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The Triboelectric Effect and Faraday Ice Pail

AP Physics C

Objective: I will qualitatively describe the charges on two conducting surfaces through use of the electric potential by analyzing interactions between charged and neutral objects through friction and by classifying the tendency of various materials to lose or accept electrons by friction.

Pre-lab Questions

1. Why do we say that objects lose/accept *electrons* instead of protons when they are charged?
   Electrons transfer a lot more easily than protons because protons are much heavier and are attracted to neutrons by strong force.
2.
   a. What is the triboelectric series (Look it up)?
      The triboelectric effect (also known as triboelectric charging) is a type of contact electrification on which certain materials become electrically charged after they are separated from a different material with which they were in contact. Rubbing the two materials with each other increases the contact between their surfaces, and hence the triboelectric effect. Rubbing glass with fur for example, or a plastic comb through the hair, can build up triboelectricity. Most everyday static electricity is triboelectric. The polarity and strength of the charges produced differ according to the materials, surface roughness, temperature, strain, and other properties.
   b. Which of the two objects would acquire a more positive charge when they are rubbed together: rabbit fur or plastic wrap? How do you know?
      Rabbit fur from the triboelectric series
3. What is the importance of grounding an object (why do we do it)?
   So it is neutral
4. If
   Mr. shee
5. Are there any risks associated with working with charges? If so, what are they and how can you avoid putting yourself in danger?
   Don’t get electrocuted guys

Materials

- Faraday ice pail
- 3 charging “wands”

- Electrometer and electric clips
- Various types of cloth (even a fuzzy jacket will do!), plastic wrap, and other insulating materials

Procedure Points

1. Set up the Faraday ice pail and electrometer as shown at the demonstration station. You will need to turn on the electrometer and zero it, and also ground the ice pail before starting.
2. Rub one of the wands gently with a cloth-like (or other) material.
3. Place the disk of the wand inside the inner part of the Faraday ice pail, but do not have it touch the actual pail.
4. Record the deflection of the electrometer (the reading that it shows). Make sure it is reading up to 10 V based on the slider at the bottom.
5. Ground the wand and ice pail, and repeat with another combination of wand/cloth. Do this for at least 9 cloth/wand combination sets (3 types of cloth or other material, with all 3 wands for each cloth material).

Results and Discussion

Show your results here and discuss them and how they relate to the triboelectric effect: rank your materials and the wands on a vertical list. Note that positive voltage would imply that the wand obtains negative charge.

Also, how might the charge be distributed inside the ice pail, in the presence of a charged disk? What errors were made?

Equally distributed inside the ice pail. When putting a positively charged disk inside, positive charges distribute to the outside, while negative charges are on the inside. Opposite for the negatively charged disk.

Table 1. Voltage readings from the electrometer for different wand/material combinations.

Voltage (V)	Wand 1 (metal)	Wand 2 (plastic)	Wand 3 (tape)
Material 1: 羽绒服 Sorry, we do not know the English. Here is a picture:	8	8	8

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Material 2: tennis ball	0.5	1	1
Material 3: table	3	2	4

Post-lab Questions

1. If you had touched the wand to the ice pail after charging the wand and grounding the pail, what would have happened to the voltage reading when you removed the wand?
   Reading would be negative
2. I said above that *positive voltage would imply that the wand obtains negative charge.* Why is this, conceptually? Hint: What happens to the charges on the mesh wirings?
   Saying that negative attracts positive.
3. The inner mesh cylinder has a radius of 5.3 cm and the outer one has a radius of 7.9 cm. Ignoring edge effects and assuming both cylinders have a length of 20 cm, estimate the charge on the inner cylinder (assume also that both cylinders are solid wire) by deriving an expression for the potential difference between both cylinders.