

TOPICS COVERED

- 15.1 Electrical Charge: Charging by Rubbing, Types of Charges, Properties and Transfer of Charge
15.2 Natural Destructive Phenomena: Lightning and Earthquake

IMPORTANT POINTS TO REMEMBER

- A sudden electric discharge from one cloud to another or from a cloud to the earth is called **lightning**.
- Some objects get electrically charged when they are rubbed against one another. For example, plastic refill rubbed with polythene, plastic comb rubbed with hair, glass rod rubbed with silk cloth, etc.
- When a glass rod is rubbed with silk then as per convention the charge on glass rod is taken as positive. On the other hand, the charge on silk is taken as negative.
- Like charges repel each other. Unlike charge attract each other.
- **Electroscope** is a simple device to study transfer of charges. It is composed of a glass container, a metallic rod, a metallic top and leaves of metal foil.
- Acquiring a charge is called charging. Losing a charge is called discharging.
- Transfer of charge from a charged body to the earth is called earthing. Earthing wire is present in household wiring to prevent any electric shock due to leakage in electric current.
- **Formation of Lightning:** During the development of thunderstorm, air currents move upward and water droplets move downward. Vigorous movements of air current and water droplets result in separation of charges. Positive charges accumulate near the upper edges of cloud and negative charges accumulate near the lower edges of cloud. Positive charge accumulates near the ground also. Air is a poor conductor of electricity. But when accumulation of charges becomes too much, air is unable to hold them. As a result, electric charge is passed to the ground.
- **Lightning conductor** is a safety device which prevents damage to a building due to lightning.
- The sudden shaking or trembling of earth which lasts for a short time is called **earthquake**. Earthquake is caused by disturbances deep inside the earth.
- Earth's crust is divided into many pieces. Each piece is called a tectonic plate. The tectonic plates are always in motion. When a plate brushes against another or goes over another, it creates huge disturbance in plates. This is felt as earthquake.
- Boundaries of tectonic plates are more prone to getting hit by earthquakes. These are called **seismic zones**.

- The scale on which power of an earthquake is measured is called **Richter Scale**. This scale ranges from zero to 10.
- A machine which records seismic activity in the form of a graph is called seismograph. It is composed of a vibrating rod or pendulum. A pen is attached to the vibrating rod so that it can plot graph on a paper.
- The location where earthquake begins is called the focus of the earthquake.
- The point on the earth's surface located directly above the focus is called **epicenter**.
- Till date no technology could be developed which can predict an earthquake. Making a 'Quake Safe' building is the first step towards protection against an earthquake.

15.1 ELECTRICAL CHARGE: CHARGING BY RUBBING, TYPES OF CHARGE, PROPERTIES AND TRANSFER OF CHARGE

Charging by Rubbing: When two objects are rubbed against each other, they get electrically charged. This force is called *electrostatic force*. So, a body having electrical charge is called a *charged body*.

The process of giving electric charge to an object is called *charging* the object. Charging an object by rubbing it with another object is called *charging by friction*.

Types of Electric Charge: There are two types of electric charge: Positive charge and Negative charge.

- The electric charge acquired by a glass rod when it is rubbed with silk is considered as positive charge.
- The electric charge acquired by an ebonite rod when rubbed with fur or wool is considered as negative charge.

Properties of Electric Charge

- Like charges repel each other and unlike charges attract each other.
- The force of attraction or repulsion operates even when the charges are placed in vacuum.

Transfer of Charge: Electrical charge can be transferred from a charged body to another metal conductor. It is because metals are good conductors of electricity.

Earthing: The process of transferring of charge from a charged body to the earth is called earthing.

Gold Leaf Electroscope: An electroscope is an instrument used for detecting electrical charge and its nature on a body. It consists of a brass rod, which passes through a rubber stopper in a glass jar. The top end of the brass rod carries a brass disc and the lower end carries two thin gold leaves. Such that they hang parallel to each other. The lower end of the glass jar in the interior is surrounded by a metal foil.

When the electroscope is used, the metal foil is earthed. This increases the sensitivity of the electroscope.

Uses of a Gold Leaf Electroscope

- To detect charge on a body.
 - To identify the nature of charge.
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Exercise 15.1

I. Very Short Answer Type Questions (1 Mark)

1. Give one word for the following:
 - (a) Charge produced on a glass rod when rubbed with silk. _____
 - (b) Charge produced on an ebonite rod when it is rubbed with fur. _____
 - (c) Charges which repel each other. _____
 - (d) Device used in detecting electric charges. _____
2. Fill in the blanks:
 - (a) _____ charges attract each other.
 - (b) _____ is the process of discharging atmospheric electricity through a conductor into the earth.
 - (c) A force due to electric charge produced on a body by rubbing is called _____.
 - (d) The mutual push between two bodies (not in contact) away from one another is called _____.
3. If a charged plastic straw is brought near to smaller uncharged plastic straw. What will happen?
4. Plastic straws A and B are rubbed with dry cotton cloth. What will happen if they are brought near each other?

II. Short Answer Type Questions-1 (2 Marks)

5. In an electroscope, if a negatively charged body is brought in contact with the metal clip. The strips of the electroscope diverge. If now another charged object carrying equal amount of positive charge is brought in contact with the clip. What will happen? *(NCERT Exemplar)*
6. The strips of an electroscope diverge when a charged body is brought in contact with the metal clip. Now the clip is touched gently by our hand. What will happen to the strips? Explain. *(NCERT Exemplar)*

III. Short Answer Type Questions-2 (3 Marks)

7. What is a gold leaf electroscope? List its uses.
8. A boy placed an uncharged metal rod at an insulating stand. He then brought a +ve charged conductor close to the metal rod. He touched the uncharged rod with finger and removed it first then the charged conductor.
 - (a) What is the nature of charge acquired by the uncharged rod?
 - (b) Why does it acquire the charge?
9. Sometimes, a crackling sound is heard while taking off a sweater during winter. Explain. *(NCERT)*
10. Explain why a charged balloon is repelled by another charged balloon whereas an uncharged balloon is attracted by another charged balloon?

ANSWERS

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|-----------------|------------------|-------------------------|---------------|
| 1. (a) positive | (b) negative | 2. (a) Unlike | (b) Earthing |
| (c) similar | (d) electroscope | (c) Electrostatic force | (d) Repulsion |
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- The small plastic straw will get charged by the process of induction.
- They acquire similar charge and hence they repel each other.
- If a positively charged object is brought in contact with the clip of an electroscope, the negative charge previously acquired by the strips will be neutralized and the strips will collapse.
- The strips will lose their charges and return to their original position. The reason is that the foil strips lose their charges to the earth through the human body on touching the clip. It means that the foil is discharged. This process of transferring of charge from a charged object to the earth is called earthing.
- An electroscope is an instrument used for detecting electrical charge and its nature on a body. It consists of a brass rod, which passes through a rubber stopper in a glass jar. The top end of the brass rod carries a brass disc and the lower end carries two thin gold leaves. Such that they hang parallel to each other. The lower end of the glass jar in the interior is surrounded by a metal foil.

When the electroscope is used, the metal foil is earthed. This increases the sensitivity of the electroscope.

Uses of a Gold Leaf Electroscope

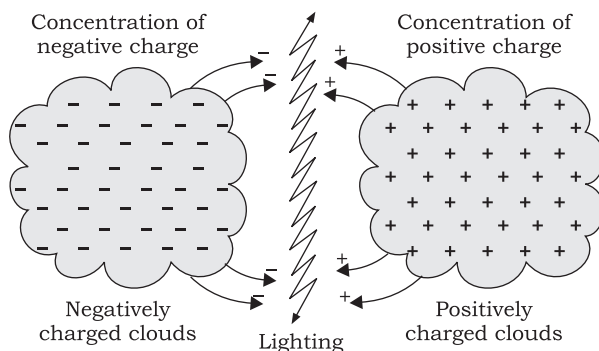
- To detect charge on a body.
 - To identify the nature of charge.
- (a) Charge acquired by uncharged rod is positive due to transfer of charge by one conductor to other conductor.
(b) Initially, rod lose the charge to the earth through the human body on touching it but even after removing the hand the positively charged conductor still in contact with the rod so it acquires positive charge by conduction.
 - Sweater is a woollen cloth which loses charged electron on rubbing against shirt and produces opposite charge and gets positively charged. Hence a crackling sound is heard.
 - Both the charged balloon have same type of charge, hence they repel each other. A charged balloon attracts an uncharged balloon by producing opposite charges in the nearer end of the uncharged object by electric induction.

15.2 NATURAL DESTRUCTIVE PHENOMENA: LIGHTNING AND EARTHQUAKE

Lightning: A rapid flow of electric charges through the air between the two oppositely charged clouds seen as an intense spark of electricity in the sky is called lightning. It is the lightning we see and the thunder we hear during thunderstorm.

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

A cloud has the negative charges concentrated at the base and positive charges concentrated at the upper region. When a charged cloud passes over a tall building or a tall tree, it induces an opposite charge on them. The negative charge at the base of the clouds pull the positive charges induced on the tall buildings upwards at a tremendous speed. As soon as the negative and positive charges



connect, a continuous path is formed which comes down as lightning strike. It has a temperature of about 30,000°C.

Harmful Effects

- (a) It can cause fire and shatter buildings.
- (b) It can burn trees and cause forest fires.
- (c) It injures or sometimes even kills animals and human beings instantly.

Lightning Conductor: A lightning conductor is a device which is fixed on the top of tall building to protect them from damage due to 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. The rod provides easy route for the transfer of electric charge in the ground.

The metal columns used during construction, electrical wires and water pipes in the buildings also protect us to an extent.

Safety measures to be taken during lightning.

Outside home:

- (a) Rush to a safer place.
- (b) Do not lie flat on the ground.
- (c) Do not take shelter under a tree.
- (d) Stay away from all types of water bodies.
- (e) Open vehicles like scooters, motorbikes, tractors, open cars, open fields, do not protect us when lightning strikes.
- (f) Quickly come down from elevated places like from the top of a hill, the summit of a mountain or the roof top of a building.

Indoor safety measures:

- (a) Avoid using electrical appliances, such as television, air-conditioners, computers etc.
- (b) Do not take bath on shower during blooms.
- (c) Stay away from landline phones, plumbing wires as these metals provide a good conducting path for the lightning charge.

Earthquakes: An earthquake is a sudden shaking of the Earth's crust which lasts for a very short time. It is caused by a disturbance deep inside the Earth's crust.

Cause of Earthquake: The main causes of earthquake are:

- (i) *Movement of Tectonic Plates:* The surface of the earth is broken into many large pieces called tectonic plates. Due to the slow movement (convection current). These plates move with respect to one another. This movement causes edges of the tectonic plates to grind each other with a force. They may get deformed, displaced or fractured. Such changes send a tremor or set up vibrations through the crust causing earthquakes.
 - (ii) *Volcanic Eruptions:* Volcano is a hole in the earth's crust through which the molten rocks and hot gases under high pressure rush out. The energy released during volcanic eruption causes vibrations in the crust causing earthquakes.
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- (iii) *Dislocation (or faults) of the Crust:* Over millions of years, the movement of the tectonic plates have created weak points in the earth's crust called fault zones. Most faults occur along the boundaries of the tectonic plates and these are the zones where earthquakes occur. They are also known as **seismic zone**.
- (iv) *Underground Nuclear Explosions:* Underground nuclear explosions cause very powerful vibrations. These vibrations cause **earthquake in the area around the nuclear explosion site**.

Terms related to Earthquake

- *Seismic focus:* A place of origin of an earthquake inside the earth is called seismic focus.
- *Focal depth:* The depth of seismic focus below the earth's surface is called focal depth of an earthquake.
- *Epicentre:* The point on the surface of the earth, directly above the focus of an earthquake is called an epicentre.
- *Seismic waves:* The waves generated inside the earth's surface due to earthquake are called seismic waves or shock waves.
- *Seismograph:* An instrument which detects and records the intensity of seismic waves generated by an earthquake is called seismograph.
- *Richter Scale:* The magnitude of an earthquake is a measure of amplitude of seismic waves. It is a scale for measuring the magnitude of earthquakes.

Damaging Effects of Earthquake

- Human made structure such as buildings, railway tracks, roads, bridges, factories, dams get severely damaged and people can get trapped inside the collapsed structures and may die.
- Fire often breaks which can be caused by sparking from electrical short circuits.
- Ground water pipes usually rupture, totally disrupting municipal water supply systems.
- Tremors in hilly areas cause landslides and cause huge loss of life and property.
- The course of rivers can also change causing floods.
- Communication system come to a stand-still.
- Earthquakes under the ocean floor sometimes generate powerful sea waves called *Tsunamis*.

Safety measures to be taken during an earthquake.

Outdoors

- Move to an open area.
- If driving, move away from tall building, trees or overhead electric cable lines.
- Move away from flyovers, bridges etc.

Indoors

- Take shelter under a table.
- Stay away from windows, book shelves, heavy objects that could fall.
- Turn off the power and gas supply if possible.

Earthquake-safe Buildings

- In highly seismic areas, light construction material like mud or limba should be used.
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- The cupboards and shells should be fixed to the walls.
- All buildings should have fire-fighting equipments in working order.
- Install outward opening doors which open easily.

Exercise 15.2

I. Very Short Answer Type Questions (1 Mark)

1. Give one word for the following:

- (a) An intense spark of electricity in the sky. _____
- (b) A place of origin of an earthquake inside the earth. _____
- (c) The point on the surface of the earth, directly above the focus of an earthquake. _____
- (d) An instrument which records the intensity of the earthquake. _____
- (e) A scale which measures the magnitude of an earthquake. _____
- (f) Device used to protect all buildings from lightning. _____

2. Fill in the blanks:

- (a) _____ is a brilliant spark produced in the sky due to electric discharge passing through oppositely charged clouds.
- (b) _____ is a giant sea wave produced due to an earthquake under the sea.
- (c) Giant plates of lithosphere floating over the mantle of the earth _____.
- (d) _____ is the surest test of electrification.
- (e) _____ is produced when oppositely charged clouds get discharged.

II. Short Answer Type Questions-1 (2 Marks)

3. What are tectonic plates?
4. What is lightning?
5. What is an earthquake?
6. How is an earthquake measured?
7. During the construction of a building the lightning conductor was left hanging in the air by mistake. Would the lightning conductor be still effective? Explain.

III. Short Answer Type Questions-2 (3 Marks)

8. How do clouds acquire huge electric charges?
 9. What are the harmful effects of lightning?
 10. Sameer goes to market with his younger brother Sachin. While returning, a sudden lightning and thunder strike the nearby place. They both get scared. Sameer and his brother take shelter in a building although there is a tall tree nearby.
 - (a) Why did Sameer and Sachin not take shelter under the tree?
 - (b) Has Sameer done the right thing in your opinion?
 11. If you are outside your home what precautions would you take to protect yourself from lightning?
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12. If air and cloud are good conductors of electricity. Do you think lightning could occur? Explain. *(NCERT Exemplar)*
13. Explain, why it is safer to use a wireless telephone instead of a landline telephone during lightning? *(NCERT Exemplar)*
14. List three states in India where earthquakes are more likely to occur.

IV. Long Answer Type Questions (5 Marks)

15. What are the causes of an Earthquake?
16. Mention the damaging effects of an earthquake.
17. What safety measures should we take inside our homes during lightning?

ANSWERS

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| <p>1. (a) Lightning
(c) Epicentre
(e) Richter scale
(f) Lightning conductor</p> <p>2. (a) Lightning
(c) Tectonic plates
(e) Lightning</p> <p>3. The surface of the earth is broken into many large pieces called tectonic plates. Due to the slow movement (convection current). These plates move with respect to one another. This movement causes edges of the tectonic plates to grind each other with a force. They may get deformed, displaced or fractured. Such changes send a tremor or set up vibrations through the crust causing earthquakes.</p> <p>4. A rapid flow of electric charges through the air between the two oppositely charged clouds seen as an intense spark of electricity in the sky is called lightning. It is the lightning we see and the thunder we hear during thunderstorm. An electric discharge or lightning can occur not only between two clouds but also between a charged cloud and the earth.</p> <p>5. An earthquake is a sudden shaking of the Earth's crust which lasts for a very short time. It is caused by a disturbance deep inside the Earth's crust.</p> <p>6. The magnitude of an earthquake is a measure of amplitude of seismic waves. Richter scale is the scale for measuring</p> | <p>(b) Seismic focus
(d) Seismograph</p> <p>7. No, it will not be effective because lightning conductor was not connected properly to the earth, due to which the charge will not pass to the earth.</p> <p>8. Air current move in the upward direction while the water droplets move in downward direction. These movements cause separation of charges in such a way that the positive charges collect near the upper limits of the clouds whereas the negative charges accumulate near the lower limits. There is accumulation of positive charges near the ground also. When the magnitude of the accumulated charges becomes very large, the air being a poor conductor of electricity, is no longer able to repel their flow. Negative and positive charges meet giving rise to lightning.</p> <p>9. (a) It can cause fire and shatter buildings.
(b) It can burn trees and cause forest fires.
(c) It injures or sometimes even kills animals and human beings instantly.</p> <p>10. (a) A tree does not have a lightning conductor, so lightning can fall on the trees.
(b) Yes, Sameer did the right thing, since a tall building always have a lighting conductor which can acquire lightning and discharge it down into the earth.</p> <p>11. (a) Rush to a safer place.
(b) Do not lie flat on the ground.</p> |
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- (c) Do not take shelter under a tree.
 - (d) Stay away from all types of water bodies.
 - (e) Open vehicles like scooters, motorbikes, tractors, open cars, open fields, do not protect us when lightning strikes.
 - (f) Quickly come down from elevated places like from the top of a hill, the summit of a mountain or the roof top of a building.
12. Air current move in the upward direction while the water droplets move in downward direction. These movements cause separation of charges in such a way that the positive charges collect near the upper limits of the clouds whereas the negative charges accumulate near the lower limits. There is accumulation of positive charges near the ground also. When the magnitude of the accumulated charges becomes very large, the air being a poor conductor of electricity, is no longer able to repel their flow. Negative and positive charges meet giving rise to lightning. But if air and clouds become good conductor of electricity this phenomenon will not take place.
13. A wireless telephone has no wires, so no lightning can fall on it.
14. (a) Jammu and Kashmir
(b) Uttarakhand (c) Gujarat
15. The main causes of earthquake are:
- (a) Movement of Tectonic Plates

- (b) Volcanic Eruptions
 - (c) Dislocation of the Crust
 - (d) Underground Nuclear Explosion
16. (a) Human made structures such as buildings, railway tracks, roads, bridges, factories, dams get severely damaged and people can get trapped inside the collapsed structures and may die.
- (b) Fire often breaks which can be caused by sparking from electrical short circuits.
 - (c) Ground water pipes usually rupture, totally disrupting municipal water supply systems.
 - (d) Tremors in hilly areas cause landslides and cause huge loss of life and property.
 - (e) The course of rivers can also change causing floods.
 - (f) Communication system come to a stand-still.
 - (g) Earthquakes under the ocean floor sometimes generate powerful sea waves called Tsunamis.
17. (a) Avoid using electrical appliances, such as television, air-conditioners, computers etc.
- (b) Do not take bath on shower during blooms.
 - (c) Stay away from landline phones, plumbing wires as these metals provide a good conducting path for the lightning charge.

Did You Know?

- It is not wise to take shelter under a tall tree or a high building during lightning storm. It is because each leaf of a tall tree acts as a lightning conductor. Further more, being higher it is nearer to the clouds. This in way is perfect condition for the lightning to strike.
- The Sumatra-Andaman Islands earthquake in the Indian Ocean on 26 Dec. 2004 lasted for 500 to 600 seconds making it the longest-lasting earthquake ever recorded.
- The worst devastation due to an earthquake was in Japan in 1923. In Tokyo and Yokohama in Japan, 5,75,000 dwellings were destroyed. The total number of people killed and missing was 1,42,807.

HOTS & VALUE BASED QUESTIONS

- When you rub an ebonite rod with wool and touch the rod to the brass cap of electroscope, then
 - What happens to the gold leaves? Why?
 - What is the nature of charged acquired by the gold leaves? **(HOTS)**
- You might have observed on a dry day that when you touch the screen of a television or computer monitor (with picture tube), you get a slight shock. Why does it happen? **(HOTS)**
- How does a lightning conductor protect a building from getting struck by lightning? **(HOTS)**
- It was raining heavily along with lighening. Rohit had to go school to participate in an art competition. He took out his umbrella but his elder sister advised him to take a raincoat instead of umbrella.
 - Why did his sister ask Rohit to use a raincoat instead of an umbrella?
 - What values were shown by his sister? **(VBQ)**
- Raj had gone to the market with his father. They were caught in a thunder and lightening storm while returning home from the market Raj ran for cover under a big tree on the side of the road but his father advised him to take correct precautions and not to stand under tall trees? **(VBQ)**

ANSWERS

- Gold leaves acquire similar charge thus, repels each other.
 - The leaves acquire negative charge.
 - This is due to accumulation of electric charge on the screen which gets discharged through our body on touching the screen. Thus we get a slight shock.
 - A lightning conductor is a device which is fixed on the top of tall building to protect them from damage due to 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. The rod provides easy route for the transfer of electric charge in the ground.

The metal columns used during construction, electrical wires and water pipes in the buildings also protect us to an extent.
 - An umbrella has a metal rod handle and it can conduct lightning if it falls on it. So Rohit's sister asked him to use a raincoat which is made of plastic/cloth which cannot conduct electricity.
 - His sister is intelligent and has a scientific bent of mind.
 - Tall trees do not have a lightning conductor and nearer to the thunder clouds and are most likely to be hit by lightning.
-