their acidity or basicity. Activity 5.34 uses some such natural indicators.

Activity 5.34

Find samples of red hibiscus, "blue katarolu", banana inflorescence, turmeric, arecanut.

- Boil each one separately, filter the coloured solution obtained, put into separate bottles label and keep.
- Take three samples of an acid, a base and a neutral substance to three test tubes and test with each plant indicator. Observe the colour changes.
- Use suitable colours/ paints and draw a colour range on paper.
- Use the indicators you made to identify the substances in the home as acidic, basic or neutral substances.
- Make a colour chart using suitable colours to identify the bases, acids and neutral substances you find at home.

Use of acidic substances in everyday life:

- Preparation of food (goraka, tamarind, vinegar)
- Preserving food (vinegar)
- Vehicle batteries (sulphuric acid)
- Making rubber from latex (acetic acid)

Use of basic substances in everyday life:

- Bathing and washing (soap, shampoo, other alkalis)
- Making cakes and hoppers (baking soda)
- Neutralising stomach acidity (Milk of Magnesia)
- Reducing acidity of soil (lime)

Use of neutral substances in everyday life:

- Cooking and washing (water)
- Cooking (salt)
- Preserving food (salt)
- Germicide (surgical spirit)

Assignment 5.11

Find information about substances such as soaps, washing powders, shampoos you use for bathing, washing and for washing vehicles.

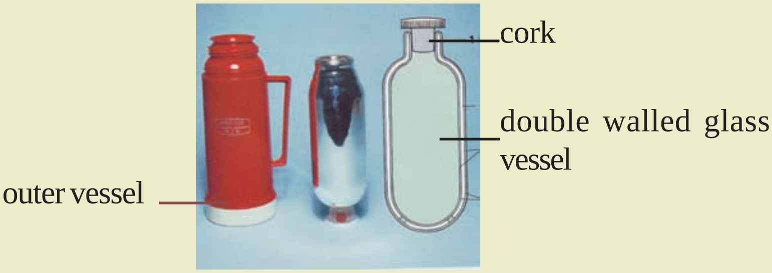
See whether these substances have basic properties.

Find out why each basic substance is used for.

Present your findings to the class.

Exercises

1. Classify the substances given below as pure substance or mixture.
   Concrete, granite, sugar, distilled water, spring water, tea, brass and copper.
2. i) From the following metals, select the correct answer.
   Magnesium,sodium,copper,iron,zinc,silver
   a) A metal that reacts with cold water.
   b) A metal that does not react with cold water but reacts with hot water.
   c) Metals that react with dilute acids
   d) Metals that react with steam and dilute acids.
   ii) Answer the follwing questions
      a) What is 'hydration'?
      b) Name two hydrated salts.
      c) State an instant when hydrated salts are used in daily life.
3. The seeds of orange juice sink to the bottom of the glass when prepared. But as sugar is added they come to the surface. Explain this on the basis of relative density.
4. Parts of a vacuum flask are given below. The air from the double walled glass vessel inside is removed and sealed.



i) What property of glass makes it suitable for this vessel?
ii) Which method of heat transmission is prevented by removing air from the double walled flask?

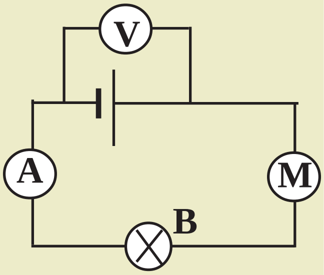
iii) Which type of heat transmission is prevented by silvering the inside walls?

iv) Ice can be kept in this flask without melting. How does this take place?

5. What is the factor that should be removed to control a fire in instances mentioned below?
   - Spraying water over the fire.
   - Covering the burning material with a solid material like a gunny bag.
   - Putting sand over a fire caused by oil.
   - Putting a firebrand under the ash.
   - Covering a lighting spirit lamp with the lid.

6. i) Mention a source that produce electricity using sunlight.
   ii) What is the appliance that can be fixed on to an electric circuit to obtain electricity whenever you want.

7. Answer the questions regarding the electric circuit shown below.
   i) What is measured by Ⓥ ?
   ii) What is measured by Ⓐ ?
   iii) If the battery used in the circuit is a new torch battery, what will be the value of Ⓥ ?
   iv) What is symbol Ⓜ stands for ?
   v) Redraw the circuit diagram using two torch batteries so as to increase the intensity of light and put a suitable meter to measure the potential difference along the bulb 'B'.



8. i) Write 3 examples for each of the acidic, basic and neutral substances in your home.
   ii) Write the colour changes of following substances with wet litmus and categorize them as acidic, basic or neutral according to the previous observation.