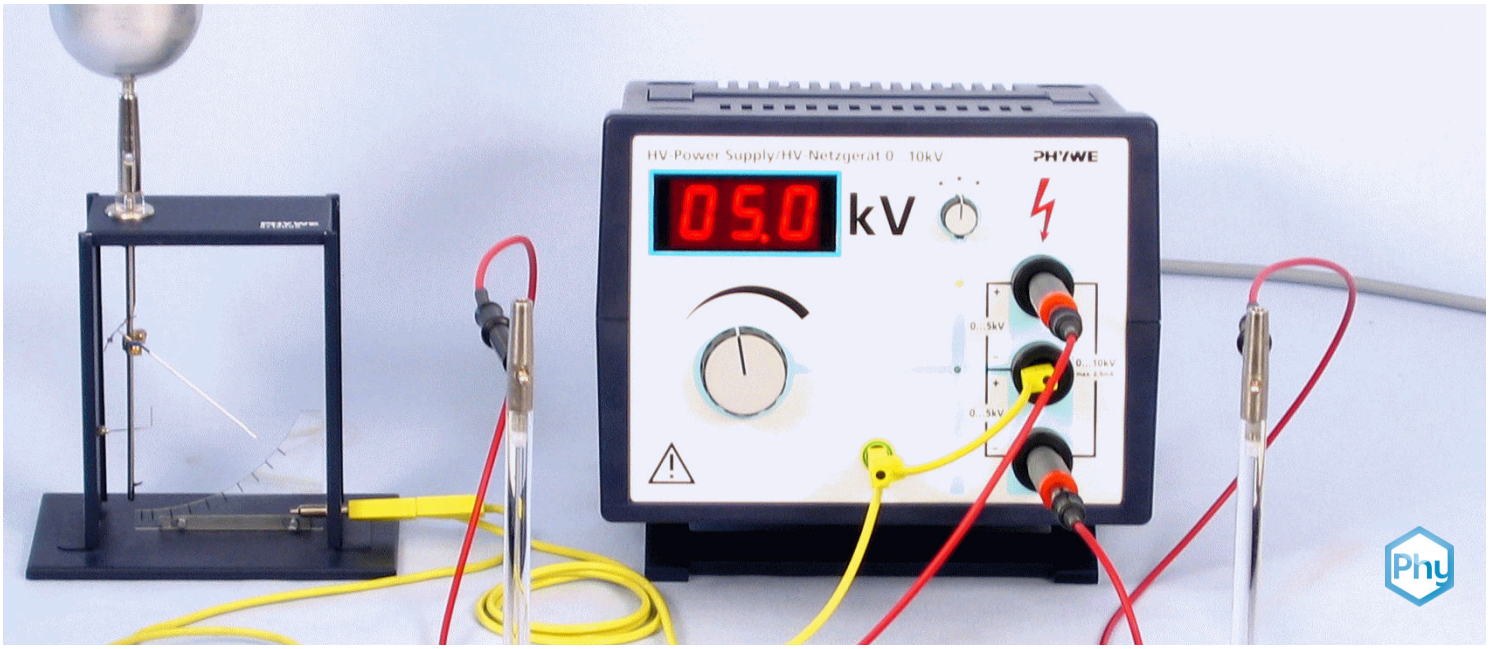
The electric charge quantity (with an electroscope)



Physics > Electricity & Magnetism > Electrostatics & electric field

Difficulty level	Group size	Preparation time	Execution time
easy	-	10 minutes	20 minutes

This content can also be found online at:

http://localhost:1337/c/65c2190cdd1b3f00025e3e00

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Teacher information

Application

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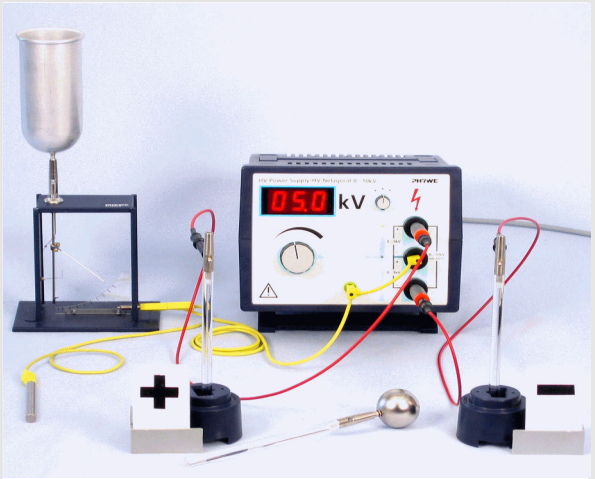

Fig. 1: Experimental setup

Understanding the quantity of charge is a cornerstone for understanding electric current and as such is fundamental to modern life.

This experiment provides initial insights into the principles of charge quantity.

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Other teacher information (1/2)

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Prior knowledge

No prior knowledge is required for this experiment.

Principle

Charges can be gradually accumulated and cancelled out again. This shows that the electrical charge is a quantity. Positive and negative charge quantities can be added and subtracted like positive and negative numbers.

Other teacher information (2/2)

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Learning objective

Pupils should be familiarised with the principle of charge quantity.

Tasks

1. Measure the charge quantity for several charging processes

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Safety instructions (1/2)

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AC voltages above 25 V are dangerous to touch if the current is greater than 0.5 mA. In the 2nd part of the test, the long-distance cables have such a Dangerous to touch Apply voltage. The experiment may only be carried out by qualified teaching staff; under no circumstances may pupils carry out the experiment. Experiments are carried out with high voltage that is dangerous to touch. The experimental set-up does not have sufficient insulation against this dangerous high voltage. For this reason absolutely follow the instructions below!

Safety instructions (2/2)

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- The first thing to do is to put up the warning sign "High voltage" (e.g. 06543-00).
- The circuit to be connected (test setup) must first be fully assembled in a de-energised state (absolute disconnection from the mains, pull out the mains plug!) and checked again before the system is connected to the mains and switched on.
- Interventions or changes to the test setup may only be made when the power is switched off.
- Important: Carry out the test with one hand only (other hand in your trouser pocket) to avoid the risk of electric shock.

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Student information

Motivation

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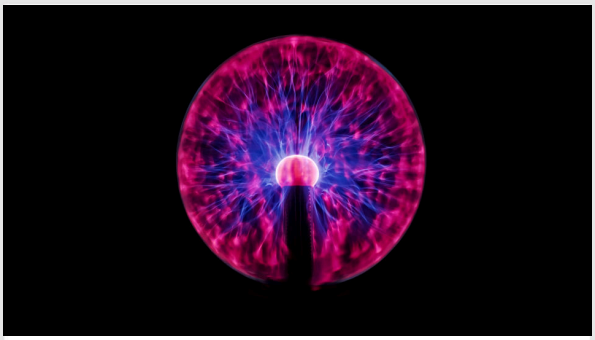
Understanding the quantity of charge is a cornerstone for understanding electric current and as such is fundamental to modern life.



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Equipment

Position	Equipment	Item no.	Quantity
1	Barrel base, for 1 rod, d ≤ 13 mm	02004-00	3
2	Stand rod, stainless steel, l = 100 mm, d = 10 mm, with hole	02036-01	1
3	Installation corner	02066-00	2
4	Electrical symbols for demo board, 12 pieces	02154-03	1
5	Insulating handle	06021-00	3
6	Faraday cup	06231-00	1
7	Conductor sphere, d = 40 mm	06237-00	1
8	Warning sign, Dangerous electrical voltage	06543-00	1
9	Electroscope according to Kolbe	07120-01	1
10	Resistor with 4 mm plug and socket, 10 MOhm	07160-00	2
11	Connecting cable, 19 A, 10 cm, green-yellow experimental cable, 4 mm plug	07359-16	1
12	Connecting cable, 32 A, 50 cm, green-yellow experimental cable, 4 mm plug	07361-15	1
13	Connecting cable, 32 A, 100 cm, green-yellow experimental cable, 4 mm plug	07363-15	1
14	Connecting cable, 30 kV, 1000 mm	07367-00	2
15	PHYWE high voltage power supply 10 kV with digital display DC: 0... ± 10 kV, 2 mA	13673-93	1

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Setup

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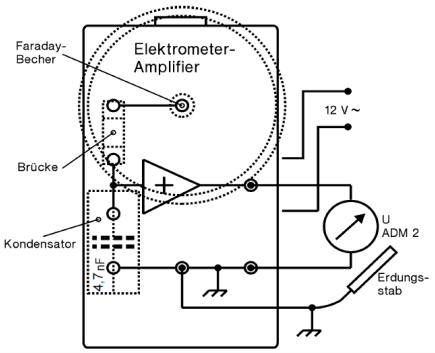
The experiment can be carried out with an electroscope (Fig. 1) or with an electrometer amplifier and ADM 2 (Fig. 2). Fig. 3 shows how to connect the electrometer amplifier. The experiment with an electroscope is described here.

Fig. 2

Fig. 3



Procedure (1/2)

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- Connect centre tap with earth connection at High-voltage power supply unit.
- Set the changeover switch of the high-voltage power supply unit to the centre position
- The electroscope housing and the stand rod are also connected to the earth connection
- Insert one insulating rod into each barrel base - connect one to the positive pole and the other to the negative pole of the high-voltage power supply unit
- Put the conductor ball on the third insulating stem
- Set power supply unit to 5 kV

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Procedure (2/2)

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- Bring the Faraday cup on the electroscope into contact with the earth
- Touch a pole with the ball, discharge the ball in the beaker, note the pointer position (Table 1)
- Repeat several times
- Discharge the beaker in stages with a charge of the opposite sign and charge it in reverse, observe pointer position

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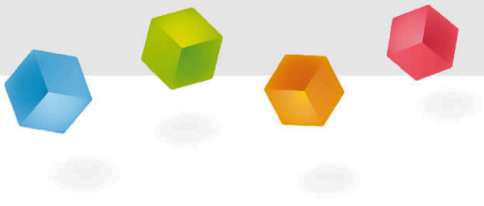

Report

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Observations

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Initially, the electroscope shows no deflection. If the ball is held against one of the contacts and then placed in the beaker, the pointer deflects. The pointer deflection increases when the ball is held against the same contact again and placed back in the beaker.

Number of charging processes	0	1	2	3
Pointer setting / scale parts				

If the ball is held against the other pole and placed in the cup, the pointer gradually returns to zero. The same number of transfers as in the first attempt are required to bring the pointer back to zero. If more charge is transferred, the pointer deflects again.

Evaluation (1/2)

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Drag the words into the correct gaps

The _____ on the _____ can be summed up on the _____. The _____ is transferred from the sphere to the Faraday cup. Multiple charging also causes multiple _____. The pointer deflection is proportional to the amount of charge.

pointer deflection | electroscope | charge | charge | spheres

See

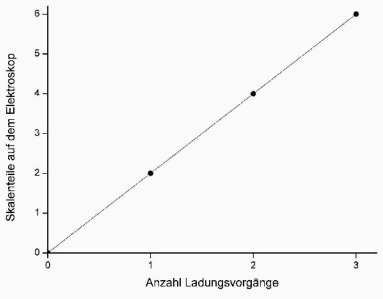

Fig. 4

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Evaluation (2/2)

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Drag the words into the correct gaps

The _____ from one contact cancels out with the charge from the other contact - this corresponds to withdrawing the same _____. For this reason, a distinction is made between _____ and negative charges or charge quantities, which are calculated in the same way as positive and _____ numbers.

charge quantity
positive
charge
negative

See

Remark

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1. Before the experiment, the insulating stems should be cleaned with a cloth and methylated spirits to remove any conductive impurities.
2. To avoid influence effects, the distance between the electroscope and the parts under high voltage should be more than half a metre if possible.
3. A complete discharge of the sphere only takes place in the field-free interior of the Faraday cup. When transferring charge from the sphere to the beaker, the sphere should only touch the beaker when the sphere and the metal part of the insulating support are completely in the field-free area of the beaker.

The experiment must be carried out reasonably quickly to avoid loss of charge. The beaker must not be touched by hand during the experiment. Ensure correct earthing (also of the person conducting the experiment).

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Slide	Score / Total
Slide 15: Charge quantity	0/5
Slide 16: Charging the contacts	0/4

Total score 0 / 9

Show solutions | Repeat | Export text

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