

# Lab 12

## Electrostatics

### OBJECTIVES

- (1) To investigate charging by friction, charging by contact, and induced charge.
- (2) To discover some of the effects of static electricity.
- (3) To observe the effect of an electric charge in an electric field.

### EQUIPMENT

Plastic rod, fur, pith balls, balloons, thread, Van de Graff generator, pie plates, Styrofoam cup, puffed rice, electric pom pom, metal wand, animal fur bits, meter stick, and support rods.

### PROCEDURE

#### Part 1: Induced Charge

- (1) Charge a plastic rod and then bring it near, but not touching, the top of the electric pom pom. *Explain what you observed in terms of induced charge.* Now touch the top of the electric pom pom with the charged rod. Notice that the strings of the electric pom pom repel each other. *Why? Touch the top of the electric pom pom with your fingers. What happens and why?*
- (2) Suspend a pith ball from a support rod with a piece of tape. Bring a charged plastic rod close to, but not touching, the pith ball. *What did you observe?* Now let the pith ball touch the charged rod. Notice that the pith ball is not *completely* repelled away from the charged rod. If you move the rod, the pith ball follows the rod even though the rod repels it. *Explain this odd behavior.*

**Challenge:** See if you can get two pith balls to attract each other.

- (3) Rub a balloon on your hair or on a piece of clothing. Now touch the balloon to a wall. *Explain what you observed in terms of charging by friction and induced charge. Draw a sketch showing the charges in the balloon and the wall when the balloon is against the wall.*
- (4) Quickly tear a piece of clear packing tape from the roll hanging on the support rod. Bring your hand near the hanging end of the tape. This is another example of charging by friction and of induced charge.

- (5) Make a prediction: *What will happen to a small neutral stream of water when a charged rod is brought near? Why?* Rub the rod to charge it and observe its effect on a water stream. *Draw and describe what you see.*

### **Faraday's Ice Pail**

- (6) The conducting sphere connected to the voltage source (+3000 V) is charged positively. This positive charge induces the charges on the nearby conducting sphere to redistribute. *Predict which side you think will be positive and which side you think will be negative.* Test out your predictions by touching one side of the conducting sphere with the small metal wand and then touching the wand to the inner surface of the Faraday's ice pail. Ground the wand and the ice pail and then repeat the procedure on the other side of the conducting sphere. *Report on your results.*
- (7) Charge a plastic rod negatively by rubbing it with fur or wool. Place the rod inside **but not touching** the inner surface of the ice pail. With the rod still inside the ice pail, ground the pail by touching your finger across the inner and outer surfaces. Remove your finger and then remove the charged rod. *What is the charge on the inner surface of the ice pail? Explain how this occurred.*
- (8) Place your hand inside but not touching the inner surface of the Faraday's ice pail and observe the reading on the voltmeter. *Are you charged? If so, how do you think it occurred?*
- (9) Ground yourself by touching the outer surface of the ice pail (which is connected to the ground). Again, place your hand inside but not touching the inner surface of the Faraday's ice pail. The voltmeter should not indicate any charge. Experiment with different ways of charging yourself: rub your hands together, scuff your feet across the floor, touch the Van de Graff generator, ... *Report on several of the ways that worked and what charge you acquired in each case.*

### **Part 2: Van de Graff Generator**

- (10) Turn the generator while holding a second metal sphere connected to the bottom of it. *What do you observe when the two spheres are brought close together?*
- (11) Place the aluminum pie plates stacked together on top of the Van de Graff generator. Turn on the generator. *Why do the pie plates fly off one at a time?*
- (12) Turn on the generator and bring an electric pom pom near the charged sphere. *Explain what you observed in terms of electric field and induced charge.*

(13) Tape the electric pom pom to the top of the Van de Graff generator. Turn on the generator and *record what you observed*. Turn off the generator and observe the strings of the electric pom pom for a few minutes. Eventually, the electric pom pom would completely discharge. *How?* Charge the electric pom pom again and then turn off the generator. Bring your hand close to but not touching the generator. *What did you observe?*

(14) Hold a small piece of animal fur near the Van de Graff generator and then let it go. *Explain the behavior of the fur*. See if you can get to animal fur to bounce back and forth between your hand and the generator – it's pretty cool!

**Challenge:** As the Van de Graff generator becomes charged; you may be able to hear the motor slow down. Can you explain why?