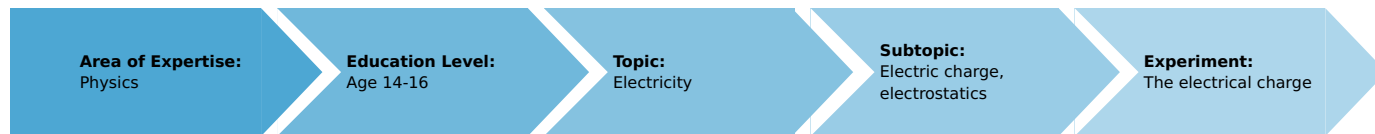


The electrical charge (Item No.: P1432700)

Curricular Relevance



Difficulty



Easy

Preparation Time



10 Minutes

Execution Time



20 Minutes

Recommended Group Size



2 Students

Additional Requirements:

Experiment Variations:

Keywords:

Introduction

Overview

This experiment shows that positive and negative electrical charge exists. Positive and negative charges cancel each other out.

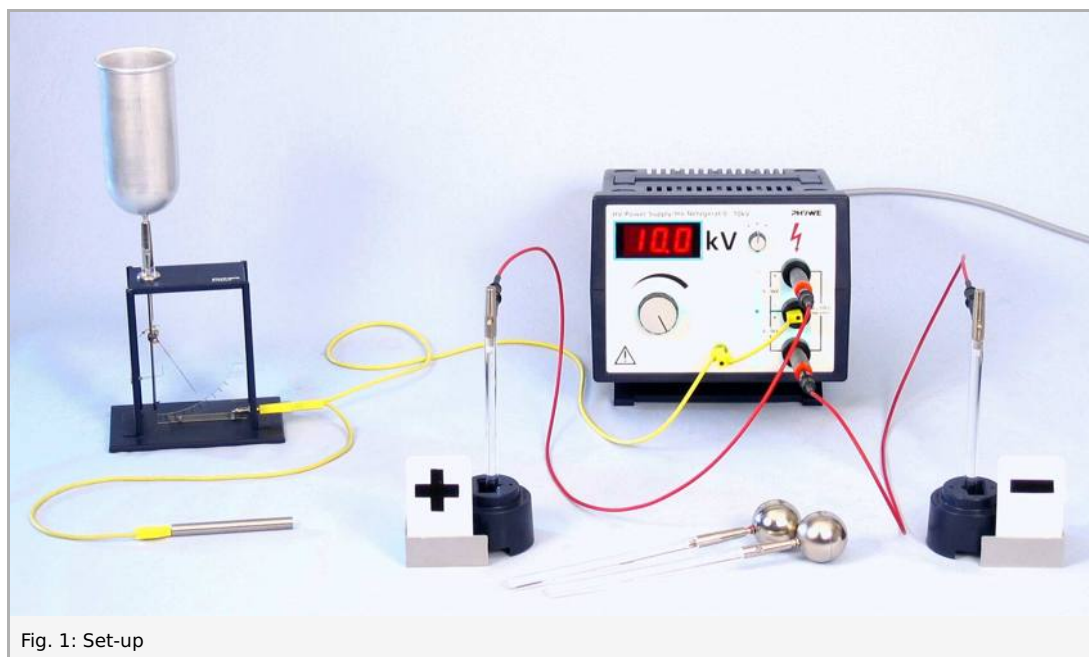


Fig. 1: Set-up

Safety information



Voltages exceeding 25 V are hazardous if the current is greater than 0,5 mA. In the 2. experimental part, voltages that are **dangerous to touch** are delivered to the long distance cables.

The experiment is only to be operated by a specialist supervisor; never let students perform the experiment.

This experimental set-up delivers high voltages that are dangerous to touch. The set-up does not ensure a sufficient isolation against this high voltage. Therefore, the following advice is **strictly** to be followed!

- Put up a warning sign "high voltage" (e.g. 06543-00) before starting the experiment.

- The experiment is to be set up only when there is absolutely no voltage applied (disconnect power plug completely!); check every part once again before connecting the power supply to the mains.
- Changes in the experimental set-up are only to be made after disconnecting the power plug.
- **Important:** In order to prevent the danger of an electric shock, only perform the experiment with one hand (and the other hand in the trouser pocket).

Equipment

Position No.	Material	Order No.	Quantity
1	Barrel base PHYWE	02006-55	3
2	Support rod with hole, stainless steel, 10 cm	02036-01	1
3	Sign holder	02066-00	2
4	Electr.symbols f.demo-board,12pcs	02154-03	1
5	Insulating stem	06021-00	4
6	Faraday pail	06231-00	1
7	Conductor ball, d 40mm	06237-00	2
8	Danger sign - high-voltage -	06543-00	1
9	Electroscope, Kolbe type, Electrometer	07120-00	1
10	High-value resistor, 10 MΩ	07160-00	2
11	Connecting cord,100 mm, green-yellow	07359-15	1
12	Connecting cord, 32 A, 500 mm, green-yellow	07361-15	1
13	Connecting cord, 32 A, 1000 mm, green-yellow	07363-15	1
14	Connecting cord, 30 kV, 1000 mm	07367-00	2
15	PHYWE High voltage supply unit with digital display DC: 0... ± 10 kV, 2 mA	13673-93	1

Set-up and procedure

Set-up

- Connect the center tap with the grounding connection at the high voltage supply unit
- Move the switch of the high voltage supply unit to the middle position
- Also connect the electroscope housing and the support rod with hole with the grounding connection
- Place one insulation stem in each barrel base. Connect one of these with the positive pole and the other with the negative pole of the high voltage supply unit using a 10 MΩ - resistor
- Place one conductor ball on each of the other insulation stems
- Adjust the power supply to 10 kV

Procedure

1. Experiment

- Connect the Faraday pail to the electroscope with the grounding contact (grounding)
- At first ground the conductor ball, then place it into the pail, watch the pointer of the electroscope
- Hold the conductor ball to the contact that is connected with the positive pole of the power supply
- Allow the conductor ball to come in contact with the floor of the pail, watch the pointer
- Ground the pail, afterwards let the ball touch the contact that is connected with the negative pole of the power supply and apply the same procedure

2. Experiment

- Ground the pail, use a second insulation stem with conductor ball: Allow one ball to come in contact with the minus pole, then the second with the plus pole
- Then allow them to come in contact with the base of the pail, one after the other
- Ground the pail, allow one ball to come in contact with the minus pole, then the second with the plus pole
- Allow the balls to touch each other, and then bring them in contact (one after the other) with the base of the pail.

3. Experiment

- Ground the pail, allow both conductor balls to touch the same contact and then (one after the other) the base of the pail
- Ground the pail, allow both conductor balls to touch the same contact and then allow the balls to touch and (one after the other) allow them to touch the base of the pail

Evaluation

Observation

1. Experiment

After grounding the Faraday pail the pointer of the electroscope does not move. A ball grounded beforehand also does not have an impact on the movement of the pointer. If the ball is held up to one of the contacts and then placed into the pail, the pointer moves. The pointer stops moving after the ball has touched the inside of the pail. If the ball is held up to the other contact, the electroscope reacts in the exact same manner.

2. Experiment

If two balls with different poles are allowed to touch and afterwards are brought into contact with the base of the pail (one after the other), then the pointer moves with the first ball and then returns back to zero with the second. If the balls are brought into contact with different poles and then allowed to touch each other, no movement of the pointer on the electroscope can be generated with them anymore.

3. Experiment

If two balls are brought into contact with the same pole, they both can move the pointer even more than with only one ball.

If two balls are brought into contact with the same pole and then with each other, they can also double the movement of the pointer.

The ball is electrically charged when it touches a high voltage pole. This is demonstrated with the movement of the electroscope pointer when the ball is put into the Faraday pail. The electroscope can be positively or negatively charged. The polarity of the charge cannot be distinguished. In both cases the pointer moves. Charges from different contacts do not behave the same, however. They cancel each other out. If they are from the same pole, then they add up.

Remarks

1. Before the experiment the insulation stems should be cleaned with a towel and methylated spirit, in order to remove existing conducting contaminants.
2. In order to avoid influential effects, the distance between the electroscope and the parts under high voltage should be more than 50 cm (approx. 2 feet).
3. A complete discharging of the ball only occurs in the field-free inside of the Faraday pail. When transferring charges from the ball to the pail the ball should touch the pail only if the ball and the metal parts of the insulating stem are completely within the field-free range of the pail.
4. In addition it can also be demonstrated that it makes no difference for the charging of the ball, whether it touches one of the contacts several times or for a longer period of time.