Electricity and Magnetism

Lesson 2: Creation & Transfer of Charges and Static Electricity

In this lesson, we discuss, charge transfer in Static Electricity.

Static Electricity is different from Current Electricity.

In current electricity, we discuss flow of electricity in the electrical circuits.

Your Tasks

Task 1: Introduction Quiz on Socrative: RENUKA1

Task 2: Check for Understanding Quiz on Socrative: RENUKA2

Task 3: Planning the Investigation: Planning done on Google Docs and Shared With me: Renuka.Rajasekaran@henry.k12.ga.us

Your Project is due: April 15, 2020.

Electricity and Magnetism – Lesson 2

Today's Standard: *SP5b. Plan and carry out investigations to demonstrate and qualitatively explain charge transfer by conduction, friction, and induction.*

Learning Goals

1. To explain charge transfer
2. To define conduction, friction, and induction processes of charge transfer
3. To distinguish the charge transfer processes of conduction, friction, and induction
4. To plan investigations to demonstrate charge transfer by conduction, friction, and induction processes of charge transfer
5. To carry out investigations to carry out charg transfer by conduction, friction, and induction processes

Your Task

Read the content on the right and take the **Quiz on Socrative: RENUKA1**. You also need to peruse today's standard to take the quiz.

http://www.esdsystems.com/whitepapers/wp_carpet.html

Take these images for Figure 4

Transferring Charge

An object becomes charged only when electrons are transferred from one location to another. Charges are neither created nor destroyed. This is a rule known as the law of conservation of charge. If one object gives up electrons, another object gains those electrons. **There are three methods by which charges can be transferred to build up static electricity: charging by friction, by conduction, and by induction.**

Charging by Friction

When two uncharged objects rub together, some electrons from one object can move onto the other object. The object that gains electrons becomes negatively charged, and the object that loses electrons becomes positively charged. Charging by friction is the transfer of electrons from one uncharged object to another by rubbing. In Figure 4, when the girl's socks rub the carpet, electrons move from the carpet onto her sock. This causes an overall negative charge on the sock. Clothing that sticks together when it is taken out of the dryer is another example of charging by friction.

The method of creating charges by friction is called triboelectricity

Charging by Conduction

When a charged object touches another object, electrons can be transferred between the objects. Electrons transfer from the object that has the more negative charge to the one that has the more positive charge. For example, a positively charged object will gain electrons when it touches an uncharged object. Charging by conduction is the transfer of electrons from a charged object to another object by direct contact. In Figure 4, charges are transferred from the girl's feet to the rest of her body because of charging by conduction.

Charging by Induction

In charging by friction and by conduction, electrons are transferred when objects touch one another. In charging by induction, however, objects do not touch when the charges transfer. Charging by induction is the movement of electrons to one part of an object that is caused by the electric field of a second object. The electric field around the charged object attracts or repels electrons in the second object. In Figure 4, for example, the negative charges in the girl's fingertip produce an electric field that repels the electrons on the surface of the doorknob. The electrons on the doorknob move away from the finger. This movement produces an induced positive charge on the doorknob.

Mechanism of charge transfer (Read the Content and take a quiz on Socrative: RENUKA2)

All materials are made up of atoms and atoms are made up of electrons and protons.
We know that atoms are electrically neutral; that is, they have equal amount of protons (positively charged particles in the nucleus of the atom) and electrons (negatively charged particles in the shells of the atom). So, there is no net charge on them. Remember that the charges on electron and proton have the same magnitude even though they differ in their masses. The charge on an electron or a proton is known as the ELEMENTARY CHARGE, or "e", where e = 1.602×10^{-19} C. Here, C is the unit for the quantity of charges, called Coulomb.

However when different atoms combine to form a molecule, the type of bonding (pure covalent, polar covalent, or ionic) determine the polarity of the molecule. Polarity in chemistry nothing but presence of charge.

Depending on the electronegativity of the atoms in the molecule, there is some degree of polarity in most of the molecules. When such molecules make up a material, although the molecules per se are electrically neutral, they do eventually, possess a degree of polarity.

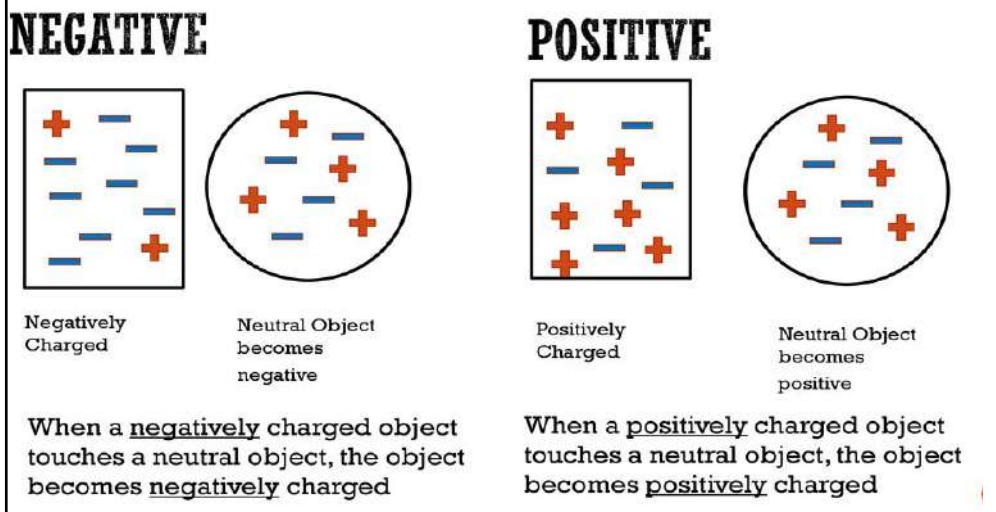
The polarity in a molecule can be enhanced by contact with another material or sometimes the same material. Contact includes actual touch, rubbing, or proximity.

Electrons, especially, the valence electrons are mobile in nature and they can leave a material and would get transferred to another material during the contact process.

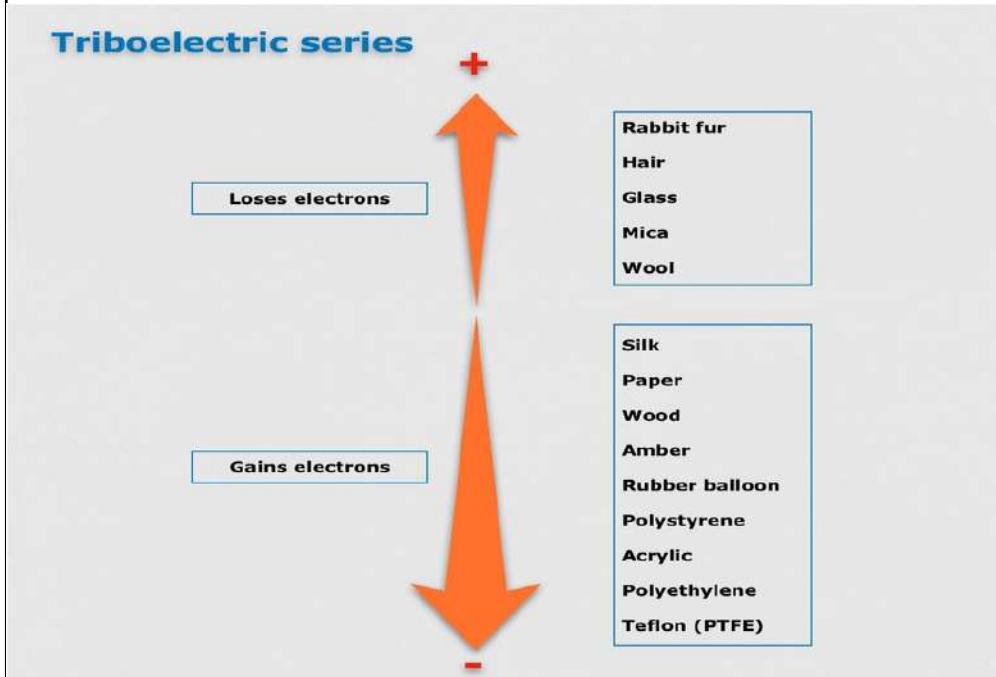
During the contact of two materials, the material, which has lost the electrons becomes positively charged. The material, which has gained electrons becomes negatively charged. Hand, glass, wool, fur, and hair are good examples of materials which will give up electrons easily. Polyester, Plastic, Rubber, etc. will gain electrons.

When such two materials are now individually contacting a neutral substance, then the negatively charged material is going to create negative charge in the neutral object. See image on the right. Some electrons will move from the negatively charged body onto the neutral object, thus charging it negatively. The original negatively charged object will lose some of its electrons, thus becoming less negatively charged.

Electrons seek balance. They always flow from negatively charged objects to neutral/positive objects, trying to balance the objects out. So, what would happen if two objects (both conductors of similar size and shape), having charges of -6 C and +6 C respectively, touched each other. The extra electrons on the negative object would move onto the positive object, and the objects would both become neutralized. Similarly, if a 50nC (nC means nanocoulomb) object touched a 30nC object, electrons from the 30nC object would move onto the 50nC object, thus balancing the charge on both objects at 40nC.



Tribo Electric Series is a series in which different materials are organized in an order of their charges during rubbing process



https://www.sciencelearn.org.nz/resources/2746-static-electricity-and-electrical-charge

Your Task for Planning an investigation to demonstrate and qualitatively explain charge transfer by conduction, friction, and induction. After Planning, you will carry out the investigations at home and will create a video of your demonstration with a clear commentary explaining the charge creation and charge transfer processes and the mechanism involved. Before the end of this class period, you will share your plan to me by google docs. I am available on google meet in the last 30 minutes of the class. Please visit my website to get the code for joining the google meet.

In the google meet, you can ask questions and clear your doubts on today's learning content. You will turn in your project on or before April 15. If the project is turned in before April 15, you will receive 20% of your Final Exam Grade besides receiving the Course Work Grade.

Some Resources for Your Planning the Investigations for Charge Transfer by Conduction, Friction, and Induction

https://www.youtube.com/watch?v=VhWQ-r1LYXY

http://buphy.bu.edu/~duffy/elec/5A10_10.html

http://avstop.com/ac/apgeneral/staticelectricity.html

https://www.youtube.com/watch?v=jLgSXryMxwM

https://www.youtube.com/watch?v=pIMG_R6mKQ0

https://www.youtube.com/watch?v=ZVsGRwDzsZc

https://www.youtube.com/watch?v=U6bKDaZiy_k

https://www.youtube.com/watch?v=GEhUfXb6bIQ

https://www.youtube.com/watch?v=F109U6KpD3I

https://www.youtube.com/watch?v=VhWQ-r1LYXY

https://www.sciencelearn.org.nz/resources/2746-static-electricity-and-electrical-charge

https://www.youtube.com/watch?v=x1-SibwIPM4