A conductor as a capacitor

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/6426c560ab58420002f629de

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Teacher information

Application

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Schematic representation of a battery

Just as batteries can store electrical energy in the form of statically separated charges, all kinds of metallic objects can store electrical charge. For example, objects such as the electroscope used in the previous experiments, the induction plate or, for example, a Faraday cup.

The possible amount of electric charge that a metallic body can store depends essentially on its size and shape. A very thin metallic rod could store less electric charge than a large cylinder of the same material. The size of the surface of the respective body is decisive.

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Other teacher information (1/2)

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Prior knowledge

The students should already have studied electric charge and its effects. The experiments in which the electric charge was investigated using a simple electroscope provide very good basic knowledge for this.

Principle

Electrical conductors such as metallic objects are well suited to storing electrical charge because the electrons can move relatively freely in these materials. This stored charge can then be transported from one place to another. The nature of the conductor used has a significant influence on the amount of energy that can be stored.

Other teacher information (2/2)

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Learning objective

The students recognise that metallic objects, such as an electroscope, an induction plate and a Faraday cup, can store charges and thus also transport them. They realise that the amount of charge stored depends on the size and shape of the bodies.

Tasks

With the help of this experiment, the students should prove that:

1. conductive (metallic) bodies can store electrical charges.
2. the amount of electrical charge that a body can store depends on its nature and shape.

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Safety instructions

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

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Student information

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Motivation

Schematic representation of a battery

Batteries are often used to store and transport electrical energy. You are probably already very familiar with these from everyday life. You have probably already held a small battery in your hand when you screwed on a torch or something similar.

So far you have studied electric charge and its effects in great detail. But how could you store electrical charge and transport it in a similar way to the electrical energy stored in a battery? You will investigate this phenomenon in the following experiment.

Tasks

In this experiment you will investigate the suitability of different objects for storing electrical charge.

For this, you will examine with the help of an electroscope:

1. whether conductive bodies can store electrical charges.
2. how the condition of the body influences the suitability for storage.

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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
5	Electrostatic influence plate, 30 x 60 mm	13027-12	1
6	Film, transparent, DIN A4, 100 sheets	08186-10	1
7	Rubber stopper,d=49/41mm, 1 hole	39263-01	1

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Set-up

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

Then attach the influence plate to the polypropylene rod and the Faraday cup to the acrylic rod. Then insert the acrylic rod into the rubber stopper as shown in the illustration opposite.

Procedure (1/5)

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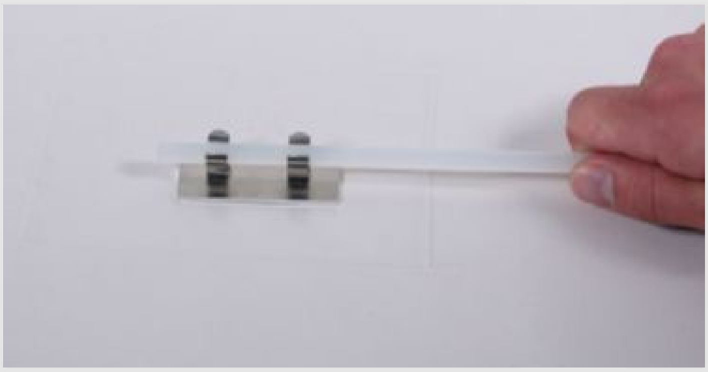
Experiment 1: Rub the influence plate over the transparent film lying on the table. Then touch the electroscope from above with the influence plate and observe the pointer. Repeat the process until the maximum pointer deflection is reached.



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Procedure (2/5)

Unloading the Influence Plate

Experiment 2:

- Touch your hand and then the electroscope alternately with the influence plate.
- Count the number of touches until the pointer is vertical again and write it down if necessary.

Procedure (3/5)

Connecting the Influence Plate and Fararday Cup

Experiment 3:

- Rub the clear film again with the influence plate and then touch the Faraday cup with the plate.
- Repeat this process three times.
- Then discharge the Influence Plate and the electroscope by touching them with your hand.

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Procedure (4/5)

Alternately touching the Faraday cup and the electroscope

Experiment 3:

- Now touch the Faraday beaker and the electroscope alternately with the influence plate.

Procedure (5/5)

Remove Faraday cup from rubber stopper

Experiment 4:

- Pull the acrylic rod out of the rubber stopper and discharge the Faraday cup.
- Charge the electroscope again as in the 1st measurement.
- Touch your hand and the electroscope alternately with the Faraday cup.
- Again, count the number of touches until the pointer is vertical and note them down if necessary.

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Report

Task 1

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What were your observations during the first trial?

- ○ Each contact with the influence plate increases the pointer deflection of the electroscope until the pointer stops.
- ○ The pointer of the electroscope deflects at the first touch and does not move significantly at subsequent touches.
- ○ The pointer of the electroscope deflects every time it is touched and returns to its original position when disconnected.

Check

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Task 2

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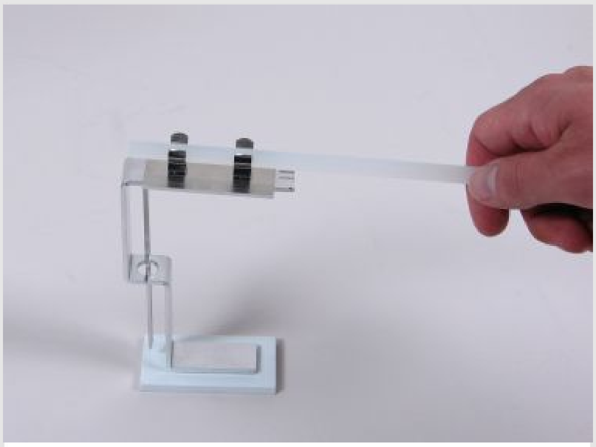

Connecting the electroscope and the influence plate

How can you explain the change in the pointer deflection at the individual touches in the 1st experiment?

The ______ was further ______ with every ______ and thus the pointer was always further ______.

charged | touch | deflected | electroscope

Check

Task 3

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What were your observations during the second experiment?

- ○ The pointer of the electroscope has gradually moved back to its original position.
- ○ The pointer of the electroscope remained permanently in the deflected position.
- ○ The pointer deflection decreased slightly when touching, and increased again when disconnecting.

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How many repetitions and touches did you have to do?

Note your result:

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Task 4

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Unloading the Influence Plate

Why did the pointer deflection change as observed during the 2nd experiment?

With each ____________ the electroscope was further ____________ and thus the ____________ continuously decreased.

pointer deflection | discharged | touch

Check

Task 5

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Alternately touching the Faraday cup and the electroscope

What were your observations during the 3rd experiment?

- At the first touches of the electroscope, the pointer deflection always increases slightly, then its position no longer changes.
- When the electroscope is touched for the first time, the pointer deflection increases sharply and does not change its position on subsequent touches.

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Task 6

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What happened to the charges when the Faraday beaker and the electroscope were touched alternately in the 3rd experiment?

The charges were transferred from the ________ to the ________.
The Faraday cup had the electric charge ________ and the electroscope had it stored in it ________.

- at the end
- electroscope
- initially
- Faraday cup

Check

Task 7

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How many repetitions and touches did you have to do this time?

Note your result:

What were your observations during the 4th experiment?

- [ ] The pointer remained in its deflected position.
- [ ] The pointer has returned to its original position.
- [ ] The movements of the pointer take place in larger steps than in the 2nd part of the experiment.

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Task 8

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By comparing the results from the 2nd and 4th experiments, what can we surmise about the relationship between the shape of the object and the amount of charge stored?

The ______ the surface area of an object, the better its ability to ______ electric charge. (The ______ the surface of an object, the better its ability to ______ electric charge. (Cf. Influence plate)

smaller
store
larger
emit

Check

Slide	Score / Total
Slide 17: Observation: Experiment 1	0/1
Slide 18: Explanation: Experiment 1	0/4
Slide 19: Observation: Experiment 2	0/1
Slide 20: Explanation: Experiment 2	0/3
Slide 21: Observation: Experiment 3	0/1
Slide 22: Explanation: Experiment 3	0/4
Slide 23: Observation: Experiment 4	0/2
Slide 24: Conclusion	0/4

Total 0 / 20

Solutions Repeat Export text

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