PhyzGuide: Getting and Losing a Charge

TRIBOELECTRICITY: GETTING RUBBED THE RIGHT WAY

When certain objects are rubbed against each other, charge is separated. One object becomes positive, the other becomes negative. Charge separation by rubbing is called **triboelectricity** (*tribo* means friction). Charge is separated in this way due to differences in electron affinity. Some materials are "electron grabbers," others are "electron donors." The atoms or molecules in electron grabbers hold on to electrons tightly and can even hold excess electrons effectively. The atoms or molecules in electron donors hold on to electrons loosely and can give away some of the electrons they own. But the distinction between electron grabbers and electron donors is a relative one. Material A may be able to grab electrons from material B but may also find itself donating electrons to material C. Materials can be arranged in a spectrum called the triboelectric sequence.

The Triboelectric Sequence

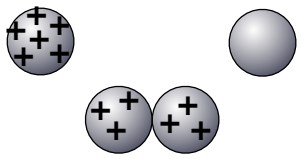
ELECTRON GRABBERS							ELECTRON DONORS	
rubber	**amber**	**cotton**	**skin**	**silk**	**cat fur**	**wool**	**glass**	**rabbit fur**

A partial listing of the triboelectric sequence. When rubbed together, a material from the left will gain electrons from a material on the right. The farther apart the two materials are, the greater the difference in electron affinity. In typical electrostatics experiments, rubber is rubbed with wool or rabbit fur to produce a negative charge on the rubber; glass is rubbed with silk to produce a positive charge on the glass.

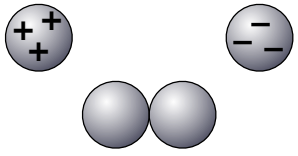
CONDUCTION: CHARGE-SHARING

When objects having different charges touch, conduction may occur. **Conduction** is the transfer of electric charge by direct contact. As you might suspect, conduction works much better between conductors than it does between insulators. Consider the following examples involving conductors that are identical except for their charge.

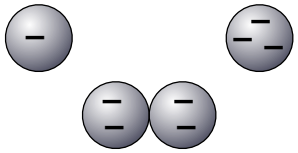
1. A charged object touches a neutral object; the two objects share the charge equally.



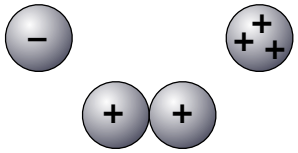
2. A positively charged object touches an equally charged negative object; the two objects neutralize each other.



3. An object with one unit of negative charge touches an object with three units of negative charge; the objects are left with two units of negative charge each.



4. An object with one unit of negative charge touches an object with three units of positive charge; the objects are left with one unit of positive charge each.

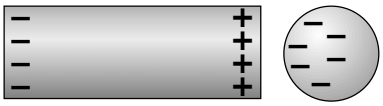


INDUCTION: SAFE CHARGING

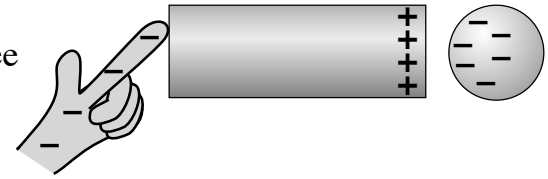
It is possible to use one charged object to charge another object without the two ever coming into direct contact. This process is known as **induction**. Consider the following sequence.

1. A negatively charged object (conductor or insulator) is brought near a neutral object (preferably a conductor).

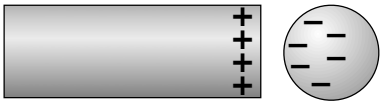
2. Electrons in the neutral object move away from the charged object.



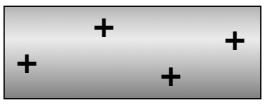
3. The neutral object is grounded somehow. Usually, this is done by touching the object with a finger. This allows the electrons to flee the negative object by traveling to the earth.



4. The grounding connection is broken while the negative object is still nearby.



5. The negative object can be withdrawn. Because the previously neutral object lost electrons in step 3, it is now positively charged.



The same procedure can be used to leave a negative charge on an object using a positively charged object.

GROUNDING AND CORONA DISCHARGE: LOSING A CHARGE

When a charged object loses its charge, we say it has been **neutralized**. An object can be neutralized if it is allowed to conduct its charge to something much larger than itself. This process is called **grounding** because the larger object is often the earth. (In Great Britain, it's called *earthing*.)

A highly charged surface can discharge directly to the air in a process known as **corona discharge**. The term *corona* refers to the aura-like glow produced by the ionization of air that occurs in this discharging process. Ionization gives electrostatic sparks their luminosity, too. (A spark is electric conduction through air.)