

Static forces between electric charges (Item No.: P1432900)

Curricular Relevance



Difficulty



Easy

Preparation Time



10 Minutes

Execution Time



20 Minutes

Recommended Group Size



2 Students

Additional Requirements:

Experiment Variations:

Keywords:

Introduction

This experiment demonstrates that charged bodies exert forces on each other. Like electrical charges repel and unlike electrical charges attract each other.

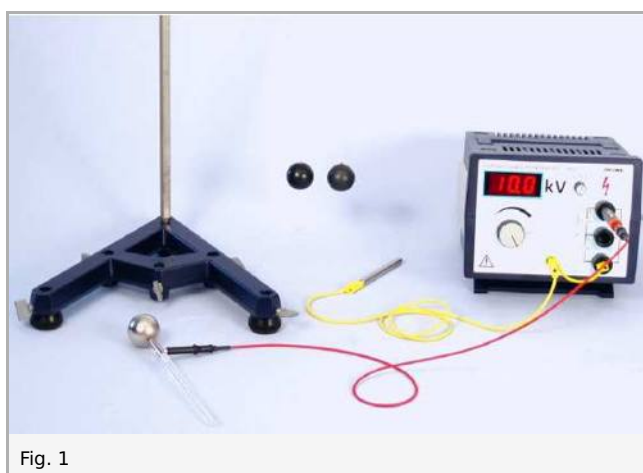


Fig. 1

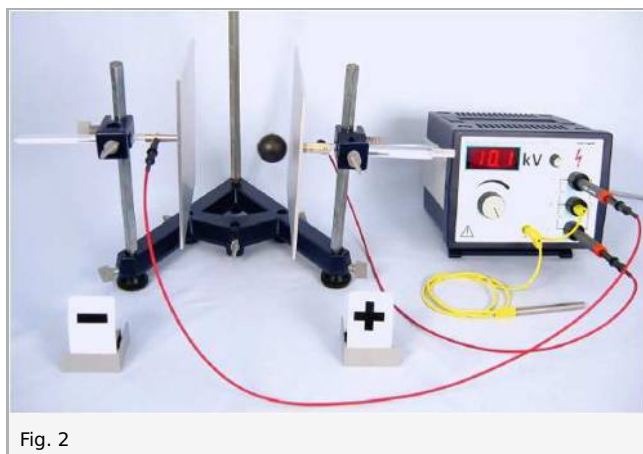


Fig. 2

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	Support base DEMO	02007-55	1
2	Barrel base PHYWE	02006-55	1
3	Support rod with hole, stainless steel, 10 cm	02036-01	1
4	Right angle clamp expert	02054-00	3
5	Sign holder	02066-00	2
6	Electr.symbols f.demo-board,12pcs	02154-03	1
7	Silk thread, l = 200 m	02412-00	1
8	Danger sign - high-voltage -	06543-00	1
9	Insulating stem	06021-00	3
10	Conductor ball, d 40mm	06237-00	2
11	Hollow plastics ball,w. eyelet	06245-00	2
12	High-value resistor, 10 MOhm	07160-00	2
13	Connecting cord,100 mm, green-yellow	07359-15	1
14	Connecting cord, 32 A, 1000 mm, green-yellow	07363-15	1
15	Connecting cord, 30 kV, 1000 mm	07367-00	2
16	PHYWE high voltage supply unit with digital display, 10 kV DC: 0... ± 10 kV, 2 mA	13673-93	1
17	Spacer plates,1 set	06228-01	1
18	Plate capacitor, 283x283 mm	06233-02	1
19	Support rod, stainless steel, l = 250 mm, d = 10 mm	02031-00	0
20	Support rod, stainless steel 18/8, l = 1300 mm, d = 12 mm	02041-00	0

Set-up and procedure

- Fasten conductible plastic ball to the ends of an approx. 2.5 m-long thread
- Wrap the middle of the string approx. 5 times around the upper rod
- Adjust the balls by pulling on the string so that they just barely touch each other and are hanging at the same height
- Connect the grounding with the lower tap (minus pole) of the high voltage supply unit
- Move the switch of the high voltage supply unit to the middle position
- Connect the support rod with hole as a grounding contact with the grounding connection
- Connect the insulation stem with the conductor ball with the upper connection (plus pole) of the high voltage supply unit via the high-value resistor

Implementation

Experiment 1

- Adjust the power supply unit to 10 kV
- Positively charge both plastic balls by touching them with the conductor ball on the insulation stem, watch what happens
- Set the power supply unit to zero, before reversing the polarity
- Connect the grounding with the plus pole on the power supply unit and connect the contact to the insulation stem with the minus pole
- Apply 10 kV and negatively charge the plastic balls
- Move the plastic balls so that there is approx. 5 cm distance between them
- Adjust the power supply unit to zero, connect the grounding with the center tap, connect one insulation stem with conductor ball to the plus pole and one with the minus pole, each via a highvalue resistor.
- Adjust the power supply unit to 10 kV
- Try to charge both balls simultaneously, one positively and the other negatively, watch what happens

Experiment 2

- Hang one of the conductible plastic balls in the middle of the parallel-plate capacitor
- Adjust the power supply unit to zero, connect the grounding with the center tap, the one parallel plate with the plus pole, the other with the minus pole
- Adjust the power supply unit to 10 kV
- Move the ball so that it comes in contact with a plate of the capacitor.
- Release the ball, watch the movement

Results and evaluation

Observation

Experiment 1

Balls charged with the same polarity repel each other and remain hanging at a distance from each other. It makes no difference whether the balls are positively or negatively charged. If an attempt is made to charge the balls with unlike poles, then they immediately attract each other and discharge again as soon as they touch.

Experiment 2

If the balls touch one of the capacitor plates, they begin to swing back and forth between the plates.

Evaluation

Experiment 1

Positive charges repel positive charges; negative charges repel negative charges. Positive and negative charges attract each other.

Experiment 2

The metal plate that is connected at the plus pole is positively charged and the metal plate connected to the minus pole is negatively charged. If the ball, for example, touches the metal plate that is at the plus pole, then it becomes positively charged. It is then repelled by this plate, because like charges repel each other. It is attracted to the other plate, because it is negatively charged. The ball moves to the negatively charged plate. If it touches this plate, it loses its positive charge and is then negatively charged, and as a result it is repelled by the negatively charged plate and attracted by the positively charged plate and so on, etc.

Remarks

1. This experiment explains how the electroscope from experiment E 2.01 functions.
2. For a better demonstration of the difference between a charged and discharged state of the ball in the first experiment the balls are discharged with the 100 mm - rod as grounding contact and recharged with the conductor ball.
3. If a 25 kV power supply unit is available, then the experiments function much better with it.