Demonstration Electroscope

P6-1170

INSTRUCTIONAL GUIDE

Contents

- Demonstration Electroscope
- Charging Ball
- Condenser plates with insulated rod

Recommended for Activity:

- Friction Rod Kit (P6-1600)
- E-Field Detector (96-3580)
- UVC Lamp (P3-6550)

Introduction

The primary purpose of the apparatus is to detect and measure the magnitude of a static electric charge. A charge is either induced or conducted through the metal plate on the top of the device. The needle mounts to the central rod, and deflects due to the charge on the metal plate.

As charges are collected on the apparatus, the lever arm, which is adjacent to the stationary arm, rotates due to the repulsion of like charges. This process will not determine the type of charge, only that a charge does exist. The greater the charge, the farther the lever arm will move.

Background

Atoms have the same number of positively charged protons as negatively charged electrons, so the overall charge is neutral. Atoms with an uneven number of electrons and protons are called ions. Ions are created when electrons are added or removed from atoms. Since electrons are negatively charged, removing electrons will create a positive ion (cation) and adding electrons will create a negative ion (anion).

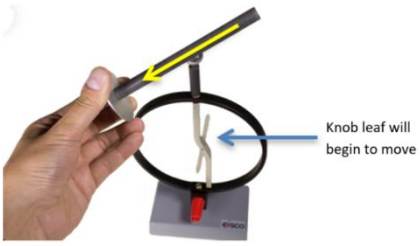
Ionization takes energy, like rubbing two materials together. Electrons are stripped from one material and transferred to another to create either a positive or negative charge. Insulators and conductors without a ground can maintain their charge as static electricity.

Tips for Use

Be sure the washer/bushing/insulator that separates the charging assembly is separate from the frame. If the insulator is NOT positioned correctly and the charging assembly (knob leaf) is in contact with the frame you will not be able to charge the electroscope.

The best technique for charging is to charge up the material you are using then “wipe” the charge off onto the electroscope’s plate.

It is much easier to charge the electroscope negative than it is to charge it positive. Faux fur on any form of plastic rod, plastic rulers, and plastic meter sticks, etc. gives a great negative charge. Use the Triboelectric series under “Resources” to determine which materials can easily gain a negative or positive charge.



Make sure you are using the electroscope in dry, NOT HUMID conditions

Activities

Demonstration of Static Charge
Students can populate their own triboelectric series with the Demonstration Electroscope and an E-Field Detector. Collect several materials from the triboelectric series under “Resources” or use the Friction Rod Kit for students to charge the electroscope.

1. Charge the Electroscope by rubbing two materials together and “wiping” them onto the ball or plate of the electroscope.
2. Record qualitatively how far the needle of the electroscope moves when the charge is applied.
3. Use the E-Field Detector to determine the charge on the electroscope.
4. Record the findings in a list and arrange the materials from most positive to most negative.

Demonstration of the Photoelectric Effect
The negatively-charged demonstration electroscope can be discharged simply by shining energetic short-wave UV-C light on the plate. This is another way to determine the charge on the electroscope since the UV-C light will only discharge a negatively-charged electroscope. Negatively-charged electrons are held on the outside of the atom and are susceptible to high-energy light. Positively-charged protons are held by strong forces in the nucleus of an atom and need much more energy to be removed.

1. Prepare the plate attachment of the electroscope by using steel wool to remove the zinc oxide layer. The bare zinc is more sensitive to incoming light.
2. Attach the plate to the electroscope and apply a negative charge.
3. Making sure the needle is NOT vertical, shine a short-wave UV-C light onto the zinc surface. The needle will move back to its neutral vertical position, indicating the electroscope has been discharged.

Resources

Triboelectric Series
(Positive items at the top and negative items are at the bottom)

- Human hands (**Very positive)**
- Rabbit Fur
- Glass
- Human hair
- Nylon
- Wool
- Fur
- Lead
- Silk
- Aluminum
- Paper
- Cotton
- 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 (**Very negative)**

Demonstration of the Photoelectric Effect video and article

Related Products

E-Field Detector (96-3580) Using the E-field detector, teachers and students can investigate the effects of positive and negative charge. The probe of this detector can "sniff out" unknown charges, demonstrate charging by induction, and even prove the inverse square dependence of Coulombs Law.

Fun Fly Stick (11-0058) Fun Fly Stick is a must have electrostatics experiment that is as easy to demonstrate as it is fun. Requires 2 AA batteries (not included).

Dissectible Leyden Jar (P6-3380) Demonstrate storage of electrical charges! The inner and outer metal conductors are separated by a plastic insulator cup. Charge the aluminum terminal with a Van de Graaff Generator or Wimshurst Machine, and take the jar apart.