

Charging by electrostatic induction

Class practical

Electrostatic induction is a quick way of using a charged object to give something a charge, of the opposite sign, without losing any of the original charge.

Apparatus and materials

Gold leaf electroscope [1]

Acetate rod or strip

Polythene rod or strip

Cloth for rubbing

Small calorimeters (or similar metal canisters), 2

Polythene tile

Electrophorus plate

Proof plane

Tin can

Health & Safety and Technical notes

Check the tin cans before use for a sharp edge where it was opened. Remove it if necessary by pressing it outwards with a steel rod.

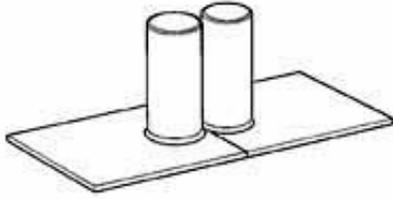
[Read our standard health & safety guidance](#)

Procedure

a Charge the polythene rod by rubbing it with the cloth. Rub the charged rod on the top plate of the electroscope. Observe the movement of the gold leaf. Discharge the electroscope by touching it.

b Bring a charged polythene strip near to the top plate of the uncharged electroscope, but without touching it. Then touch the electroscope plate with a finger so that the leaf falls. Take away the finger, then take away the charged polythene strip and watch what happens. The electroscope has been charged by induction.

c Charge the electroscope by rubbing a charged polythene strip along the plate. The leaf should hang at about 45° .



d Invert the metal canisters and place each on a polythene tile. Lift the tile to bring each canister in turn close to the electroscope, to show they are uncharged.

e Place the tiles on the bench, with the two canisters touching each other.

f Rub the polythene rod with the cloth and bring it up close to one of the canisters; while the rod is still there, separate the canisters. Bring each up to

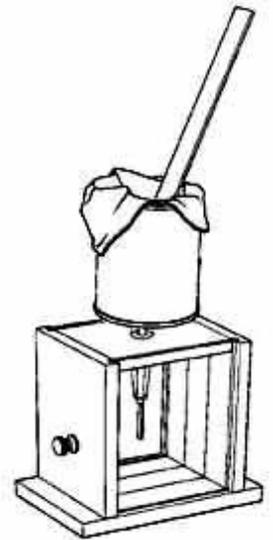
the gold leaf electroscope.

g Repeat the above, but this time, when the charged strip is brought up near one of the two canisters, earth the second canister by touching with a finger. Test each canister.

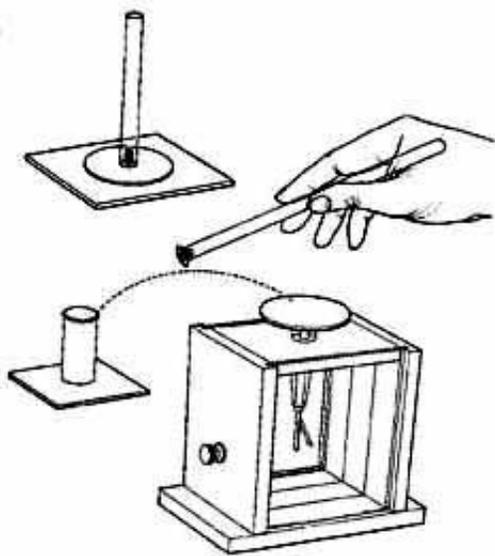
h With the gold leaf electroscope discharged, bring up a rubbed polythene strip, close to the plate. Touch the plate momentarily so that the leaf falls, then remove the polythene strip.

i Rub one of the tiles with the cloth. Place the electrophorus plate on the tile and then remove it and test it on the electroscope. Repeat this, this time earthing the plate with your finger whilst it is in contact with the tile, before testing on the electroscope.

j Put a tin can on top of the electroscope. Give a charge to the end of the proof plane and bring that charge, held by the insulator, into the tin on the electroscope. Watch what the electroscope does when the charge is moved about inside it, without touching it, and then when the charge is removed. Repeat the whole experiment, this time allowing the charged object to touch the inside of the can.



k Put a tin can on top of the electroscope. The electroscope should be discharged with the leaf down. Insert a cloth into the tin, if necessary holding it down with a mass. Insert the polythene rod into the cloth (having previously discharged the strip by passing it over a Bunsen flame). Then pull out the rod, rubbing it against the cloth in the process. Observe how the leaf moves. Then re-insert the rod and observe the leaf.



l The metal washer on the end of the Perspex rod, which forms the proof plane, can be used to investigate the distribution of charge over a charged conductor. Place one of the canisters on a polythene tile and charge it by repeated contact with the electrophorus plate. Touch different parts of the canister with the proof plane, each time testing it on the charged electroscope. Compare the sides, the edges and the bottom of the inside.

Teaching notes

1 Note the sequence when charging a gold leaf electroscope. A charged object is brought close to the top plate (so that the leaf deflects). With the charged object still close by, the top plate is touched to earth (the leaf falls). The earthing finger is removed. The charged object is removed (the gold leaf rises again).

2 The proof plane consists of a metal washer on the end of an insulating handle. By touching it on a charged object, a fraction of the object's charge is removed.

If a charged proof plane is brought near a charged electroscope, the deflection of the gold leaf will change. If the charges are like, the deflection will increase; if they are unlike, it will decrease.

3 Step **k** shows that charge is conserved; the cloth gains a certain amount of charge; the rod gains an equal but opposite charge.

Step **l** shows that charge is not evenly distributed over a conductor; it is more concentrated at points which are strongly curved, e.g. edges.

This experiment was safety-tested in January 2007

Related guidance

Electrostatics [3]

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Links:

[1] <http://www.nuffieldfoundation.org/node/1878>

[2] <http://www.nuffieldfoundation.org/node/1634/>

[3] <http://www.nuffieldfoundation.org/node/1828>