Discharging at points

Physics > Electricity & Magnetism > Electrostatics & electric field

Difficulty level	Group size	Preparation time	Execution time
easy	-	10 minutes	10 minutes

This content can also be found online at:

http://localhost:1337/c/64280d855e30a7000275e9de

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Teacher information

Application

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Lightning in a thunderstorm

For the exchange of electrical charge between two bodies to take place, they do not necessarily have to come into contact. It is even sufficient if they approach each other at a certain distance (in this case a few centimetres).

This transition of the electrical charge then usually becomes visible in the form of a spark.

A classic example of the visible exchange of electrical charges over long distances is lightning in a thunderstorm. Here, the transition of the charge from the cloud to the ground is very clearly visible.

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Other teacher information (1/2)

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Prior knowledge

Students should already have thoroughly studied and understood electric charge and its effects. In addition, they should have understood that electric charge can be transferred between two bodies by touching them.

Principle

If the electric charge of a body is sufficiently large, it can also be transferred to other bodies that are close to it without touching it!

Other teacher information (2/2)

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Learning objective

The students should realise that charges can be transported through the air with the help of sparks and that these sparks mainly occur at the tips and corners of objects.

Tasks

In this experiment, students are asked to discharge an electrically charged electroscope without touching it.

They are to show that charge can also be transported without contact between two bodies and that the shape of the bodies can play a role in this.

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Safety instructions

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The general instructions for safe experimentation in science lessons apply to this experiment.

Notes on set-up and procedure:

This experiment is not mainly about the spark itself, but about the transfer of charges between two bodies at points. Point discharge on bodies can only be shown in demonstration experiments, as higher voltages are needed. The comparison of distances in the first sub-experiment is limited by the fact that the electroscope would have to carry the same amount of charge each time. However, this is difficult to realise. For the series of events in the third part of the experiment, the spark is already easily visible in moderately darkened rooms. An explanation of the mechanism of conduction through air can be omitted if the students' prior knowledge is not sufficient for this.

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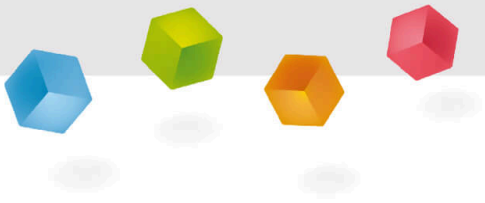

Student information

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Motivation

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Lightning in a thunderstorm

Electrically charged objects can transfer this charge when in direct contact with conductors.

But how does the exchange of charge work in the event of a thunderstorm between the cloud and the ground? In this case, the discharge is very clearly visible as a flash of lightning, when the excess charges are transferred from the cloud to the ground. However, the principle also works in the same way on a smaller scale, for example with the Tesla transformer or with plasma spheres.

You will investigate the phenomenon of contactless charge transfer more closely in the next experiment.

Tasks

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In this experiment you will again deal with the discharge of different bodies.

To do this, first set up an electroscope.

Then examine the electrically charged electroscope without touching it!

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Equipment

Position	Material	Item No.	Quantity
1	Electroscope w. metal pointer	13027-01	1
2	Faraday pail, d. 40mm, h. 75mm	13027-03	1
3	Polypropylene rod, l=175mm, d=10 mm	13027-09	1
4	Acrylic resin rod, l=175 mm, d=8 mm	13027-08	1

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Additional Equipment

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Position	Equipment	Quantity
1	Dry, rough paper	DIN A4

Set-up (1/2)

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Structure of the electroscope

First assemble the electroscope.

The pointer should hang vertically (one side is slightly longer and thus minimally heavier) without bumping, the axis is in the notch.

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Set-up (2/2)

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Attach Faraday cup to acrylic rod

Then mount the Faraday cup at the end of the acrylic rod.

Procedure (1/5)

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- Rub the polypropylene rod vigorously with paper to charge it.
- Then charge the electroscope with the polypropylene rod rubbed against the paper. Repeat the rubbing and charging a few times to fully charge the electroscope.

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Procedure (2/5)

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Bring your finger close to one corner of the electroscope (without touching it!)

Experiment 1, Part 1:

- Slowly move a finger towards a corner on the upper arm of the electroscope.
- Note the distance between the finger and the corner of the electroscope when a small crack is heard.
- Also observe the behaviour of the pointer.

Procedure (3/5)

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Bring your finger close to the upper surface of the electroscope (without touching it!).

Experiment 1, part 2:

- Repeat the experiment, but this time move your finger towards a surface on the electroscope.
- Again, note the distance when a crack is heard.

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Procedure (4/5)

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Approach Faraday cup to electroscope

Experiment 2:

- Recharge the electroscope as much as possible.
- Move the Faraday cup on the acrylic rod to one corner of the electroscope until you hear a crack, but do not touch the electroscope.
- Now devise an experiment to find out whether charges were transferred from the electroscope to the Faraday cup.
- Carry out this experiment.

Procedure (5/5)

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Charge mug

Approach cup to electrohead

Experiment 3:

- Charge the Faraday cup strongly on the acrylic rod with the polypropylene rod rubbed on the paper.
- Then move it slowly to a corner of the electroscope, which should be discharged beforehand.
- Listen carefully to the crackling and watch the hand.

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Report

Task 1

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Bring your finger close to one corner of the electroscope (without touching it!)

What were your observations of part 1 of the 1st experiment?

- The pointer did not move at any time during the experiment.
- The pointer was deflected even further after cracking.
- The pointer has clearly moved back towards the starting position after the crackling.

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Task 2

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Bring your finger close to the upper surface of the electroscope (without touching it!).

What were your observations of part 2 of the 1st experiment?

- The pointer was deflected even further after cracking.
- The pointer has clearly moved back towards the starting position after the crackling.
- The pointer did not move at any time during the experiment.

Task 3

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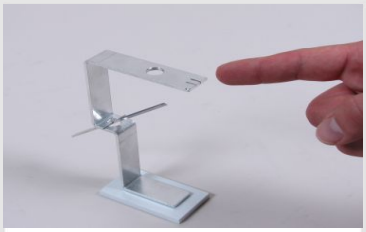

Experiment 1, Part 1

Experiment 1, Part 2

In which part of experiment 1 was the distance between the finger and the electroscope greater than the crackling sound?

- In the 1st part, the distance was greater (finger approaching the corner of the electroscope).
- In the 2nd part, the distance was greater (fingers approaching the surface of the electroscope).
- The distance was the same in both sub-tests.

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Task 4

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Approach Faraday cup to electroscope

What were your observations of the second experiment?

- The pointer did not move at any time during the experiment.
- The pointer was deflected even further after cracking.
- The pointer has clearly moved back towards the starting position after the crackling.

Task 5

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Approach Faraday cup to electroscope

What were your observations of the third experiment?

- The pointer did not move at any time during the experiment.
- The hand briefly left its initial position, but then returned to it.
- A repeated cracking sound is heard on approach, and the pointer deflection increases with each crack.

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Task 6

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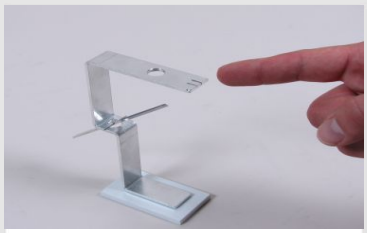

Experiment 1, Part 1

Experiment 1, Part 2

What influence does the shape of the surface have on the distance at which the observed phenomenon occurred?

The _____ the shape, the easier it is to transfer charge.

The _____ the shape, the closer you have to get to the body for the charge to be transferred.

more pointed | blunter

Check

Task 7

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Faraday cup attached to electroscope

How can the spark be made more visible or the distance be increased?

- [ ] Approach oppositely charged object
- [ ] Increase charge quantity (through Faraday cup)
- [ ] Darken room
- [ ] Approaching a conductive object at the tip

Check

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Task 8

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In the individual experiments, the bodies were always negatively charged. Think about whether you would observe or obtain the same phenomena and results with positive charges?

- No, the observations and results would only be partially the same.
- No, the observations and results would always be opposite.
- Yes, the observations and results would be the same.

Slide	Score / Total
Slide 19: Observation: Experiment 1, Part 1	0/1
Slide 20: Observation: Experiment 1, Part 2	0/1
Slide 21: Comparison Experiment 1, Part 1 & 2	0/1
Slide 22: Observation: Experiment 2	0/1
Slide 23: Observation: Experiment 3	0/1
Slide 24: Conclusion 2	0/2
Slide 25: Sparks clarify	0/4
Slide 26: Positive charges	0/1

Total 0 / 12

Solutions Repeat

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