Discharging by ionisation

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/64280b3e5e30a7000275e9d4

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Teacher information

Application

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Heating the charged electroscope for ionisation

Ionisation is a process in which electrons are removed from a molecule or, in a broader sense, the charge state of a molecule is changed away from its neutral state.

There are different processes/mechanisms that can cause ionisation. One of these mechanisms is the so-called impact ionisation. This occurs when sufficient energy is introduced, in this case in the form of heat. The impact of the hot, excited gas molecules with the charged metal sucks electrons away.

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Other teacher information (1/2)

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Prior knowledge

Students should already have thoroughly studied and understood electric charge and its effects.

Principle

By collisions of the hot, excited gas of a flame with the electrically charged metal ions, one can discharge them. This effect is called ionisation.

Other teacher information (2/2)

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Learning objective

The students should realise that electrically charged bodies can be discharged with the help of a flame.

Tasks

In this experiment, the students are to heat up an electrically charged electroscope with the help of a lighter and thus discharge it. With the help of this experiment, the students should learn about ionisation.

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Safety instructions

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

Great care must always be taken during experimental work with fire! Especially when working with alcohol, the fuel must be handled with care!

Notes on set-up and procedure:

Lighters, but especially matches, give sooty flames. Therefore, the distance to the bodies should be sufficiently large and the time should be short. It would be more favourable to use non-sooting fuels such as methylated spirits.

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Student information

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Motivation

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Aurora Borealis - Northern Polar Light

Ionisation is the name given to the process in which electrons are generally removed from an atom or molecule, leaving the atom or molecule as a positively charged ion (cation). Particularly impressive are those natural phenomena in which subsequent recombination leads to luminous phenomena such as the aurora borealis.

But ionisation also has technical applications, for example for sterilisation in medicine or in the food industry. In particular, ionisation can also prevent or eliminate electrostatic charges on objects. In this experiment you will learn how to discharge a charged object with a flame.

Tasks

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In this experiment, you will look closely at what is known as ionisation and learn what it means.

To do this, first set up an electroscope.

Then investigate what happens when the electrically charged electroscope is heated with the help of a lighter.

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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	Electrostatic influence plate, 30 x 60 mm	13027-12	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	Fire source (lighter)	1
1	Dry, rough paper	DIN A4

Set-up (1/2)

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Structure of the electroscope

First 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.

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Set-up (2/2)

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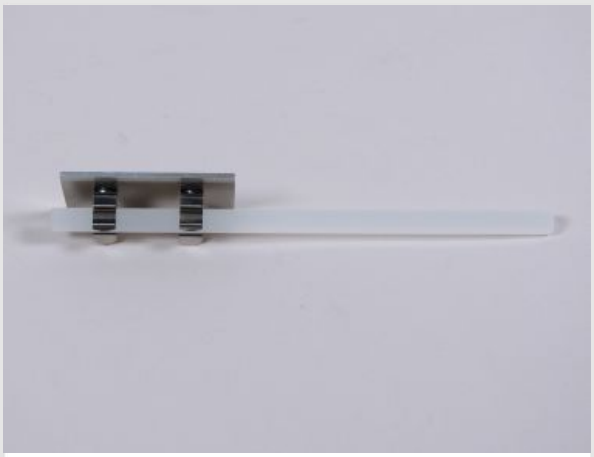

Attach the Influence Plate to the end of the Polypropylene Rod

Then mount the influence plate at the end of the polypropylene rod.

Attention!

If you work with a match or lighter, do not approach the flame too close or for too long to the experimental equipment so that it does not become sooty.

Procedure (1/4)

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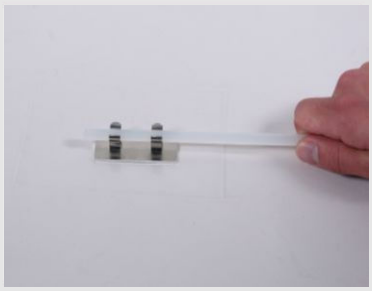

Experiment 1:

- Charge the Influence Plate by rubbing it against the transparent film.
- Bring the influence plate closer to the electroscope without touching it.
- Then hold the influence plate over a flame for about two seconds at a distance of 10 cm and approach it to the electroscope again.
- In both cases, observe the behaviour of the pointer on the electroscope.

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Procedure (2/4)

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Experiment 2: Repeat the experiment in the same way, but use the acrylic rod rubbed on paper instead of the influence plate. Again, observe the behaviour of the pointer on the electroscope in both cases.

Procedure (3/4)

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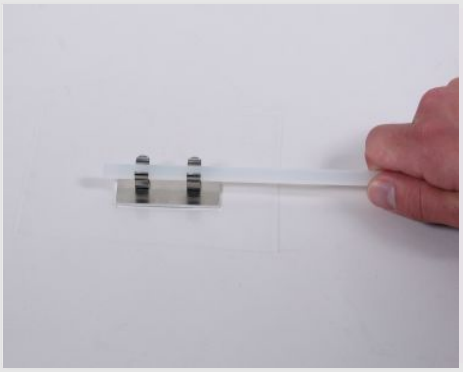
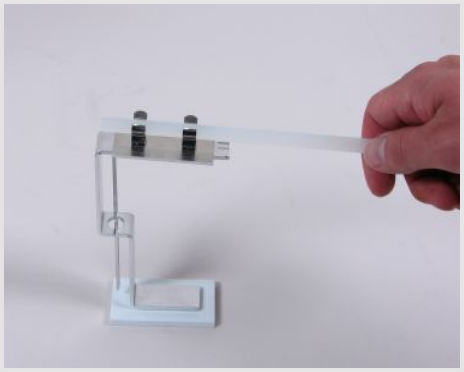
Experiment 3: Charge the electroscope through the influence plate rubbed on the transparent film. Again observe the pointer deflection and then approach a flame to the electroscope. Observe the behaviour of the pointer.





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Procedure (4/4)

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Approach lighter from above to electroscope

Experiment 4:

- Repeat the experiment as before, but approach the flame to the electroscope from above.
- As before, observe the behaviour of the pointer deflection.

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Report

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Task 1

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Heat up the Influence Plate

What were your observations of the first experiment?

- The pointer did not move at any time during the experiment.
- A pointer deflection occurs both without application of the flame and after application of the flame.
- Without application of the flame there is a pointer deflection, after application of the flame there is no pointer deflection.

Task 2

PHYWE

Heat up acrylic rod

What were your observations of the second experiment?

- A pointer deflection occurs both without application of the flame and after application of the flame.
- The pointer did not move at any time during the experiment.
- Without application of the flame there is a pointer deflection, after application of the flame there is no pointer deflection.

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Task 3

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Approach the lighter to the electroscope from below

What were your observations of the third experiment?

- The pointer was first deflected. The pointer deflection remained the same as the flame approached.
- The pointer was initially deflected. The pointer deflection has decreased due to the approach by the flame.
- The pointer was only deflected by the approach of the flame.

Task 4

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Approach the lighter from above to the electroscope

What were your observations of the 4th experiment?

- The pointer was first deflected. The pointer deflection remained the same as the flame approached.
- The pointer was only deflected by the approach of the flame.
- The pointer was initially deflected. The pointer deflection has decreased due to the approach by the flame.

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Task 5

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Approach the lighter from above to the electroscope

Which effects of flames on electrically charged bodies did you demonstrate with the three experiments?

With the help of flames, bodies can be _____. This flame _____ have to be held directly under the _____ object.

Not needed: _____

does | charged | discharged | does not

Check

Task 6

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Strong heating causes the air to break down into charged particles. Can you explain the observed phenomena with this knowledge?

Due to the _____ energy in the flame, the gas molecules are _____ into _____ parts. The particles with the _____ charge from the air are _____ from the _____ charged body. This results in a charge balance on the bodies and they are thus _____.

Not needed: _____

attracted | split | opposite | thermal | charged | electrically | same | discharged

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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: Observation: Experiment 4	0/1
Slide 22: Conclusion 1	0/4
Slide 23: Conclusion 2	0/8

Total 0 / 16

Solutions Repeat

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