SNC1D
UNIT 3: CHARACTERISTICS OF ELECTRICITY
CHAPTER 10: STATIC CHARGES & ENERGY

10.1: EXPLORING STATIC CHARGES

Introduction: Types of Electricity

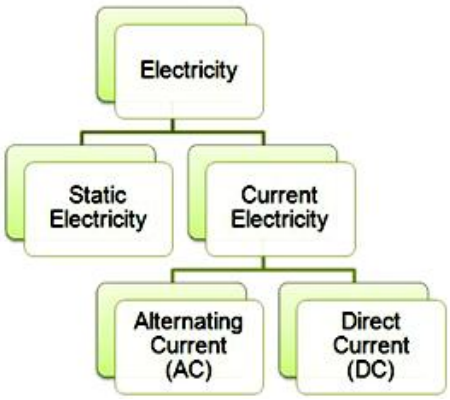
What is Electricity?

Electricity is something you use every day, and most people take it for granted. Imagine what your life would be like without electricity. You wouldn't be able to turn the lights on when it gets dark, listen to music, or turn the heater or air conditioner on! However, what is electricity exactly?

Recall the structure of the atom and the Periodic Table:

The metals are on the left side of the table, and one of the physical properties of metals is that they can conduct electricity. Notice that metals have outer electron shells that are closer to being empty than full. It is the flow of these weakly-held electrons that creates electricity.

There are two different types of electricity, ***static*** electricity and ***current*** electricity. Current electricity can be further subdivided into ***alternating*** current (AC) and ***direct*** current (DC).



The classification of electricity

***EXAMPLES*:**

Have you ever **rubbed a balloon on your head and then stuck it to a wall**? That is **static electricity**! Static means stationary, or not moving

Have you ever **plugged an electrical device into the wall**? That uses **current electricity** in the form of **alternating current!**

Have you ever used a **flashlight**, or used an electrical device, that needs a battery? That is **current electricity** in the form of **direct current!**

Charging By Friction

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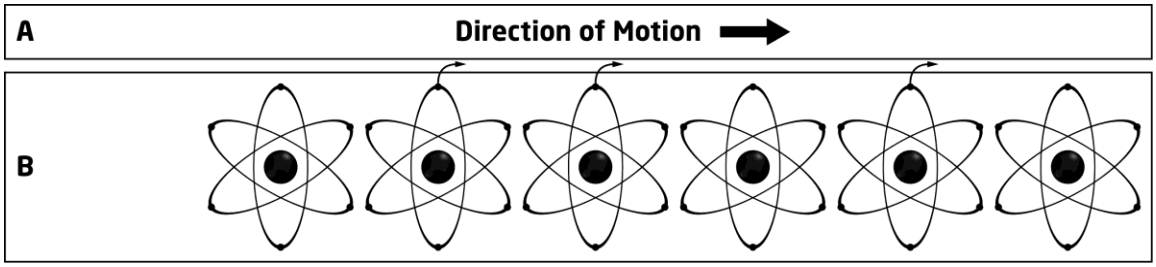
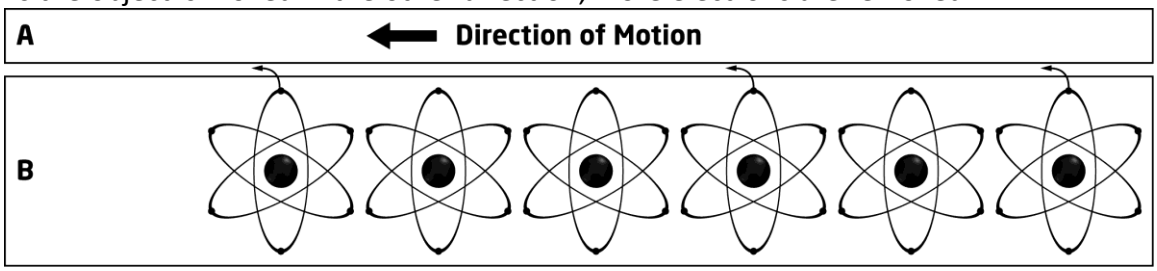
An object becomes "charged" when electric charges build up on the surface.
All matter is composed of atoms. Each atom is made up of a positively charged nucleus in the centre (containing the positive protons and the neutral neutrons) surrounded by the tiny, negatively charged electrons. Those electrons are in constant motion and travel relatively far from the nucleus.

Objects that conduct electricity, such as metals, are made up of atoms with freely moving electrons that easily flow back and forth between atoms and do not stay in one place. For this reason, electric charges do not collect on the surface of metals. However, in non-conducting substances, the electrons tend to stay around individual atoms and do not flow from one atom to another. When two non-conducting materials, such as a comb and a piece of wool cloth, are rubbed together, the friction can cause electrons to get knocked off one material and transferred to the other material.

As one non-conducting object is rubbed against another in one direction, electrons are removed.



As the object is moved in the other direction, more electrons are removed.



Object B loses electrons to object A. Object A gains a negative charge and object B is left positively charged.

Static charges are produced by rubbing two different objects together, resulting in the movement of **electrons** from one object to another. ***Static charge (static electricity) refers to electric charge that tends to stay on the surface of an object, rather than flow away quickly.***

The charges on objects due to friction can be predicted with an **ELECTROSTATIC SERIES.** If two objects are rubbed, electrons will be ripped off the one that holds them more loosely and onto the one that holds them more strongly.

THE ELECTROSTATIC SERIES

See Page 405

Material	Strength of Hold on Electrons
acetate	Weak Hold (Positive)
glass	
Nylon	
wool	
cat's fur, human hair	
calcium, magnesium	
lead	
silk	
aluminum, zinc	*increased tendency to gain or hold on to electrons*
cotton	
paraffin wax	
Ebonite (hard rubber)	
polyethylene (plastic)	
carbon, copper, nickel	
rubber	
sulfur	
platinum, gold	Strong Hold (Negative)

Answer the following questions:

1. Using your own words, define the electrostatic series.

2. Use the series to indicate what charge will be placed on each material listed below:

   A. Plastic Comb rubbed with Wool

   B. Glass rubbed with Polyethylene

   C. Ebonite rubbed with Fur

   D. Acetate rubbed with Rubber

3. Which of the following four materials will produce the strongest charge when used to rub a piece of sulfur: **cotton, wool, rubber,** or **fur**? Give reasons for your answer.

4. Fill in the blanks:
   Locate silk and plastic in the electrostatic series. Silk is above plastic and therefore _____ when compared to plastic. When silk is rubbed over a plastic material, the silk will _____electrons to the plastic rod and the net charge on the plastic will be _____leaving the silk with a _____charge.

5. When a copper pipe is rubbed with a rayon cloth, the rayon becomes positively charged. When the pipe is rubbed with a foam cup, it becomes positively charged. In which order would you place rayon, copper, and foam on the electrostatic series?

6. Give two reasons why only electrons are transferred. In other words, why are protons and neutrons never transferred?

7. When you comb your hair with a plastic comb, which object, the hair or the comb, holds on to its electrons more tightly? What is the charge on this object?

8. If leather is rubbed with polyester, the polyester becomes negatively charged. Would you place leather above or below polyester in an electrostatic series?

9. In the winter, removing a wool hat can give your hair a static charge. Predict the type of charge on your hair.

INSULATORS & CONDUCTORS **See Page 406**

10. What is the difference between a conductor and an insulator?

11. Which types of materials are good insulators and good conductors? [Refer to the electrostatic series.] Give two examples of each type.

12. Explain how a conductivity tester works.

13. Why could a steady stream of water electrocute a firefighter? Why do you think the mist is safer?

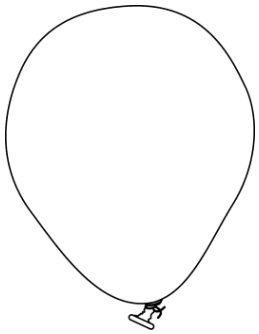
GROUNDING **See Pages 407–409**

14. What is grounding and why must fuel trucks be grounded before they can be fuelled?

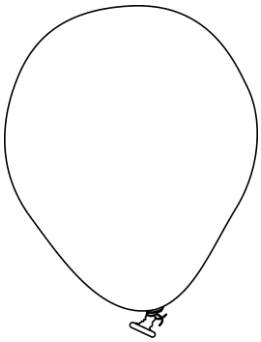
REVIEW 10.1

1. Different materials hold on to electrons with a different strength.
   In _____, electrons are able to move easily from one atom to another.
   In _____, electrons cannot move easily from one atom to another.

2. Draw charges on each balloon.
   a. Negative balloon



   b. Positive balloon



3. If you want to avoid charge build-up on your hair, should you use a plastic comb or an aluminum comb? Explain.

4. Refer to the electrostatic series. Some nylon and silk are in a clothes dryer together.

   Which material holds on to its electrons more strongly? _____

   What is the charge of the nylon? _____

   What is the charge of the silk? _____

5. Write each material in the appropriate column.

Material	Electrical Conductors	Insulators
• aluminum • copper • plastic • rubber • salt water • silver • wood		

   The electrical properties of copper are useful in _____.

   The electrical properties of plastic are useful in _____.

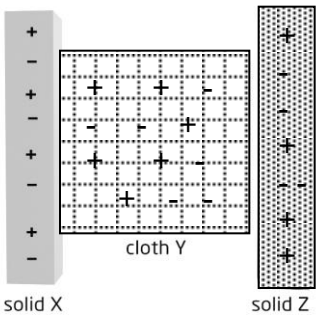
6. Refer to the diagrams to the right to answer each question.

a) What type of net charge is on each item?

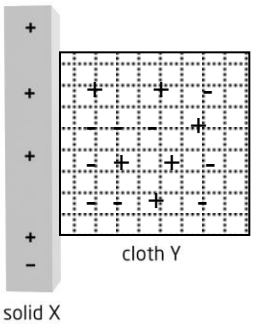
X= _____

Y= _____

Z= _____

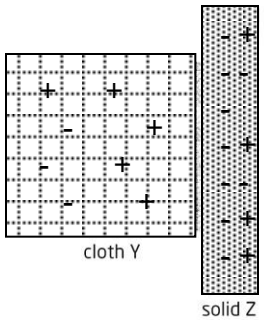


b) Cloth Y is rubbed on solid X.
Which material holds electrons better?



c) Cloth Y is rubbed on solid Z.
Which material holds electrons better?
_____

d) Rank the 3 materials, from greatest to least, according to their ability to hold on to electrons.
_____



7. Would you be electrocuted if you walked under an electric transmission line during a rainstorm? [circle the letter of the correct answer.]
   A. Yes, because rainwater conducts electricity.
   B. No, because rainwater does no conduct electricity.
   C. No, because there is no steady stream of rainwater to conduct the electricity.
   D. Yes, because electricity is always trying to go into the ground.

8. The flooring in an operating room is made of a conducting material because _____
_____. The floor
_____ (should / should not) be waxed because
_____

Predicting Charges

BLM 10-6

What to Do

Refer to the electrostatic series to answer the following questions.

1. Materials listed at the bottom of the electrostatic series are those that have a strong hold on their electrons, which means that when two materials are rubbed together, the material that is lower on the electrostatic series will become _____ while the other material becomes _____.

2. Materials that are close together on the electrostatic series generate a _____ amount of charge, and those farther apart generate a _____ amount of charge.

3. What is the charge on hair when a wool hat is taken off? How do you know?

4. A glass rod is rubbed with a piece of silk. What is the charge on each object?

5. When plastic wrap is used to rub a piece of wood, the plastic wrap becomes negatively charged. Would you place plastic wrap above or below wood in an electrostatic series? Explain your answer.

6. a. When a copper pipe is rubbed with a rayon cloth, the rayon becomes positively charged. When the pipe is rubbed with a foam cup, it becomes positively charged. In which order would you place rayon, copper, and foam on the electrostatic series?

   b. When aluminum foil is used to rub a glass rod, the aluminum becomes negatively charged. When it is used to rub a brass frame, the aluminum becomes positively charged. In which order would you place aluminum, glass, and brass on the electrostatic series?