SOME NATURAL PHENOMENA

5
CHAPTER

CONTENTS

CHARGING BY RUBBING

The ancient Greeks knew as early as 600 B.C. that when amber (amber is a kind of resin) was rubbed with fur, it attracted light objects such as hair. If you take off these clothes in the dark, you see even a spark and hear crackling sound.

In 1752 Benjamin Franklin, an American scientist, showed that lightning and the spark from your clothes are essentially the same phenomena.

When a plastic comb is rubbed with dry hair, it acquires a small charge. These objects are called charged objects. In the process of charging the plastic comb, hair also get charged.

The method of charging by friction is called **frictional charging.**

TYPES OF CHARGES AND THEIR INTERACTION

There are two kinds of charges same kind of charges repel each other, while charges of different kind attract each other

It is a convention to call the charge acquired by a glass rod when it is rubbed with silk as positive. The other kind of charge is said to be negative.

TRANSFER OF CHARGE & EARTHING

Take an empty jam bottle. Take a piece of cardboard slightly bigger in size than the mouth of the bottle. Pierce a hole in it so that a metal paper clip could be inserted. Cut two strips of aluminium foils. Hang them on the paper clip as shown. Insert the paper clip in the cardboard lid so that it is perpendicular to it (Fig.). Charge a refill and touch it with the end of the paper clip. Observe that they repel each other.

Fig. : A simple electroscope

This device is known as **electroscope**. Thus, we find that electrical charge can be transferred from a charged object to another through a metal conductor.

Touch the end of the paper clip gently with hand and you will find a change in the foil strips. They come back to their original state. The reason is that the foil strips lose charge to the earth through your body. We say that the foil strips are discharged. The process of transferring of charge from a charged object to the earth is called **earthing**.

RAIN

Water from the water bodies on the surface of the earth get converted into water vapour by evaporation goes into the atmosphere and then rises up in the air. The water droplets, which float in the air in the form of clouds. These water droplets by colliding against each other and stick together to form bigger water droplets. When these water droplets become too heavy to float, they come down as rain.

LIGHTNING

During the development of a thunderstorm, the air currents move upward while the water droplets move downward. These vigorous movements cause separation of charges. The positive charges collect near the upper edges of the clouds and the negative charges accumulate near the lower edges. There is accumulation of positive charges near the ground also.

When the magnitude of the accumulated charges becomes very large, the air which is normally a poor conductor of electricity, is no longer able to resist their flow. Negative and positive charges meet, producing streaks of bright light and sound. We see streaks as lightning (Fig.). The process is called an electric discharge. The process of electric discharge can occur between two or more clouds, or between clouds and the earth & at that moment air near lightning path reaches up to 30,000°C

Fig. : Accumulation of charges leading to lightning

LIGHTNING SAFETY

- **Finding a safe place :**

  A house or a building is a safe place. If you are travelling by car or by bus, you are safe inside with windows and doors of the vehicle shut.

  If outside the home :

  Open vehicles, like motorbikes, tractors, construction machinery, open cars are not safe. Open fields, tall trees, shelters in parks, elevated places do not protect us from lightning strokes. Carrying umbrella is not a good idea at all during thunderstorms.

  If you are in a forest, take shelter under shorter trees. If no shelter is available and you are in an open field, stay far away from all trees. Stay away from poles or other metal objects. Do not lie on the ground. Instead, squat low on the ground. Place your hands on your knees with your head between the hands (Fig.).

Fig. : Safe position during lightning

This position will make you the smallest target to be struck.

If inside the house :

Lightning can strike telephone cords, electrical wires and metal pipes. During a thunderstorm contact with these should be avoided. It is safer to use mobile phones and cordless phones. However, it is not wise to call up a person who is receiving your phone through a wired phone. Bathing should be avoided during thunderstorms to avoid contact with running water. Electrical appliances like computers, TVs, etc., should be unplugged. Electrical lights can remain on. They do not cause any harm.

LIGHTNING CONDUCTORS

Lightning Conductor is a device used to protect buildings from the effect of lightning. A metallic rod, taller than the building, is installed in the walls of the building during its construction. One end of the rod is kept out in the air and the other is buried deep in the ground (Fig.). The rod provides easy route for the transfer of electric charge to the ground.

The metal columns used during construction, electrical wires and water pipes in the buildings also protect us to an extent. But do not touch them during a thunderstorm.

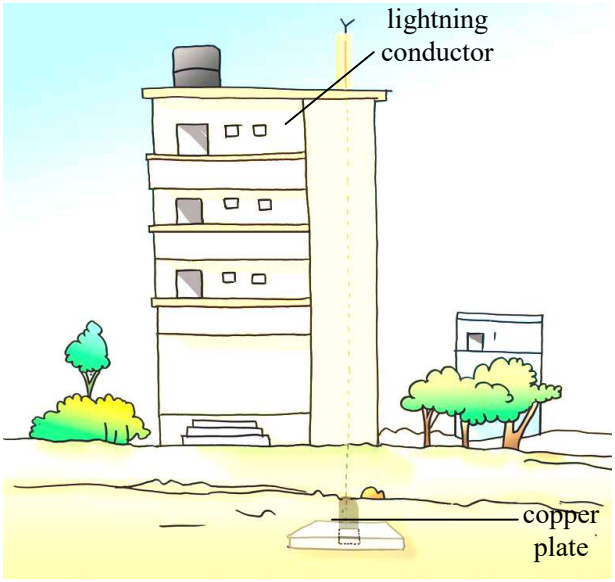


Fig. : Lightning conductor

EARTHQUAKES

If a thunderstorm occurs there is always a possibility of lightning and cyclones accompanying it. So, we get time to take measures to protect ourselves from the damage caused by these phenomena. There is, however, one natural phenomenon which we are not yet able to predict. It is an earthquake. It can cause damage to human life and property on a huge scale.

An **earthquake** is a sudden shaking or trembling of the earth lasting for a very short time. It is caused by a disturbance deep inside the earth's crust.

Earthquakes occur all the time, all over the earth. They are not even noticed. Major earthquakes are much less frequent. They can cause immense damage to buildings, bridges, dams and people. There can be a great loss to life and property.

The earthquakes can cause floods, landslides and tsunamis. A major tsunami occurred in the Indian Ocean on 26th December 2004. All the coastal areas around the ocean suffered huge losses.

CAUSES OF EARTHQUAKES

The tremors are caused by the disturbance deep down inside the uppermost layer of the earth called the crust (Fig.).

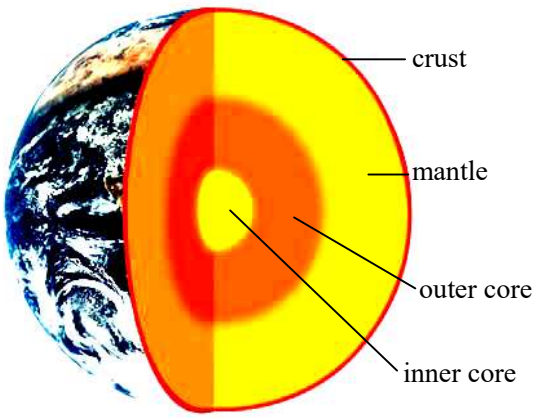


Fig. : Structure of the earth

The outermost layer of the earth is not in one piece. It is fragmented. Each fragment is called a plate (Fig.).

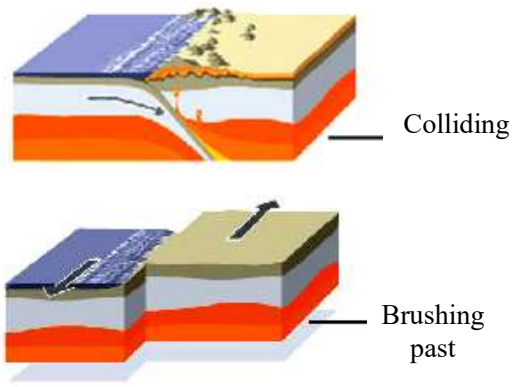


Fig. : Movements of earth's plates

These plates are in continual motion. When they brush past one another, or a plate goes under another due to collision (Fig.), they cause disturbance in the earth's crust. It is this disturbance that shows up as an earthquake on the surface of the earth.

Tremors on the earth can also be caused when a volcano erupts, or a meteor hits the earth, or an underground nuclear explosion is carried out. However, most earthquakes are caused by the movement of earth's plates.

Since earthquakes are caused by the movement of plates, the boundaries of the plates are the weak zones where earthquakes are more likely to occur. The weak zones are also known as **seismic or fault zones.** The power of an earthquake is expressed in terms of a magnitude on a scale called **Richter scale**. Really destructive earthquakes have magnitudes higher than 7 on the Richter scale.

PROTECTION AGAINST EARTHQUAKES

(a) Before earthquakes

- Consult qualified architects and structural engineers.
- In highly seismic areas, the use mud or timber is better than the heavy construction material. Keep roofs as light as possible. In case the structure falls, the damage will not be heavy.
- It is better if the cupboards and shelves are fixed to the walls, so that they do not fall easily.
- Be careful where you hang wall clocks, photo-frames, water heaters etc., so that in the event of an earthquake, they do not fall on people.
- Since some buildings may catch fire due to an earthquake, it is necessary that all buildings, especially tall buildings, have fire fighting equipment in working order.

(b) At the time of earthquakes

In the event that an earthquake does strike, take the following steps to protect yourself :

1. If you are at home :

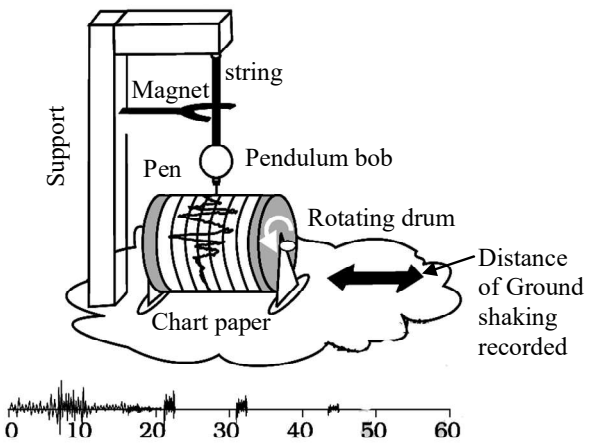
- Take shelter under a table and stay there till shaking stops.
- Stay away from tall and heavy objects that may fall on you.
- If you are in bed, do not get up. Protect your head with a pillow.

2. If you are outdoors:

- Find a clear spot, away from buildings, trees and overhead power lines. Drop to the ground.
- If you are in a car or a bus, do not come out. Ask the driver to drive slowly to a clear spot. Do not come out till the tremors stop.

SEISMOGRAPH

The tremors produce waves on the surface of the earth. These are called seismic waves. The waves are recorded by an instrument called the **seismograph.**



The instrument is simply a vibrating rod, or a pendulum, which starts vibrating when tremors occur. A pen is attached to the vibrating system. The pen records the seismic waves on a paper which moves under it. By studying these waves, scientists can construct a complete map of the earthquake, as shown in figure. They can also estimate its power to cause destruction.

Like many other scales in science (decibel is another example), Richter scale is not linear. This means that an earthquake of magnitude 6 does not have one and half times the destructive energy of an earthquake of magnitude 4. In fact, an increase of 2 in magnitude means 1000 times more destructive energy. For example, an earthquake of magnitude 6 has thousand times more destructive energy than an earthquake of magnitude 4

➢ IMPORTANT POINTS TO BE REMEMBER

- Some objects can be charged by rubbing with other objects.
- There are two kinds of charges — positive charge and negative charge
- Like charges repel and unlike charges attract each other.
- The electrical charges produced by rubbing are called static charges.
- When charges move, they constitute an electric current.
- An electroscope may be used to detect whether a body is charged or not.
- The process of transfer of charge from a charged object to the earth is called earthing.
- The process of electric discharge between clouds and the earth or between different clouds causes lightning.
- Lightning strike could destroy life and property.
- Lightning conductors can protect buildings from the effects of lightning.
- An earthquake is a sudden shaking or trembling of the earth.
- Earthquake is caused by a disturbance deep inside the earth's crust.
- It is not possible to predict the occurrence of an earthquake.
- Earthquakes tend to occur at the boundaries of earth's plates. These boundaries are known as fault zones.
- Destructive energy of an earthquake is measured on the Richter scale. The earthquake measuring 7 or more on Richter scale can cause severe damage to life and property.
- We should take necessary precautions to protect ourselves from earthquakes.

EXERCISE # 1

EXERCISE QUESTIONS

Q.1 Write T against true and F against false in the following statements:
(a) Like charges attract each other (T/F)
(b) A charged glass rod attract a charged plastic straw (T/F)
(c) Lightning conductor cannot protect a building from lightning (T/F)
(d) Earthquakes can be predicted in advance (T/F)

Q.2 Sometime, a crackling sound is heard while taking off sweater during winters. Explain.

Q.3 Explain why a charged body loses its charge if we touch it with our hand.

Q.4 Name the scale on which the destructive energy of an earthquake is measured. An earthquake measures 3 on this scale. Would it be recorded by a seismograph? Is it likely to cause much damage ?

Q.5 Suggest three measures to protect ourselves from lightning.

Q.6 Explain why a charged balloon is repelled by another charged balloon whereas an uncharged balloon is attracted by another charged balloon ?

Q.7 Describe with the help of a diagram an instrument which can be used to detect a charged body.

Q.8 List three states in India where earthquakes are more likely to strike.

Q.9 Suppose you are outside your home and an earthquake strikes. What precaution would you take to protect yourself ?

Q.10 The weather department has predicted that a thunderstorm is likely to occur on a certain day. Suppose you have to go out on that day. Would you carry an umbrella? Explain.

Q.11 What is the use of step leader ?

Q.12 What to do mean by lightning conductor ? Write their importance.

Q.13 Why do we hear a thunder after lightning ? Explain.

Q.14 Give one importance property of electric charge.

Q.15 Explain the working of seismograph with the help of a diagram.

Q.16 Define seismology.

Q.17 Write the process of occurring of earthquake.

Q.18 Explain the following terms with respect to earthquakes :
(i) Focus (ii) Epicentre

Q.19 Write a note on the precautions we should take while designing buildings to reduce loss of life and property due to an earthquake.

EXERCISE # 2

Single Correct Answer type Questions

Q.1 Which of the following cannot be charged easily by friction ?
(A) A plastic scale
(B) A copper rod
(C) An inflated balloon
(D) A woollen cloth.

Q.2 When a glass rod is rubbed with a piece of silk cloth the rod -
(A) and the cloth both acquire positive charge.
(b) becomes positively charged while the cloth has a negative charge.
(c) and the cloth both acquire negative charge.
(d) becomes negatively charged while the cloth has a positive charge.

Q.3 Generally lower part of clouds has
(A) positive charge
(B) negative charge
(C) zero charge
(D) any type of charge

Q.4 Electric charges are
(A) only positive
(B) only negative
(C) either positive or negative
(D) insulators

Q.5 In a neutral object, there are
(A) equal number of atoms
(B) more positive charges than negative charges
(C) more negative charge than positive charge
(D) equal number of positive and negative charges

Q.6 In the air the path of lightning goes up to a temperature of about :
(A) 300ºC (B) 3,000ºC
(C) 300,000ºC (D) 30,000ºC

Q.7 A lightning conductor
(A) conducts light
(B) stops lightning
(C) protects buildings from the damaging effects of lightning
(D) prevents clouds from coming near a building and thus protects it

Q.8 If you are caught in a thunderstorm you should
(A) go and stand on a high ground
(B) stand under a tree
(C) take shelter indoors
(D) all of the above

Q.9 Charged objects exert a …… on each other
(A) cloud (B) lightning
(C) force (D) power

Q.10 We hear a thunder because
(A) a lot of charge goes in lightning
(B) because lightning is very bright
(C) because the air heats up and expands all of a sudden
(D) clouds bang against each other

Q.11 The correct relation between speed of light (c) and speed of sound (v_s) is
(A) $c < v_s$ (B) $c \geq v_s$
(C) $c >> v_s$ (D) $c = v_s$

Q.12 Lighting occurs because of
(A) rain (B) electric discharge
(C) wind (D) angry Gods

Q.13 Which instrument is used to measure earthquake waves ?
(A) Seismogram (B) Seismograph
(C) Seismic wave (D) Seismology

Q.14 The point at which the rocks on either side of the plate give way is called
(A) focus (B) epicenter
(C) aftershock (D) fault

Q.15 The outermost layer of the earth is called
(A) Mantle (B) Core
(C) Crust (D) Center

Q.16 The branch of science concerned with earthquakes and related phenomena is called
(A) Electrostatics (B) Optics
(C) Seismology (D) Geology

Q.17 Earthquakes are generally followed by
(A) rain (B) after shocks
(C) thunder (D)lighting

ANSWER KEY

EXERCISE-2

Ques	1	2	3	4	5	6	7	8	9	10
Ans	A	B	B	C	D	D	C	C	C	C
Ques	11	12	13	14	15	16	17			
Ans	C	B	B	A	C	C	B			