10

Static Electricity

In your earlier classes, you have learnt that electricity is very useful in our day-to-day life. Electricity is used to light homes, schools, offices, *etc*. A number of appliances like fan, T.V., refrigerator, room heater, washing machine, *etc*. are used by most of us. All these appliances run on electricity. These appliances have made human life much comfortable. All these are examples of current electricity or charges in motion.

In this chapter, we shall confine our studies to the charges at rest *i.e.* static electricity.

The word electricity was derived from the greek word **elektron** which means amber (a kind of resin produced by certain plants).

Looking back at the history of electricity, it is found that electricity was initially produced by friction. It is believed to have been discovered by Thales of Miletus - one of the seven wire men of ancient Greece about 600 B.C. He found that after rubbing a piece of amber with wool, the amber would attract light objects like tiny pieces of dry paper, grass, feather, *etc*. This phenomenon was not very clear and was confusing till around 1600 AD, when father of electricity, William Gilbert gave a theory about electricity. He was able to explain satisfactorily about attraction of certain tiny substances by amber rubbed with wool.

If you bring a plastic comb near a few small pieces of paper, comb will not attract the pieces of paper. If the same comb is first rubbed with dry hair and then brought over the pieces of paper, then it will attract them.

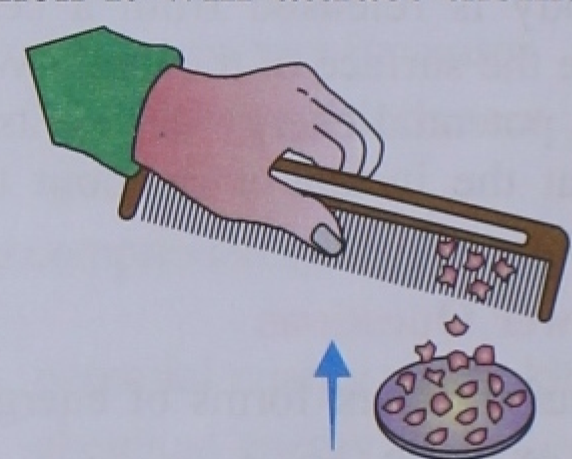
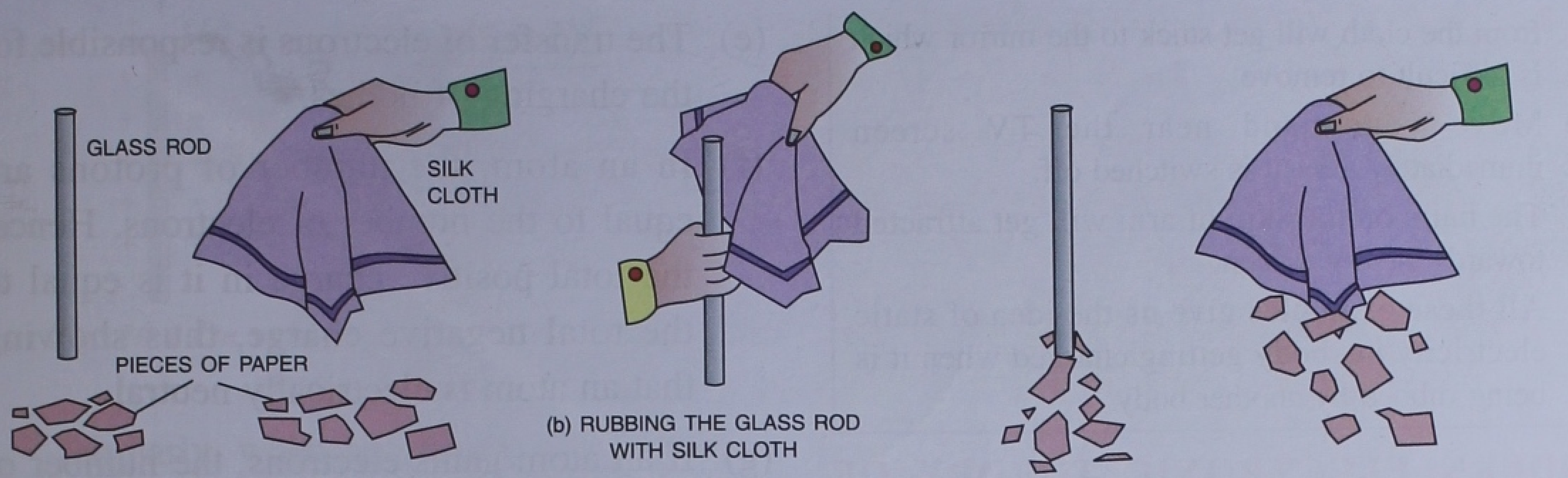


Fig 10.1 Plastic comb rubbed with dry hair attracts small pieces of paper

Let us take the following examples :

Take a glass rod and a piece of silk cloth. Hold them close to small pieces of paper. None of them will attract the pieces of paper [Fig. 10.2(a)].

Now rub the glass rod with the silk cloth [Fig. 10.2(b)]. Bring the glass rod and the cloth slightly above the bits of paper, separately. You will observe that both glass rod and silk cloth are attracting the pieces of paper [Fig. 10.2(c)].



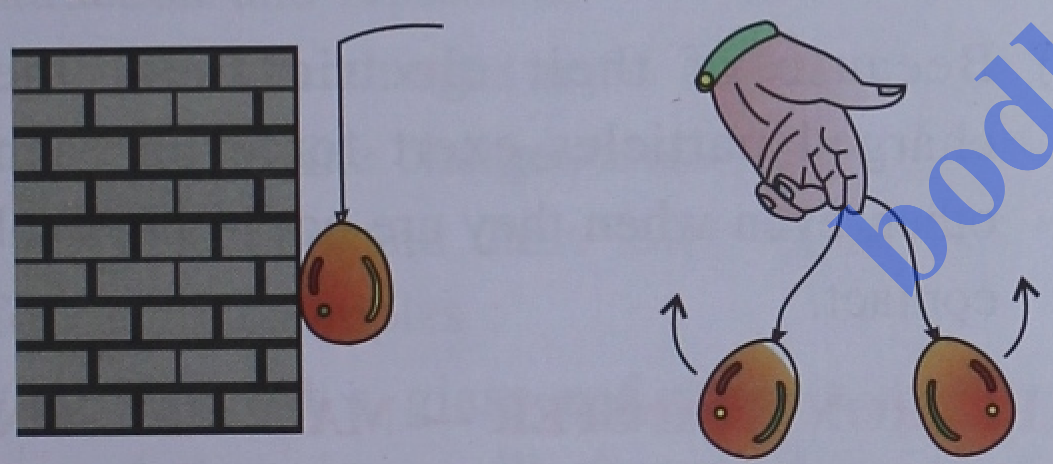
(a) NO ATTRACTION TAKEN PLACE

(b) RUBBING THE GLASS ROD WITH SILK CLOTH

(c) GLASS ROD AND SILK CLOTH ATTRACT PIECES OF PAPER

Fig. 10.2 Glass and silk get charged on being rubbed

Take an inflated balloon. Put it against a dry wall. You will observe that the balloon is sliding down. Now rub it with a woollen material and place it against the wall. The balloon will stick to the wall [Fig. 10.3(a)]. Now take two such balloons and rub both of them with woollen material. Bring the balloons close to each other. Both will move away from each other *i.e.* both will repel each other [Fig. 10.3(b)].



(a) Balloon rubbed with woollen material sticks to the wall

(b) Two balloons rubbed with the same woollen material repel each other

Fig. 10.3

From the examples given above, we find that rubbing a comb against dry hair or a balloon against woollen material produces in them a kind of charge which helps them to attract as well as repel objects. The force so developed is called the **electrostatic force**. The comb, balloon, glass rod and silk cloth are said to be electrically charged when they are rubbed against hair or woollen clothes *i.e.* they acquire **electrical charge**. If this charge is not allowed to flow, it is termed as **static electricity**.

Note : (1) The body which possesses electric charge is called charged body.

(2) The body which do not possess any electric charge is called uncharged or neutral body.

(3) A charged body attracts an uncharged body.

(4) Only insulators and isolated conductors can be charged with static electricity.

(5) Like charges repel and unlike charges attract.

ACTIVITY 1

Observe some simple electrostatic phenomenon in our everyday life.

(a) Comb your hair and bring the comb near tiny bits of paper.

You will hear a faint cracking sound when you are combing your dry hairs. Bits of paper will get attracted when you take the same comb towards these bits of paper.

(b) Rub a mirror with a dry piece of cloth for sometime.

You will notice that dust particles and fluff from the cloth will get stuck to the mirror which is difficult to remove.

(c) Move your hand near the TV screen immediately after it is switched off.

The hairs on the skin of arm will get attracted towards the TV screen.

All these examples give us the idea of static electricity *i.e.* body getting charged when it is being rubbed by another body.

MODERN ELECTRONIC THEORY OF STATIC ELECTRICITY

To understand the static electricity and its nature, we must understand the basic construction of matter. Following are the characterstics of matter and its constituent particles :

(a) Each matter is made up of tiny particles known as **atoms**. An atom consists of three main particles - **protons, electrons** and **neutrons**.

(b) A proton carries a positive charge, an electron carries a negative charge while a neutron has no charge *i.e.* it is electrically neutral. Numerically, the charges on proton and electron are equal. In other words, we can say that charges on proton and electron are equal and opposite.

(c) The central part of the atom is called its nucleus and it contains protons and neutrons. The electrons revolve round the nucleus along circular paths called **orbits** or **shells**.

(d) The electrons present in the outermost orbit of an atom are called **valence electrons**. Electrons present in an orbit beyond the valence orbit are very weakly attracted by the nucleus. Therefore, these electrons can easily be removed from an atom. They are called **free electrons**.

(e) The transfer of electrons is responsible for the charging of bodies.

(f) In an atom, the number of protons are equal to the number of electrons. Hence, the total positive charge in it is equal to the total negative charge, thus showing that an atom is electrically neutral.

(g) If an atom gains electrons, the number of electrons in it becomes more than the number of protons *i.e.* total negative charge in the atom becomes more than the total positive charge. Thus, the atom becomes **negatively charged**.

(h) If an atom loses electrons, the number of electrons in it becomes less than the number of protons *i.e.* total negative charge in the atom becomes less than the total positive charge. Hence, the atom becomes **positively charged**.

(i) Because of their electric field, the charged particles exert force on each other, even when they are not in physical contact.

ELECTRON TRANSFER — MAIN REASON FOR FRICTIONAL ELECTRICITY

When we rub a glass rod with a piece of silk, the glass rod loses electrons to the silk piece. It happens because the free electrons in the glass rod are less tightly bound as compared to those in the silk cloth. As a result, the glass rod has a deficiency of electrons and hence acquires a positive charge. Silk cloth has excess of electrons, so, it becomes negatively charged.

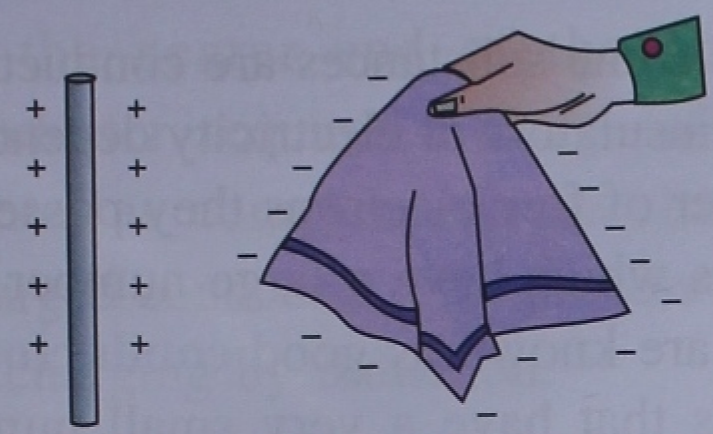


Fig. 10.4 On rubbing, electrons move from glass rod to silk

Similarly, when an ebonite rod is rubbed with fur, the fur loses electrons to the ebonite rod because the electrons in the outermost orbit in case of fur are loosely bound as compared to those in an ebonite rod. Now the ebonite rod has excess of electrons, so it becomes negatively charged, while the fur has a deficiency of electrons, so it acquires a positive charge.

LAWS OF ELECTROSTATIC ATTRACTION AND REPULSION

According to the laws of electrostatic attraction and repulsion,

– Two like charges repel each other.

– Two unlike charges attract each other.

To understand these laws, let us take the following examples :

(1) Suspend a glass rod rubbed with silk cloth, using a silk thread. Bring another glass rod rubbed with silk cloth close to the first rod (Fig. 10.5). We observe that the suspended glass rod moves or tends to move away from the second glass rod. Both the glass rods are positively charged so they repel each other.

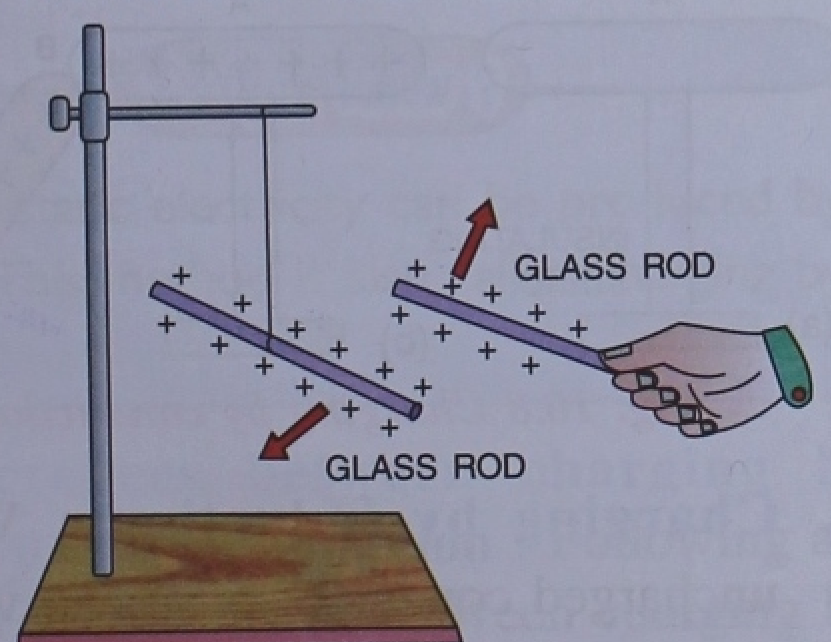


Fig. 10.5 Two charged glass rods repel each other

(2) Suspend, using silk thread, an ebonite rod rubbed with fur to a stand. Bring another ebonite rod rubbed with fur near the suspended rod (Fig. 10.6). We observe that ebonite rod moves or tends to move away from the suspended rod. Both the ebonite rods have negative charges so they repel each other.

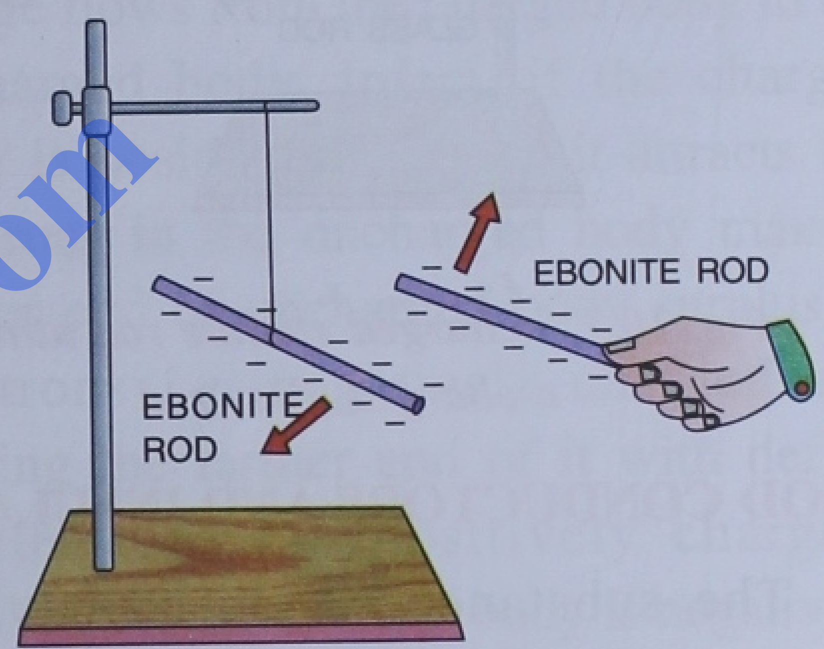


Fig. 10.6 Two charged ebonite rods repel each other

(3) Suspend, using silk thread, a glass rod rubbed with silk cloth to a stand. Bring an ebonite rod rubbed with fur near the suspended glass rod. We see that the suspended glass rod moves towards the ebonite rod (Fig. 10.7). In this case, on rubbing the glass rod has acquire positive charge while the ebonite rod has acquired a negative charge. As a result, two rods attract each other.

Conclusions : From this activity the following conclusions are drawn –

(1) The charge produced on the ebonite rod when rubbed with a fur is opposite to that produced on the glass rod when robbed with a piece of silk.

(2) Two similarly charged rods repel each other, whereas two rods having opposite charges attract each other. Thus, we find that, like-charges repel each other, whereas unlike-charges attract each other.

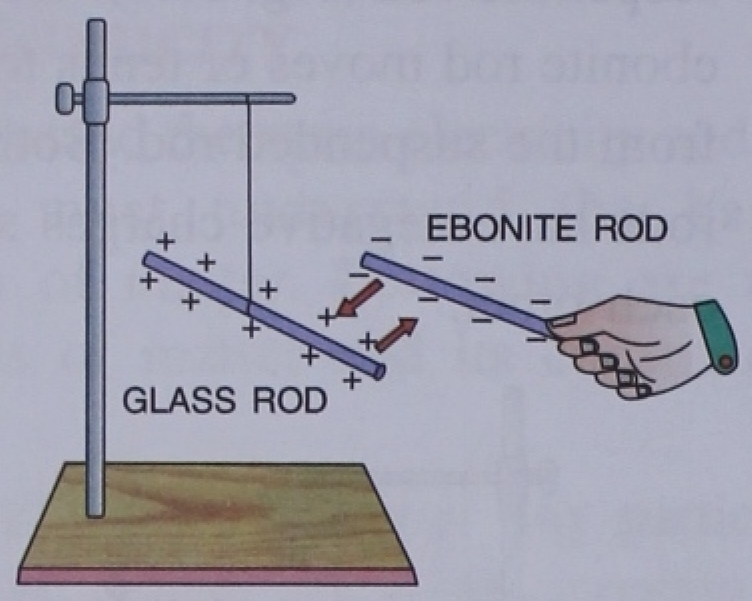


Fig. 10.7 A charged ebonite rod attracts a charged glass rod

GOOD CONDUCTORS AND INSULATORS

The substance which allows electric charge to flow through it is called a **good conductor** of electricity. All metals are good conductors. Silver, copper and aluminium are some of the very good conductors of electricity. Mercury, earth and human body are also good conductors of electricity.

Some substances hardly allow electric charge to flow through them; they are called **bad conductors** of electricity. Most of the non-metals are bad conductors of electricity. Some exceptions are graphite, tap water, *etc*. However, some of the substances do not allow electric charge to pass through them at all. They are called **insulators**. *Examples :* Sulphur, rubber, oxygen, wood and hydrogen.

Why some substances are conductors and some are insulators of electricity depends upon the number of free electrons they possess. The substances which have a large number of free electrons are known as good **conductors**. The substances that have a very small number of free electrons or which do not have any free electrons are called **bad conductors** and **insulators** respectively.

METHODS OF CHARGING A CONDUCTOR

We may charge an uncharged conductor by the following two methods :

1. **Charging by conduction :** When we touch an uncharged conductor with a charged conductor, the charged conductor shares the charge with uncharged conductor. This process is called charging by conduction.

Take an uncharged metal rod A mounted on an insulating stand as shown in Fig. 10.8. Now, touch a positively charged conductor B, with an insulating handle, with the rod A. It will be observed that the uncharged metal rod gets positively charged. If B is a negatively charged conductor, then conductor A acquires a negative charge.

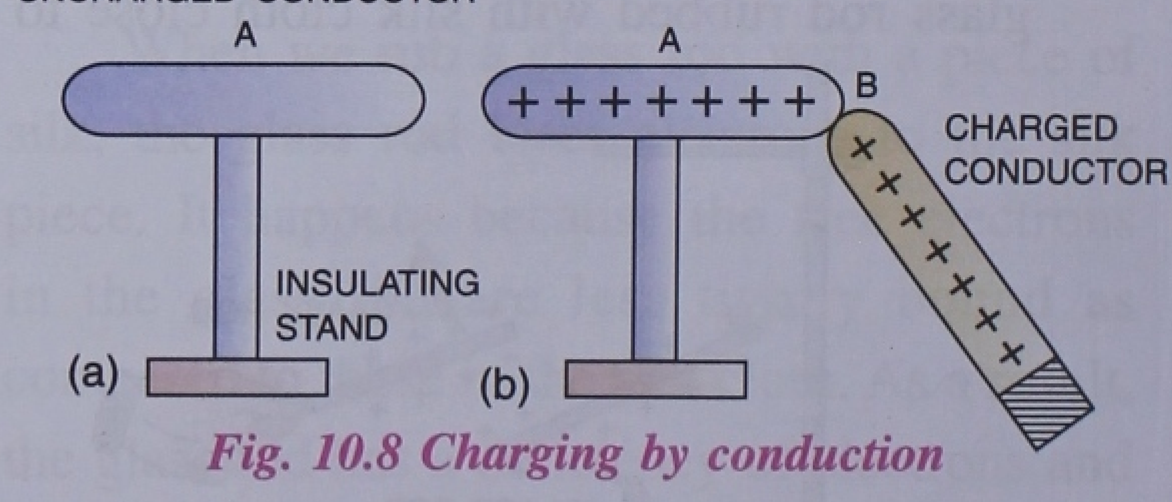


Fig. 10.8 Charging by conduction

2. **Charging by induction :** When an uncharged conductor is placed very close to a charged conductor, without touching

it, the nearer end of the uncharged conductor acquires a charge of opposite nature as compared to the charge on a charged conductor. This process is known as charging by induction.

Take an uncharged conductor A mounted on an insulating stand, and bring a charged conductor B very close to it. It will be observed that an opposite charge develops on the end of the conductor A which is nearer to conductor B. At the same time, same kind of charge as that on B is developed on the farther end of A. Thus, if charge on B is positive, the charge developed on the nearer end of A will be negative and its farther end will acquire a positive charge. Conversely, if charge on B is negative, the charge developed on the nearer end of A will be positive and its farther end will acquire a negative charge.

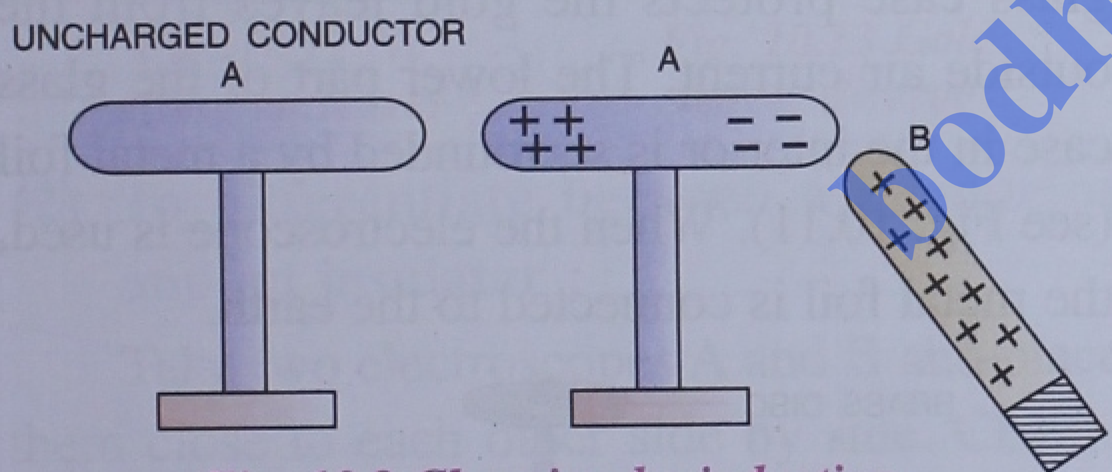


Fig. 10.9 Charging by induction

Do You Know ?

The static electricity can be produced by rubbing. This method is also called charging by friction.

Differences between charging by conduction and by induction : Following are the points of differences between charging by induction and by conduction :

(1) The process of charging a body by actually touching a charged body is called charging by conduction, whereas the process of charging a body by keeping it near (without touching) a charged body is called charging by induction.

(2) In charging by conduction, charge moves from the charged body to the uncharged body, with the result, the strength of charge on the charged body reduces. Now, on separating the two bodies, they retain their charges.

Whereas, in charging by induction, no charge flows from the charged body to the uncharged body. Infact, if the charged body is positively charged, it attracts the electrons in the uncharged body making nearer end of uncharged body surplus of electrons *i.e.* negatively charged and making the farther end of it with deficit of electrons *i.e.* positively charged. Similarly, if the charged body is negatively charged, it repels the electrons in the uncharged body making near end of uncharged body with deficit of electrons or positively charged and farther end of it with surplus of electrons *i.e.* negatively charged. Now, on removing the charged body, the body charged by induction will become neutral.

(3) In charging by conduction, some charge is lost (given) by charged body but in charging by induction, no charge is lost (given) by the charging body.

ELECTROSCOPE

An electroscope is a device with the help of which we detect whether the body is charged or uncharged and if it is charged, what kind of charge does it carry, *i.e.*, positive or negative.

In general, the electroscopes are of the following two types :

(i) Pith ball electroscope

(ii) Gold leaf electroscope

(i) Pith ball electroscope :

A pith ball electroscope is shown in Fig. 10.10. It consists of a small pith ball suspended with the help of a dry silk thread from an insulating stand.

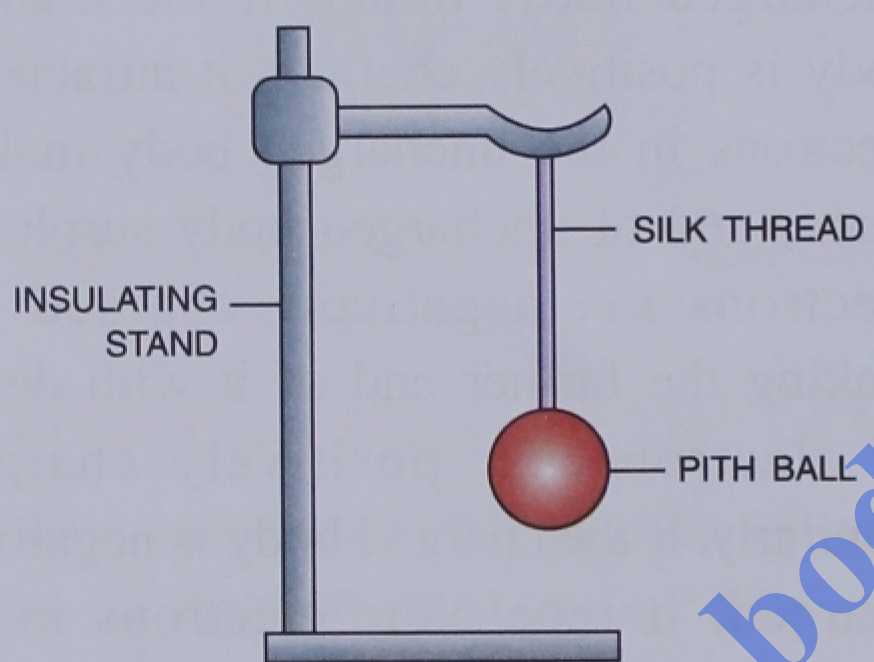


Fig. 10.10 Pith ball electroscope

To find out whether the body is charged or uncharged : The body is brought near the pith ball (without touching it). If the pith ball shows a movement towards the body, the body is charged, but if the pith ball remains static, the body is uncharged.

To find out whether the body has a positive charge or a negative charge : First of all, a pith ball electroscope is charged positively by conduction. Now the charged body is brought near the electroscope. If the pith ball moves away, the body has a positive charge, but if the pith ball moves towards the body, it has a negative charge.

ACTIVITY 2

Take a plastic ball and cover it with silver foil or aluminium foil. Hang it with a silk thread from a hook mounted on an insulating stand.

Take an ebonite rod and rub it several times with fur. Now touch the rod with the ball.

When you touch the two, the negative charge on rod will be shared by the ball.

Now the ball and the rod have same kind of charge (both negative) so they repel each other.

(ii) Gold leaf electroscope :

A gold leaf electroscope is shown in Fig. 10.11. It consists of a brass rod which passes through an insulator stopper or plug in a glass case. The top end of the brass rod carries a brass disc (also called brass cap), while its lower end has two thin gold leaves. The glass case protects the gold leaves from the outside air current. The lower part of the glass case in the interior is surrounded by a metal foil (see Fig. 10.11). When the electroscope is used, the metal foil is connected to the earth.

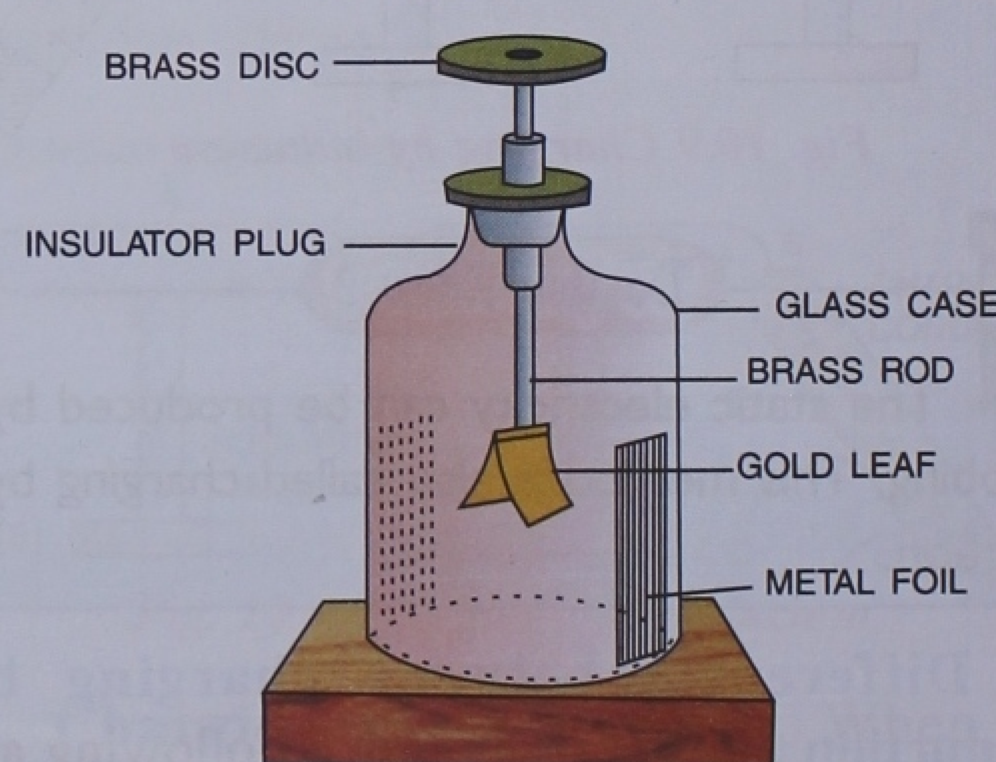


Fig. 10.11 Gold leaf electroscope

FUNCTIONS OF A GOLD LEAF ELECTROSCOPE

The following are the functions of a gold leaf electroscope :

(1) Detection of charge :

The conductor (which is to be tested whether charged or not) is touched with the brass cap of the gold leaf electroscope. It will be observed that if the body has charge, then the gold leaves will diverge. If the body is uncharged, then there will be no effect on the gold leaves (see Fig. 10.12 and 10.13).

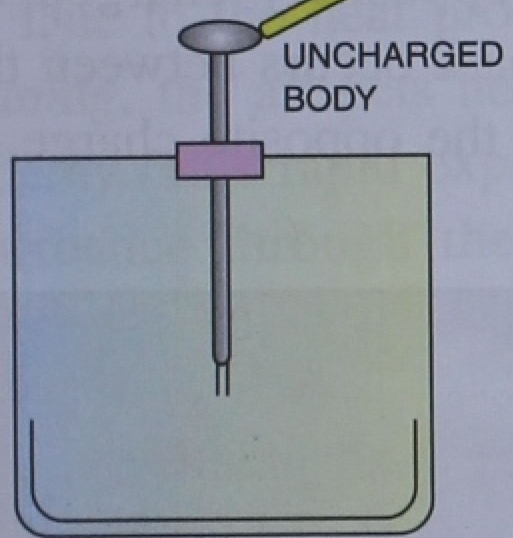


Fig. 10.12 No effect on leaves

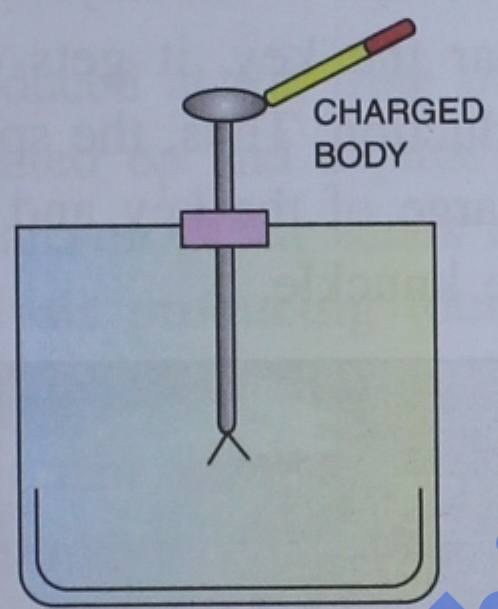


Fig. 10.13 Gold leaves diverge

(2) To differentiate between a conductor and an insulator :

Take two electroscopes A and B and place them close to each other side by side. Charge one of the electroscopes by touching its brass cap with a charged ebonite or glass rod. The gold leaves will diverge. Now take the body to be tested and touch it with the brass caps of both the gold leaf electroscopes. If the body is a conductor, then the leaves of other uncharged electroscope will also diverge.

If the body is an insulator, then the leaves of the other uncharged electroscope will not diverge (see Fig. 10.14 and 10.15).

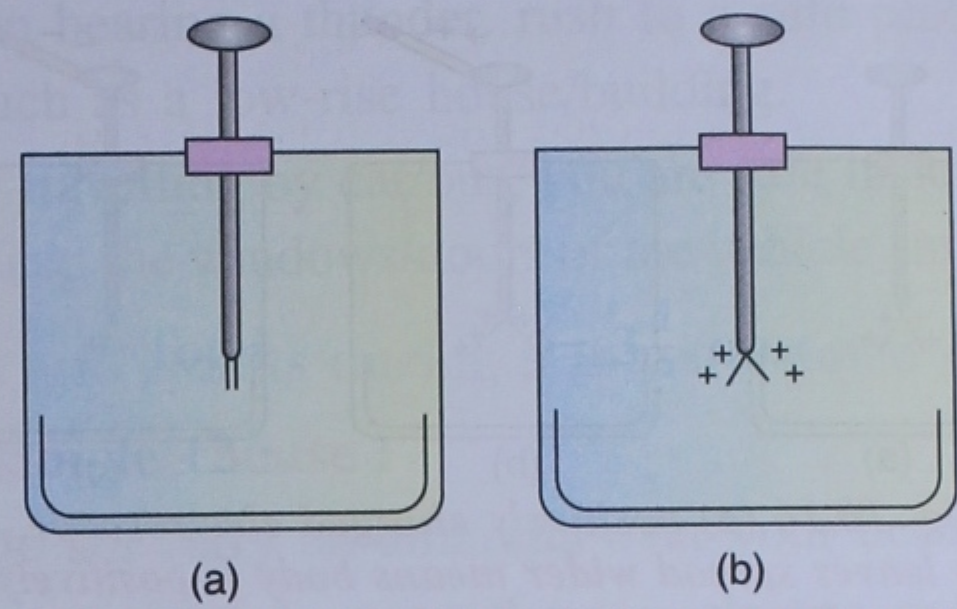
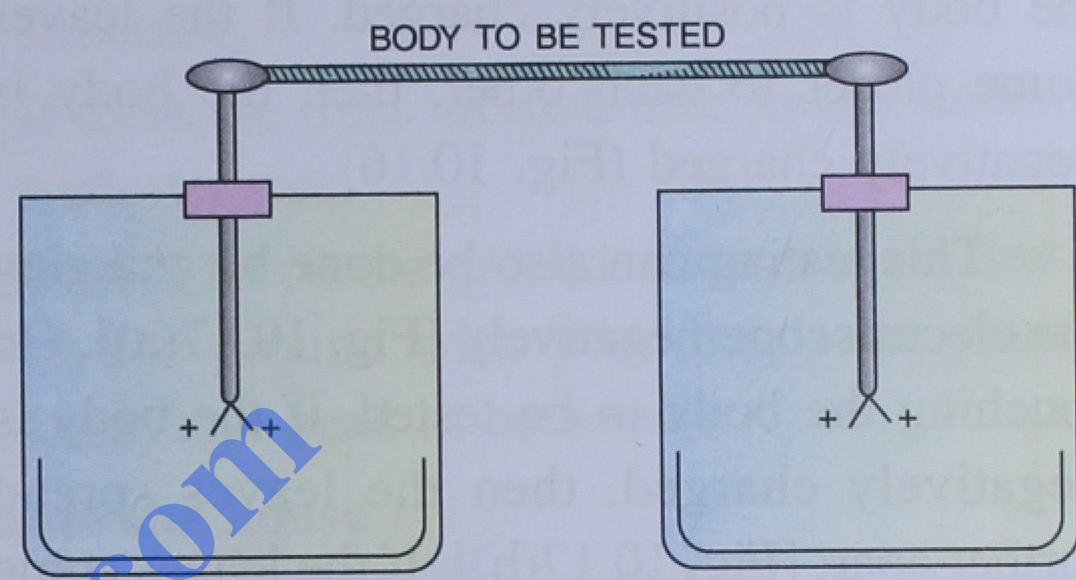
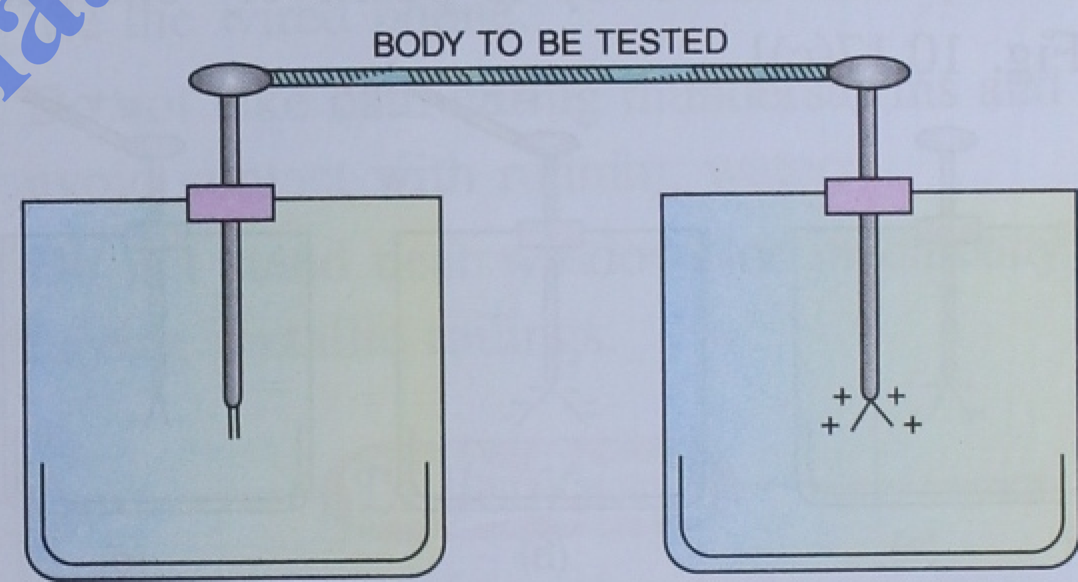


Fig. 10.14 (a) Uncharged electroscope and (b) Charged electroscope



(a) Body is a conductor



(b) Body is an insulator

Fig. 10.15 To test whether the body is a conductor or an insulator

(3) To identify the nature of charge :

First of all, it is tested whether the body is charged or not. Let the body be charged. Now the electroscope is charged positively. On charging, the leaves of the electroscope diverge. Touch the body to be tested with the brass cap. If the leaves diverge further, then

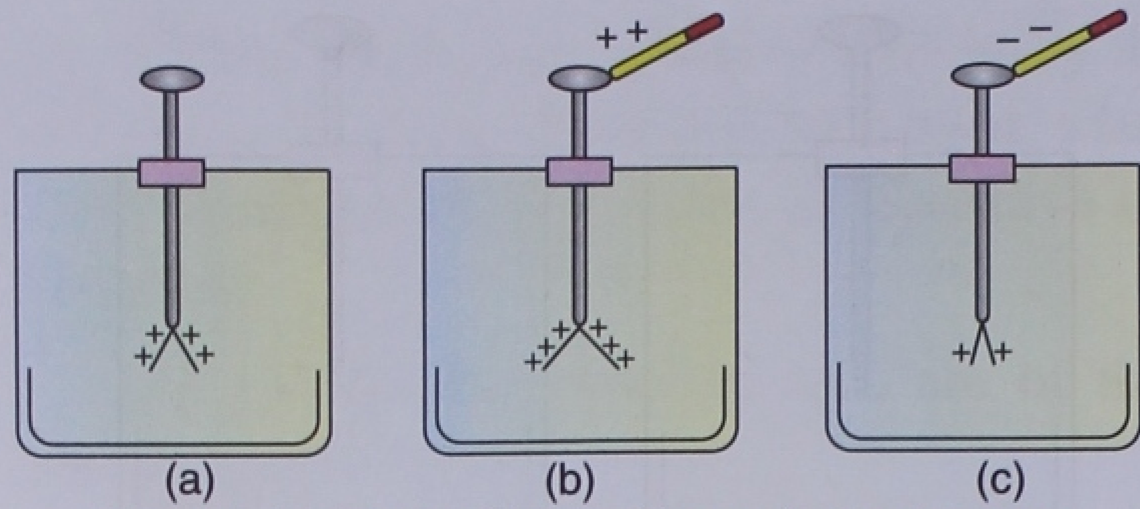


Fig. 10.16 (a) positively charged electroscope, (b) leaves spread wider means body is positively charged, (c) leaves come closer means body is negatively charged

the body is positively charged. If the leaves come closer to each other, then the body is negatively charged (Fig. 10.16).

This testing can also be done by charging the electroscope negatively [Fig. 10.17(a)]. On touching the body to be tested, if the body is negatively charged, then the leaves spread further apart [Fig. 10.17(b)]. If the leaves come closer, then the body is positively charged [Fig. 10.17(c)]

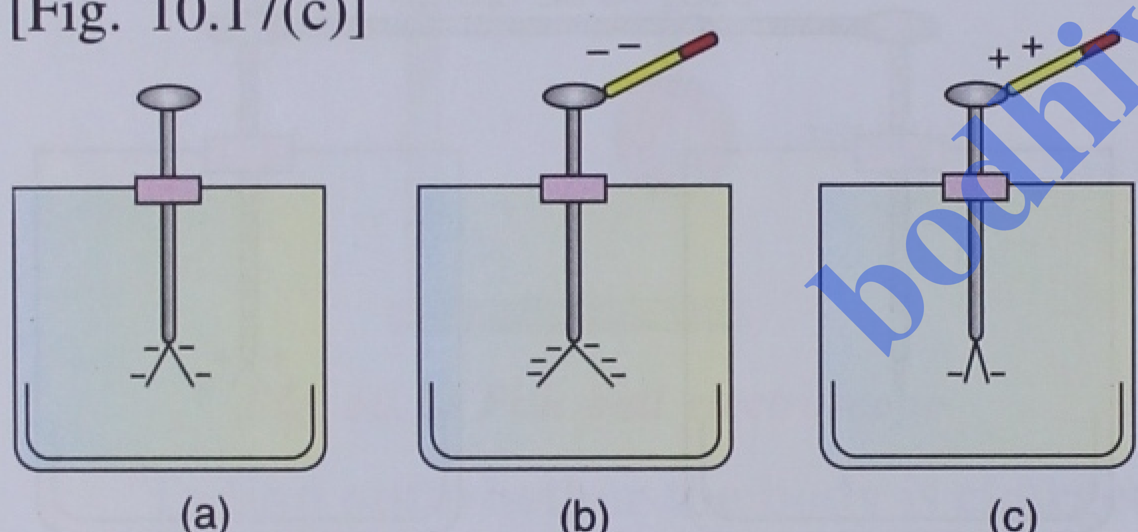


Fig. 10.17 (a) Negatively charged electroscope, (b) Body is negatively charged, (c) Body is positively charged

ATMOSPHERIC ELECTRICITY

Benjamin Franklin, an American scientist in 1749, was the first to determine that in a thunderstorm, the clouds are electrically charged.

For his experiment, he made a kite of silk cloth. He attached a pointed metal wire of about 30 cm length at the top corner of the kite. The other end of the wire was attached to the string. At the lower end of the string of the kite, he tied a metallic key and then a silk strip to insulate the string from the earth. When the kite was high enough in the sky during a thunderstorm and the string got wet due to rain, he obtained a number of sparks between his knuckle and the key. During a thunderstorm, the clouds get charged due to friction. This charge flows through the metal wire and the wet string to the metal key and the charge gets collected on the key. When the knuckle comes near the key, it gets oppositely charged by induction. Thus, the spark occurs between the charge of the key and the opposite charge of the knuckle.

Fig. 10.18 Benjamin Franklin proved that during a thunderstorm, clouds are electrically charged

This experiment led him to invent a safety device called the lightning conductor.

Do You Know ?

It is believed that lightning played a major role in the evolution life on the earth.

LIGHTNING

During thunderstorm, when a charged cloud passes over an uncharged cloud, the uncharged cloud acquires an opposite charge by induction. When two such clouds with opposite charges come closer to each other, they attract each other strongly and combine to produce a very large amount of heat, light and sound. A spark is produced which is called **lightning**.

The effects of such lightning are very dangerous. It can cause fire and shatter the buildings.

Due to the heat produced at the time of lightning, the air gets heated up and expands suddenly. This rapid expansion of air sends a disturbance through the air producing loud sound. This loud sound is heard as **thunder**.

An electric discharge can occur not only between two clouds but also between a charged cloud and the earth.

- When a charged cloud passes over a tall building or a tree it induces an opposite charge on them. If the built up charge is large, it leads to an electrical discharge in the form of a **lightning streak**.

  When lightning strikes a building or a tree, it can shatter and set them on fire. Lightning can severely burn and cause death of living beings if they happen to be in that area.
- That is why one is not advised to stand under a tree or near a tall building during a thunder storm.

Lightning safety :

During lightning and thunderstorm, follow the following suggestions –

1. On hearing a thunder, rush to a safe place such as a low-rise house/building.
2. If travelling by car/bus, you are safe inside. Keep the windows/doors of the vehicle shut.

Do's and Don'ts during a thunderstorm —

Outside the house :

1. Do not carry an umbrella over your head.
2. Do not stand near tall trees, electric pole, high-rise building and any metallic structure.
3. If there are trees around, take shelter under a shorter tree.
4. Do not lie on the ground, instead squat low on the ground with your hands on your knees and head in between.

Inside the house :

1. Unplug the TV sets, computers, etc. Do not use the wired phone.
2. Do not take bath during thunderstorms and avoid contact with running water.
3. Do not stand near windows or in balcony having metallic railings.

Do You Know ?

The process of transferring charge from a charged object to the earth is called earthing.

LIGHTNING CONDUCTOR

To protect tall buildings from damage by lightning, a conductor is fixed on top of the building. The conductor consists of several sharp metal spikes connected to a thick copper strip. The other end of the copper strip is fixed to a metal plate buried deep

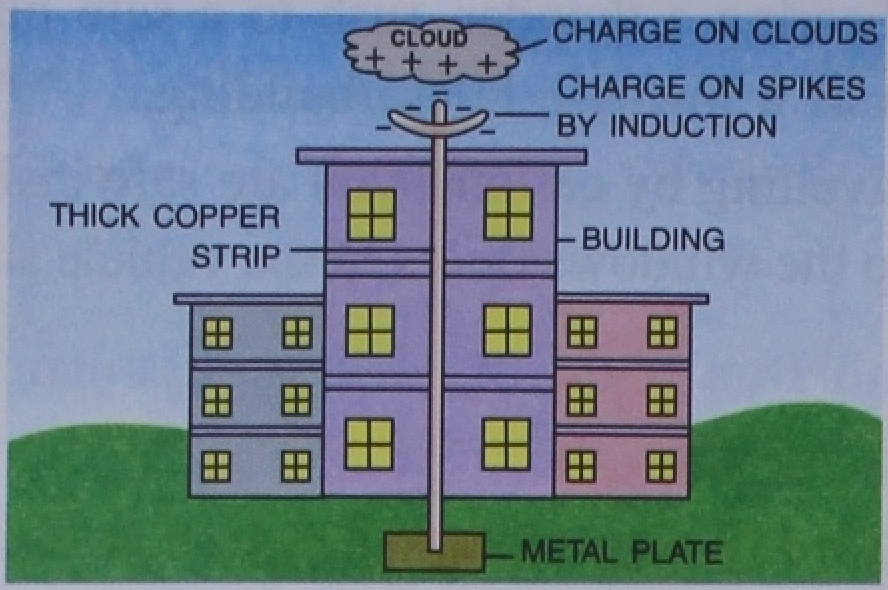


Fig. 10.19 Lightning conductor

inside the ground (Fig. 10.19). The process is called the **earthing**.

In rainy season, the roofs of tall buildings and monuments are wet, so they become good conductors of electricity. Imagine a positively charged cloud passing over the building fixed with the earthing system. By induction, the upper part of the building *i.e.* its roof will acquire opposite charge (negative charge).

In case the building does not have an earthing system, the large force of attraction between the positively charged clouds and the negatively charged roof of the building will make the charge of the cloud fall on the building. This may cause fire and damage to the building.

Useful effects of lightning

It is said that the evolution of life on the earth is due to lightning.

1. Fixation of atmospheric nitrogen by electric discharge during lightning — during rains, when lightning strikes, nitrogen and oxygen of the atmosphere combine to form nitric acid after a series of reactions. Rain water brings this nitric acid to the earth. Nitric acid reacts with some alkalies in the soil to form nitrates. These nitrates serve as plant food and help them in their growth.
2. Formation of ozone from the atmospheric oxygen — Electric discharge during lightning results in the formation of ozone (O_3) from oxygen (O_2). Ozone layer in the earth's atmosphere absorbs ultraviolet radiation coming from the sun and protects the living organisms on the earth.

RECAPITULATION

- Some substances like plastic, ebonite and glass rod can be charged by rubbing with suitable materials.
- An atom is, in general, electrically neutral *i.e.* the total number of protons in the nucleus is equal to the total number of electrons in the different orbits around the nucleus.
- In the outermost orbit, the electrons are loosely bound to the atom and are almost free to move. Hence they are called free electrons.
- Whenever two different bodies are rubbed together, electrons move from one body to the other. The body which loses electrons gets positively charged while the body which gains electrons becomes negatively charged.
- Unlike charges attract each other, while like charges repel each other.
- Repulsion is the surest test of electrification of two bodies.
- The bodies which allow the charges to flow are called conductors. The bodies which do not allow the charges to flow are called insulators.

- When an uncharged body is touched by a charged body, the uncharged body acquires a similar charge. This is known as charging by conduction.
- When an uncharged body is charged by bringing a charged body near it but not by touching it, the process is called the charging by induction.
- The principle of gold leaf electroscope is used for detection of charge, differentiating a conductor and an insulator and also finding the nature of charge.
- Earthing process saves a building from damage during lightning as the charges are directly transferred from the top of a building to earth through a metal strip.

TEST YOURSELF

A. Short Answer Questions :

1. State *true* or *false* for each statement and rewrite the false statement correctly.
   (a) The number of electrons and protons in an atom are not the same.
   (b) If the charge is not in motion, we call it static electricity.
   (c) Human body is an insulator of electricity.
   (d) When an ebonite rod is rubbed with fur, the electrons move from ebonite to fur.
   (e) When, glass rod is rubbed with dry silk cloth, the electrons move from glass to silk.
   (f) The cap of gold leaf electroscope is made of copper.
   (g) If a glass rod rubbed with silk is brought near the cap of a negatively charged electroscope, the divergence of leaves will decrease.
   (h) In induction, a positively charged body can make an uncharged body positively charged.
   (i) A lightning conductor saves the building from lightning.
   (j) A comb rubbed with hair and brought near pieces of paper attracts them, because both comb and paper get similarly charged.

2. Fill in the blanks :
   (a) In an atom, the number of electrons is equal to the number of ....
   (b) Two unlike charges .... each other.
   (c) Two like charges .... each other.
   (d) When a glass rod is rubbed with dry silk cloth, the glass rod acquires .... charge.
   (e) .... is the surer test for electrification.
   (f) .... is a non-metal which is a good conductor of electricity.
   (g) When a charged rod is touched with the brass cap of gold leaf electroscope, the leaves will ....
   (h) We may charge an uncharged body by the method of .... or ....
   (i) .... protects a building from damage caused by lightning.
   (j) A gold leaf electroscope can be negatively charged by conduction by bringing .... rod in contact with the brass cap.

3. Match the following :

(a) Two dissimilar charges	(i) negative charge
(b) Two similar charges	(ii) repel
(c) Silver is a	(iii) insulator
(d) Sulphur is an	(iv) attract
(e) Ebonite rubbed with fur acquires	(v) conductor

4. Tick the most appropriate answer :
   (a) Father of electricity is considered to be
   (i) Isaac Newton
   (ii) Galileo
   (iii) Albert Einstein
   (iv) William Gilbert
   (b) Atom, in general, is electrically
   (i) neutral (ii) positive
   (iii) negative (iv) none of these
   (c) When a glass rod is rubbed with dry silk cloth, the charge acquired by the silk cloth is
   (i) positive (ii) negative

(iii) both positive and negative
(iv) none of these

(d) When an ebonite rod is rubbed with fur, the rod acquires
(i) positive charge (ii) negative charge
(iii) no charge (iv) none of these

(e) When a negatively charged body is brought closer to another negatively charged body, then they will show
(i) attraction (ii) no effect
(iii) repulsion (iv) none of these

(f) Silver is a
(i) bad conductor of electricity
(ii) good conductor of electricity
(iii) magnetic substance
(iv) none of these

(g) Charging a conductor by bringing another charged conductor close to it is called
(i) induction (ii) conduction
(iii) convection (iv) radiation

(h) The factor responsible for charging a conductor is
(i) transfer of protons
(ii) transfer of neutrons
(iii) transfer of electrons
(iv) none of these

(i) An atom with deficiency of electrons is
(i) positive ion (ii) negative ion
(iii) neutral (iv) none of these.

(j) If the charges are not allowed to flow, then it is called
(i) static electricity (ii) magnetism
(iii) current electricity (iv) none of these

5. Answer the following questions :
(a) What do you understand by static electricity?
(b) Who discovered the method of producing electricity by friction ?
(c) Name two substances which can be charged by friction.
(d) What are the two kinds of charges ?
(e) What is the net charge on an atom ?
(f) Define conductors and insulators.

B. Long Answer Questions :

1. When a glass rod is rubbed with silk, what kind of charge is acquired by each. Explain.
2. Describe an experiment to show that there are two kinds of charges.
3. Name three constituents of an atom and state the kind of charge on them.
4. State two methods of charging a conductor.
5. Describe a method of charging a conductor by conduction.
6. What is an electroscope ? Name the two electroscopes.
7. Draw a labelled diagram of a gold leaf electroscope and describe its construction.
8. What is a lightning conductor? How does it work?
9. What are free electrons ?
10. What is the net charge in an atom ?
11. A glass rod is rubbed with a silk cloth and acquires a charge of $+1 \cdot 6 \times 10^{-12}$C. What is the charge on the silk cloth ?

Find out from your surroundings —
Petrol tanks along the highways often have metal chains attached that drag along the road. Why ?

PLAY AND LEARN

Unscramble these letters to make a word.

1. The sound which we hear after light.	RTHUEND	....
2. The shining streaks of light seen during rainy day.	TNINGGLIH	....
3. The negatively charged particles in an atom.	TROELECNS	....
4. The positively charged particles in an atom.	TORPNOS	....