

SOME NATURAL PHENOMENA

LIGHTNING FLASH

- Electric spark that releases enormous amount of electrical energy at an instant.
- Electricity at homes/buildings is released in a controlled way when current flow through electrical wires.

STATIC ELECTRICITY

Charging by rubbing (frictional electricity)

- Electricity developed on the surface of insulating bodies when rubbed against each - other is called 'Frictional electricity' or 'Static electricity'.



MODERN THEORY OF ELECTRIC CHARGES

- Matter consist of tiny particles called atoms.
- Atoms contain particles called proton, neutrons and electrons.
- Protons are positively charged and neutrons have no charge.
- Electrons are negatively charged.
- An electrically charged atoms is called ions.

SOURCE OF FRICTIONAL ELECTRICITY

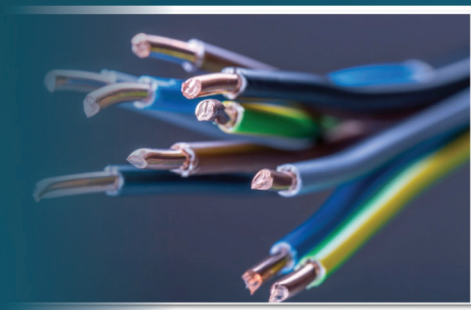
- When two substances are rubbed together, some electrons are removed from the atoms on the surface of one and transferred to other.
- The substance which gain electrons becomes negatively charged and the one which losses electrons becomes positively charged.
- Thus, the excess or deficiency of electron make a substance negative or positive.

CONDUCTORS

- The substances which allow the electric current to flow through them are called 'conductors'.
- Conductors have free electrons due to which they conduct electricity.

Example

- (1) Metals : Copper (Cu), aluminium (Al), silver (Ag), iron (Fe), etc.
- (2) Non metals : Graphite
- (3) Electrolytic solution : Aqueous solutions of NaCl, HCl, H₂SO₄, etc.



INSULATORS

The substances which do not allow the electric current to flow through them are called 'insulators'. They do not have free electrons.

Example

Rubber, glass, wood, plastics, porcelain, pure water, sugar, etc.

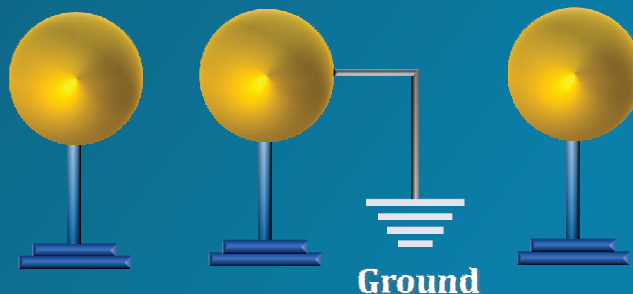


CHARGING BY INDUCTION

- The process of charging a conductor from a charged body without touching them together is **called induction**.
- The charges developed on an object without any contact with another object is **called Induced charges**.

CHARGING A METAL SPHERE USING INDUCTION

- If the sphere is negatively charged, the electrons will move from sphere to the earth. Again, sphere becomes neutral.



TRANSFER OF CHARGE

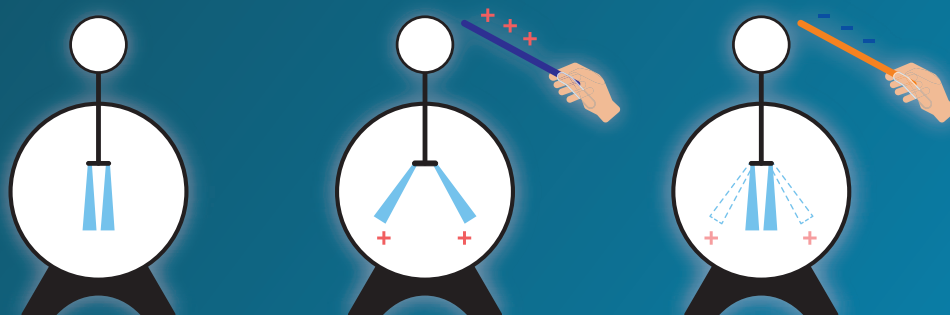
- If a charged body is put in contact with an uncharged conductor, the uncharged conductor becomes charged due to transfer of charged particles (electrons) between the charged body and the uncharged conductor. This is called Conduction.

(A) If charged body is positive, it will withdraw some electrons from uncharged body and the uncharged body become positively charged.

(B) If charged body is negative, it will transfer some electrons to uncharged body and the uncharged body becomes negatively charged.

LEAF ELECTROSCOPE

- 🔍 It is an instrument used to get a rough idea of the presence of electric charge on a body.
- 🔍 When uncharged, two leaves hang parallel due to their weight
- 🔍 When a negatively charged rod touches the knob. metal is a good conductor, electrons travel down. Both leaves become negatively charged. Because the leaves have similar charges, they repel.
- 🔍 When positively charged rod is brought into contact, electrons flow out of the metal leaves onto the rod, both leaves acquire positive charge and hence leaves repel each other.





THE STORY OF LIGHTNING

How clouds get charged ?

- During a thunderstorm, the air currents move upward while water droplets move downward. These vigorous movements cause separation of charges. A churning cloud formation causes water vapour molecules to collide to another, leaves the molecules oppositely charged.
- Cooling causes water vapour molecules to condense into water droplets which hold electrons more readily than water vapour, Thus droplets become negatively charged.
- Being heavier, negatively charged water droplets accumulate at the bottom of the cloud, causing the bottom of the cloud to become negatively charged. Top of the cloud, containing the water vapour, becomes positively charged.

Why air becomes a conductor during lightning ?

- Positive charges at the upper edge of the clouds, negative near the lower edges. Also, Induced positive charges near the ground.
- When the magnitude of the accumulated charges becomes very large, the attractive force between Negative electrons on the clouds and ground with induced positive charge, pulls electrons to the ground.
- Negative and positive charges meet, producing a streak of light and sound causing electric discharge, called 'Lightning'.



LIGHTNING SAFETY

- 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 an open umbrella during a thunderstorm increase your odds of being hit by lightning.

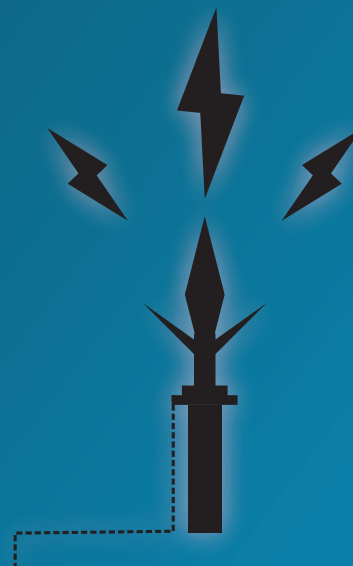


What are the safe places during lightning ?

- A house or a building is a safe place.
- Find shelter in a fully enclosed metal vehicle such as a car, truck or a van with the windows completely shut.

LIGHTNING CONDUCTOR

- It is a device which protects buildings from the lightning either by neutralizing or by conducting.



WORKING

- When a negatively charged cloud passes over the building, it induces a positive charge on the point ends of lightning conductor and equal negative charge at the metal plate.
- Charges are always concentrated at sharp points; they strongly repel the positive ions of the air particles.
- These positive ions move towards the negatively charged cloud.
- Neutralize some negative charges on the cloud thereby reducing the amount of charges on the cloud.
- Possibility of electric discharge through air from cloud to earth is reduced.
- Even if the electric discharge from cloud takes place, the negative charge of the cloud passes through copper wire to metal plate in the ground.

WHAT IS AN EARTHQUAKE?

- Occurs when a sudden release of energy causes the ground to shake and vibrate, passage of waves from source can be extremely devastating, killing thousands and destroying entire cities in a few seconds.
- Major tsunami in Indian Ocean on 26th December 2004. Coastal areas suffered huge losses.
- Secondary hazards, such as tsunami, landslides, fire, famine, and disease that also exert their toll on humans and animals.

STRUCTURE OF THE EARTH

The earth is organized into three major layers which are as follows:

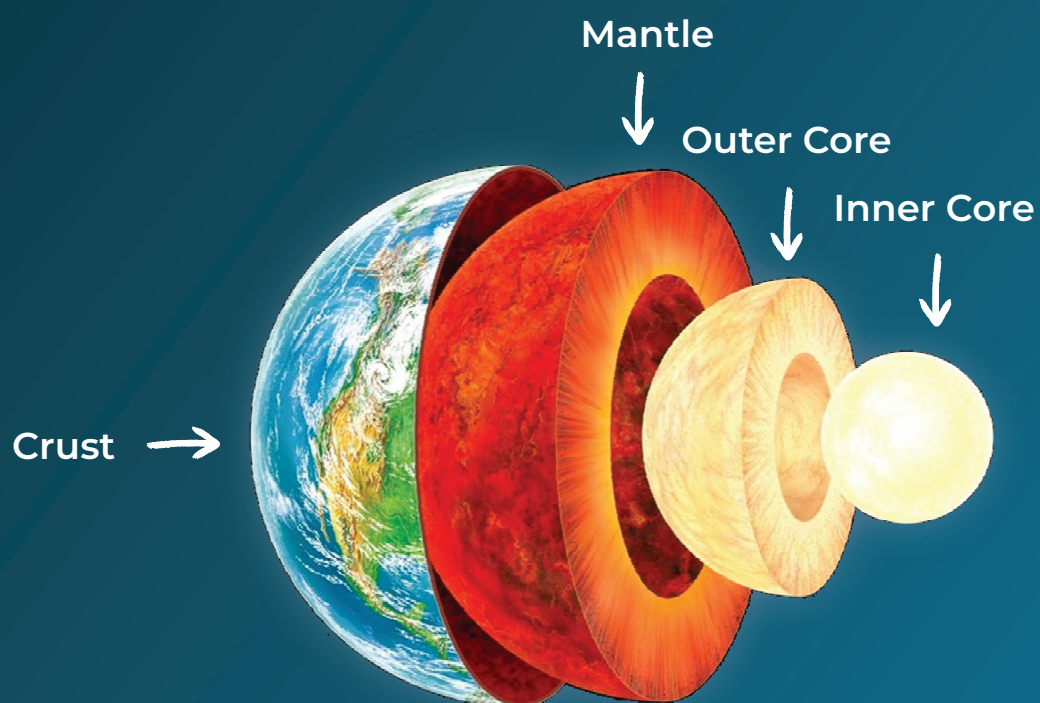
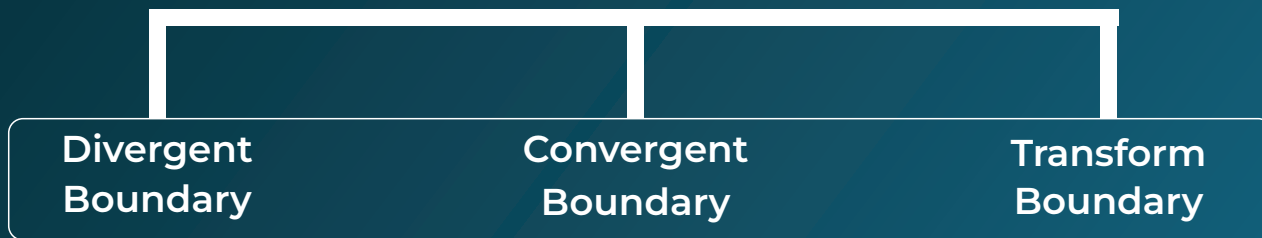


PLATE TECTONICS

- Crust, is not in one piece, it is fragmented, each fragment form continental and oceanic crust, Geologists named these as 'Tectonic plates' that fit together at their edges.
- There are about 12 major plates and several smaller ones, that move very slowly, few centimeters each year, similar to the rate at which fingernails grow.



TYPES OF BOUNDARIES



- Divergent boundary occurs where tectonic plates move away from each other.
- Convergent boundary occurs where tectonic plates move toward each other.
- Transform boundary where tectonic plates move horizontally past each other.

How Earthquake occurs ?

Stress and strain

- Along the boundaries between two plates, rocks in the crust often resist movement. Over time stress builds up. Stress is the total force acting on crustal rocks per unit area builds up.
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There are three kinds of stress that act on Earth's rocks:

Compression

Tension

Shear

- The deformation of materials in response to stress is called 'Strain'.
- Even though twisted, squeezed, and stretched, rocks fracture when stress reach a critical point.
- Fracture or system of fractures (Faults) or (Earthquakes) occur as a result of this release of energy.

FAULTS

- Crustal rocks fail when stresses exceed the strength of the rocks. The resulting movement occurs along a weak region in the crustal rock called a fault.
- Surface along which the movement takes places is 'Fault plane'
- Orientation of fault plane can be nearly horizontal to almost vertical.

REVERSE FAULTS

- Movement in tectonic plates is partly horizontal and partly vertical.
- Tectonic plates move apart, stretches the crust.
- Normal faulting is seen near divergent plate boundaries.

NORMAL FAULTS

- Result from a horizontal and vertical compression that squeezes rock.
- Creates a shortening of the crust.
- Rock on one side is pushed up relative to the other side.
- Can be seen near convergent plate boundaries.

STRIKE-SLIP FAULTS

- Caused by horizontal shear.
- Movement at a strike-slip fault is mainly horizontal and in opposite directions.
- Weak zones are also called Seismic or Fault zones.

EARTHQUAKE WAVES

- Energy in the form of vibrations called 'Seismic Waves' is released to produce an earthquake.

Types of seismic waves

PRIMARY WAVES

The back-and-forth motion produces as P-wave travel along the surface can cause the ground to buckle and fracture.

SECONDARY WAVES

They are slower than P-waves

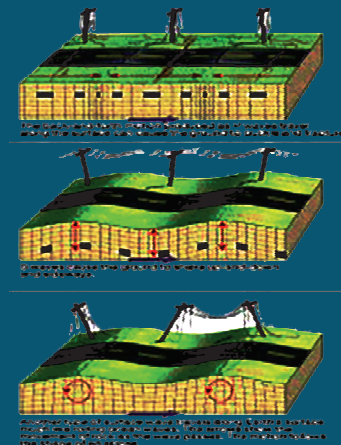
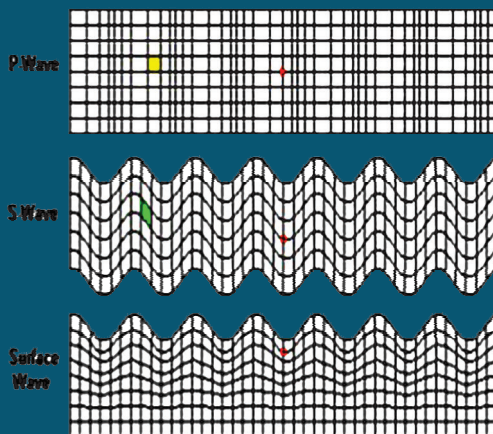
S-waves have a motion that causes rocks to move at right angles in relation to the direction of the waves.

SURFACE WAVES

The slowest type of waves are surface waves.

Cause ground to move sideways, up and down like ocean waves.

most destructive as cause most movement of the ground and take longest time to pass.

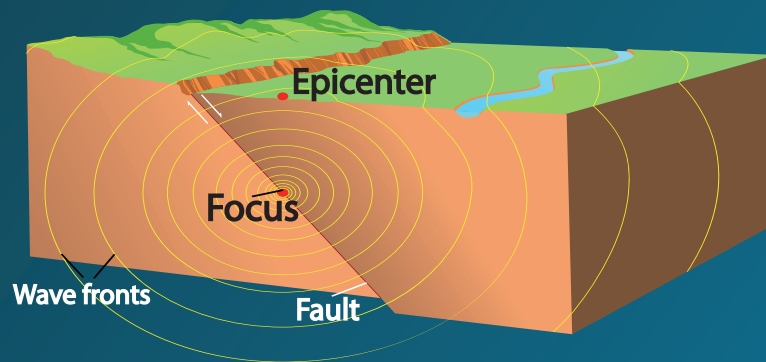


GENERATION OF SEISMIC WAVES

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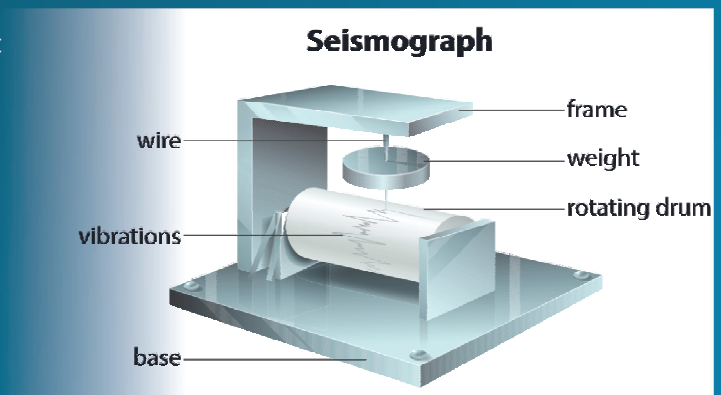
GENERATION OF SEISMIC WAVES

- Waves are generated from the point of failure of crustal rocks.
- Point where the waves originate is the 'Focus' of the earthquake, usually several kilometers below the Earth's surface.
- The point on Earth's surface directly above the focus is the epicenter.



SEISMOGRAPH (OR SEISMOMETER)

- Surface waves or The seismic waves are recorded by an instrument called 'Seismograph'.
- Instrument has a vibrating rod or a pendulum, which vibrates when tremors occur.



RICHTER SCALE

- The Richter scale, devised by a geologist named 'Charles Richter', is a numerical rating system that measures energy of the largest seismic waves, produced during an earthquake, called the magnitude of the earthquake.
- The numbers in the Richter scale are determined by the amplitude, of the largest seismic wave.
- Each successive reading of a Richter Scale increase the amplitude by a factor of 10. For example, the seismic waves of a magnitude-8 earthquake are ten times larger than those of a magnitude-7 earthquake.



PROTECTION AGAINST EARTHQUAKES

- People living in seismic zones, Earthquakes are more likely, they have to be specially prepared.
- Designing of buildings : Using modern building technology can withstand major tremor.
- Qualified architects/ structural engineers can design buildings 'Quake Safe'.
- The 'Central Building Research Institute', Roorkee, has developed techniques to make Quake proof houses.