The mode of operation of 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/6426b870ab58420002f62854

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Teacher information

Application

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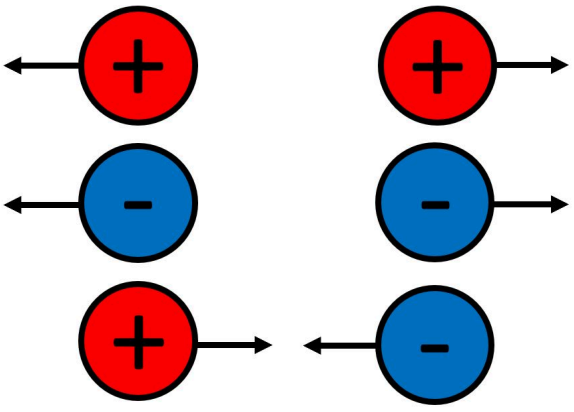

Interactions between charged particles

Equally charged particles repel each other, whereas unequally charged particles attract each other. This effect has already become apparent from the previous experiments with the electroscope.

With the help of the electroscope, electric charge can be detected, but not the type of charge. However, if the polarity of the charge of the electroscope is known, it is possible to determine the type of charge of a specimen.

The electroscope also provides information about the size of the charge. This can be determined by the strength of the pointer beat.

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Other teacher information (1/2)

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Prior knowledge

The students should ideally already have some knowledge of the force effect of charged materials and have already carried out the experiment on the model of the electroscope.

Principle

The function of the electroscope is based on the phenomenon that equally charged particles repel each other and unequally charged particles attract each other.

With the help of the electroscope, electrical charges can be detected. In addition, it is possible to determine the type of charge of a specimen with the help of the electroscope, provided that the polarity of the charge of the electroscope itself is known.

Other teacher information (2/2)

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Learning objective

Students should recognise that:

1. you can generally detect electrical charges with an electroscope.
2. the pointer deflection correlates with the size of the charge.
3. you can discharge the electroscope by touching it with your hand.
4. if the polarity of the charge of the electroscope is known, the type of charge of a specimen can be determined.

Tasks

In this experiment, the students are to investigate how an electroscope reacts when it is first touched with an electrically charged object and then with the hand.

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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 measurement 5, after rubbing, the students should place the plate and the foil between the palms of their hands without separating them, so that any charge on the entire system is removed and no pointer deflection occurs yet when the plate is placed on the electroscope.

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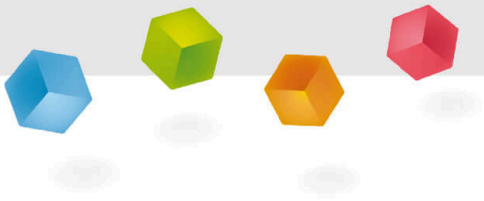

Student information

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Motivation

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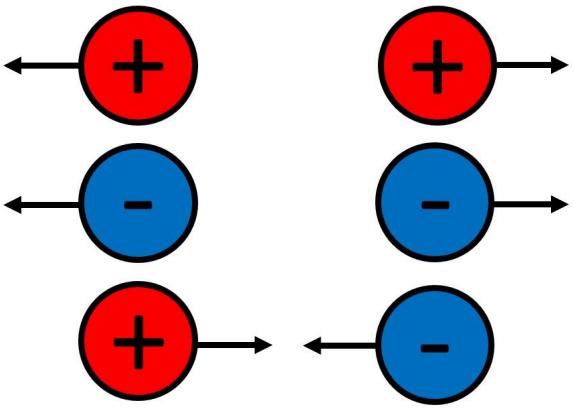

Interactions between charged particles

The phenomenon of electric charge is probably already familiar to you by now, especially if you have already completed experiments on it.

Charged particles have different effects on each other depending on the type of charge. Equally charged particles repel each other and unequally charged particles attract each other.

This phenomenon is very common in everyday life and can be studied with the help of an electroscope. In this experiment, you will therefore familiarise yourself with how it works.

Tasks

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In this experiment you will investigate what the principle of operation of the electroscope is based on.

For this purpose you will work on the following tasks:

1. Touch the electroscope with different charged objects.
2. Then touch it directly with your hand.
3. Always observe what happens.

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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	Polycarbonate plate, 136x112x1 mm	13027-05	1
5	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.

The pointer is made of very thin sheet metal and can easily bend. Therefore, be especially careful with it.

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Procedure (1/5)

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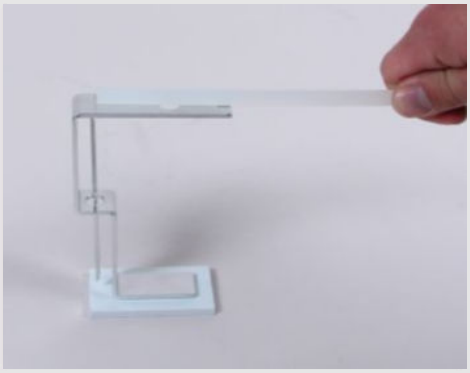
Experiment 1: Charge the polypropylene rod electrically by rubbing it vigorously with paper and rubbing the rubbed rod lengthwise across the electroscope. Observe the pointer.

Experiment 2: Now place your hand on the electroscope and watch the pointer again.


Procedure (2/5)

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Experiment 4: Now charge the acrylic rod electrically by rubbing it vigorously with paper and rubbing the rubbed rod lengthwise across the electroscope. Observe the pointer again.

Experiment 4: Now place your hand on the electroscope and watch the pointer again.



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Procedure (3/5)

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Touching the electroscope with the hand

Experiment 5:

- Now rub the polypropylene rod again and stroke it over the electroscope.
- Then rub the acrylic rod and also stroke the electroscope (without touching the electroscope in between).
- Always watch the pointer.
- Repeat the process several times with the acrylic stick.
- Discharge the electroscope last by touching it with your hand.

Procedure (4/5)

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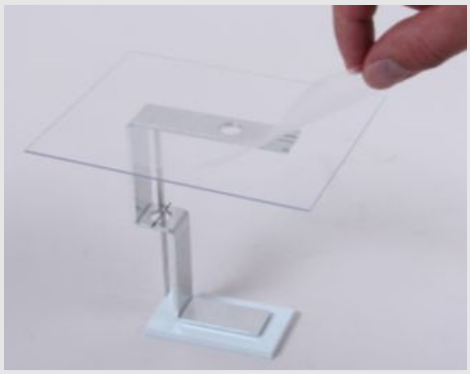
Experiment 6: Place the transparent film on the polycarbonate sheet and rub it vigorously with the paper. Take the plate and the film between your two palms without separating them and press firmly.

Now place the plate and foil, again without separating them, on the electroscope with the foil on top. Lift the foil off while the plate remains on the electroscope and observe the pointer.



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Procedure (5/5)

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Experimental procedure with foil underneath

Experiment 7:

- Repeat the experiment as described before, leaving the foil under the plate and on the electroscope.
- To do this, rub the foil and plate together with the paper, press them together firmly with your hands and then place them on the electroscope.

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Report

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Task 1

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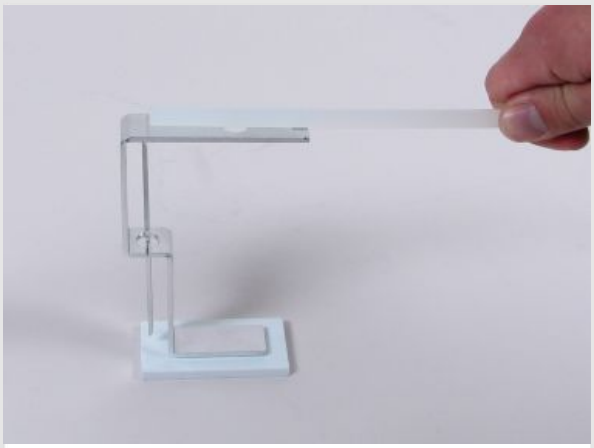

Stripping the polypropylene rod via the electroscope

What were your observations during the 1st experiment? (Polypropylene rod)

- [ ] As the wand approaches the electroscope, the pointer begins to tilt.
- [ ] Nothing worth mentioning has happened.
- [ ] When touching the electroscope with the rod, the deflection of the pointer becomes strongest.

Check

Task 2

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Touching the electroscope with the hand

What were your observations during the 2nd attempt? (Placement of the hand)

- ○ Nothing worth mentioning has happened.
- ○ The pointer returns to its original vertical position. When it is released, it moves out again.
- ○ The pointer returns to the vertical starting position. When it is released, it remains there.

Check

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Task 3

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Passing the acrylic rod over the electroscope

What were your observations during the 3rd experiment? (Acrylic rod)

- ☐ Nothing worth mentioning has happened.
- ☐ As the wand approaches the electroscope, the pointer begins to tilt.
- ☐ When touching the electroscope with the rod, the deflection of the pointer becomes strongest.

Check

Task 4

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Touching the electroscope with the hand

What were your observations during the 4th attempt? (Placement of the hand)

- ○ Nothing worth mentioning has happened.
- ○ The pointer returns to the vertical starting position. When it is released, it remains there.
- ○ The pointer returns to its original vertical position. When it is released, it moves out again.

Check

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Task 5

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What were your observations during the 5th experiment?

- ○ Neither when wiping the polypropylene rod nor when wiping the acyl rod over the electroscope could any movement of the pointer be recorded.
- ○ The polypropylene rod causes the pointer to deflect. When the acrylic rod is moved closer to and over the pointer, the pointer deflection initially decreases. When the acrylic rod is rubbed over the pointer again, the pointer deflection increases again.
- ○ The polypropylene rod causes a pointer deflection, which also remains when the acrylic rod is brushed over it.

Check

Task 6

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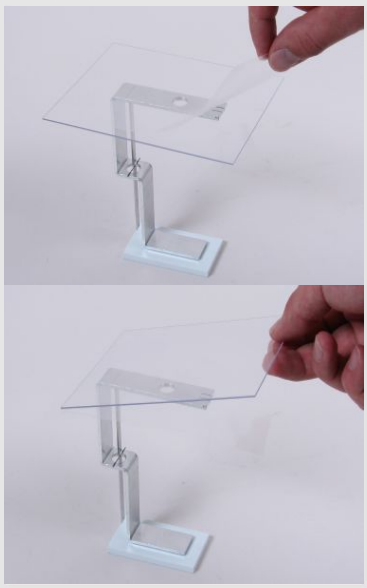

What were your observations during the 6th experiment?

- ☐ Nothing worth mentioning happened.
- ☐ When separating the plate and the foil, a pointer deflection occurs.
- ☐ If you put the plate and the foil together again, the pointer deflection goes back.

Check

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Task 7

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Summarise how an electroscope works: Drag the texts to the right places.

If you touch the electroscope with an _____ object, the electroscope and its _____ are also charged. Since the electroscope and the pointer have the same _____, there is _____ and the pointer moves at an angle. Since this is true for both positive and _____ charges, we can only tell in this way that the body is charged, but not what kind of charge it is. If you touch the electroscope with your _____, the charge is transferred to the person, the electroscope is _____ and the pointer deflection goes down.

repulsion
electrically charged
negative
hand
pointer
charge
discharged

Check

Slide	Score / Total
Slide 18: Observation: Experiment 1	0/2
Slide 19: Observation: Experiment 2	0/1
Slide 20: Observation: Experiment 3	0/2
Slide 21: Observation: Experiment 4	0/1
Slide 22: Observations: Experiment 5	0/1
Slide 23: Observations: Experiment 6	0/2
Slide 24: Functioning of the electroscope	0/7

Total 0 / 16

Solutions Repeat

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