

ELECTROSTATICS

Friction And Charge

When two materials rub together the contact between their surfaces may cause:

- the surfaces to become hot and show wear and tear.
- the surfaces to become attracted to other materials. (e.g. When we rub a plastic comb with a fabric it can attract small pieces of paper.

In this example we can say that the plastic comb was electrified or charged by the rubbing and this process is called charging.

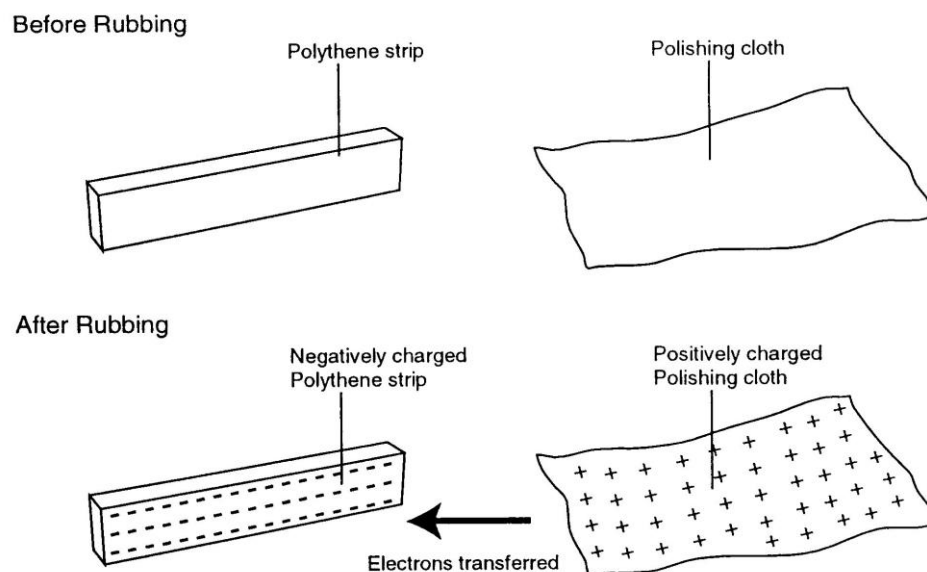
Either adding electrons or removing electrons from an object can charge it. Adding electrons to an object causes the object to be negatively charged. Removing electrons from an object causes the object to be positively charged.

We can use simple experiments involving cellulose acetate rods and polythene rods to demonstrate that there are only two kinds of electric charge and that they are opposite because they have the ability to neutralise each other.

Polythene Rod and Cellulose Acetate Rod

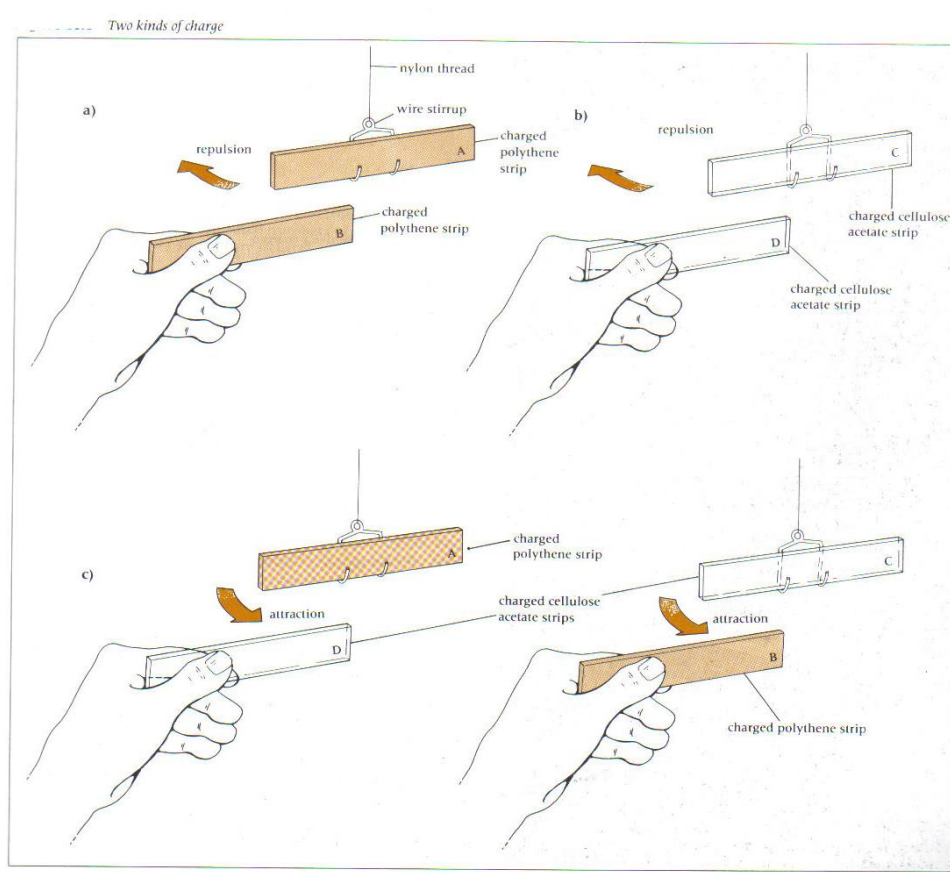
When we rub the polythene rod with a cloth, it gains electrons from the cloth and becomes negatively charged. This leaves a deficiency in the cloth and hence it becomes positively charged.

When we rub a cellulose acetate rod with a cloth, it loses electrons to the cloth and becomes positively charged. This causes an excess of electrons in the cloth, which makes it negatively charged.



Attraction and Repulsion

If we place two charged cellulose acetate rods together, they will repel each other. This situation also occurs if two charged polythene rods are used. However, if we place a charged cellulose acetate rod and a charged polythene rod next to each other they would attract to each other. We can therefore conclude that like charges always repel each other and unlike charges always attract each other.



Read and make notes (also include diagrams) on:

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- charged and neutral objects
- where charge come from
- how do objects become charge?

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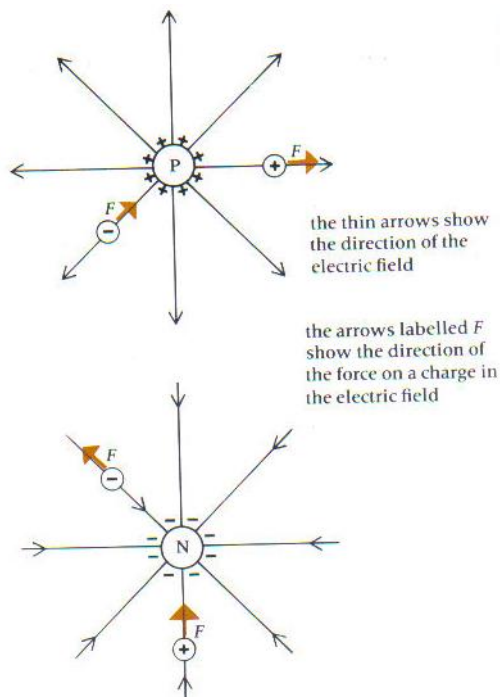
- charging by induction
- separating conductors
- earthing a conductor

Electric Fields

An electric field is defined as the region in which an electric charge will experience a force. Any charge entering an electric field will experience a force acting on it and that action reveals the nature and the existence of the field.

Direction of An Electric Field

We define the direction of an electric field at a particular place as being the direction of the force it produces on a positively charged object.

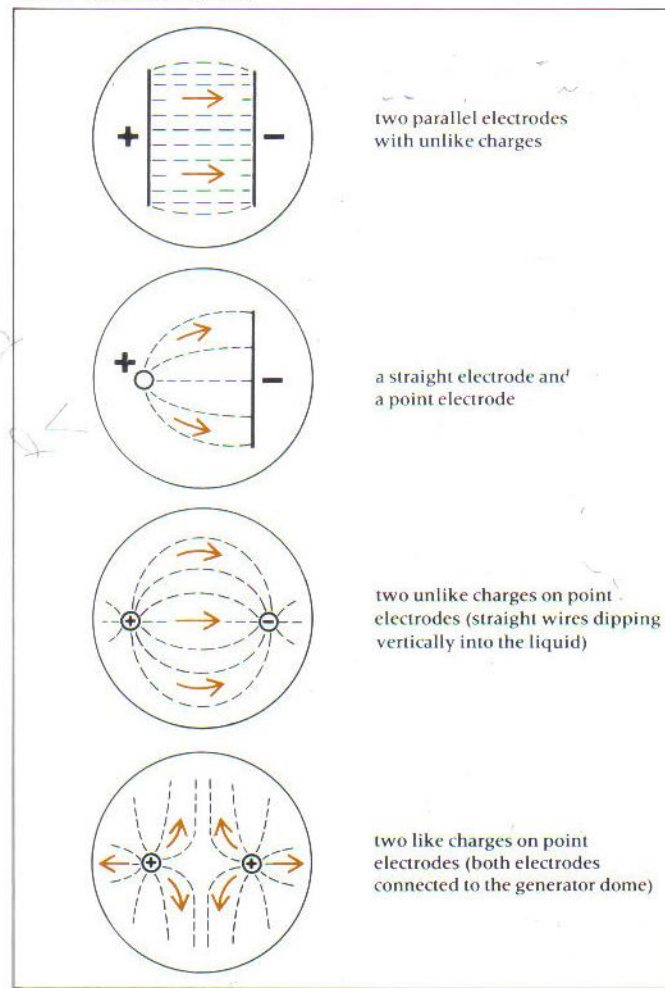


From the diagrams above we can make the following points.

- 1) In both cases the direction of the force on the positively charged particle is the same as the electric field direction but the force acting on the negatively charged particles moves in a reverse direction to the magnetic field.
- 2) The basic rule of like charges repelling and unlike charges attracting applies to these diagrams.
- 3) Electric fields around the object are symmetrical in all directions (dimensions)
- 4) There would always be an equal and opposite force acting on charged producing an electric field (Newton's Third Law)

Electric fields can be represented by drawing lines, which have arrows on them. These are called the field lines and they always start at a positive charge and end at a negative charge.

Shapes of Some Electric Fields



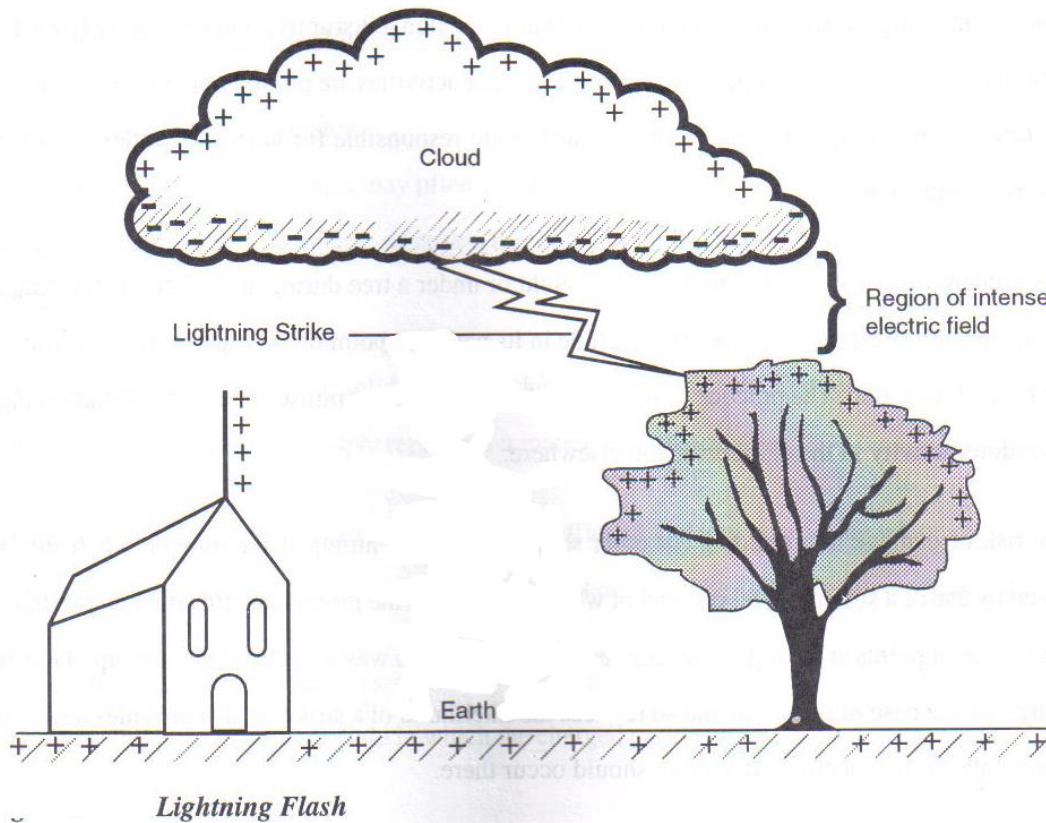
Lightning

Lightning is the most spectacular natural electric phenomena. It is essentially a large electrical spark between the cloud and the Earth or between two clouds or even two parts of the same cloud.

The top and the bottom of the cloud may become oppositely charged because of friction. (See Diagram below) the negative charge at the base of the cloud induces a positive charge on the Earth's surface and the tops of trees and buildings in the vicinity of the cloud. A strong electric field also exists between the base of the cloud and the charges that are induced.

In such an intense electric field relatively strong forces act on the electrons and cause them to move downwards towards the earth. This discharge takes place at a high voltage and an electric current may be set up during the strike.

During the discharge, the kinetic electric energy of the moving electrons is converted into heat, by collisions with atoms and molecules of the air. The air is heated to high temperatures and is also ionised. Light is therefore produced and the violently expanding heated air produces a shock wave (thunder).



Read and make notes (also include diagrams) on:

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- lightning conductor
- electrostatic precipitator