

## Electrostatic Project – Laboratory Activities

### Part I – Electrophorus Apparatus Test and Observations

#### Background and Theory:

Johannes Wilcke invented the electrophorus over two hundred years ago. Scientists everywhere used this simple device because it has a reliable and easy to use source of charge for electrical experiments. The term **electrophorus** is a Greek term for charge carrier. When you rub the Styrofoam plate with a wool or silk cloth, electrons are transferred to the Styrofoam plate from the cloth. This process is called **triboelectrification**. The charging process occurs by a chemical reaction between two dissimilar materials. The rubbing process produces a larger surface area contacted thus resulting in a greater exchange of electrons. Styrofoam is an insulator therefore the it will hold the static electric charge until such time the charge bleeds off into the atmosphere or it is transferred by direct contact or induction.

Review the following procedures for testing the electrophorus apparatus. Each students' observations and analysis **must be typed**.

1. Rub the insulating base (plastic plate) with a wool or silk cloth for one full minute.
2. Use the Styrofoam cup as a handle and place the metal plate on the base.
3. Quickly touch the metal plate with your finger. (Observation 1)
4. With the Styrofoam cup handle, lift the apparatus from the plate.
5. Touch the metal pan with your finger to discharge it. (Observation 2)

**Observation 1:** What did you feel and or observe when you touched the metal plate?

**Observation 2:** Again, what did you feel and or observe when you touched the metal plate?

6. Repeat steps 1, 2, and 4.
7. Discharge the metal plate using a **Ne** bulb. Hold the **Ne** bulb by one lead and touch the other lead to the metal plate. (Observation 3)

**Observation 3:** When the lead of the **Ne** bulb touched the metal plate, what happened? Which terminal of inside the **Ne** bulb flashed, the one connected to the wire in your hand or the one connected to the wire that contacted the metal plate?

#### Analysis:

1. The original source of the charge for the electrophorus is the charged Styrofoam plate. How does this charge develop and is the charge positive or negative?
2. Describe the flow of electrons to or from the metal plate when it is in contact with the Styrofoam plate and the bulb is touched.
3. Draw a diagram indicating charge distributions before and after the hand contacts the bulb.
4. Closely examine the **Ne** bulb during the down-touch, up-touch cycle. Only one side of the **Ne** bulb should glow at a time, and this should change depending on whether the **Al** plate is up or down. Which side (most positive or most negative) glows?

## Part II – Electroscope Test and Observations

**Objective:** To observe the behavior of the metal leaf electroscope when charging it by conduction and induction.

**Materials:** Metal leaf electroscope                      silk or wool cloth  
Aluminum tube                                              rubber rod                                              acrylic strip

### Procedures:

1. Rub the rubber rod with the available cloth and touch it to the sphere of the electroscope. Observe what happens.
2. Rub the aluminum tube with the available cloth and touch it to the sphere of the electroscope. Observe what happens.

### Observations:

1. Which of the two items provides the most visible reaction of the electroscope?
2. One of the items is a metal and the other is a non-metal. Explain why the electroscope would have such a different response to the two items.

### Part A – Procedures: Charging the Electroscope by Conduction

1. Observe the metal leaves of a neutral electroscope. **Make a sketch** of the neutral electroscope and show the charges.
2. Charge the rubber rod by rubbing it with the wool or silk cloth.
3. Touch the rubber rod to the top of the electroscope. **Make a sketch** of the rubber rod touching the charged electroscope and show the movement of the charges.

### Observations and Analysis:

1. What is the charge of the electroscope after it is touched by the rubber rod?
2. Which direction did the charge move?
3. Why do the leaves of the electroscope diverge?
4. Why do the leaves remain diverged even when the rod is removed?
5. Touch the top of the electroscope with your finger. Where did the electrons move to make the electroscope neutral?
6. Summarize your observations involving charging the electroscope by conduction.

**Discharge (neutralize) the electroscope by touching a wire to the top sphere of the electroscope and to a water faucet.**

### Part B – Procedures: Charging the Electroscope by induction

1. Once again Charge the rubber rod by rubbing it with the wool or silk cloth.
2. Bring the charged rod **NEAR** to but **DO NOT** touch the electroscope. **Make a sketch** of the electroscope with the rod close to the sphere and label the movement of the charges.
3. Remove the rod.

### Part B – Observations and Analysis:

1. What is the charge of the electroscope after the rod was brought near the electroscope?
2. Explain why the electroscope would have this charge if you used a positively charged rod.
3. Compared with the charging body, what is the charge on an electroscope when it is charged by:  
conduction? \_\_\_\_\_ (Answer “The same” or “Different”)  
induction? \_\_\_\_\_ (Answer “The same” or “Different”)

Note the construction of the laboratory electroscope. Perform the same tests to the laboratory scope as you did to the electroscope you constructed (no need to record each of the observations or analysis).

**Observations:**

1. Write a brief summary comparing your electroscope's performance to the laboratory's electroscope's performance.
2. Describe what you could change in your construction method to improve the performance of your electroscope.