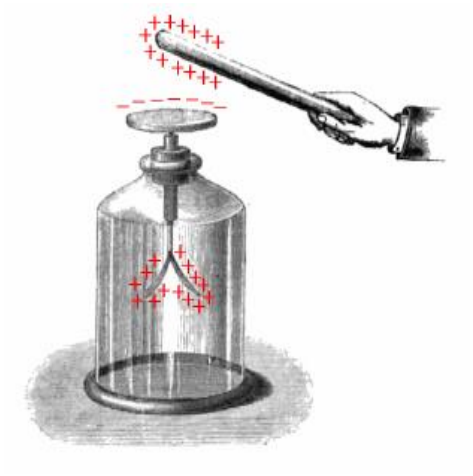
Name _____ Date _____ Period _____

Lab: Making an Electroscope

CHAPTER 14: Electric Charges and Forces

Background

An *ELECTROSCOPE* is an instrument used for detecting differences of electric potential and hence electrification. The earliest form of a scientific electroscope was the *versorium,* or electrical needle of William Gilbert (1544-1603). It consisted simply of a light metallic needle balanced on a pivot like a compass needle. Gilbert employed it to prove that numerous other bodies besides amber are susceptible of being electrified by friction. In this case the visible indication consisted in the attraction exerted between the electrified body and the lightweight pivoted needle which was acted upon.



The next improvement was the invention of simple forms of repulsion electroscope, in which two similarly electrified bodies repel each other. Abraham Bennet invented the modern form of gold-leaf electroscope. Inside a glass shade he fixed to an insulated wire a pair of strips of gold-leaf. The wire terminated in a plate or knob outside the vessel. When an electrified body was held near or in contact with the knob, repulsion of the gold leaves ensued.

In this lab you will be constructing and experimenting with your own electroscope using some simple materials.

Method

Materials

Glass Jar with large mouth
15 cm rigid copper wire (10 gauge sheathed)
wire strippers
3 cm of thin copper wire (solid)
aluminum foil (heavy duty)
straight pin
polymer clay
Glass and acrylic rod
wool or flannel cloth
Silk cloth

Part 1: Making the Electroscope

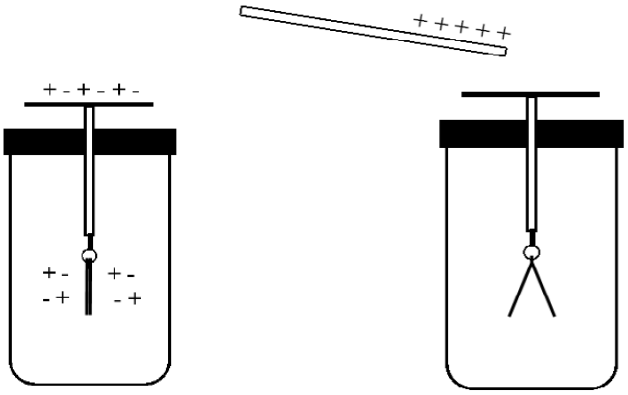
1. Wash, rinse and dry glass jar and lid.
2. Drill small hole slightly larger in diameter than the sheathed wire in the center of the lid.
3. Take your thick piece of wire (15 cm long) and strip off the insulation on about 12 cm on one end.
4. Strip the other end of the wire 3-4 mm.
5. Bend bare wire at right angle and roll up in a spiral.
6. Push wire through hole in lid, making sure the insulated part of the wire is in contact with the lid, then fasten in place with polymer clay.
7. Wrap the small bare wire on the other end finishing with a circular hook, to which you will fasten the two foil leaves.
8. Fold an aluminum foil on a thick piece of paper. Cut out in the form of a triangle (*about 1½" long and ¾" wide at base*).
9. Cut out once again in the form of a pear and pierce with straight pin.
10. Hang foil on small hook you formed.
11. Screw on plastic lid with wire and foil leaves onto top of jar. You are ready to charge!

Part 2: Charging by Induction

1. Charge a glass rod positively by rubbing it with silk and bring the charged (rubbed) end close to, but not in contact with, the outside terminal of the electroscope.
2. Observe the leaves of the electroscope diverge (go apart from each other).
3. Remove the charged rod away from the electroscope terminal and observe the leaves collapse.
4. Repeat the entire procedure above and observe the leaves repeat the behavior.
5. Repeat the entire procedure above using an uncharged glass (or other) rod. Observe that the leaves do not diverge.
6. Instead of the positively charged glass rod, use a negatively charged rod by rubbing acrylic with wool or flannel, and repeat the experiment. Observe that the leaves behave exactly as they did before for a positively charged rod.
7. Try a variation now. Bring a positively charged rod close to the electroscope terminal,and with it still there, touch the terminal with your finger. Then remove the rod. Notice that the diverged leaves remain diverged, instead of collapsing as they did in steps 3 and 4.
8. Collapse the leaves by touching the terminal with your finger.
9. Repeat step 7 using a negatively charged rod. Observe that the leaves behave exactly as they did for a positively charged rod.

Discussion questions. Answer the below questions, examining the pictures.

1. The picture on the left illustrates an uncharged electroscope. The picture on the right illustrates bringing a positively charged rod close to the electroscope as in you did in Step 2. Label the charges on the terminal and on the leaves.

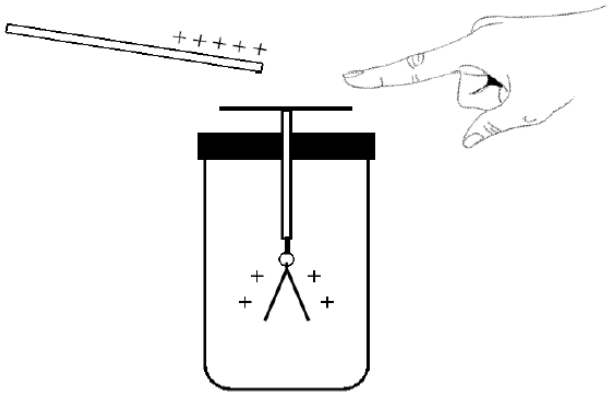
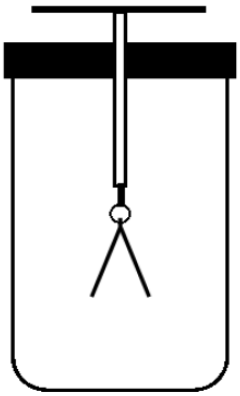


2. The previous experiment illustrates charging by electrostatic induction where a charged body induces an opposite charge in an uncharged body (the electroscope in this case). Explain how this works and why the leaves diverge.

3. What makes the leaves collapse when the positively charged rod is removed as in Step 2?

4. Why do the leaves retain their charge when you touch the terminal with your finger as in Step 7?

5. The picture on the left below illustrates a positive charge near an electroscope. The terminal is then touched by the finger. The picture on the right illustrates the end result after the finger and rod are removed as in Step 7. Label the charges inside the terminal and on the leaves.

Part   **3:**

Charging by Contact

1. Bring a positively charged rod close to the terminal and observe the leaves diverge.
2. Touch the terminal with the charged end of the rod, note that the leaves remain diverged.
3. Remove the rod and observe that the leaves still remain diverged.
4. Discharge the electroscope by touching it with your finger.
5. Repeat the steps above, this time using a negatively charged rod. Note that the leaves behave in the same way as before and remain diverged.

Discussion questions. Answer the below.

1. Describe how charging by conduction works. Be sure to explain why the leaves remain diverged after the terminal is touched.

2. Compare and contrast the processes of electrostatic induction and conduction.

3. Design a testing procedure to determine the unknown charge of an object.