Experiments with Static Electric Charges
Spring 2010

Introduction

This is an informal laboratory exercise designed to give you an understanding of how electric charges behave on insulators and conductors. We will perform several experiments, including the "sticky tape experiments" described in section E1.2 in T. Moore's text, *Electric and Magnetic Fields are Unified*. You should describe your observations and explain what is happening at each section.

Experiments

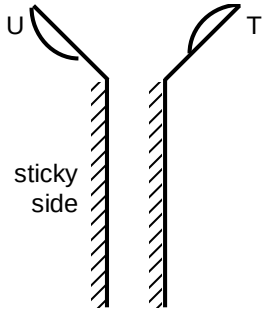
1. *Charging foil by charge transfer*:
    a. When a rubber rod is rubbed with fur, the rod becomes *negatively* charged. When a glass rod is rubbed with silk or a paper towel, the glass rod becomes *positively* charged. You will see that the rods gain opposite charge by observing their behavior near a piece of aluminum foil that has been charged by direct contact (*charge transfer*).

       The foil is suspended by a silk thread. Ground the foil by touching it with your fingers; this will remove any excess charge that is on the foil. Charge the rubber rod with a piece of fur, then *slowly* bring it near the foil – don't let the rod and foil touch just yet! Describe what happens, and explain why.

    b. Now let the negatively charged rubber rod touch the foil, and then hold the rod near the foil. Describe what happens, and explain why.

    c. Charge the glass rod with a piece of paper towel, and carefully move it toward the foil (don't let them touch just yet!). Describe the reaction of the foil. Note that you have created a device that will detect the presence of a charged object; if you know the charge on the foil, you can then determine the sign of the charge on the object by observing the behavior of the foil.
2. *Fun with an oscilloscope:* Charge the rubber rod with fur, and bring it close to the bright spot on the face of the oscilloscope in the lab. The bright spot is caused by electrons (negatively charged) striking a phosphor coating on the back of the scope face. Now charge the glass rod with the paper towel, and again bring it near the spot on the electroscope. Describe your observations and explain why this happens.
3. *Fun with tape:*
    a. Follow the instructions in section E1.2; the figure at right shows the notation used. Tape lengths of about 5 inches seem to be easier to use than 8 inches. If you have trouble observing what is described, ask your lab instructor for help.

    b. Do exercises E1.X.1 and E1.X.2. Write up your observations and conclusions.



4. *Fun with water:* Turn on the faucet in the sink to produce a smoothly flowing stream of water. You want a flow rate just fast enough not to give drops but slow enough not to give turbulence. Hold a charged rubber rod next to the water stream (don't get the rod or the fur wet!). What happens? Predict what will happen to the stream when the charged glass rod is held close. Try it, describe the results, and explain why it happens.
5. *Separation of charges*: Using the rubber rod, fur and the two metal spheres on insulating stands, figure out a way to give the metal spheres equal but opposite charges *without* touching either sphere with the rod or fur (the spheres *can* touch each other). Listen carefully while performing this experiment; if you hear a "click", then there has been a transfer of charge, and the experiment won't work.

Test the charge on each sphere by using the foil "charge detector" you created in step 1. Include a sketch showing how the charges move between the spheres; remember that electrons are free to move in a conductor and will seek to disperse themselves as widely as possible; positive charges are fixed in place. Describe your solution using words and diagrams.

Discussion

- Briefly summarize the results for the experiments you performed today.
- Remove the tape you placed on the bench before leaving lab!