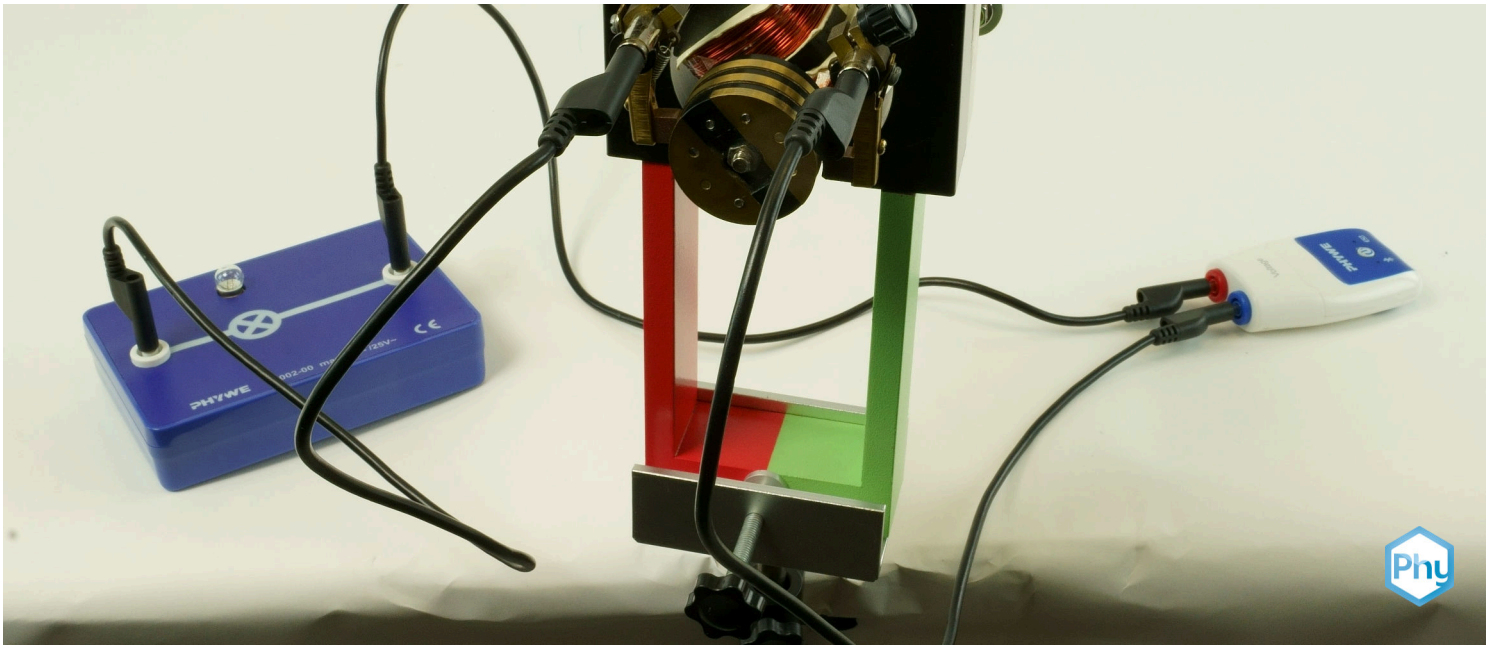
The alternating current generator (DEMO)



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/6492fdcd3759e100020691af

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Teacher information

Application

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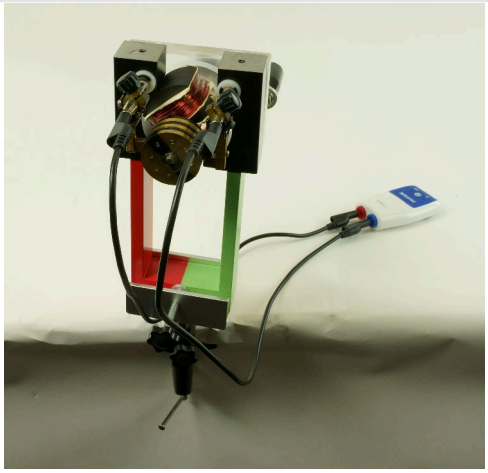

Experimental setup

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 and current change sign. The resulting electrical energy can be used to operate a light bulb.

Other teacher information (2/2)

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Learning objective

Students should understand how a generator works.

Tasks

Investigate how to generate voltage and current using a generator.

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Student information

Motivation

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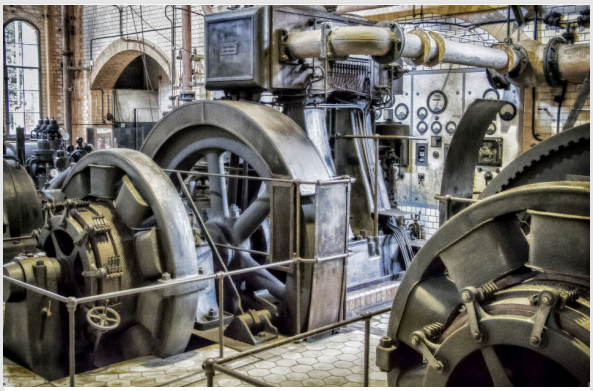
An electrical generator is an electrical machine that converts kinetic energy into electrical energy. The generator is the counterpart to the electric motor, which converts electrical energy into kinetic energy. It is based on the principle of electromagnetic induction discovered by Michael Faraday in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



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, black	07362-05	3
13	Cobra SMARTsense Current - Sensor for measuring electrical current ± 1 A (Bluetooth + USB)	12902-01	1
14	measureAPP - the free measurement software for all devices and operating systems	14581-61	1

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Set-up (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 and fig. 3 on the next slide.
- 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.
- Place the abrasive brushes [4] of the motor attachment against one unbroken slip ring each as shown in Fig. 3.

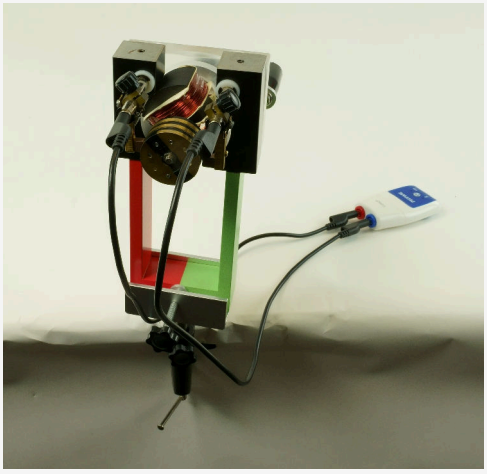

Fig. 1

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Set-up (3/3)

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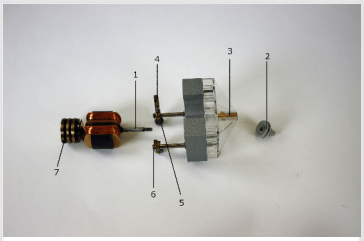

Fig. 2

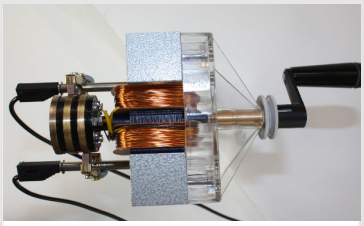

Fig. 3

- 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].
- On the multimeter, select the measuring range -10 mV- ... +10 mV-, i.e. the measuring range with zero point in the middle.

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 cords [6] of the motor to the inputs of the multimeter for voltage measurement.
- Turn the crank slowly in one direction, watch the meter.
- Change the direction of rotation.
- Select the AC voltage measuring range 3 V~ (Fig. 4).
- Turn the crank quickly, watch the meter.

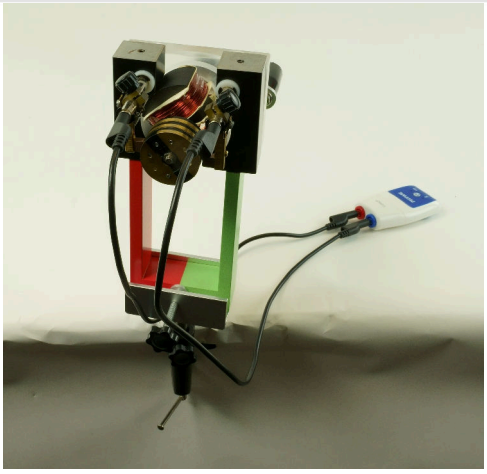

Fig. 4

Procedure (3/4)

PHYWE

- Set up the experiment according to Fig. 5.
- Attach the lamp socket with 4 V bulb to the stand rod using the boss head.
- Select the measuring range -10 mA- ... +10 mA-.
- Turn the crank slowly at first, then faster, watch the meter and the bulb.
- Change the direction of rotation.

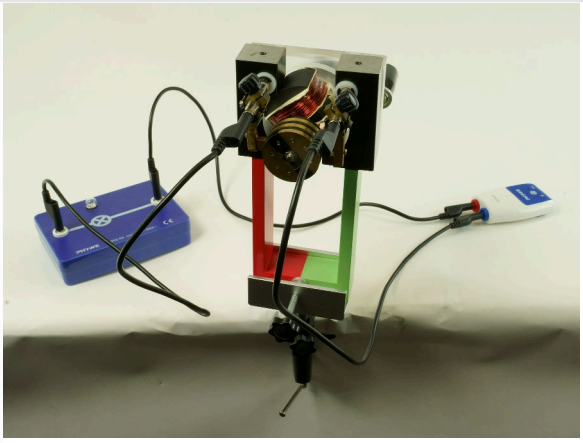

Fig. 5

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Procedure (4/4)

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- Select the measuring range 100 mA~ (Fig. 6).
- Turn the crank quickly, watch the lamp and meter.
- Insert the 3.5 V / 0.2 A bulb.
- Select the measuring range 300 mA~.
- Turn the crank quickly, watch the lamp and meter.

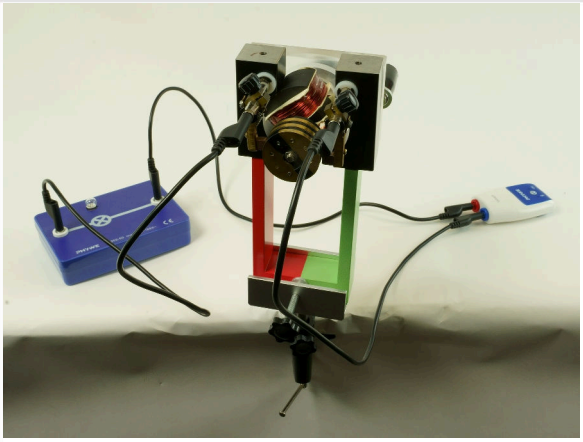

Fig. 6

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Report

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Task (1/5)

PHYWE

How does the pointer behave when measuring DC voltage?

- It does not move.
- It swings to the right.
- It swings to the left.
- It swings alternately to the left and to the right.

Task (2/5)

PHYWE

Drag the words into the correct boxes!

When the crank is turned _____, the pointer of the measuring instrument in particular moves back and forth with large deflections, while a _____ glow of the bulb is only slightly visible. At _____ revolutions, the movement of the pointer becomes _____, but it gradually increases. The bulb becomes brighter and brighter.

slowly
smaller
weak
higher

Check

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Task (3/5)

PHYWE

How does the pointer behave when measuring direct current?

- It strikes out alternately to the left and to the right.
- He does not strike out.
- He swings to the right.
- He swings to the left.

Task (4/5)

PHYWE

Drag the words into the correct boxes!

An electrical voltage is generated in a coil that rotates in the _____. This process is called _____. When measuring _____ and current in measuring ranges for _____ or direct current, the pointers of the measuring instruments deflect to the right and left, so an _____ is generated whose period corresponds to one full coil rotation.

- alternating voltage
- voltage
- induction
- direct voltage
- magnetic field

Check

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Task (5/5)

PHYWE

Drag the words into the correct boxes!

If the measuring instruments are set to ranges for _____ or AC current, the pointer deflection increases with the _____, i.e. the induced voltage and the current _____. An alternating current flows through the connected bulb. Mechanical energy is therefore converted into electrical energy. The greater the speed, the greater the _____, the brighter the lamp burns.

electrical power
speed
AC voltage
increase

Check

Slide	Score / Total
Slide 16: Voltage measurement	0/3
Slide 17: Speed during voltage measurement	0/4
Slide 18: Current measurement	0/4
Slide 19: Operating principle of the alternator	0/5
Slide 20: AC voltage and electrical power	0/4

Total score 0 / 20

Show solutions Repeat

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