

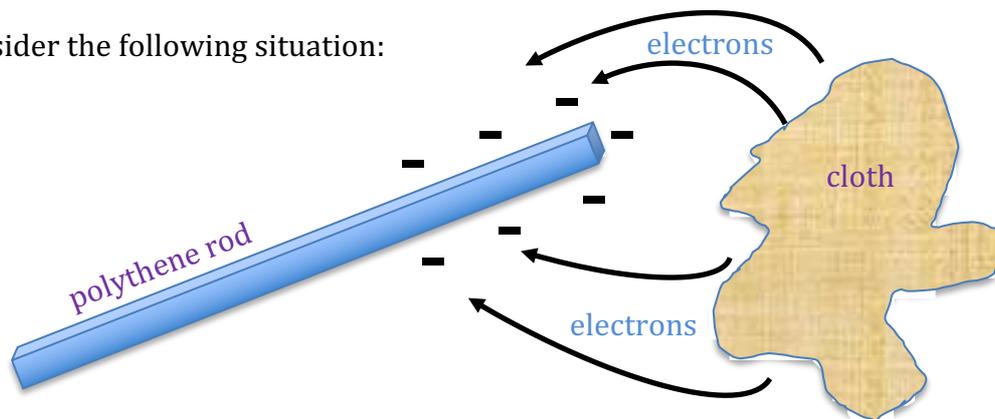
2.1 Static electricity

Electric charge comes in two varieties – positive and negative. In an atom the proton carries a charge of $+1.6 \times 10^{-19}$ coulombs, and the electron carries a charge of -1.6×10^{-19} coulombs. Overall, the atom is neutral, because there are equal numbers of protons and electrons.



When some insulators are rubbed, they can gain an overall, “static”, charge. This occurs because the rubbing removes electrons from one material and transfers them to another.

Consider the following situation:

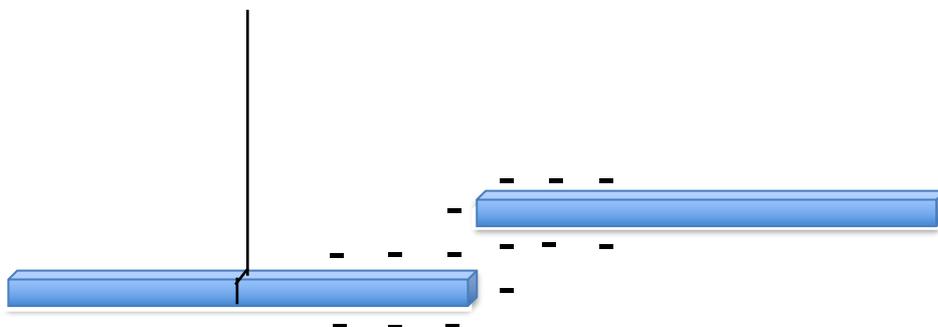


A polythene rod is rubbed with a cloth. The rod becomes negatively charged because electrons are rubbed off the cloth and transferred to the rod.

(1) What charge does the cloth get? Explain why.

The direction that the electrons move depends on what two materials are rubbed together.

Consider the following situation:

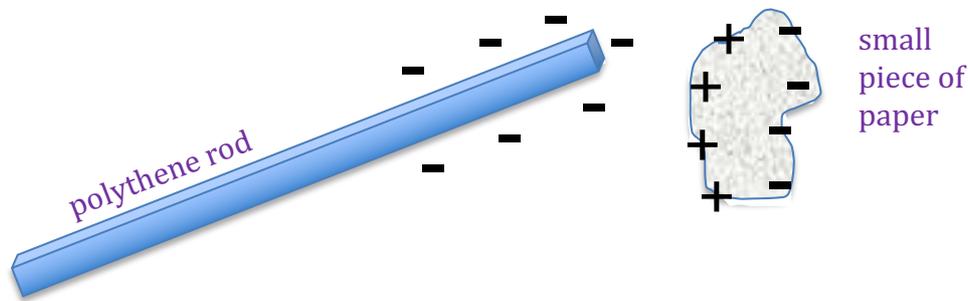


Two polythene rods are given a negative, static charge by rubbing with a cloth. The first rod is suspended from a non-conducting string,

(2) *What happens as the second rod is brought close to the first? Why?*

(3) *What would happen if one of the rods was replaced with an acetate rod that goes positive when rubbed?*

Objects which are uncharged can be attracted to a charged object. For example, a charged, polythene rod can be used to attract small pieces of paper. Let's consider why this happens:



As the rod approaches the piece of paper, electrons in the paper are repelled by the negative charge on the polythene rod. The electrons move away from the side closest to the polythene rod. This leaves a positive charge on the paper surface closest to the polythene rod. This is called an 'induced' charge.

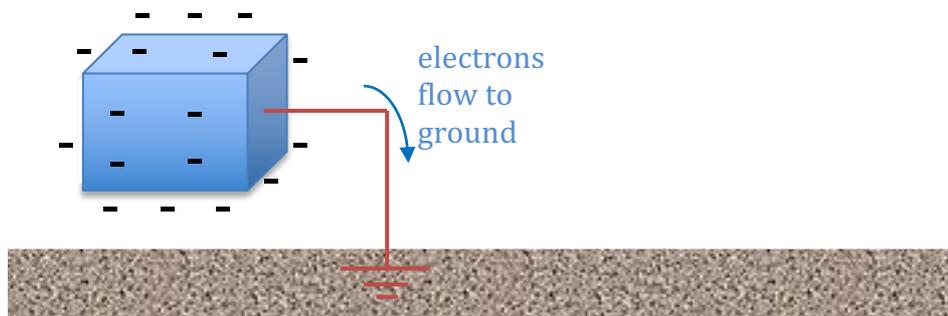
(4) *Why does the piece of paper feel a force towards the polythene rod?*

(5) *Does the piece of paper have an overall charge? How can you tell from the diagram?*

(6) *What do you think happens to the charges in the piece of paper when the polythene rod is moved away?*

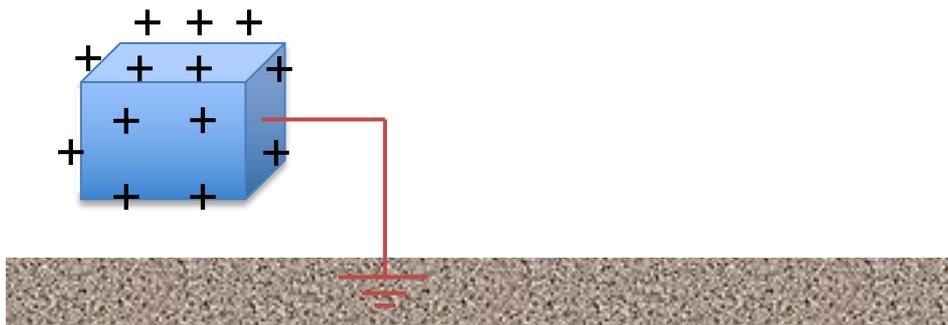
A charged object can be discharged by connecting it through a conductor to the ground. This is called 'grounding' or 'earthing'.

Consider the following:



When an object with a negative charge is connected to the ground with a conductor, the electrons (which are negatively charged) flow through the conductor to the ground and the object becomes discharged.

Consider the following:



The object, above, is positively charged. When it is grounded with a conductor it becomes discharged.

(7)  Explain, in terms of the flow of electrons, why the object becomes discharged?

(8)  Which charges are the ones that can move?

Run the following simulation:

<https://tinyurl.com/m9psy7g>

(9)  What do you have to do to charge up John Travoltage?

(10)  Why does he get a shock when he touches the door handle?