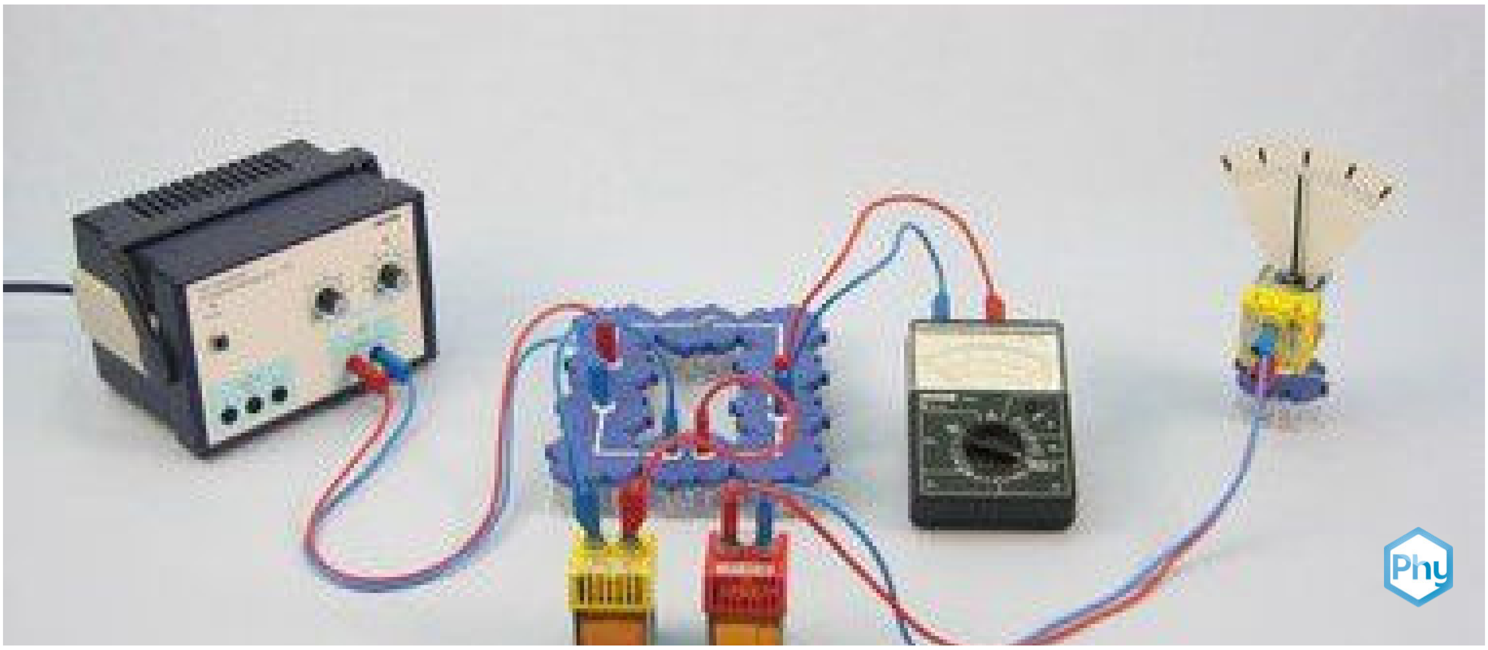
Generating an induction voltage with electromagnets



With this experiment, students check electrical induction with electromagnets.

Physics → Electricity & Magnetism → Electromagnetism & Induction

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

Difficulty level	Group size	Preparation time	Execution time
easy	1	10 minutes	10 minutes

This content can also be found online at:

http://localhost:1337/c/617aabc78e47ed0003a82b65

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Teacher information

Application

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Test setup

Electromagnetic induction (also Faraday induction, after Michael Faraday, induction for short) refers to the creation of an electric field when the magnetic flux changes.

In many cases, the electric field can be detected directly by measuring an electric voltage. If the induction process can be triggered by means of a permanent magnet, then this should also be possible with an electromagnet.

PHYWE

Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
Fax: 0551 604 - 107

info@phywe.de
www.phywe.de

Other teacher information (1/2)

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Previous

The fact that a voltage is induced in a coil as long as the magnetic field encompassed by the coil changes is assumed to be known by the students.

Principle

The change in magnetic flux through an electrical conductor induces an electric current in it.

Other teacher information (2/2)

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Learning

With this experiment, students check electrical induction with electromagnets.

Tasks

Investigate whether a voltage can be induced with the help of an electromagnet. Also investigate the way in which this is possible.

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Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
Fax: 0551 604 - 107

info@phywe.de
www.phywe.de

Safety instructions

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

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Student Information

PHYWE

Robert-Bosch-Breite 10
37079 Göttingen

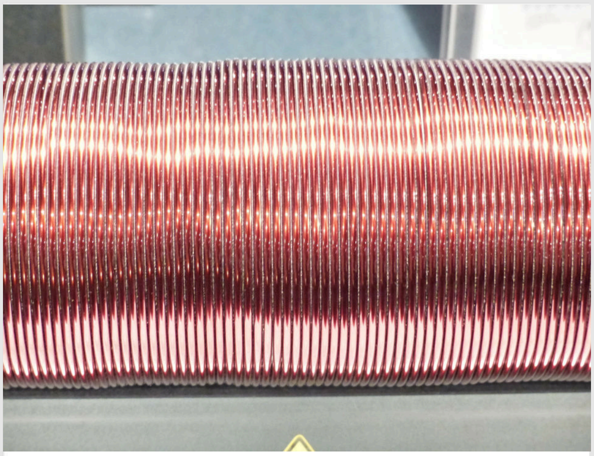
Tel.: 0551 604 - 0
Fax: 0551 604 - 107

info@phywe.de
www.phywe.de

Motivation

Electromagnetic induction (also Faraday induction, after Michael Faraday, induction for short) refers to the creation of an electric field when the magnetic flux changes.

In many cases, the electric field can be detected directly by measuring an electric voltage.



Coil

Robert-Bosch-Breite 10
37079 Göttingen
Tel.: 0551 604 - 0
Fax: 0551 604 - 107
info@phywe.de
www.phywe.de

Equipment

Position	Material	Item No.	Quantity
1	Straight connector module, SB	05601-01	1
2	Angled connector module, SB	05601-02	4
3	Interrupted connector module with sockets, SB	05601-04	2
4	Junction module, SB	05601-10	2
5	Straight connector module with socket, SB	05601-11	1
6	On-off switch module, SB	05602-01	1
7	Coil, 400 turns	07829-01	2
8	Coil, 1600 turns	07830-01	1
9	Iron core, U-shaped, laminated	07832-00	1
10	Iron core, I-shaped, laminated	07833-00	1
11	Galvanometer movement	07875-00	1
12	Galvanometer scale	07876-00	1
13	Notch bearing with plug	07877-00	1
14	Connecting cord, 32 A, 250 mm, red	07360-01	2
15	Connecting cord, 32 A, 250 mm, blue	07360-04	2
16	Connecting cord, 32 A, 500 mm, red	07361-01	2
17	Connecting cord, 32 A, 500 mm, blue	07361-04	2
18	PHYWE Power supply, 230 V, DC: 0...12 V, 2 A / AC: 6 V, 12 V, 5 A	13506-93	1
19	Analog multimeter, 600V AC/DC, 10A AC/DC, 2 MΩ, overload protection	07021-11	1

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Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
Fax: 0551 604 - 107

info@phywe.de
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Structure and implementation

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- Build the model of a galvanometer according to Figs. 3, 4 and 5. Insert the model into a circuit module.
- Set up the experiment according to Fig. 1 and Fig. 2. First, the switch is open and the yoke is not in the field coil (400 turns). Use two 50 cm long leads for the connection between the galvanometer and the induction coil (1600 turns).
- Select the measuring range 3 A-. Switch on the power supply and set it to 4 V. Close the switch.

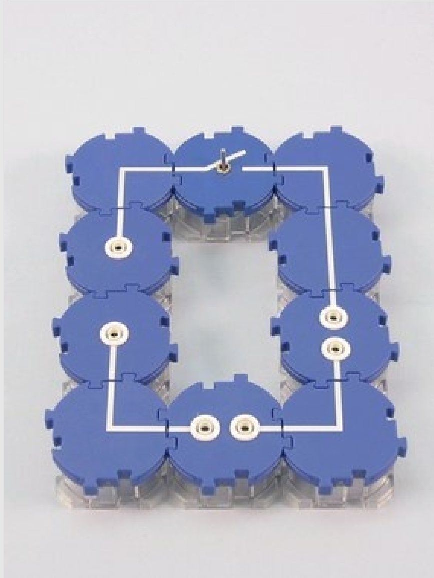

Fig. 1

Structure and implementation

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- Move the field coil and the induction coil as fast as possible towards and away from each other (along the coil axes and also perpendicular to them). Observe the deflection of the galvanometer and note your observations under "Result - Observations 1" in the protocol. Also note the current in the field coil.
- Push the yoke (I-core) into the field coil and perform the same relative movements of the coils as before. Note your observations under "Result - Observations 2" in the protocol.

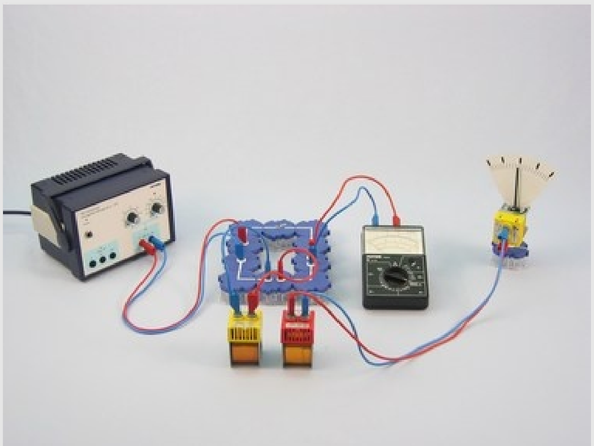

Fig. 2

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Robert-Bosch-Breite 10
37079 Göttingen

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Structure and implementation

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- Place the coils close together as in Fig. 6 and open and close the switch. Note your observations under "Result - Observations 3" in the protocol.
- Push the yoke equally far into both coils and open and close the switch again. Note your observations under "Result - Observations 4" in the protocol.
- Connect the field coil and the induction coil to the U-core (see Fig. 7). Open and close the switch. Note your observations under "Result - Observations 5" in the protocol. Note the size of the pointer deflection.

Fig. 3

Structure and implementation

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- Change the voltage at the power supply unit between 0 V and 4 V with the switch closed. Note your observations under "Result - Observations 6" in the protocol.
- Set the power supply to 0 V and select the measuring range of 300 mA. Place the yoke on the U-core.
- Adjust the voltage until the ammeter reads 100 mA. Open and close the switch. Observe the pointer deflection and compare with that noted under (5). Note your observations under "Result - Observations 7" in the protocol.

Fig. 4

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Robert-Bosch-Breite 10
37079 Göttingen
Tel.: 0551 604 - 0
Fax: 0551 604 - 107
info@phywe.de
www.phywe.de

Structure and implementation

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- Adjust the voltage until the ammeter reads 200 mA. Open and close the switch. Observe the pointer deflection and compare it with the previous one. Note your observations under "Result - Observations 8" in the protocol.
- Set the power supply to 0 V and switch it off.

Fig. 5

Structure and implementation

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Fig. 6

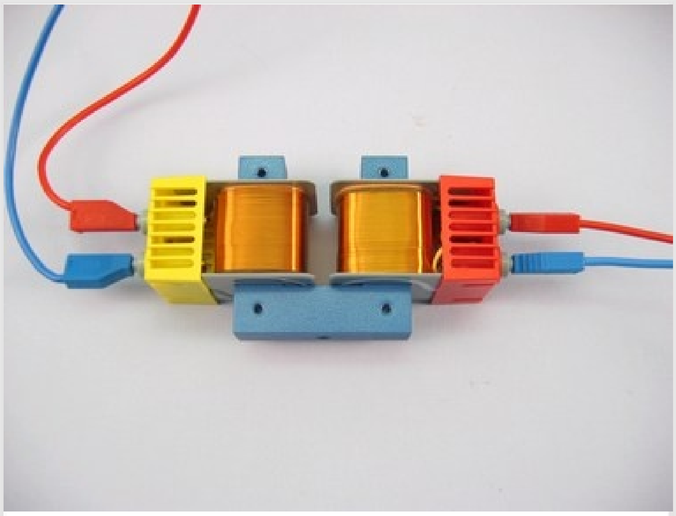

Fig. 7

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37079 Göttingen

Tel.: 0551 604 - 0
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Report

Observation (1/8)

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Write down your observations.

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Robert-Bosch-Breite 10
37079 Göttingen

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Fax: 0551 604 - 107

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Observation (2/8)

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Write down your observations.

Observation (3/8)

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Write down your observations.

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Observation (4/8)

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Note down your observations.

Observation (5/8)

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Write down your observations.

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37079 Göttingen

Tel.: 0551 604 - 0
Fax: 0551 604 - 107

info@phywe.de
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Observation (6/8)

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Write down your observations.

Observation (7/8)

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Write down your observations.

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Observation (8/8)

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Write down your observations.

Task (1/3)

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In what principally different ways were induction voltages generated during the experiment?

- Change in magnetic flux density.
- Change in area cross-section.
- Change in inductance.

Check

So what is important when a voltage is to be generated in the induction coil?

- On the magnetic flux density.
- On the coil count.
- On the amperage.

Check

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Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
Fax: 0551 604 - 107

info@phywe.de
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Task (2/3)

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What was accomplished by using the yoke, the U-core, and most recently the U-core with yoke?

- This resulted in a higher stability of the coil.
- This resulted in an increase in inductance.
- This resulted in a change of the magnetic flux.
- None of the answers are correct.

Task (3/3)

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Why is the induction voltage highest when both coils are on a closed iron core (U-core with yoke)?

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Robert-Bosch-Breite 10
37079 Göttingen
Tel.: 0551 604 - 0
Fax: 0551 604 - 107
info@phywe.de
www.phywe.de

Slide	Score / Total
Slide 24: Multiple tasks	**0/2**
Slide 25: Increase in inductance	**0/1**

Total score 0 / 3

Show solutions Repeat Export text

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Robert-Bosch-Breite 10
37079 Göttingen
Tel.: 0551 604 - 0
Fax: 0551 604 - 107
info@phywe.de
www.phywe.de