

# Electric Charge experiment

## Part 1 – Introduction

In this experiment, you have various types of rods available to you. You can place one rod at a time on a rotating stand, and you can also use an electroscope to test for the presence of electric charge.

Without doing anything to any of the rods, try the following.

- Bring a rod close to, but not touching, the top metal plate of an electroscope. What do you observe?
- Place a couple of very small pieces of paper (about the size of the paper circles you get if you use a hole-punch on a sheet of paper) on the table. Bring a rod close to, but not touching, the small pieces of paper. What do you observe?
- Place a rod on the rotating stand so that the rod is balanced and at rest. Bring a second rod close to, but not touching, the first rod. What do you observe?

Now, repeat all three experiments above, but, this time, rub each rod with one of the materials you have before you bring it close to something else. In at least some cases, you should notice a different outcome from what you observed above. What do you observe?

What do you think the act of rubbing an insulating rod with a material does?

Try placing a metal rod on the rotating stand, without rubbing the metal rod beforehand. When an insulating rod you have rubbed with material is brought near the metal rod, what happens? Explain why this happens.

## Part 2 – Charging insulating materials

Here, you should do a systematic study of the different materials you have available to you. The basic method is as follows. Select one of the rods and one of the materials. Rub the rod with the material, and then place the rod on the rotating stand so that the rod is balanced and at rest. Take a second rod, and, using either the same material as before or a different material, rub the second rod with the material you select. Bring the second rod close to, but not touching the first rod, and observe what happens. What do you observe?

Carry out a detailed study of the various combinations of rods and materials you have available to you. You should be able to organize the rod-material combinations into at least two categories (according to whether the second rod after rubbing attracts or repels the first rod, for example). Use the space below to write down your observations. Suggestion – creating a table might help.

### Part 3 – Soda can attraction and/or repulsion

Prediction 3.1 – Before actually doing the experiment below, read what you will be doing and then use this space to predict what you think will happen.

Take one rod-material combination from part 2 (which provides a strong charge to the rod), and rub the rod with the material to charge the rod. Place an empty soda can on its side on a flat surface, and bring the charged rod close to, but not touching the side of the can. What do you observe? Draw a picture to explain your observations.

Prediction 3.2 – Before actually doing the experiment below, read what you will be doing and then predict what you think will happen in this space.

Now use a second rod-material combination from part 2, one in which the second rod attracted the rod you used above. Place an empty soda can on its side on a flat surface, and bring the second charged rod close to, but not touching the side of the can. What do you observe? Draw a picture to explain your observations.

#### Part 4 – Using an electroscope

You should have predicted the outcomes of the following experiments on the pre-lab assignment.

Take one rod-material combination from part 2 (which provides a strong charge to the rod), and rub the rod with the material to charge the rod. Bring the charged rod close to, but not touching, the electroscope. What does the electroscope do?

Take the rod away. What does the electroscope do?

Use a second rod-material combination from part 2, one in which the second rod attracted the rod you used above. Rub the rod with the material to charge the rod. Bring the charged rod close to, but not touching, the electroscope. What does the electroscope do?

Take the rod away. What does the electroscope do?

Return to the first rod-material pair. Rub the rod with the material to charge the rod, and then charge the electroscope by rubbing the rod on the top of the electroscope. The electroscope should register that it is charged when you take the rod away. Rub the rod with the material again to charge the rod again, and now bring this rod close to, but not touching, the electroscope. What does the electroscope do?

Use your second rod-material combination from part 2, rubbing the second rod to charge it. Bring the charged rod close to, but not touching, the electroscope. What does the electroscope do?

## Part 5 – Charging by induction

In part 4, you gave an electroscope a net charge by rubbing the electroscope with a charged rod. The electroscope ended up with the same sign charge as the charge on the rod. By following the procedure below, we can give an electroscope a charge with the opposite sign as the charge on the rod. This is trickier, so it involves more steps – the whole procedure is known as *charging by induction*.

This procedure also uses a ground – a ground is essentially a neutral reservoir of charge that is so large that it can donate or accept electrons without becoming particularly positive or negative itself. Houses, for instance, are grounded by being electrically connected to a metal pole that is driven into the Earth – the Earth acts as the ground in that situation.

For the purposes of our experiment, you can act as a ground, because you are considerably larger than the electroscope. Note that the electroscope should start off uncharged. You can ensure this by touching the top of the electroscope with your hand.

Step 1. Select a good rod-material combination from part 2, and rub the rod with the material to charge the rod. Bring the charged rod close to, but not touching, the electroscope.

Step 2. Ground the electroscope by touching the metal part of the electroscope with your hand (use the hand that is not holding the rod, or get your partner to ground it).

Step 3. Remove the ground connection (in other words, take your hand off the electroscope).

Step 4. Take the rod away from the electroscope (note that the rod should never touch the electroscope during this process). The electroscope should register that it has a net charge, at this point.

Verify that the sign of the charge on the electroscope is opposite to the sign of the charge on the rod. Describe how you verify this.

Will the charging by induction process work if you reverse the order of step 1 and step 2 above? What if you reverse the order of step 3 and step 4? Explain.

## Part 6 – The electrophorus

The electrophorus is a fancy name for a simple device – a metal plate with an insulating handle. Your goal here is to see if you can create a spark with your electrophorus. First, make sure the electrophorus is uncharged by bringing it close to (but not touching) the top plate of an electroscope.

Now, charge a piece of plastic by rubbing it with one of the materials from part 2. Check to make sure that it is charged by bringing it close to (but not touching) the top plate of an electroscope. Place the charged plastic down on the table, and, holding the insulating handle of the electrophorus, place the electrophorus on the piece of plastic (the metal plate should be touching the plastic).

Slowly bring your finger close to the metal plate of the electrophorus. Try to bring it as close as possible, but do not touch it. See if you observe a spark – do you? If so, explain why. By the way, do you need to see a spark to observe it, or can you observe the spark some other way?

If you don't observe a spark, try rubbing the piece of plastic with a different material from part 2. Try the various materials and see what works best. Record here which of the various materials from part 2 works best.

Using the insulating handle, carefully lift the electrophorus off the piece of plastic. Bring the electrophorus close to (but not touching) the top plate of an electroscope now. What do you observe?

Once you have moved the electrophorus off the plastic, is the piece of plastic still charged? How do you know?