Electrostatic induction with an electroscope

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/6426bf428000e100027732d8

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Teacher information

Application

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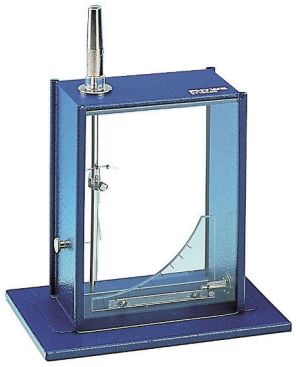

Electroscope according to Kolbe

The force effect between electrically charged objects with equal and unequal names, which has been studied in detail so far, is not only an interesting phenomenon, but can also be used practically.

The force generated in this way can be used to deflect the pointer of the electroscope in the following experiment.

Furthermore, electroscopes can be used not only to measure electrostatic charges directly, but also to detect the presence of ionising radiation.

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Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
Fax: 0551 604 - 107

info@phywe.de
www.phywe.de

Other teacher information (1/2)

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Prior knowledge

The students should already have learned and understood the interaction between positively and negatively charged bodies. They should already know that a force exists between charged particles, where it comes from and that objects can be moved with the help of this force.

Principle

There is a force effect between electrically charged objects when they are brought closer together. In an electroscope, a rotating pointer is in electrical contact with the suspension. The pointer is repelled by an applied electrical charge and thus deflects. The pointer also deflects due to the approach of electrical charges (without contact).

Other teacher information (2/2)

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Learning objective

The students apply their knowledge about electrical influence to the electroscope. They recognise why a pointer deflection can already occur when a charged body approaches the electroscope. They can explain the processes in the electroscope.

Tasks

In this experiment, students will investigate how the pointer of an electroscope reacts when electrically charged objects are brought close to the pointer or the body of the electroscope.

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Robert-Bosch-Breite 10
37079 Göttingen

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Fax: 0551 604 - 107

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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:

For all partial experiments it is important that the electroscope is not touched by the charged objects. It is also important not to bring the objects too close to the electroscope, otherwise sparks could cause a charge, which would mask the effects of the influence. If a charge does occur accidentally, the electroscope must be discharged again before the next partial experiment.

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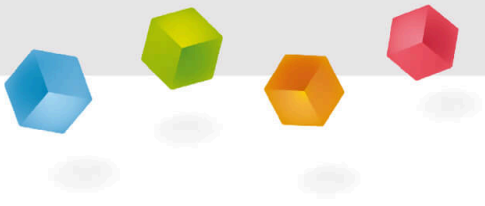

Student information

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Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
Fax: 0551 604 - 107

info@phywe.de
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Motivation

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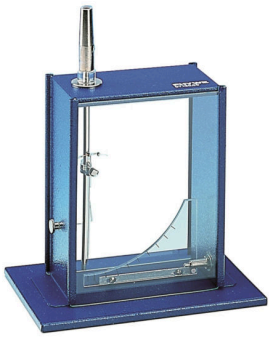

Electroscope according to Kolbe

As you know, there is a repulsive or attractive force effect between electrically charged objects with the same or different names. This is not only an interesting phenomenon, but can also be used practically.

In the example of the electroscope, the force generated can be used to deflect the pointer of the electroscope and thus detect electrostatic charges. Furthermore, electroscopes can also be used to detect ionising radiation, among other things.

In this experiment you will investigate the behaviour of an electroscope when it is affected by electric charges that are not transferred to the electroscope.

Tasks

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In this experiment you will investigate the reaction of the pointer of an electroscope.

For this, you will work through the following steps:

1. Set up an electroscope and make sure it is discharged.
2. Approach a charged rod to the pointer of the electroscope.
3. Approach the electroscope (frame) with a charged rod.
4. Approach the electroscope with a charged transparent film.

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Equipment

Position	Material	Item No.	Quantity
1	Electroscope w. metal pointer	13027-01	1
2	Polypropylene rod, l=175mm, d=10 mm	13027-09	1
3	Acrylic resin rod, l=175 mm, d=8 mm	13027-08	1
4	Film, transparent, DIN A4, 100 sheets	08186-10	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

Hook the pointer into the electroscope like this. The pin is in the notches, the pointer goes through the middle of the hole. One end of the pointer is slightly longer and therefore heavier than the other. This heavier end must point downwards.

The pointer must be free and approximately vertical. If the pointer does not remain vertical after hanging, but tilts, you probably have the heavier end of the pointer pointing upwards: In this case, turn the pointer around.

Caution: The pointer is made of very thin sheet metal and can easily bend.

Then discharge the electroscope by touching it with your hand.

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Procedure (1/5)

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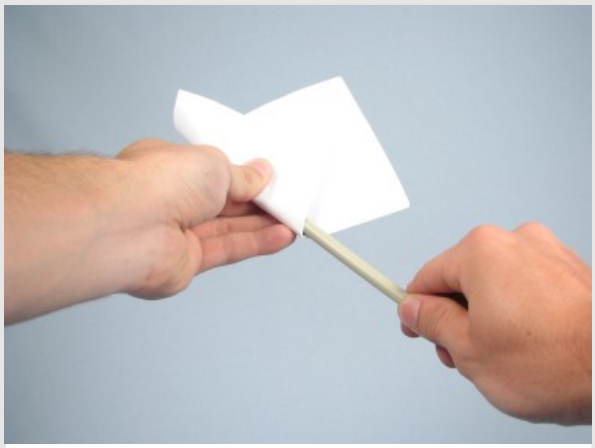

Charging the polypropylene rod by rubbing it with paper

Experiment 1:

- Rub the polypropylene rod vigorously with paper to charge it.

Procedure (2/5)

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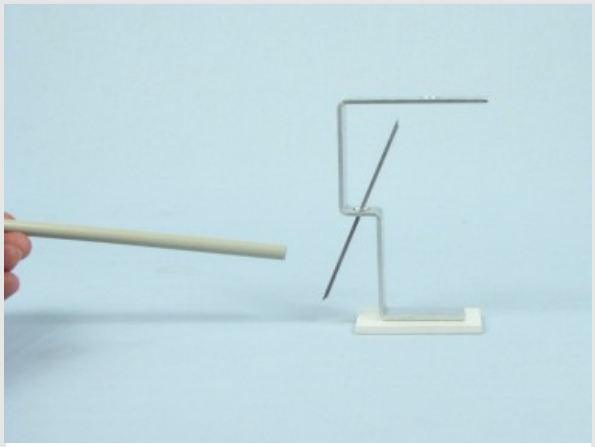

Bring the charged end of the rod close to the pointer

Experiment 1:

- Bring the rubbed end closer to the pointer without touching it!
- Repeat the experiment with the acrylic rod.
- Observe the behaviour of the pointer carefully.

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Procedure (3/5)

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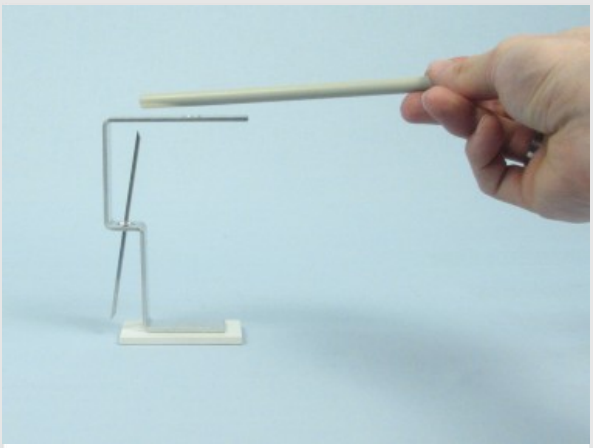

Approach the charged end of the rod to the electroscope

Experiment 2:

- Approach the grated polypropylene rod to the electroscope from above without touching it.
- Again, observe the behaviour of the pointer carefully!

Procedure (4/5)

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Approach charged transparent film to the electroscope

Experiment 3:

- Charge the cling film by rubbing it with paper.
- Then hold it horizontally and approach it to the electroscope from above until the pointer tilts by about 20°.

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Procedure (5/5)

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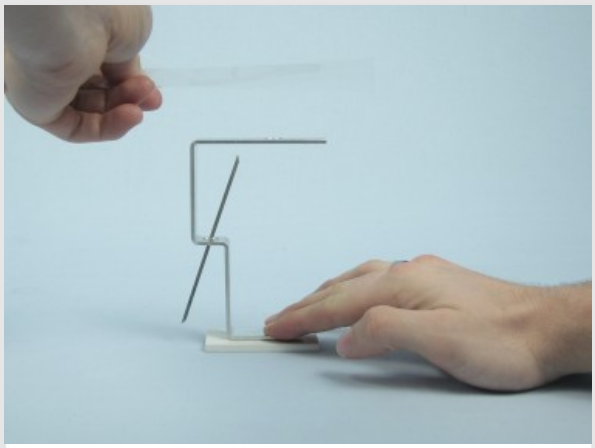

Removing the hand and the transparent film from the electroscope step by step

Experiment 3:

- Now touch the lower part of the electroscope with your hand.
- Take your hand away from the electroscope again and then also put the transparent film aside.
- Again, observe the behaviour of the pointer during each operation.

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Report

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37079 Göttingen

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Fax: 0551 604 - 107

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Task 1

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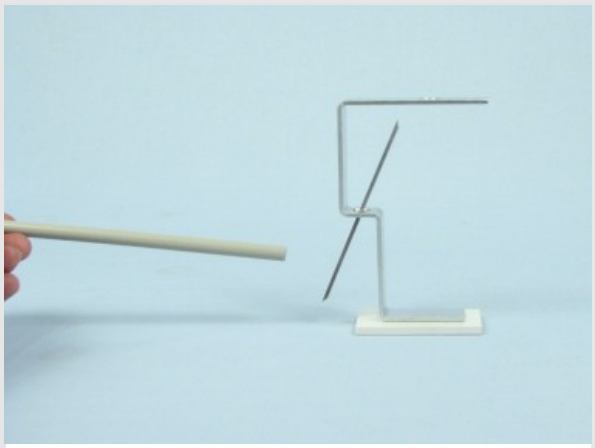

Bring the charged end of the rod close to the pointer

What were your observations during the first experiment?

- ○ The polypropylene rod has repelled the pointer, the acrylic rod has attracted the pointer.
- ○ The polypropylene rod has attracted the pointer, the acrylic rod has repelled the pointer.
- ○ The pointer was tightened in both cases.

Check

Task 2

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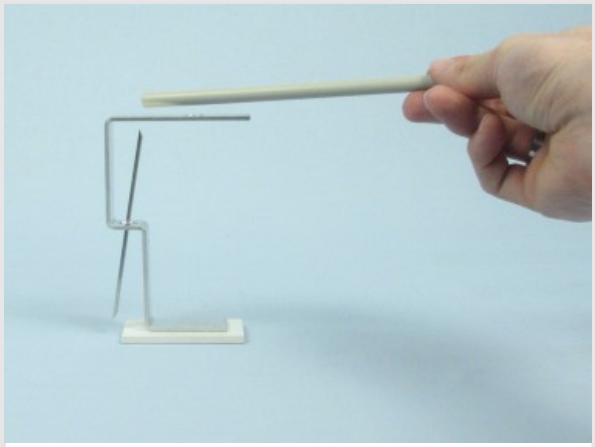

Approach the charged end of the rod to the electroscope

What were your observations during the second experiment?

- ○ The pointer deflects in the same way, but much more strongly than in the first part of the test.
- ○ The pointer deflects in the same way, but less strongly than in the first part of the experiment.
- ○ The pointer moves in the opposite direction.

Check

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37079 Göttingen

Tel.: 0551 604 - 0
Fax: 0551 604 - 107

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Task 3

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Approach charged transparent film to the electroscope

What were your observations during the 3rd experiment?

- ○ The deflection of the pointer was initially similar to that of the first experiment, but then the pointer deflection increased again!
- ○ The deflection of the pointer was initially opposite to that in the 1st experiment, but then it returned to its starting position.

Check

Task 4

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Explain the observations of the first measurement. Consider the different charges of the different rods. Draw the words into the correct boxes!

The approach of a _____ rod causes a charge separation in the _____ in such a way that _____ charges in the _____ are stronger than _____ charges. As a result, the attractive _____ predominate and the pointer moves towards the _____. This applies equally to a _____ and a negatively charged rod.

forces
rod
charged
pointer
repulsive
attractive
electroscope
positive

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Robert-Bosch-Breite 10
37079 Göttingen
Tel.: 0551 604 - 0
Fax: 0551 604 - 107
info@phywe.de
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Task 5

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Drag the words into the correct boxes and thus complete the explanation of the 2nd attempt!

The charged rod causes _____ in the electroscope. The _____ charge of the polypropylene rod forces the negative charges of the electroscope _____. The lower pointer part and the lower half of the electroscope are negatively charged, and _____ occurs between them. The same applies to the upper parts, where _____ charges predominate.

- influence
- positive
- downwards
- negative
- repulsion

Check

Task 6

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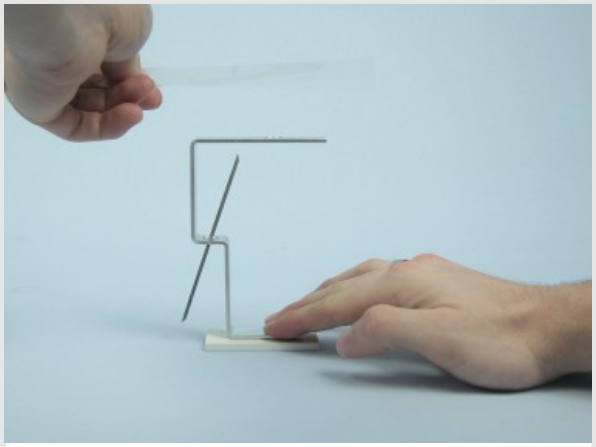

Removing the hand and the transparent film from the electroscope step by step

After removing the hand and the foil, the electroscope remains charged in the 3rd experiment. Consider what type of charge the electroscope carries.

- The electroscope remains **negative** loaded.
- The electroscope remains **positive** loaded.

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37079 Göttingen

Tel.: 0551 604 - 0
Fax: 0551 604 - 107

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Task 7

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Complete the paragraph and carry out the experiment described in it to check your reasoning from the slide before.

With the help of a charged _____, one could check whether the _____ is still positively or negatively charged.
If you bring the charged rod close to the _____ and it is attracted, the electroscope is _____ charged. However, if the rod is repelled, it is _____ charged.

electroscope
polypropylene rod
negatively
positively
pointer

Check

Task 8

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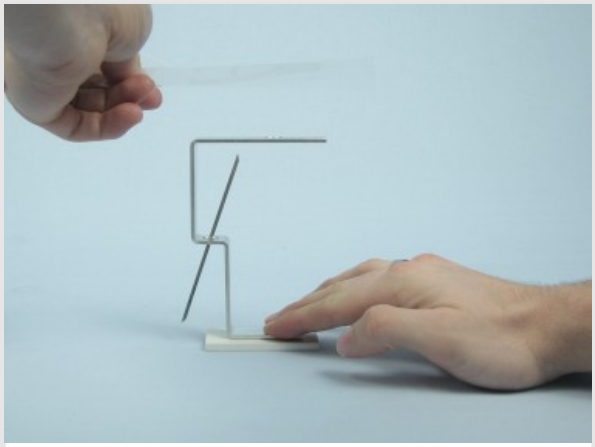

Removing the hand and the transparent film from the electroscope step by step

What would happen if you first put away the foil in the third experiment and then took your hand off the electroscope? Write down your assumption.

Then check your assumption experimentally.

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Robert-Bosch-Breite 10
37079 Göttingen
Tel.: 0551 604 - 0
Fax: 0551 604 - 107
info@phywe.de
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Slide	Score / Total
Slide 18: Observation: Experiment 1	0/1
Slide 19: Observation: Experiment 2	0/1
Slide 20: Observation: Experiment 3	0/1
Slide 21: Explanation: Experiment 1	0/8
Slide 22: Explanation: Experiment 2	0/5
Slide 23: Conclusion: Experiment 3	0/1
Slide 24: Checking the charged electroscope	0/5

Total 0 / 22

Solutions | Repeat | Export text

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Robert-Bosch-Breite 10
37079 Göttingen
Tel.: 0551 604 - 0
Fax: 0551 604 - 107
info@phywe.de
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