Physics-NYB **Lab 1: Electrostatics**

TRIBOELECTRIC SERIES

The **triboelectric effect** (also known as *triboelectric charging*) is a type of *contact electrification* in which certain materials become electrically charged after they come into contact with another ***different*** material *with or without* friction. By rubbing *neutral* glass with *neutral* fur, or by passing a *neutral* comb through the hair, one can get two ***electrically charged*** objects (one positive the other negative). Most of static electricity is built by triboelectric charging. The sign of polarity and amount of charges produced differ according to the materials properties (surface roughness, strain, temperature..)

This property was first recorded by Thales of Miletus and the word "electricity"comes from the Greek word for amber, ēlektron. Amber can acquire an ***excess*** *of electric charge by contact (or friction) with a material like wool; the same happens to glass rubbed with silk, or hard rubber rubbed with fur. Note that not all the materials can exchange a significant amount of electric charge when rubbed together. So, the related observable effect is not precisely predictable and only broad generalizations can be made.*

The following table shows the triboelectric effect polarity for many materials one may find around the house. Relatively positive items in the series are at the top, and negative items are at the bottom:

- Human hands (usually too moist, though) **Acquires a positive charge +**
- Rabbit Fur
- Glass
- Human hair
- Nylon
- Wool
- Fur
- Lead
- Silk
- Aluminum
- Paper
- Cotton
- Steel
- Wood
- Amber
- Hard rubber
- Nickel, Copper
- Brass, Silver
- Gold, Platinum
- Polyester
- Styrene (Styrofoam)
- Saran Wrap
- Polyurethane
- Polyethylene (like Scotch Tape)
- Polypropylene
- Vinyl (PVC)
- Silicon
- Teflon **Acquires a negative charge -**

(The above list is adapted from Nature's Electricity, by Charles K. Adams.)

The **relative position** of two substances in the triboelectric table tells what sign of charge they will get when brought into contact. Glass rubbed by silk causes a charge transfer such that they get charged (glass"+" and silk"-"). The same applies for wool"+" and amber"-". The farther is the separation in the table, the greater is the amount of the charge transfered. Reference: http://science.howstuffworks.com/vdg1.htm, retrieved Jan. 20, 2010

Observe the following experiments; s***tate clearly your observations and provide explanations (****using modelling, drawings and the appropriate electrostatics' terminology. +/- charge, conductor, insulator, charge transfer, by contact, by polarization , induction, ,..)* ***for each experiment.***

1. a) Rub the plastic straw (or rod) with a ***paper*** handkerchief. Remove the charged straw(or rod) and hold it close to a suspended small aluminum foil ball without touching it. What do you see?.....
   b) Next, touch the aluminum ball by the straw(or rod); remove the straw(or rod) from the ball and hold it close to the ball, without touching it. What do you observe now?.....

2. Rub the straw(or rod) with a paper handkerchief and hold the straw(or rod) just above small pieces of paper or cereals. What happens?

3. Let flow a thin dribble of water from the tap. Rub the straw(or rod) with a paper handkerchief and hold the straw(or rod) close to the dribble of water. What happens ?
   What can you assume for polarity of tap water?
   Next, rub and hold the paper handkerchief close to the dribble of water.
   What do you expect to happen..... and what happens?

4. a) **Charging and discharging an electroscope.** Put the electroscope on the table with the indicating needle vertical. Rub the straw with a paper handkerchief and put the straw **in contact** with the frame of the electroscope (touch the plate). Repeat these operations several times until the electroscope leaves remain open even when the straw is removed.
   If this doesn't work well, put a piece of aluminum on the plate, approach an electrified straw and make contact with the aluminum foil. Why do the leaves of electroscope open?

   b) Then, touch the plate of electroscope by your finger. What happens? Explain why?

5. Follow the steps below and observe what happen to the leaves of the electroscope **for each step**.
   a) Place the electrified straw *near the plate* of electroscope but *don't touch it*. ……..
   b) With your finger touch the fixed leaf (or the plate if none leaf is fixed). ……
   c) Remove your finger ……..
   d) Move the straw away……..

6. Rub a balloon against your hair and move it away.
   a) The hair sticks up. Why?
   b) Put the balloon close to a horizontal wooden surface; it will stick on wood. Why?
   c) Incline the wooden surface and verify if the balloon keeps sticking. Explain what you see.
   d) Verify if the balloon sticks on the wall. Explain.
   e) Do you expect a difference for these experiments when air is dry or not? Explain.

7**. Faraday cage**
   a) Place a small aluminum foil ball suspended on a string close to a discharged Van-de-Graff generator. Activate the generator. What happens to the ball? Explain ..
   b) Discharge the generator by approaching the other spherical head.
   c) Place the electroscope inside a metallic grid in the form of a container (Faraday cage).
   d) Activate anew the generator. What happens to the ball?