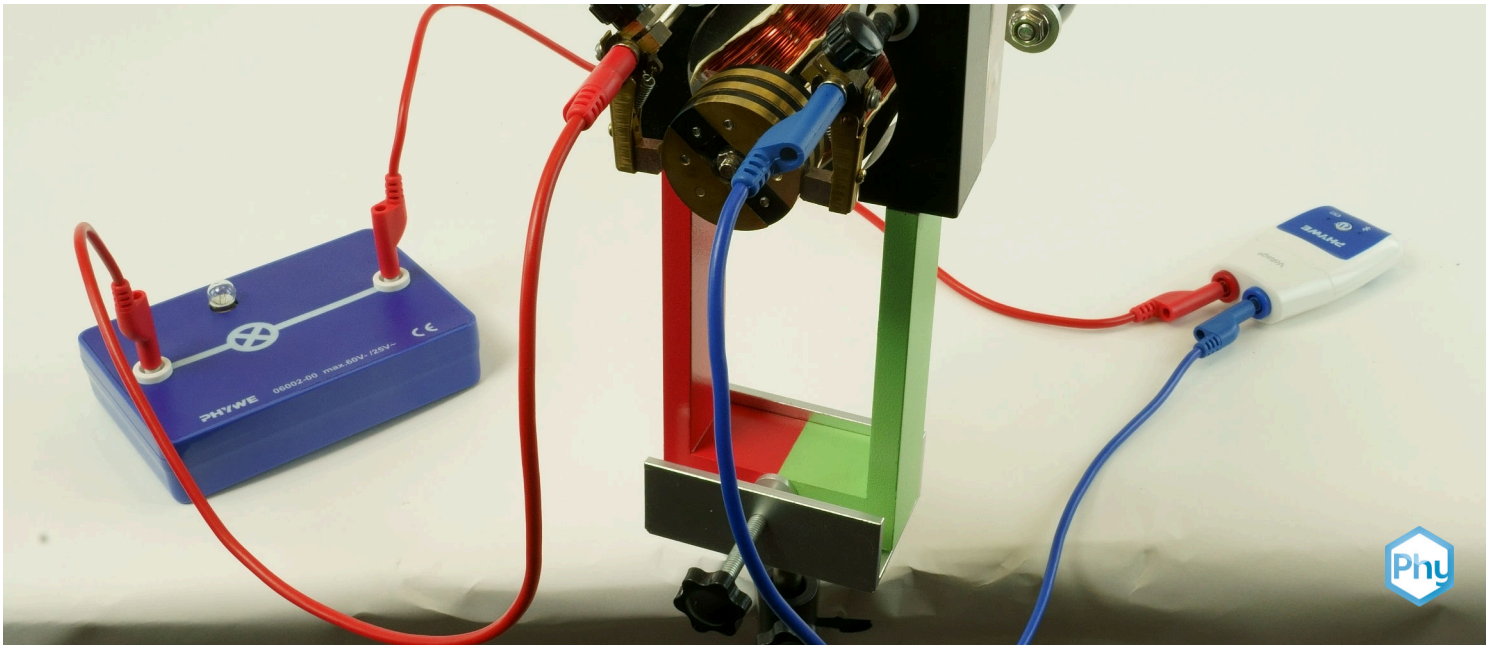
The direct current generator (DEMO)



Physics > Electricity & Magnetism > Electromagnetism & Induction

Physics > Electricity & Magnetism > Electric generator, motor, transformer

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

This content can also be found online at:

http://localhost:1337/c/649300b57844c30002a65e8f

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Teacher information

Application

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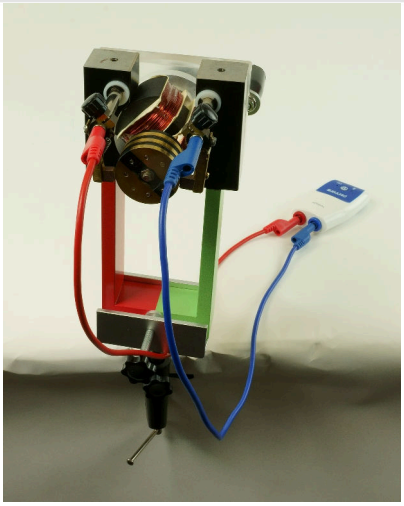

Experimental setup

An electrical generator is an electrical machine that converts kinetic energy into electrical energy. The generator is the counterpart to the electric motor, which converts electrical energy into kinetic energy. It is based on the principle of electromagnetic induction discovered by Michael Faraday in 1831.

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Other teacher information (1/2)

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Prior knowledge

No prior knowledge is required.

Principle

If a coil is rotated in a magnetic field, an electrical voltage (induction voltage) is generated at its ends. After every half turn of the coil, the voltage changes its sign. If the polarity of the terminals of the coil winding is reversed at this very moment with the help of a so-called collector, a DC voltage is generated. The resulting electrical energy can be used to operate an incandescent lamp.

Other teacher information (2/2)

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Learning objective

Students should understand how a DC generator works.

Tasks

Investigate how to generate voltage and current using a DC generator.

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Student information

Motivation

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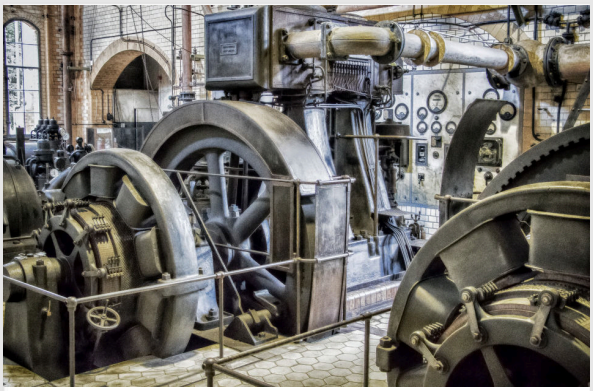

Historical generator

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Equipment

Position	Material	Item No.	Quantity
1	Cobra SMARTsense Voltage - Sensor for measuring electrical voltage ± 30 V (Bluetooth + USB)	12901-01	1
2	Bench clamp	02012-00	1
3	Plate holder, opening width 2 - 35 mm	06509-00	1
4	U-magnet, large, U-shaped, limb length 130 mm, colored poles	06320-00	1
5	Motor set	06550-00	1
6	Rotor coil, Double-T armature	06554-00	1
7	Cord pulley	06558-01	1
8	Crank handle	06559-01	1
9	Lamp holder E10, on base plate	06002-00	1
10	Filament lamps 4V/0.04A, E10, 10	06154-03	1
11	Filament lamps 3.5V/0.2A,E10, 10	06152-03	1
12	Connecting cord, 32 A, 750 mm, red	07362-01	2
13	Connecting cord, 32 A, 750 mm, blue	07362-04	1
14	Cobra SMARTsense Current - Sensor for measuring electrical current ± 1 A (Bluetooth + USB)	12902-01	1
15	measureAPP - the free measurement software for all devices and operating systems	14581-61	1

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Setup (1/3)

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For measurement with the **Cobra SMARTsense sensors** the **PHYWE measureAPP** is required. The app can be downloaded free of charge from the relevant app store (see below for QR codes). Before starting the app, please check that on your device (smartphone, tablet, desktop PC) **Bluetooth** is **activated**.

iOS

Android

Windows

Set-up (2/3)

- Set up the experiment according to Fig. 1.
- Assemble the motor attachment according to Fig. 2.
- Push the axle [1] of the double T-anchor into the bearing bore [3] of the motor attachment and screw it tight with the cord washer [2].
- Put the crank on the pulley.

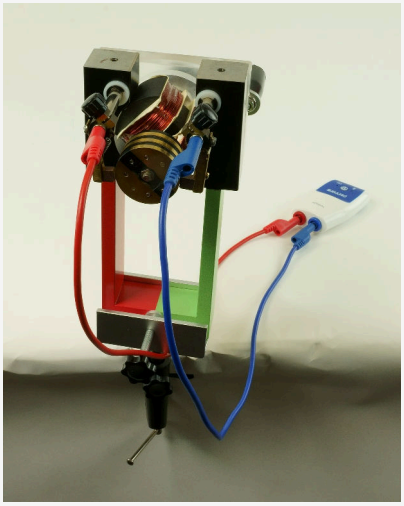

Fig. 1

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Setup (3/3)

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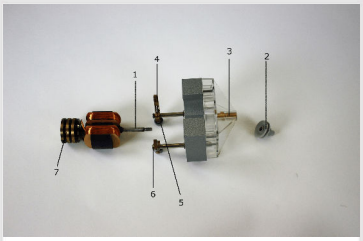

Fig. 2

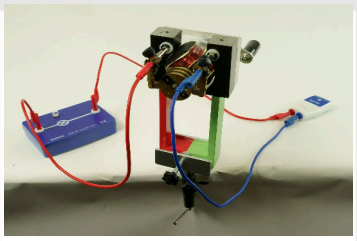

Fig. 3

- Place the grinding brushes [4] of the motor attachment against the interrupted slip ring as shown in Fig. 3.
- Pull the knurled screw [5] slightly upwards so that the two angled lever arms of the abrasive brushes are in line. This tensions the spring and presses the brushes onto the sanding rings.
- Tighten the knurled screws [5]. This establishes the electrical contact between the armature coils and the connection sockets [6].

Procedure (1/4)

PHYWE

Cobra SMARTsense

- Turn on the SMARTsense sensor currently in use and make sure the terminal can connect to Bluetooth devices.
- Open the PHYWE measureApp and select the used sensor "Current" or "Voltage".
- Select the sampling rate of your choice. The higher the sampling rate, the more accurate the measurement.

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Procedure (2/4)

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- Set up the experiment according to Fig. 1.
- Connect the connection sockets [6] of the motor to the inputs of the multimeter for voltage measurement.
- Select the measuring range 1 V-.
- Turn the crank slowly and continuously in one direction, watch the meter.
- Note: If the pointer moves to the left, change the direction of rotation or change the connections on the meter.
- Set the measuring range to 3 V-.

Procedure (3/4)

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- Increase the rotation speed.
- Adjust the zero point of the pointer on the meter slightly towards the centre.
- Carefully change the direction of rotation and observe the pointer deflection.
- Reset the zero point of the pointer.

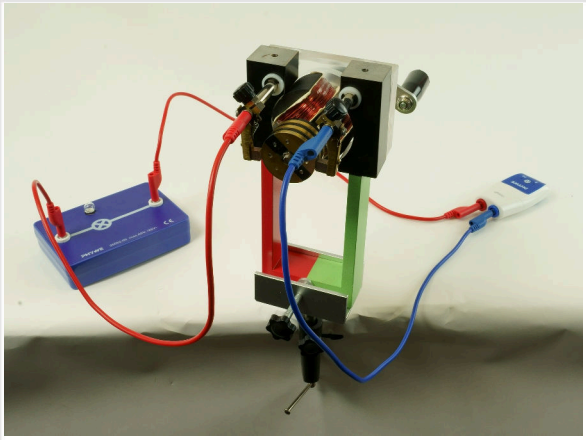

Fig. 4

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Procedure (4/4)

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- Modify the experiment according to Fig. 4, connect the meter and the 4V bulb in series and connect them to the motor. Pay attention to the correct polarity.
- Select the measuring range 100 mA-.
- Turn the crank slowly at first, then faster. Observe the meter and the bulb.
- Insert the 3.5 V / 0.2 A bulb.
- Select the measuring range 300 mA-.
- Turn the crank quickly, watch the meter and bulb.

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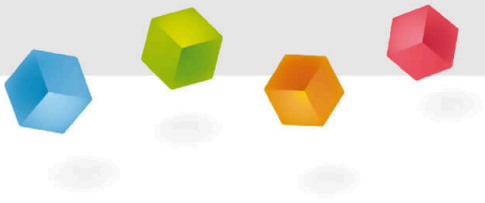

Report

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Task (1/6)

PHYWE

Drag the words into the correct boxes!

If the crank is turned very slowly, the _____ of the measuring instrument moves only very slightly to the right and goes back to almost zero after every _____. When turning faster, the pointer can follow the voltage change less and less, the _____ of the motor increases. The measuring range must then be set to 3 V-.

half turn
voltage
pointer

Check

Task (1/6)

PHYWE

Drag the words into the correct boxes!

If the crank is turned very slowly, the _____ of the measuring instrument moves only very slightly to the right and goes back to almost zero after every _____. When turning faster, the pointer can follow the voltage change less and less, the _____ of the motor increases. The measuring range must then be set to 3 V-.

half turn
voltage
pointer

Check

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Task (2/6)

PHYWE

How does the pointer behave after the direction of rotation of the crank has been changed?

- It strikes out in the same direction.
- It does not strike out.
- It strikes out in the opposite direction.

Task (3/6)

PHYWE

Drag the words into the correct boxes!

When turning the crank _____, the pointer of the measuring instrument in particular moves in the lower range of the scale, while a _____ glow of the bulb in the same cycle is only slightly visible. At _____ revs, the movement of the pointer becomes _____. The bulb gets brighter and brighter. The meter only deflects to one side. The size of the reading depends on the _____. It increases up to 40 mA.

weak
higher
slowly
speed
smaller

Check

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Task (4/6)

PHYWE

How does the second bulb compare to the first green bulb?

- It glows stronger.
- It glows more dimly.
- It shines with the same intensity.

Task (5/6)

PHYWE

Drag the words into the correct boxes!

An _____ is generated in a coil that rotates in the _____. This process is called _____. As the coil rotates slowly, the value of the voltage is seen to fluctuate, but the pointer always moves in the _____, producing a (pulsating) DC voltage.

- induction
- electrical voltage
- same direction
- magnetic field

Check

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Task (6/6)

PHYWE

Drag the words into the correct boxes!

A _____ flows through the _____. Mechanical energy is converted into _____. The greater the speed, the greater the _____, the lamp burns _____.

- brighter
- electrical power
- electrical energy
- connected light bulb
- direct current

Check

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