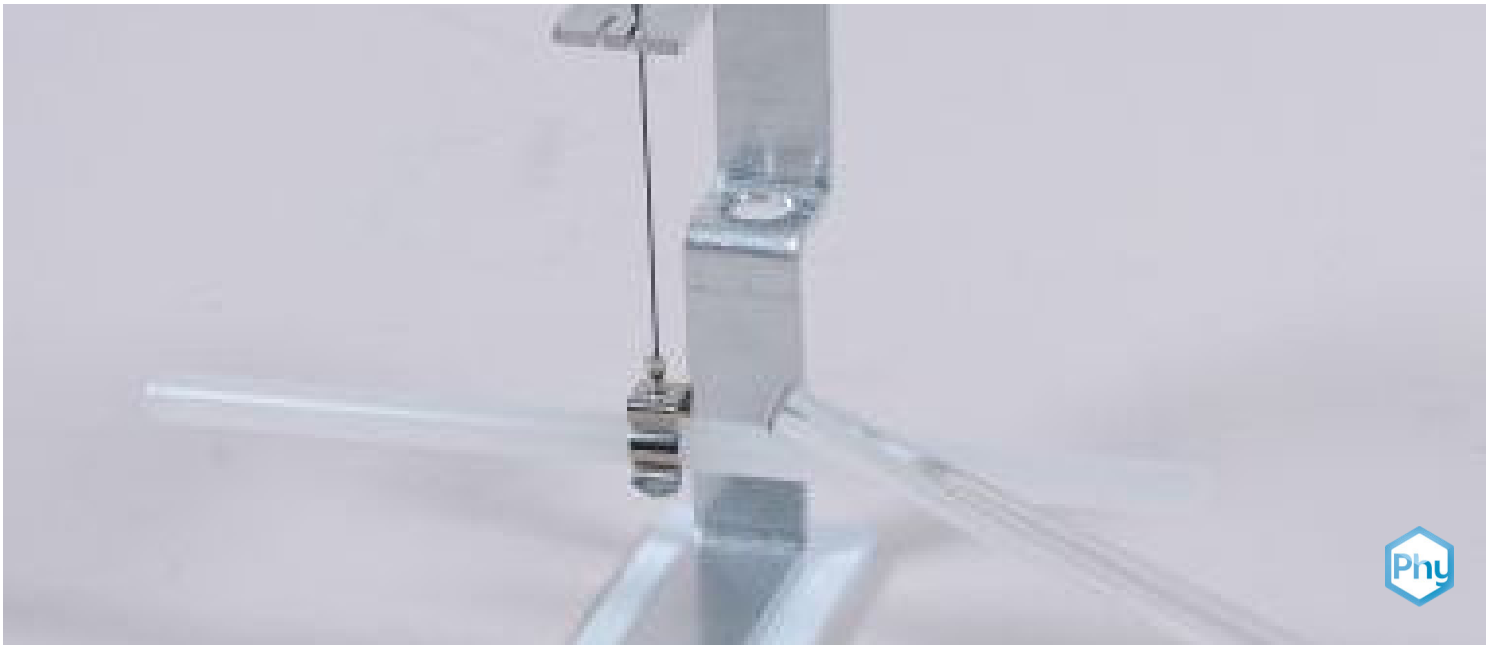
Forces between charged bodies



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/6425e211bfa95e000297f62a

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Teacher information

Application

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Lightning in a thunderstorm

Objects take on different properties when they are electrically charged. A basic distinction is made between positive and negative charge.

If certain materials are brought into close contact with each other, their electircal charge changes.

Equally charged objects repel each other, whereas unequally charged objects attract each other.

A thunderstorm is a classic example of electrostatic charge, which is discharged in the form of lightning.

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Other teacher information (1/2)

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Prior knowledge

The students should ideally have already completed the experiment on the detection of charge types on foils and plates. This provides a good basis of basic knowledge for carrying out this experiment.

Principle

Different insulators charge differently electrically when they come into contact and rub against each other.

Forces act between charged bodies, which ensure that the bodies either attract or repel each other.

Other teacher information (2/2)

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Learning objective

The students should realise that forces act between two electrically charged bodies. These are repulsive forces when the two bodies are charged in the same way. Whereas they are attractive forces when the two bodies are charged differently.

Tasks

In this experiment, the students are to investigate the forces acting between them on rubbed rods made of polypropylene and acrylic as well as on plastic films.

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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:

If the rubbed end of the suspended rod comes too close to the electroscope, it may be attracted by the influence effect and the rod will then stick to the electroscope. Therefore, the rod should hang across the foot of the electroscope. The students must be told not to touch the charged parts of the rods with their hands because they would otherwise discharge. If necessary, the suspended rod must be rubbed again before the last two measurements, as the charge only remains on the rod for a limited time, especially in high humidity.

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Student information

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Motivation

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Lightning in a thunderstorm

The exchange of electrical charge is an everyday phenomenon. Electrons migrate from one object to another if the latter has different charge properties.

This exchange can often be seen visually during a thunderstorm. The lightning represents a very strong and brief exchange of electrical charge. The two bodies in contact are usually the thundercloud and the ground.

Another interesting phenomenon of electrostatic charging is the forces acting between the charged bodies. These ensure that the bodies either attract or repel each other.

Tasks

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In this experiment, you are to investigate the electric charge and, above all, the resulting forces of various objects made of different materials.

Proceed as follows and carry out experiments with grated rods made of polypropylene and acrylic, as well as with plastic films and investigate the acting forces.

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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	2
3	Acrylic resin rod, l=175 mm, d=8 mm	13027-08	1
4	Clip for rods, with cord	13027-16	1
5	Polycarbonate plate, 136x112x1 mm	13027-05	1
6	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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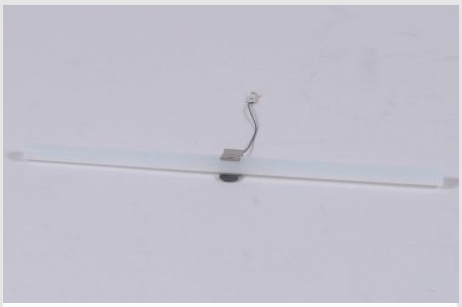
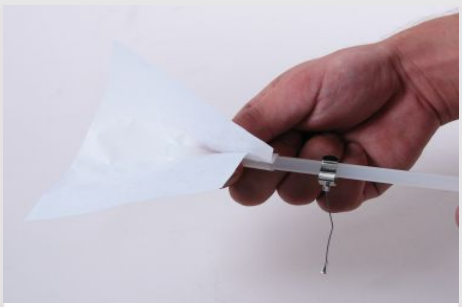
Attach the clamp to the centre of the polypropylene rod, rub one half vigorously with paper and then hang the rod in the suspension without touching the rubbed end as in the illustration. The rod should hang across the base of the electroscope and horizontally. The rubbed end of the rod is attracted or repelled by charged objects.



Attach the clamp to the rod



Rub the stick on the paper

Hanging the rod

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Procedure (1/3)

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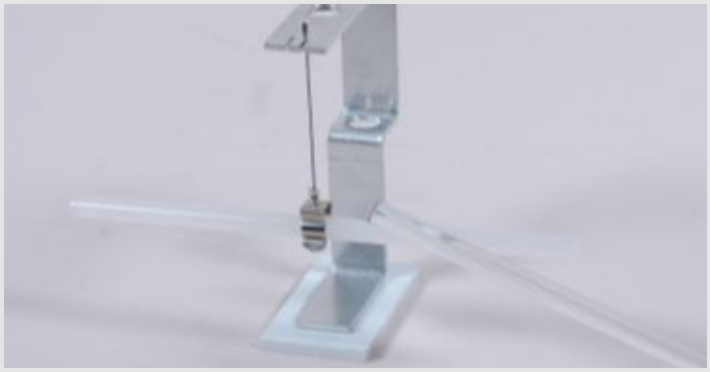
Experiment 1: Now rub one half of the other polypropylene rod vigorously with paper. Bring the rubbed end of the second stick close to the rubbed end of the hanging stick without touching it and observe the hanging stick.

Procedure (2/3)

PHYWE

Experiment 2: Now repeat the experiment with the acrylic rod and rub it vigorously with paper. Bring the rubbed end close to the rubbed end of the hanging stick without touching it and observe the hanging stick.



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Procedure (3/3)

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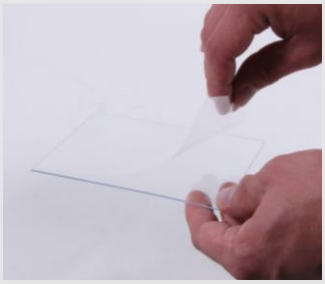
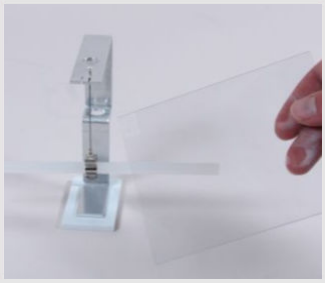
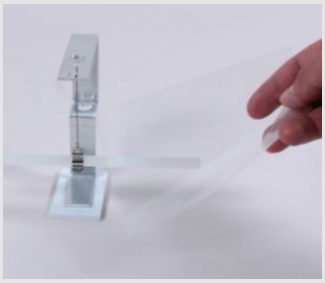
Experiment 3:

- Put the polycarbonate sheet on the table and the cling film over it. Rub the cling film with the paper.
- Now lift both together and then separate them from each other. Observe the behaviour when separating.
- Then approach first the polycarbonate sheet and then the clear film to the rubbed end of the hanging rod.
- Observe the rod.

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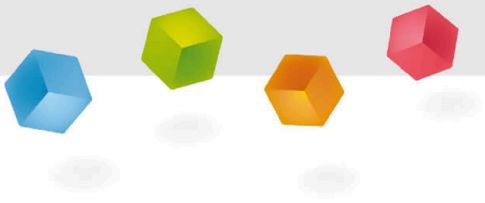

Report

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Task 1

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Bring rod ends closer together

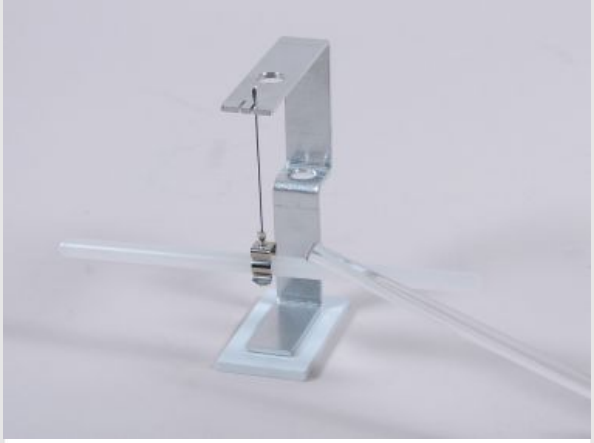
What were your observations during the first trial?

- ○ The ends of the sticks have attracted each other.
- ○ The ends of the rods have repelled each other.
- ○ Nothing worth mentioning has happened.

Check

Task 2

PHYWE



Bring rod ends closer together

What were your observations during the second attempt?

- ○ The ends of the sticks have attracted each other.
- ○ The ends of the rods have repelled each other.
- ○ Nothing worth mentioning has happened.

Check

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Task 3

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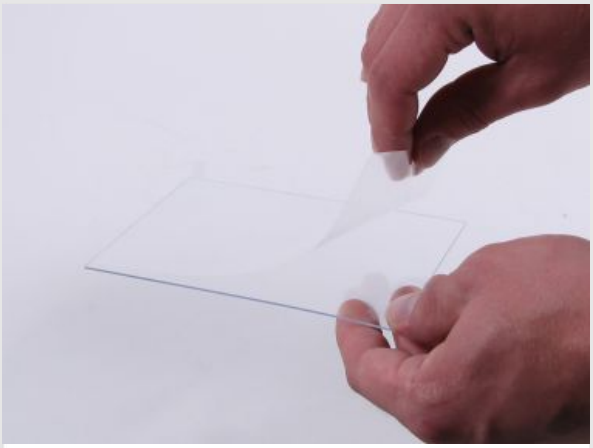


Lift the film/panel and then separate from each other

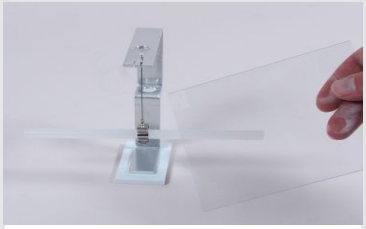
What were your observations during the 3rd attempt at separation?

- ○ The film and sheet repel each other due to the forces acting on them.
- ○ The film and sheet adhere to each other due to the forces of attraction.
- ○ No observation could be detected.

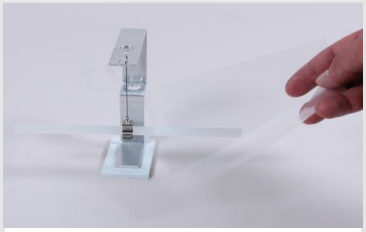
Check

Task 4

PHYWE



Approach plate/bar end



Approach foil/bar end

What were your observations during the 3rd attempt when approaching the hanging pole?

- ☐ The foil and the end of the rod repel each other.
- ☐ The foil and the end of the rod attract each other.
- ☐ The plate and the end of the bar attract each other.
- ☐ The plate and the end of the rod repel each other.

Check

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Task 5

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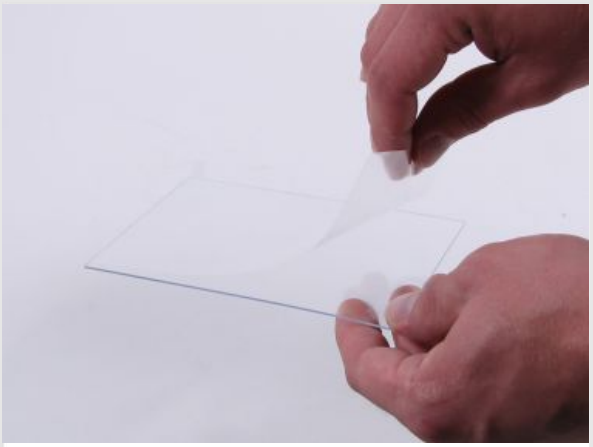
As you know, the polypropylene rod becomes negatively charged when rubbed against paper and the acrylic rod becomes positively charged. What can you deduce from your previous observations about the force effect between charged bodies? Distinguish between like and unlike charged bodies.

- ☐ Unequally charged bodies repel each other.
- ☐ Similarly charged bodies attract each other.
- ☐ Unequally charged bodies attract each other.
- ☐ Similarly charged bodies repel each other.

Check

Task 6

PHYWE



Lift the film/panel and then separate from each other

What do you conclude accordingly from the observation when separating plate and foil?

- ○ No conclusion could be reached.
- ○ The foil and plate are charged in the same way.
- ○ The foil and plate are charged unevenly.

Check

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Slide	Score / Total
Slide 16: Observation: Experiment 1	0/1
Slide 17: Observation: Experiment 2	0/1
Slide 18: Observation: Experiment 3	0/1
Slide 19: Observation 2: Experiment 3	0/2
Slide 20: Conclusion	0/2
Slide 21: Conclusion: Experiment 3	0/1

Total 0 / 8

Solutions Repeat

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