Electrostatic induction with conductors and non-conductors

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/6426b898ab58420002f62858

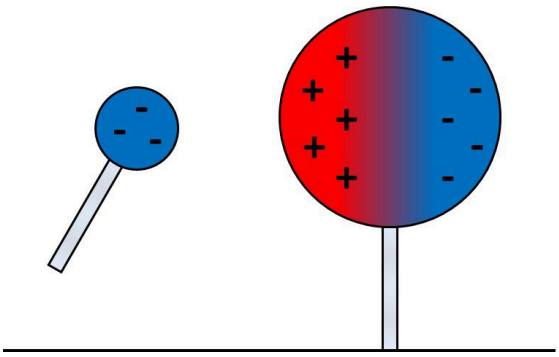
PHYWE
Robert-Bosch-Breite 10
37079 Göttingen
Tel.: 0551 604 - 0
Fax: 0551 604 - 107
info@phywe.de
www.phywe.de

PHYWE

Teacher information

Application

PHYWE



Influences in conductive bodies.

Influences, or electrostatic inductions, are interactions that are caused by electrically charged objects or by electric fields, in which spatial charge shifts may occur.

These influences are largely dependent on the nature and material of the bodies used (conductors or non-conductors).

It is well known that electrical charges of different names attract each other and charges of the same name repel each other.

PHYWE

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)

PHYWE

Prior knowledge

Students should already have learned and understood the interaction between positively and negatively charged bodies.

Principle

Influence, also called electrostatic induction, refers to the spatial displacement of electric charges due to the effect of an electric field or a statically charged body. In a conductor, the mobile charges (electrons) are displaced on the surface, which leads to location-dependent charge densities. In and on a non-conductor, no charges can be shifted, but the existing atoms or molecules are polarised.

Other teacher information (2/2)

PHYWE

Learning objective

The students recognise the force effect between charged bodies and uncharged conductors and non-conductors, they can explain the observed phenomena. They recognise that forces can also occur between two uncharged bodies when induced by a charged body.

Tasks

In this experiment, the students are to investigate the effect of electrically charged rods and foils on paper shavings, aluminium foil and suspended aluminium rods.

PHYWE

Robert-Bosch-Breite 10
37079 Göttingen

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

info@phywe.de
www.phywe.de

Safety instructions

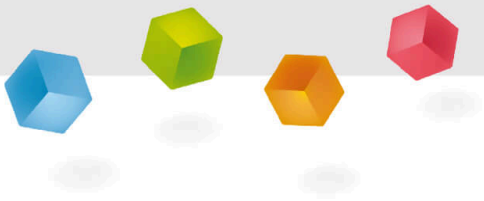
PHYWE

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

Notes on set-up and procedure:

For the paper shreds, the thinnest possible paper with a low filler content should be used. The aluminium foil should only be worked very loosely into a ball so that a favourable ratio between mass and surface is achieved. It is advisable to prepare appropriate ready-made balls for all students. For the third measurement, it is convenient not to let the rods hang next to each other, as the effects to be observed could be affected.

PHYWE



Student information

PHYWE

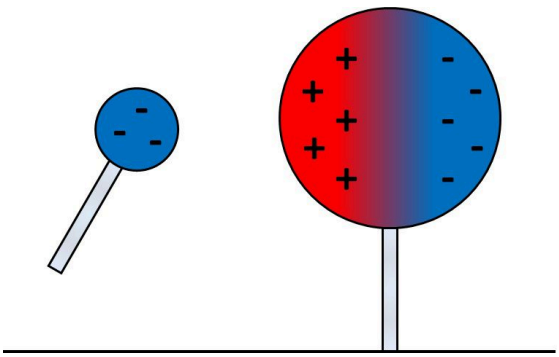
Robert-Bosch-Breite 10
37079 Göttingen

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

info@phywe.de
www.phywe.de

Motivation

PHYWE



Influences in conductive bodies.

Every electrically charged object is surrounded by an electric field. If another conductive body is now brought into this electric field, the interactions between the field and the body cause a spatial displacement of the free charge carriers and local positive and negative space charges corresponding to the electric field are formed on the object. This phenomenon of charge displacement is called induction.

However, the degree of influence can vary greatly depending on the object. In this experiment, you will examine the influence on different objects.

Tasks

PHYWE

In this experiment you will investigate what the electrostatic interactions between different objects depend on.

For this purpose, you will study the effects of the following items:

1. Electrically charged bars
2. Foils on paper chips
3. Aluminium foil
4. Hanging aluminium rods

PHYWE

Robert-Bosch-Breite 10
37079 Göttingen

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

info@phywe.de
www.phywe.de

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	Pendulums, pair, f.electrostatics	13027-15	1
5	Film, transparent, DIN A4, 100 sheets	08186-10	1

PHYWE

Robert-Bosch-Breite 10
37079 Göttingen

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

info@phywe.de
www.phywe.de

Additional Equipment

PHYWE

Position	Equipment	Quantity
1	Dry, rough paper	DIN A4
1	Thin aluminium foil	

Set-up (1/2)

PHYWE

Suspending the pendulum pair

Hang the thread on the pendulum pair through the slots on the electroscope as shown in the illustration so that the two metal pins hang at different heights and are not in electrical contact with the electroscope.

PHYWE

Robert-Bosch-Breite 10
37079 Göttingen

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

info@phywe.de
www.phywe.de

Structure (2/2)

PHYWE

Paper chips and aluminium ball

Tear off a few small pieces of paper and place them ready.

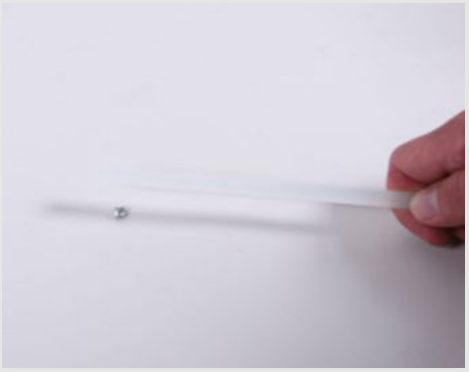
Form a loose ball out of the aluminium foil. Do not squeeze it tightly.

Procedure (1/4)

PHYWE

Experiment 1: Charge the polypropylene rod electrically by rubbing it vigorously with paper. Approach the charged polypropylene rod from above to the paper scraps lying on the table. Observe them!

Then repeat the experiment with newly charged polypropylene rod with the aluminium bead.



PHYWE

Robert-Bosch-Breite 10
37079 Göttingen

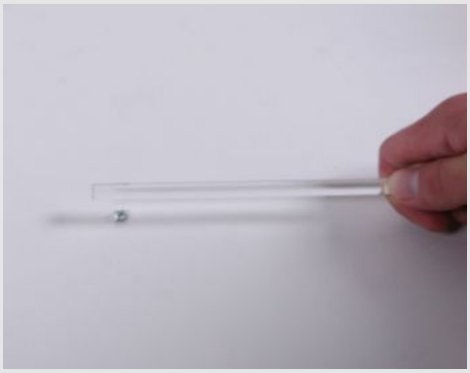
Tel.: 0551 604 - 0
Fax: 0551 604 - 107

info@phywe.de
www.phywe.de

Procedure (2/4)

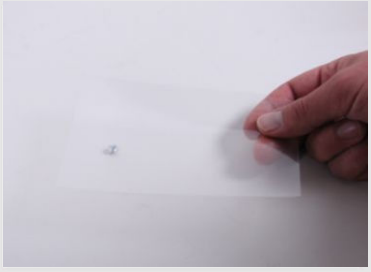
PHYWE

Experiment 2: Now charge the acrylic rod electrically by rubbing it vigorously with paper. As before, approach the charged acrylic rod from above to the paper scraps lying on the table and, after charging it again, to the aluminium bead. Observe the behaviour in each case!



Procedure (3/4)

PHYWE



Experiment 3:

- Now load up the cling film by rubbing it with paper.
- Then hold the cling film horizontally over the paper shreds and then over the aluminium bead.

PHYWE

Robert-Bosch-Breite 10
37079 Göttingen

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

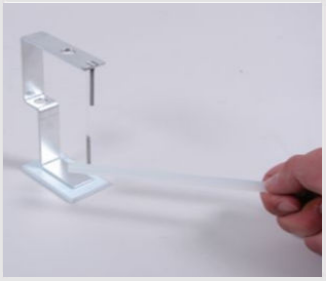
info@phywe.de
www.phywe.de

Procedure (4/4)

PHYWE

Experiment 4: Charge the polypropylene rod electrically again by rubbing it vigorously with paper.

- Now approach the grated end to one of the aluminium tubes hanging from the electroscope.
- Approach the rod until it touches the lower end of the hanging tube.
- Then unload the hanging tubes by touching them with the hand.
- Now approach the grated polypropylene rod to the tubes from below.

PHYWE

Report

PHYWE

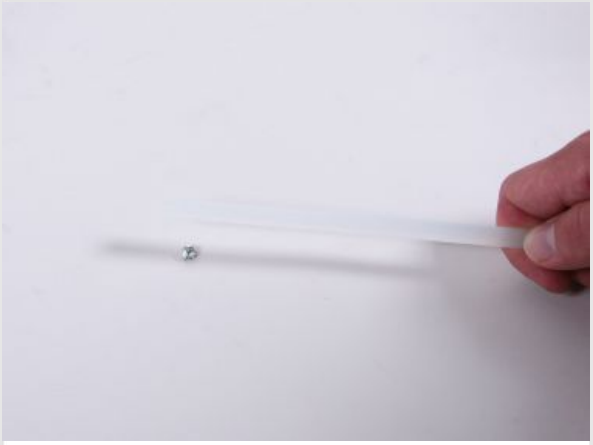
Robert-Bosch-Breite 10
37079 Göttingen

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

info@phywe.de
www.phywe.de

Task 1

PHYWE



Experiment with polypropylene rod and aluminium beads

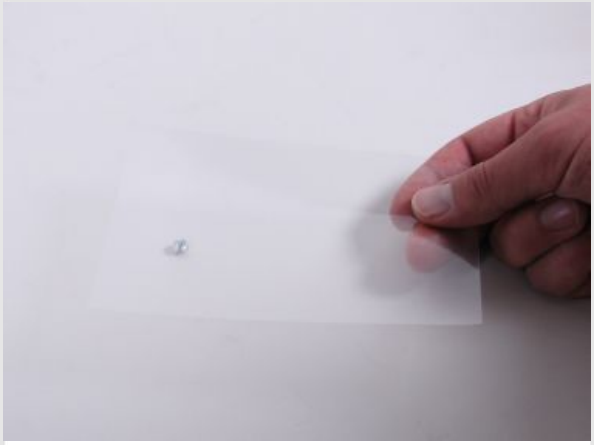
Which of the statements are true for the behaviour of the paper chips and that of the aluminium ball?

- ☐ The paper chips were moved, the aluminium ball was not.
- ☐ The paper chips and the aluminium ball are attracted by both rods.
- ☐ While the paper sticks to the rods, the aluminium ball bounces back.

Check

Task 2

PHYWE



Hold cling film over aluminium beads

How far do the observations for the charged transparent film differ from the experimental parts with the rods?

- ○ Not at all. The observation is the same.
- ○ With the film, only the paper scraps are attracted.
- ○ In the case of the foil, only the aluminium wing is tightened.

Check

PHYWE

Robert-Bosch-Breite 10
37079 Göttingen

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

info@phywe.de
www.phywe.de

Task 3

PHYWE

Describe the behaviour of the aluminium tube before, at and after contact in the 3rd measurement.

When the charged polypropylene rod is approached, the rod is initially _____. When it comes into contact, it is very suddenly _____. This effect, which occurs after the touch, then remains. When touched by hand, the metal rod is then _____.

Not needed: _____.

discharged
repelled
charged
attracted

Check

Task 4

PHYWE

Approach polypropylene rod to aluminium tube

How do the aluminium tubes hanging parallel to each other react in the 4th part of the experiment?

- ○ The aluminium tubes repel each other.
- ○ The aluminium tubes continue to just hang down.
- ○ The aluminium tubes attract each other.

Check

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

Task 4

PHYWE

Approach polypropylene rod to aluminium tube

How do the aluminium tubes hanging parallel to each other react in the 4th part of the experiment?

- ○ The aluminium tubes repel each other.
- ○ The aluminium tubes continue to just hang down.
- ○ The aluminium tubes attract each other.

Check

Task 5

PHYWE

Explain the effect created between the two rods during the 4th experiment.

- ○ When the negatively charged polypropylene rod approaches, the charge differences caused by the induction are equalised again internally because the rods are in electrical contact with each other. In this way, the rods neutralise the external electric field.
- ○ When the negatively charged polypropylene rod approaches, the suspended rods are alternately positively and negatively charged by induction. This causes them to attract each other.
- ○ When the negatively charged polypropylene rod approaches, the lower ends of the suspended rods become positive and the upper ones negative due to induction. This causes them to repel each other.

Check

PHYWE

Robert-Bosch-Breite 10
37079 Göttingen

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

info@phywe.de
www.phywe.de