

## ELECTROSCOPE

### Introduction

In this lab you will investigate some basic properties of electric charges using an electroscope. Before getting started, the following information will be useful. When a polyvinylchloride (PVC) rod is rubbed with a wool cloth, the rod and the wool become oppositely charged. Two hundred years ago Benjamin Franklin decided to call the wool positive and the PVC negative. Of course PVC did not exist in Franklin's time, but the same result occurs with wool and the natural substance, amber. Franklin mistakenly thought that the wool gained "electrical fluid" and the rod lost electrical fluid, thus the terms positive and negative. We now know that rubbing the rod with the wool causes some electrons in the wool to move to the rod. Thus the wool has fewer electrons than protons and a net positive charge, and the PVC rod has more electrons than protons and a net negative charge.

### Procedure

This experiment consists of a series of short tasks. After you have performed a task and discussed it with your partner, write a description of what you did, and what you observed, including diagrams, and then write an explanation of your observations.

#### Task 1

- a) Briefly ground the electroscope by touching the knob and the case of the electroscope with your finger. This is a simple way of making sure the electroscope is uncharged.
- b) Give the PVC rod a negative charge. Slowly move the rod toward the knob of the electroscope but do not get closer than two or three centimeters. Move the rod away from the electroscope. Explain the behavior of the electroscope in terms of electron flow.

#### Task 2

- a) Ground the electroscope. Bring a negatively charged rod very close to the knob of the electroscope. At some point you should hear a small click. When you do, remove the rod. Explain why the electroscope leaf remains deflected? What is the charge state of the stem/leaf? What is the charge state of the knob?
- b) Bring the negatively charged rod back to within a few cm of the knob of the electroscope. Explain what happens in terms of electron flow.
- c) Charge an acrylic rod by rubbing it with a piece of vinyl. Bring this rod to within a few cm of the knob of the charged electroscope. What does this say about the charge on the acrylic rod? Explain what happens in terms of electron flow.
- d) You now have a way of determining the charge of an object. Determine the charge on the following rods:
  - i) PVC rubbed with your hair.
  - ii) PVC rubbed with vinyl.
  - iii) Glass rubbed with vinyl.
  - iv) Acrylic rubbed with wool.
- e) Bring a neutral metal rod near the negatively charged electroscope. Explain. Note that when testing the charge of a metal object one has to be very careful about interpreting the results.

**Task 3**

- a) Ground the electroscope.
- b) Bring a positively charged rod to within a few cm of the knob of the electroscope and remove the rod. Compare the behavior of the electroscope to its behavior in part 1 when a negatively charged rod was used. Explain the behavior in terms of electron flow.

**Task 4**

- a) Give the electroscope a positive charge.
- b) Cover the electroscope with the metal screen, being careful not to discharge the electroscope. Bring the negatively charged rod as close to the knob as possible, without touching the screen. Explain what does, or does not, happen.

**Task 5**

- a) Place two metal spheres mounted on insulating posts next to each other so that they are touching.
- b) Bring a negatively charged rod to within about 1 cm of one of the spheres on the side opposite from the second sphere. With the negatively charged rod still in place, separate the spheres, being careful not to touch either sphere directly.
- c) Use the electroscope to determine the charge on each sphere. Explain your observations.

**Task 6**

Ground the electroscope. Bring a negatively charged rod to within about 1 cm of the knob and hold it steady. Touch the knob of the electroscope, keeping the negatively charged rod in place. Remove your finger from the knob keeping the rod in place. Remove the negatively charged rod. Bring a positively charged rod near the knob of the electroscope to test for the sign of the charge on the electroscope. Describe and explain what happens at each step of this procedure.

**Task 7**

Replace the knob of the electroscope with the circular metal plate and give the electroscope as much negative charge as possible.

- a) Place the glass plate on top of the circular metal plate.
- b) Place the circular metal plate with the insulating handle on top of the glass plate.
- c) Ground the top metal plate.
- d) Remove the top metal plate and use a second electroscope to determine its charge.
- e) Remove the glass plate.
- f) Determine the charge on the electroscope.

Describe and explain what happens at each step of this procedure.