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AP PHYSICS II

Lab 4: Triboelectric Effect

Purpose

The purpose of this lab is to use the Faraday's properties of electrostatic induction

Background

Faraday claims that the net charge of the exterior of an enclosed space is equal to the charge of the object inside of the container (as seen in **Figure 1** to the right). Knowing this, we can quantitatively measure the charge of objects which are placed inside the container. We simply need to supply a "neutral reference" referred to as "ground" which, in this experiment, is attached to Earth Ground. You will be using a modified ice pail for this as seen in **Figure 2**.

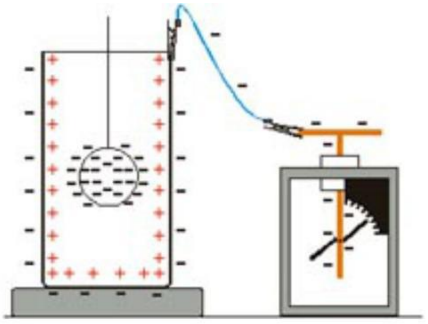

Figure 1

To record the charge on a wand, simply place is inside the ice pail but do not allow it to touch. Periodically, it will be necessary to ground (neutralize) the charge of the 2 wans as well as the inner ice pale. To do so, simply touch whatever you would like to ground to the outside mesh, which is attached to Earth Ground. To neutralize the inner ice pail, make a direct connection between ground and the pail with your as seen in **Figure 3**, HOWEVER, use an alligator wire rather than your finger to do this. This will assure the pail is grounded. You may also have to periodically "zero" the charge sensor.

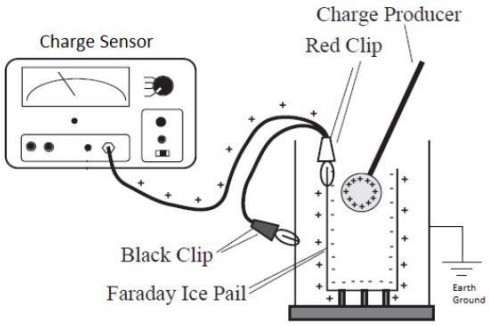

Figure 2

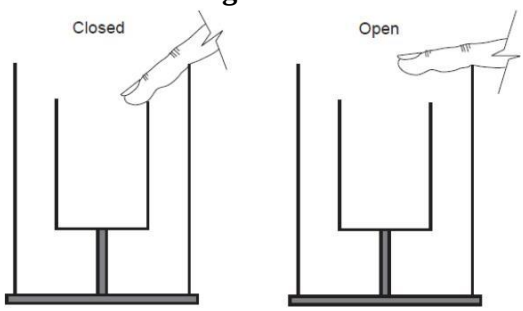

Figure 3

Procedure

1. Take the two wands and *gently* rub them together.
2. Electrons are exchanged through this rubbing. What is the process of electron exchange called?
3. Place either of the two wands in the pail but do not let it touch the mesh.
4. Note the reading on the charge sensor. What has happened to the reading? How does this happen even when the charged object does not physically touch the mesh?

The charge reading increased. The negative charges were attracted towards the inside of the pale, due to a positive charge being placed in the middle. Because the pale as a whole stays neutral, the outside of the pail gains a positive charge.

5. Make sure everything is properly grounded, including the two wands before moving onto the next step.

Please ask the teacher to check your progress before moving on.

6. Perform the experiment again. This time, we will *quickly* measure the charge of each wand. Rub the 2 wands together, then dip one into the pail (without touching the pail), quickly remove, and then dip the other (without touching the pail) and quickly remove. Record the charges for each.
"#$% '()* =___.07_____, ',-.% '()* =____-.065_____ What do you notice about the charges of the two wands?

They are almost equally opposite.

7. What do you think the charge would read if you dipped both wands into the mesh (without touching the pail) at the same time? Try it to see if your prediction was correct.

Nothing would happen, because we are introducing a net charge of 0 into the center. After experimenting, our prediction was mostly correct. We found a slight increase in charge reading, but that was likely due to the two wands being placed in slightly different locations within the pail.

8. Next, place a charged wand inside the pail (without touching the pail) and *tap* the pail with the grounding wire attached to the shield. Remove the wand and note the charge indicated by the charge sensor. Why do you think this happens?

This effect occurs because by putting the wand in, we create a positive charge around the sensor pin. Then, by grounding the inside, we restore the outside of the pail to a zero charge. When the wand is removed, the piled up negative charges on the inside of the pail all distribute throughout the pail, resulting in a negative charge throughout.

9. Lastly, ground everything and rub the wands together to build a charge once more. Dip one wand into the pail and allow it to touch the mesh this time. Remove the wand and note the reading of the charge sensor. Why do you are seeing this?

Initially, the outside gains a negative charge because we placed a negative charge in the middle. When we touch the wand to the pail, some of the positive charges in the middle are transferred to the wand, leaving behind a less positive charge. When the wand becomes neutral or is removed, the charges distribute, and we see that we now have more negative than positive charges.

10. Draw diagrams which would indicate the location of charges for the following situations. Look at Figure 2 for an example.
    a. A Positively charged object inside (but not touching) the ice pail.
    b. A Negatively charged object inside (but not touching) the ice pail.
    c. A Positively charged object inside (and touching) the ice pail.
    d. A Negatively charged object inside (and touching) the ice pail.