Name _____ **Section** _____

Period 10 Activity Sheet: Electric Charge and Force

Activity 10.1: How Do Electric Charges Exert Forces?

a) **Evidence of Electric Forces:**

1) Your instructor will show you how to give a Styrofoam ring an electric charge by rubbing it between two pieces of foam. What happens when you place the charged ring on the table and hold the foam square above the ring?

2) Rub a plastic rod with a second piece of foam to give the rod an electric charge. Charge the Styrofoam ring again as you did in part 1). Float the Styrofoam ring above the rod. Why does the ring float?

b) **Electric Force and Gravitational Force:**

1) We have learned that the force of gravity is always an attractive force. Based on your experiments in part a), is the electrical force always attractive? How do you know?

2) The Styrofoam ring you floated in part a) has a mass of 0.0065 grams or 6.5×10^{-6} kg.

a) When the ring floats, what two forces act on the ring? _____

b) Calculate the amount of electrical force that supports the ring when it floats.

_____

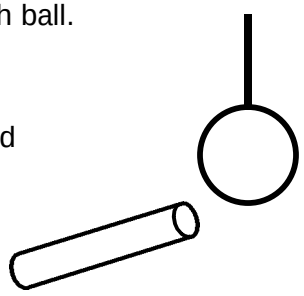
3) If you floated a ring that had twice the mass but kept the same charges on the rod and ring, would the ring float higher above the rod, closer to the rod, or at the same distance from the rod? _____ Why?

c) Group Discussion Question: When you rub the plastic rod with foam, where does the charge on the rod come from? Do you "create" charge when you rub the rod? Does the piece of foam end up with a charge?

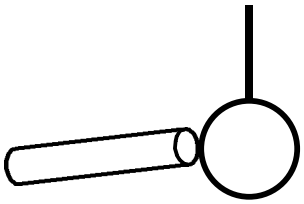
Activity 10.2: What Happens When Charge is Separated?

a) **Conductors:** Rub the plastic rod with a piece of foam. This gives the rod a net negative charge. Use the charged rod to exert electrical forces on a hanging pith ball.

1) Bring the charged rod underneath and to the side of the pith ball (but not touching the pith ball). Is the pith ball attracted to the rod or repelled by it? Draw + and – charges on the pith ball and the rod and explain the ball's movement.



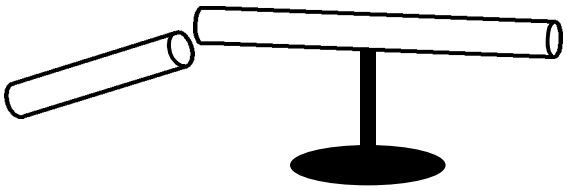
2) Touch the pith ball with the charged rod. Is the pith ball now attracted to the rod or repelled by it? Draw charges on the pith ball and the rod. Explain the ball's movement.



b) **Insulators**: Turn a wooden dowel by holding the charged rod near it. Does the plastic rod attract or repel the dowel? _____

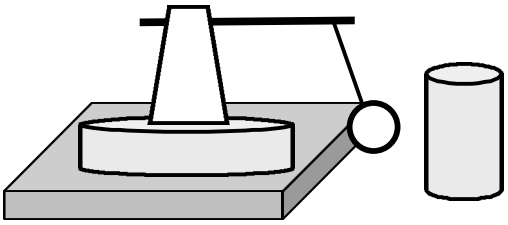
Draw charges on the rod and dowel.

Explain why the dowel moves.

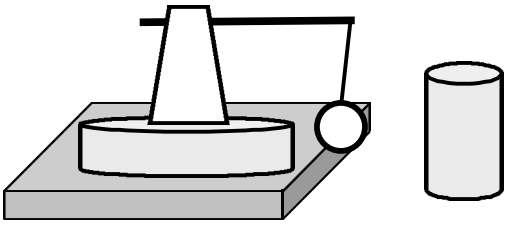


c) **Oscillator:** Rub the dull side of the blue foam briskly with a cloth. Place the electrostatic oscillator on the foam, holding it only by its foam cup. Push a soda can near to (but not touching) the ball of foil hanging from the plastic straw.

1) Why does the foil ball move away from the pan and toward the can? Draw + and – charges on the diagram to show the net charges on the objects. Draw arrows to show the movement of the foil ball. Explain why the ball initially moves toward the can.



2) After the foil ball touches the soda can, why does the ball then move away from the can and toward the pan? Draw + and – charges on the diagram to show the net charge on the object. Explain why the foil ball moves back and forth.



d) Group Discussion Question: The activities involving electric charge work best when a dehumidifier is operated in the classroom. Why is this true?

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Activity 10.3: Why Is Separating Charge Useful?

a) **Separating Charge on a Metal Jar:**

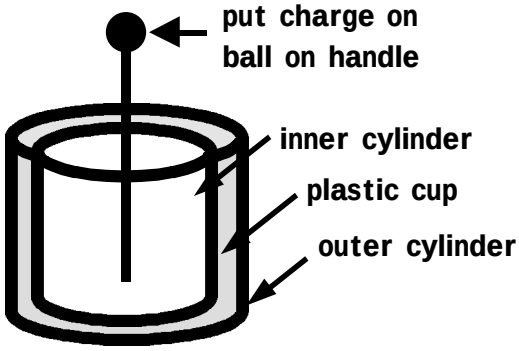
A Leyden jar consists of two metal cylinders separated by a clear plastic cup. First, we use only the inner metal cylinder in the plastic cup. Place a charge on the inner cylinder by rubbing a plastic rod with foam and sliding the rod along the ball on the cylinder's handle. Repeat 5 or 6 times without touching the ball with your hand. Then hold one wire of a small neon light bulb and touch the other wire to the charged cylinder. Describe what happens.

b) **Separating Charge on a Leyden Jar:**

Assemble the two metal Leyden jar cylinders and the plastic cup. Using a connecting wire, attach the outer cylinder to the ground wire above your table. Charge the inner cylinder with the charged plastic rod the same as you did in part a). Now touch one wire of a small neon bulb to the outer cylinder and the other bulb wire to the handle of the inner cylinder.

1) Describe what happens. How does the brightness of the bulb compare to its brightness using only one charged cylinder?

2) On the diagram draw + and – charges to show the net charge on the inner and outer cylinders of the Leyden jar before the bulb is touched to it.



c) Group Discussion Question: What is the function of the plastic cup?

Activity 10.4: What Is the Voltage of a Charge?

Your instructor will discuss the voltage of an electric charge. Voltage is a measure of the amount of energy per charge.

a) **Measuring the voltage of the Leyden jar:**

Leave the ground wire attached to the outer cylinder of the assembled Leyden jar. We will use two connecting wires to attach a tin can voltmeter. Clip the end of one connecting wire to the bottom of the tin can voltmeter and the other end to the ground wire. Attach the second connecting wire from the top of the voltmeter to the handle of the Leyden jar.

Place a charge on the jar by sliding the charged plastic rod along the ball on the jar handle as you did in Activity 10.3. How much voltage does the charge you placed on the Leyden jar have? _____

b) Your instructor will demonstrate what happens to the voltage of the inner charged cylinder when it is carefully lifted above the outer cylinder.

1) Does the voltage of the charge increase or decrease as the inner cylinder is lifted?
_____

2) Explain why the voltage of the charges changes as the inner cylinder is removed.

Activity 10.5: How is Charge Stored in Capacitors?

Your instructor will discuss capacitance. Capacitance is a measure of how easily an object stores electric charge.

a) In Activity 10.4 we found that charges on the Leyden jar have more voltage when the inner cylinder and plastic cup were removed. Next, your instructor will measure the capacitance of the charged Leyden jar when it is assembled and when the inner cylinder and plastic cup are removed. In which case will the Leyden jar have greater capacitance?

Prediction: _____ **Answer:** _____

Why does the capacitance of the Leyden jar change?

b) **Foil Capacitors:** Examine a torn apart foil capacitor. What is the purpose of the foil and the plastic? How is this capacitor similar to the Leyden jar?

c) **Capacitor Discharge**: Your instructor will demonstrate discharging a large capacitor by connecting it to a light bulb and by touching it with a metal-tipped rod

1) In which case did the capacitor discharge more quickly? _____
2) In which case is more energy released? _____
3) In which case is more power produced? _____
4) Explain why more power is produced in this case.