PS Physics **Isn't that Shocking? Electrostatics Lab**

Purpose:
The purpose of this experiment is to become acquainted with the phenomenon of electrostatics or "static electricity". Static charges will be generated and their properties will be studied.

Introduction:
All matter is composed of atoms, which are themselves composed of two charged subatomic particles; the protons and the electrons. In most instances, the matter found in our immediate environment is **electrically neutral**. That is a result of fact that absolute values of the proton's and electron's charge are equal, and the matter has the same number of protons and electrons.

Now, if some of the electrons in the neutral matter are removed, the matter will have a positive charge since it now contains more protons than electrons. Vice-versa, if electrons are added to neutral matter, the matter will have a negative charge since it now contains more electrons than protons.

If two like charged objects (two positive charges or two negative charges) are brought near each other, there will be repulsion between those objects. If two unlike charged objects (one positive and one negative) are brought near each other, there will be an attraction between those objects. The force or strength of this repulsion (or an attraction) is given by the expression where $\mathbf{q_1}$ and $\mathbf{q_2}$ are the amount of charges (not the sign) on the matter, d is the distance between the matter, and A is a constant) always the same number.)

$$F = \frac{A \cdot q_1 \cdot q_2}{d^2}$$

Thus, it can be seen that the force of repulsion or attraction can be increased by either increasing the amount of charge on the matter or by decreasing the distance between the matters. Also, the force of repulsion or attraction can be decreased by either decreasing the amount of the charge on the matter or increasing the distance between them.

In this experiment charged matter will be produced by physically removing electrons from it, or by adding excess electrons to it. Once charged, the properties of the charged matter will be investigated.

Experimental Procedures

1. Dancing Bunnies

Materials

- Paper bunnies
- A piece of thin Plexiglas® supported on two textbooks
- Fur piece
- Scissors

Procedure

a. Cut out the paper bunnies. Support a piece of Plexiglas¨ between two textbooks so that the distance between the plastic and the table is about equal to the height of a paper bunny.
b. Place the bunnies under the plastic and rub the top of the plastic vigorously with the fur. Continue rubbing for 2 to 3 minutes and observe what happens. _____,
c. What do you think will happen if you stop rubbing the plastic and wait for 10 or 15 minutes? _____ Wait 10-15 minutes. Record your results. _____
d. What do they think will happen if you then rub the plastic again? ____
e. Which material, the rabbit fur or the plastic, gives up it electrons? _____

2. Your Admirer is a Balloon

Materials

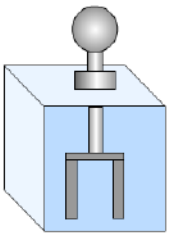
- Balloons
- String
- Felt-tip markers (permanent)
- Adhesive tape
- Fur piece
- Cardboard

Procedure

a. Inflate a balloon and draw a face on it with a permanent marker.
b. Tie off the balloon and suspend it from a doorway or ceiling using tape and string. The balloon should hang at the level of your head when you stand on the floor.
c. Rub the face of the balloon with fur. The balloon will now face you and move toward you whenever you approach it. You now have an admirer! Determine how far away the attractive force is able to act. ____
d. Is the balloon still attracted toward you if you position a piece of cardboard between the balloon and your face? _____ Can you wind up the string without touching it by making the balloon follow you round and round in a circle? _____
e. How do you think your admirer will react if you create another admirer? _____ Draw a face on a 2nd balloon, rub its face with fur, and suspend it near the 1st admirer. Describe the way they react. _____
f. Which material, the rabbit fur or the balloon, gives up it electrons? _____

3. The Electroscope: Charging by Contact and Induction

Materials



- Electroscope
- Fur
- Rubber or plastic rod
- Silk
- Fur piece

Procedure

a. Ground the electroscope by touching the top with your hand. Rub the rubber or plastic rod with fur and bring it near the electroscope without touching it. Record your observations. _____
b. Ground the electroscope and repeat and repeat part 3a, substituting a glass rod rubbed with silk for the rubbed rubber rod. Record your observations. _____
c. Ground the electroscope. Rub a rubber or plastic rod with the fur and touch the top plate of the electroscope with the rod. Record your observations. ___ Now rub the glass rod with the silk, bring it near the top plate of the plate. Record your observations. _____Now ground the electroscope with your finger and record your observations.
d. Repeat the above (part 3c) procedure, except change the order in which the rubber (plastic) and glass rods are used. Record your observations. _____
e. In parts 3c and 3d the electroscope was charged by contact. It will now be charged by induction. Ground the electroscope. Rub a rubbed rod with fur and bring it near the electroscope, without touching it. While the rod is near the electroscope, ground the electroscope. Remove your finger from the electroscope and then the rod. Record your observations. _____
f. Ground the electroscope and repeat the procedure on part 3e, except bring a glass rod rubbed with silk instead of the rubber (plastic) rod. Record your observations. _____

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Name (s) _____ _____ _____ _____

Hypothesis/Observations/Conclusions

1b			
1c			
1d			
1e			
2c			
2d			
2e			
2f			
3a			
3b			
3c			
3d			
3e			
3f			

Questions

Answer the following questions in complete sentences.

1. In part 3c, the electroscope was initially charged. Explain how the electroscope was charged in terms of the electrostatic theory.

2. Once the electroscope was charged negatively, as in part 3c, (touched with the rubbed rubber rod), why was it influenced when the positively charged glass rod was brought near it without actually touching it.

3. How can you explain the observation that when you slide over the plastic (vinyl) seat covers in a car you may get a "shock" or a spark when you touch the door handle of the car?

4. A plastic phonograph record or plastic pen seems to hold dust to it even though you try to brush it away.

5. Explain the phenomenon of "getting a shock" when you open a door immediately after taking off a wool sweater or wool clothes.

6. When any two substances are rubbed together, the substance with a greater electron affinity will attract extra electrons. Which substance in each of the following pairs would have the greater electron affinity?
   a) acetate or cotton

   b) vinyl or fur

   c) wool or fur

   d) glass or polyester

   e) nylon or glass

If time allows, experiment with the different materials to create a static build up.
Maybe you can catch your unsuspecting partner(s) by surprise.