Physics 121 Lab 1 - Electrostatics

Name _____ Partner _____ Date _____

Objective

- To understand the basic phenomena of electric charges at rest.

Introduction

Atoms consist of a central nucleus made up of protons and neutrons surrounded by one or more electrons. While the nuclei of solids are essentially localized, some of the electrons may be free to move about. A substance which has as many electrons as it has protons is said to be electrically neutral. Dissimilar objects have different affinities for electrons. When two such objects, initially neutral, are rubbed together, the friction may cause electrons to pass from one to the other. After separation, neither object is neutral. Each is said to have been "charged by friction." An isolated, electrified object becomes neutral again if its electron-proton balance is restored. A convenient means for accomplishing this is to connect the object to earth by means of a conductor, through which electrons readily travel. This process is called "grounding the body." Since an electrified object is referred to as "charged," grounding is also referred to as "discharging."

Substances through which electrons do not move easily are called "non-conductors," or "insulators." Experiment has shown that when rubber and wool are rubbed together, electrons pass form the wool to the rubber. The electrons remain on the surface of the rubber–a non-conductor–where they were transferred.

Rubbing a metal rod with a wool cloth can also transfer electrons. This rod, however, is a conductor and electrons pass through it to the experimenter and then to the earth. People, made mostly of salt water, are good conductors, as well. Metal that is isolated, however, can be electrified. This can be demonstrated with an electroscope, which has a metal disk connected to a stem from which a thin metal rod hangs. An insulator prevents contact of these metal parts with the case, and consequently the earth. The functional parts of the electroscope are shown in Figure 1.

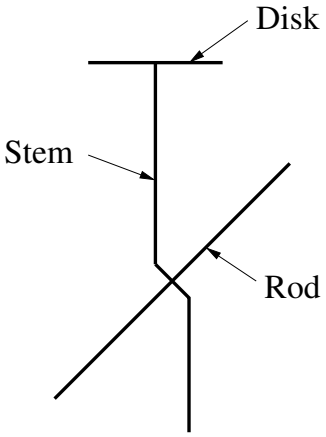

Figure 1: A diagram showing the functional parts of the electroscope.

Apparatus

- electroscope
- rubber and glass rods
- wool and silk cloth

Activity 1: Charging by Friction

1. Be sure the electroscope is discharged by touching the disk with your finger. Explain what happened and why you are convinced the electroscope is discharged.

2. **Prediction:** What will happen to the electroscope if you bring a charged rubber rod near the disk of the electroscope without touching it? Why do you think this will happen?

3. Electrify one end of the rubber rod by wrapping the wool cloth around the rod, squeezing the wool against the rod, twisting the rod vigorously to ensure good contact, and separating the wool from the rod.

4. Test your prediction by bringing the charged rubber rod near the disk of the electroscope without touching it. Describe and explain what you observe. Was your prediction correct?

5. Sketch the functional parts of the electroscope with the charged rubber rod near the disk and show the excess charges on the rubber rod and the parts of the electroscope.

Activity 2: Charging by Contact

1. Discharge the electroscope as before.
2. **Prediction:** What will happen to the electroscope if you rub a charged rubber rod along the disk of the electroscope and then remove the rod? Why do you think this will happen?

3. Test your prediction by electrifying the rubber rod as before, rubbing the rod along the disk, and then removing the rod. Describe and explain what you observe. Was your prediction correct? What is the charge state of the electroscope?

4. Sketch the functional parts of the electroscope and show the excess charges on the parts of the electroscope.

5. Repeat the procedure above until the electroscope's rod is at approximately a thirty degree angle with the stem.

Activity 3: Kinds of Electrification

1. **Prediction:** What will happen when you bring the electrified rubber rod toward, but not touching, the disk of the charged electroscope? Why do you think this will happen?

2. Test your prediction by bringing the charged rubber rod toward the disk, but do not touch it. Record and explain what happens. Was your prediction correct?

3. **Prediction:** What will happen when you bring a positively charged rod toward, but not touching, the disk of the charged electroscope? Why do you think this will happen?

4. Rub the end of the glass rod with the silk cloth and bring it toward the disk of the charged electroscope. Record and explain what happens. What must be the sign of the charge on the glass rod?

Activity 4: Charging by Induction

1. Discharge the electroscope.
2. **Prediction:** What will be the effect on the electroscope if you perform the following experiment: while grounding the electroscope with your finger, bring an electrified rubber rod near the disk, then take away your finger and then the rod (in that order)?

3. Carry out the experiment and describe the result.

4. Explain the result and why your prediction agreed or disagreed with it.

5. **Prediction:** Note that no electrons moved between the rod and the electroscope. What charge has been induced on the electroscope?

6. Test your prediction with the negatively charged rubber rod and the positively charged glass rod.
7. Does the test verify or contradict your prediction? Explain.

8. Draw a series of diagrams illustrating the charging of the electroscope by induction.