CHAPTER ONE
STATIC ELECTRICITY

Introduction:

This is the branch of electricity which deals with current at rest. When certain substances are rubbed with certain materials, they become electrically charged. For example a plastic material such as a comb, becomes electrically charged when rubbed with materials such as hair, and for this reason it can attract pieces of paper. The comb is said to have been charged with static electricity, and the charging is due to friction. Friction does not create the charges, but only causes the movement of electrons from material to the other. An ebonite rod becomes negatively charged when it is rubbed with fur, and can pick up or attract pieces of paper. Electrons move from the fur into the ebonite rod and for this reason, the fur becomes positively charged while the rod becomes negatively charged. The fur and the rod are said to have been electrically charged by friction.

Positive and negative electricity:

- An electric charge may either be positive or negative and in order to obtain a positive charge, glass is rubbed with silk.
- A negative charge can be obtained when ebonite is rubbed with fur.
- If two charges are the same then they will repel each other, but if they are not the same, then they will attract each other.
- In order to show that there are two types of charges, two ebonite rods are each rubbed with fur and suspended.
- When their ends are brought towards each other, there will be repulsion.
- But if one of these ebonite rods is suspended and glass rubbed with silk is brought near it, there will be attraction.
- We can basically conclude that there are two types of charges, and similar or like charges repel each other while unlike or different charges attract each other.
- A body becomes negatively charged when it gains excess electrons, and becomes positively charged when it loses electrons.

Experiment to show that like charges repel:

- A warm dry glass rod is rubbed with silk and suspended with a thread.
- Another glass rod is rubbed with silk and then insulated.
- This insulated glass rod is then brought near the suspended glass rod.
- Since each of the glass rods has been positively charged, repulsion occurs.

Experiment to show that unlike charges attract:

- A glass rod is charged positively by rubbing it with silk.
- An ebonite rod is charged negatively by rubbing it with fur and then insulated.
- The glass rod is then suspended and the ebonite rod is then brought near it.
- The two oppositely charged rods will attract each other.
- The first law of electrostatics states that ''like charges repel and unlike charges attract"

Conductors (electrical conductors):

- These are materials which conduct electricity.
- This is due to the fact electricity is carried by free electrons, and conductors contain a lot of free electrons.- In a conductor electrons are loosely held by their respective atoms, and these orbiting electrons which are evenly distributed on the surface of the conductor, can easily be detached.

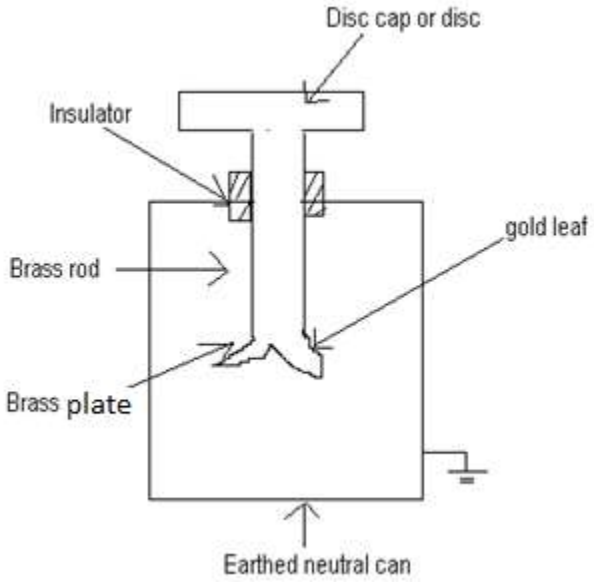
Insulators (electrical insulators):

- These are materials which do not conduct electricity under ordinary conditions.
- Under certain conditions, insulators can be made to conduct electricity and examples are rubber, polyethene and wood.
- Insulators do not conduct electricity since under ordinary conditions, their atoms exert strong hold on their electrons, including the valence (outer) electrons.
- For there are no free electrons which are responsible for the conduction of current.

Semi – Conductors:

- These are materials which are neither conductors nor insulators.
- Under certain conditions they act as conductors, and under other conditions they act as insulators.
- Examples are Germinium and Silicon.

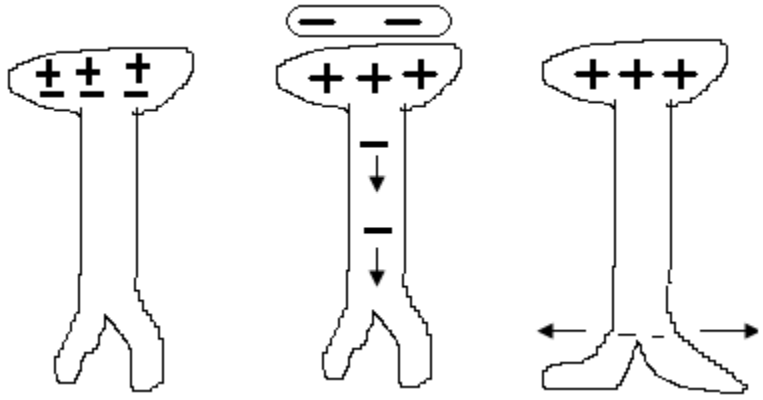
The gold leaf electroscope:



- The gold leaf electroscope is an instrument, used to detect the type of charges i.e. either negative or positive charges that a body carries.
- It can also be used to detect whether a body is charged or not.
- It consists of a brass rod which is surmounted by a brass disc or cap.
- At the lower end of this brass rod can be found a small rectangular brass plate, which has a leaf of gold or aluminum attached to it.
- The leaf is protected from draught by enclosing it in an earthed metal case with glass windows. -
The brass rod is supported by passing it through a plug of a good insulator at the top of the case.

Experiment with electroscope:

Experiment to detect the presence of a charge i.e. whether a body is charged or not:



(a) If a negatively charged object is brought near the cap of an electroscope, it will force the negative charges within the cap of the electroscope down the rod.
(b) These forced down negative charges, finally end up resting on the plate and the gold leaf.
(c) Repulsion occurs between the plate and the leaf and divergence of the leaf occurs.

Conclusion:

(1) Therefore whenever a charged body is brought near the cap of an electroscope, divergence of the leaf occurs.
(2) However if the positively or negatively charged body is removed, the leaf collapses slowly, which implies that the induced charges was only temporary but not permanent.
(3) Electroscope can only be used to test or detect only small charges.

To charge an electroscope by contact:

(1) An ebonite rod is negatively charged by rubbing it with fur, and it is the then rolled over the cap of the electroscope.
- The leaf of the electroscope diverges.
- The rod is then removed and if the leaf falls again the whole process is repeated until it does not fall, and when this occurs, then we have charged the electroscope with negative charge or negative electricity.

- Conduction of electrons from the ebonite rod onto the leaf and the plate occurred, and the electroscope is said to have been charged negatively by contact.

Earthing the electroscope:

- If the cap of the electroscope is touched with a finger, the negative charges on its leaf and the plate will flow to earth through our body.

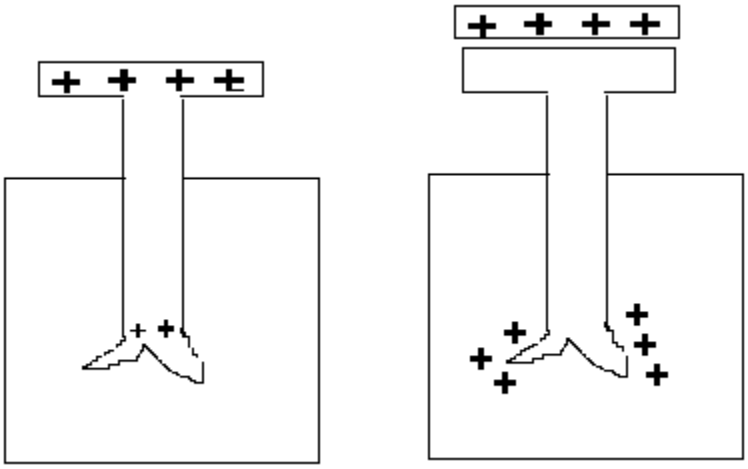
-This causes the leaf to collapse and this process is referred to as earthing the electroscope.

- Positive charges never move but rather it is negative charges which move.

- Charging an electroscope by contact is not an efficient one, since it may give the wrong rather the expected charge.

N/B: The following facts should be well taken notice of:

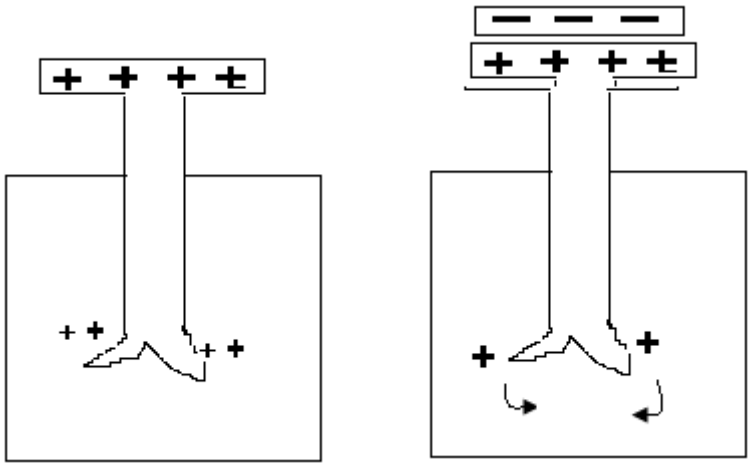
(1)



- If an electroscope is positively charged, and a positively charged rod is brought near the cap of the electroscope, there will be an increased in the divergence of the leaf.

-This is due to the fact that the positively charged rod, has repel more positive charges unto the plate and the leaf of the electroscope.

(2)

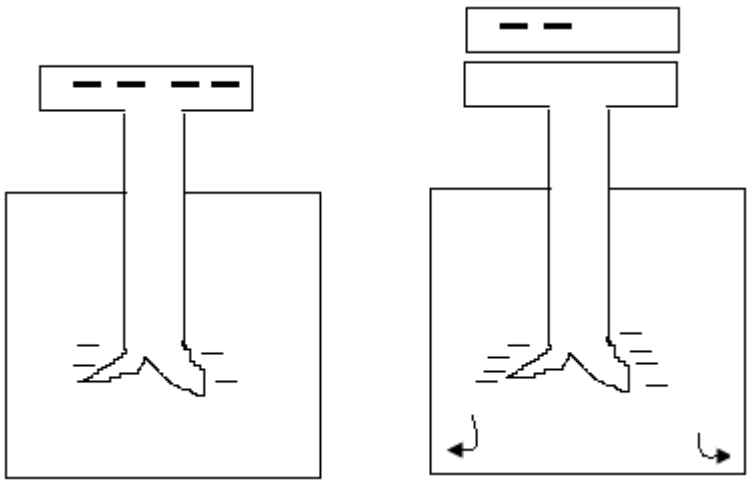


- If a negatively charged rod is brought near the cap of a positively charged electroscope, there will be a decrease in the divergence of the leaf.

- This is due to the fact that some of the positive charges on the plate and the leaf have been attracted onto the cap of the electroscope.

-This causes a decrease in the number of positive charges which resides on the plate and the leaf, which results in a divergence decrease.

(3)

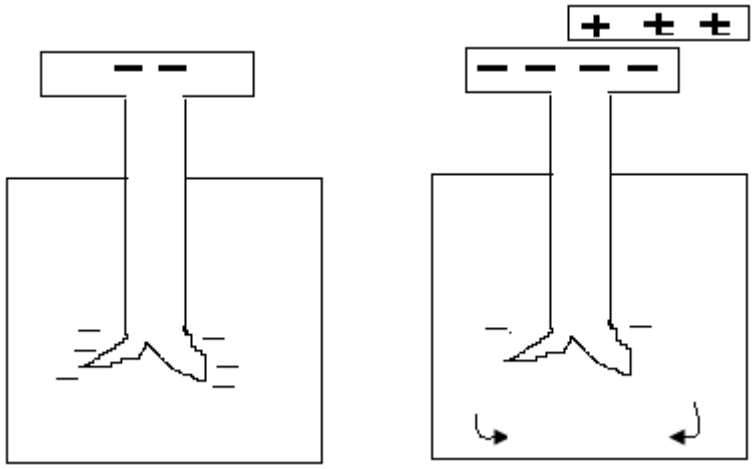


- If a negatively charged rod is brought near the cap of a negatively charged electroscope, there will be an increase in the divergence of the leaf.

-This is due to the fact that negative charges have been repelled by the rod onto the leaf and the plate.

-This is due to the fact more negative charges have been repelled by the rod onto the plate and the leaf.

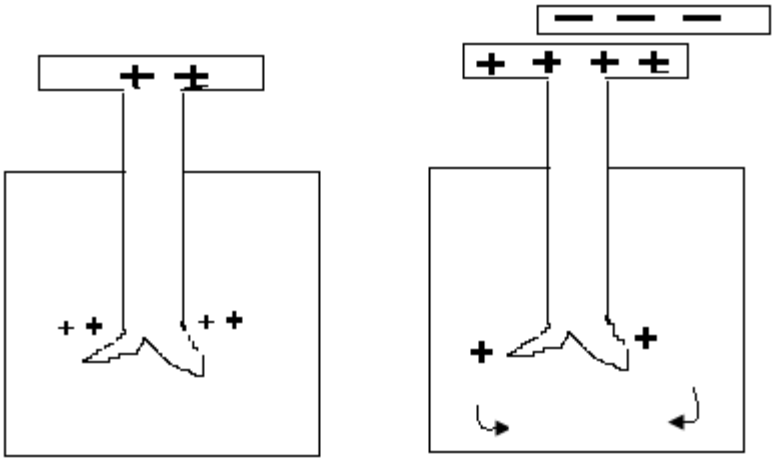
(4)



-If a positively charged rod is brought near the cap of a negatively charged electroscope, there will be a decrease in the divergence of the leaf.

-This is due to the fact that some of the negative charges on the plate and the leaf have been attracted onto the cap.

(5)



- If a negatively charged rod is brought near the cap of a positively charged electroscope, there will be a decrease in decrease in divergence.

-This is due to the fact that, some of the positive charges which reside on the plate and the leaf, will be attracted onto the cap.

- From the table, it will be noticed that a decrease in divergence, is not a sure test, but rather an increase in divergence should always be used to draw conclusions if they are to be valid.

Charge on electroscope	Charge on body	Effect on divergence
+	+	Increase
-	-	Increase
+	-	Decrease
-	+	Decrease
+ or -	Uncharged	Decrease