Technical generators with Cobra SMARTsense

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

Difficulty level	Group size	Preparation time	Execution time
easy	2	10 minutes	10 minutes

This content can also be found online at:

http://localhost:1337/c/617aab738e47ed0003a82b4b

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Teacher information

Application

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Hydroelectric power station for the generation of electric current by means of flowing water

With the knowledge of Faraday's law of induction, it is possible to convert mechanical energy into electrical energy.

Nowadays, this phenomenon is mainly used in generators, which are supposed to convert natural kinetic energy into electricity.

Typical examples of applications are turbines in hydroelectric power plants at dams. The figure shows a small example of such a hydroelectric power plant, which can be used to generate electricity from the flowing water.

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Other teacher information (1/2)

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Previous

Students should already understand the basic principle of an electricity generating generator.

Principle

The operation of the generator is based on the principle of electromagnetic induction. This means that a permanent magnet moving past an electromagnet causes a change in the magnetic flux and thus the generation of an electric current. In the generator, the principle is generated by the continuous rotary motion.

Other teacher information (2/2)

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Learning objective

This experiment should enable the students to recapitulate their knowledge of electric motors and electric generators learned up to this point.

Tasks

In this experiment, the students are to drive a generator with the aid of an electric motor and thus generate a current again from the intermediate product of mechanical energy and measure this current.

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Safety instructions

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The general instructions for safe experimentation in science lessons apply to this experiment.

Notice:

Instead of a rubber hose, adhesive tape can also be used to connect the two devices.

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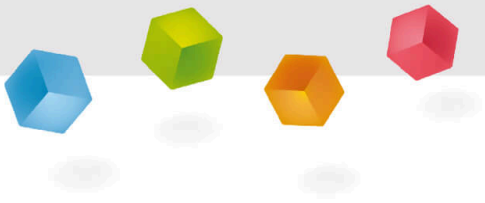

Student Information

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Motivation

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Hydroelectric power station for the generation of electric current

You have already learned about the (electric) generator and examined its properties.

Some of its applications in everyday technical situations are, for example, the dynamo, which you may know from your bicycle, or wind turbines or hydroelectric power stations for generating electricity for domestic use.

In this experiment you will find out what happens when you drive such a generator with the help of an external electric motor.

Tasks

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In technical applications, generators for power generation are usually driven by water or gas turbines. In this experiment, you will investigate how a permanently (externally) driven generator produces electricity that can actually be used. In this experiment, however, the generator is driven by an electric motor. For this purpose, build an experimental setup consisting of an electric motor, a generator and a sensor to measure the current.

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Equipment

Position	Material	Item No.	Quantity
1	PHYWE Power supply, 230 V, DC: 0...12 V, 2 A / AC: 6 V, 12 V, 5 A	13506-93	1
2	Student set Electric motor / Generator, TESS advanced Physics	15221-88	2
3	Silicone tubing i.d. 2mm	39298-00	1
4	Cobra SMARTsense - Current, ± 1 A (Bluetooth + USB)	12902-01	1
5	Cobra SMARTsense - Voltage, ± 30 V (Bluetooth + USB)	12901-01	1
6	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)

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Electric motor connected to voltage source

- Assemble the electric generator as shown in the adjacent figure.
- Then connect the motor to the voltage source, but do not switch it on yet.

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Set-up (3/3)

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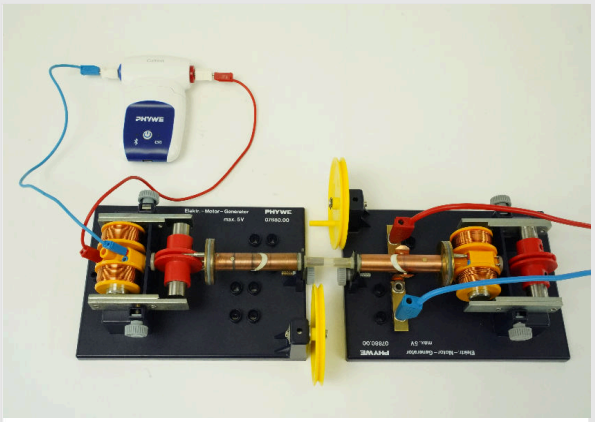

Experimental setup: Coupled Electric motor / generator

- Now set up the experimental setup as shown in the adjacent figure.
- Connect the SMARTsense Current to the coil of the generator (left).
- The commutators on the two base plates are connected with a piece of hose for this purpose.

Procedure

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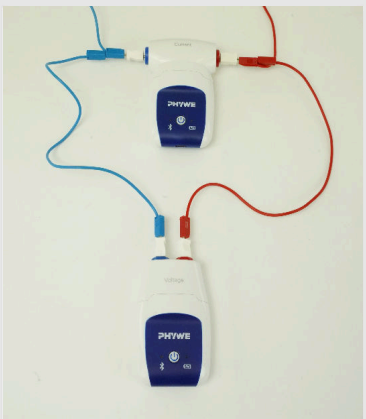

SMARTsense Current & SMARTsense Voltage connected in parallel

Note: You can also connect the SMARTsense Voltage in parallel with the SMARTsense Current to measure both current and voltage simultaneously during the experiment.

Turn on the SMARTsense(s) by pressing and holding the I/O button for about three seconds. Start the measureAPP and select the sensor(s) to connect.

Start a measurement, then with the help of the voltage source, apply a DC voltage of maximum $5\,V$ and observe what happens. If necessary, you have to give the rotor a slight push until it runs independently. Then observe what happens when you briefly increase the voltage to **maximum** $8\,V$ increase? (not longer than one minute, otherwise coil / bulb could be damaged!) Switch off the power supply and finish the measurement.

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Report

Task 1

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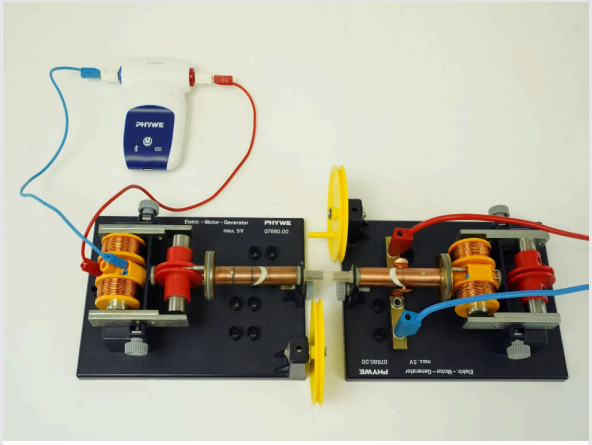

Experimental setup: Coupled Electric motor / generator

What was your observation during the experiment with $5\,V$?

- The engine and generator spun at the same speed, but the measureAPP could not register any readings.
- The engine and generator spun at the same rate and the measureAPP recorded clear readings.
- The voltage was not enough to make the motor turn.

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Task 2

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What was your observation during the experiment with $8\,V$?

- Electric motor and generator rotated slower than in the 1st test and the deflection of the measured values of the measureAPP was about the same.
- The electric motor and generator rotated faster than in the 1st test and the deflection of the measured values of the measureAPP was smaller.
- The electric motor and generator rotated faster than in the 1st test and the deflection of the measured values of the measureAPP was greater.

Task 3

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Describe how the electrical energy from the voltage source reaches the lamp.

The _____ is set in rotation by the _____. The direct coupling with the help of the _____ ensures that the _____ also rotates.
The rapid rotation of the _____ again brings the principle of electromagnetic _____ into play, inducing a current in the _____. This current causes the bulb to start glowing.

induction
electric motor
electromagnet
voltage source
hose piece
permanent magnet
generator

Check

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Slide	Score / Total
Slide 15: Observation: Experiment \(5\,V\)	0/1
Slide 16: Observation: Experiment \(8\,V\)	0/1
Slide 17: Functionality of the motor/generator system	0/7

Total 0 / 9

Solutions Repeat

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