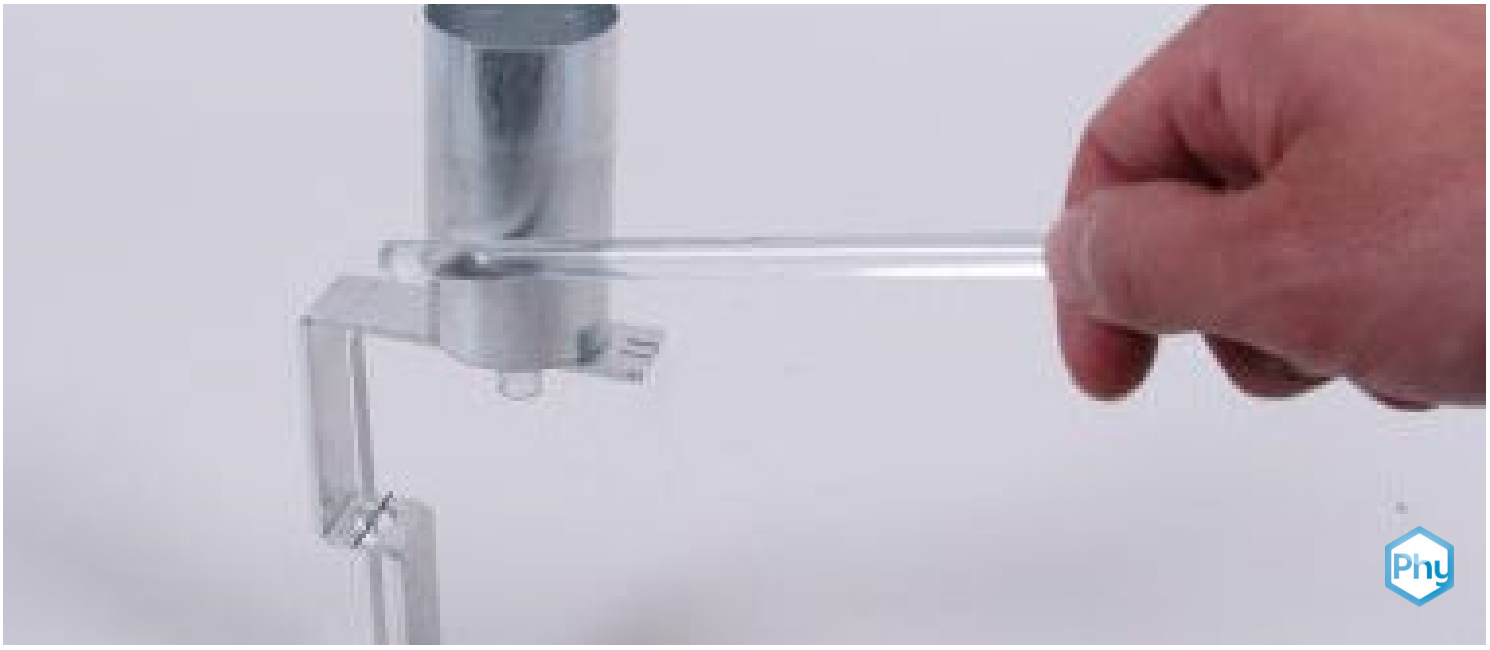
Storing of positive and negative charges



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/6426ca9dab58420002f62b09

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Teacher information

Application

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Faraday cup

A Faraday cup is - according to its name - a cup-shaped object with the help of which one can determine electric charge (especially ion beams).

The inside of the metal cup is basically field-free and electrical charges can only be taken out via the outer wall of the cup. However, the electric charge can also be supplied to the cup via the inner wall.

This therefore means that no charge can migrate from the inner wall of the Faraday cup to an influent plate, but it is possible from the outer wall of the cup.

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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 in detail. The previous experiments, in which the electric charge is examined using a simple electroscope, provide basic knowledge for this. In addition, the experiment "Conductors as charge storage" provides a good basis for successfully carrying out this experiment.

Principle

The inside of the Faraday cup is basically field-free. Thus, no electrical charges can migrate from the inner wall of the cup to other objects. The outer wall of the cup, on the other hand, is able to transfer charges to other bodies. The Faraday cup can store both positive and negative electrical charges and transfer them to other objects.

Other teacher information (2/2)

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Learning objective

The students realise that a Faraday cup can be used to store both positive and negative charges.

Tasks

In this experiment, the students are to examine the properties of the Faraday cup in detail with regard to charge storage. To do this, they should use a glow lamp to determine whether the cup can hold positive and negative charges equally.

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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:

The experiment can of course also be carried out without using the electroscope or without a Faraday cup. The decisive factor is that an insulated attached conductor with sufficient storage capacity is used. The general finding is that electrical conductors can store both positive and negative charges.

The desired realisation that a Faraday cup can store both positive and negative charges does not initially exclude the possibility of storing both types of charge simultaneously. If this problem is to be investigated, the additional task should be included. Here, the students should independently search for an experimental way.

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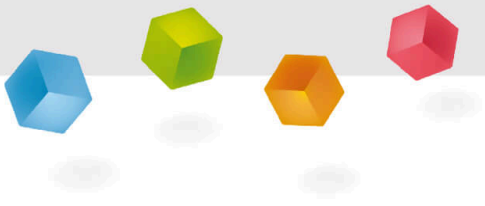

Student information

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Motivation

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Faraday cup

A Faraday cup is - according to its name - a cup-shaped object with the help of which one can determine electric charge (especially ion beams).

So far, you have investigated the extent to which the Faraday cup can absorb and release electric charge. But is its ability to store charge only limited to positive or negative charge?

You will investigate and clarify this question in this experiment.

Tasks

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In this experiment, you will take another close look at the Faraday cup and its properties.

To do this, first set up an electroscope and attach a Faraday beaker to it.

Then investigate which type of electrical charge (positive / negative) the Farday cup can absorb and store.

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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	Neon tube	06656-00	1

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Additional Equipment

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Position	Equipment	Quantity
1	Dry, rough paper	DIN A4

Set-up

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Structure of the electroscope

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 carefully insert the Faraday cup into the top hole in the electroscope with a twisting motion until the bottom of the cup makes contact with the electroscope.

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Procedure (1/2)

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Experiment 1: Charge the polypropylene rod by rubbing it vigorously with paper. Then charge the Faraday cup with the rubbed polypropylene rod. Finally, check the type of charge on the beaker with the glow lamp (notice which electrode lights up).

Procedure (2/2)

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Experiment 2: Repeat the experiment with the acrylic rod: Charge the acrylic rod by rubbing it vigorously with paper and transfer the charge to the Faraday cup. Finally, check the type of charge on the beaker again with the glow lamp (note which electrode lights up).

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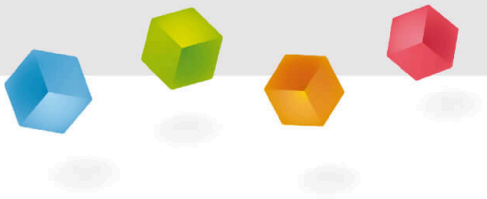

Report

Task 1

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How do the pointer and glow lamp react in the 1st experiment (polypropylene rod)?

- The pointer deflects, when touched with the glow lamp the pointer deflection decreases and the electrode facing away from the Faraday cup lights up.
- The pointer deflects, but when touched with the glow lamp, the pointer deflection does not change and no electrode lights up.
- The pointer deflects, when touched with the glow lamp the pointer deflection decreases and the electrode facing the Faraday cup lights up.

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Task 2

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How do the pointer and glow lamp react in the 2nd experiment (acrylic rod)?

- The pointer deflects, when touched with the glow lamp the pointer deflection decreases and the electrode facing the Faraday cup lights up.
- The pointer deflects, when touched with the glow lamp the pointer deflection decreases and the electrode facing away from the Faraday cup lights up.
- The pointer deflects, but when touched with the glow lamp, the pointer deflection does not change and no electrode lights up.

Task 3

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Hold the glow lamp to the Faraday cup

What do we realise about the storage capacity of a Faraday cup?

- The Farday cup can only store positive electrical charge.
- The Farday cup can only store negative electrical charge.
- The Farday cup can store both positive and negative electrical charge.

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Task 4

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Hold the glow lamp to the Faraday cup

Is it also possible to store negative and positive charges simultaneously on the Faraday cup?

- No it is not possible, because the charges would balance each other out.
- The Farday cup can only store negative electrical charge.
- Yes it is possible, because you could store positive charges on the inside and negative charges on the outside of the cup (or vice versa).

Slide	Score / Total
Slide 15: Observation: Experiment 1	0/1
Slide 16: Observation: Experiment 2	0/1
Slide 17: Conclusion	0/1
Slide 18: Consideration	0/1

Total 0 / 4

Solutions Repeat

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