Electromagnetic induction (Item No.: P6300669)

Curricular Relevance

Area of Expertise:	Education Level:	Topic:	Subtopic:	Experiment:
Physik	Klasse 10-13	Elektrizitätslehre	Elektromagnetische Induktion	Elektromagnetische Induktion

Difficulty	Preparation Time	Execution Time	Recommended Group Size
Very difficult	20 Minutes	10 Minutes	2 Students

Additional Requirements:

- Tablet with measure App
- PHYWE Netzgerät, RiSU-2016-konform
- Digital multimeter

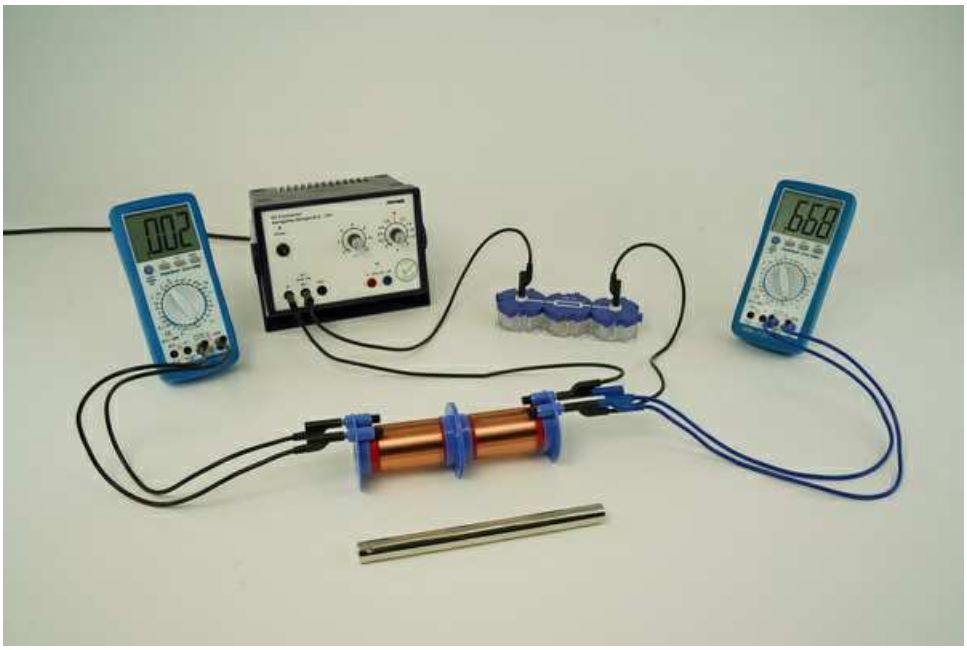
Experiment Variations:

Keywords:

Electromagnetic induction, Electromagnetic induction of a coil, Basics for a transformer, coils with AC

Information for teachers

Introduction



Application
Transmormers are based on the principle of electromagnetic induction. Tehe main task of a tranforme is to conver one input voltag into another output voltage.
Other Examples are electric toothbrosheas or smartphones with wireless charging.

Educational objective
In this experiment, you'll examinate the electromagnetic induction. An alernating magnetic flux induce a current in a coil. The effect of an iron core inside of the two coils is investigated.

Task
1. Measure the induced voltage without an iron core in the coils.

2. Measure the induced voltage with an iron core in the coils.

Prior knowledge
The students should be faliliar with the principle of electromagnetic induction and the basics of electricity.

Principle
One coil, wich is conected to an AC voltage, genaretes an alternating magnetic flux. The change of the magnetic flux produces a current by the other coil.
Faraday's law of induction is:
$rot\vec{E} = -\frac{\delta B}{\delta t}$

Notes concerning the set-up and execution of the experiment
In this experiment, AC and not DC is used. The resistence is necessary, because the coils can overheat otherwise.

Equipment

Position No.	Material	Order No.	Quantity
1	Induction coil, 100 tuns, d = 40 mm	11007-05	2
2	Iron core, rod shaped d =16 mm, l = 200 mm	11005-00	1
3	Junction module, SB	05601-10	2
4	Resistor module 10 Ohm, SB	05612-10	1
5	Connection cord, 32 A 500 mm, black	07361-05	5
6	Connection cord, 32 A, 500 mm, blue	07361-04	2
7	PHYWE power supply, 230 V, DC: 0...12 V, 2 A / AC: 6 V, 12 V, 5 A	13506-93	1
8	Digital Multimeter, 2.000 Counts, 600V AC/DC, 10A, with NiCr-Ni thermocouple and inductance measurement	07129-00	2

Safety information

For this experiment, the general notes and intructions concerning safe experimentation in science classes apply. Make sure that the resistance of 10Ω is build in, otherwise the coils get hot.

Introduction

Application and Task

Application
Electric toothbrushes or even some smartphones can charge wirelessly by placing them on a charging station. How this works, you learn in this experiment.

Task
1. Measure the electromagnetically induced voltage at the coil who is not connected to a power source.
2. Insert an iron core through both coils and repeat task 1.

Equipment

Position No.	Material	Order No.	Quantity
1	Induction coil, 100 tuns, d = 40 mm	11007-05	2
2	Iron core, rod shaped d =16 mm, l = 200 mm	11005-00	1
3	Junction module, SB	05601-10	2
4	Resistor module 10 Ohm, SB	05612-10	1
5	Connection cord, 32 A 500 mm, black	07361-05	5
6	Connection cord, 32 A, 500 mm, blue	07361-04	2
7	PHYWE power supply, 230 V, DC: 0...12 V, 2 A / AC: 6 V, 12 V, 5 A	13506-93	1
8	Digital Multimeter, 2.000 Counts, 600V AC/DC, 10A, with NiCr-Ni thermocouple and inductance measurement	07129-00	2

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Setup and Procedure

Set up

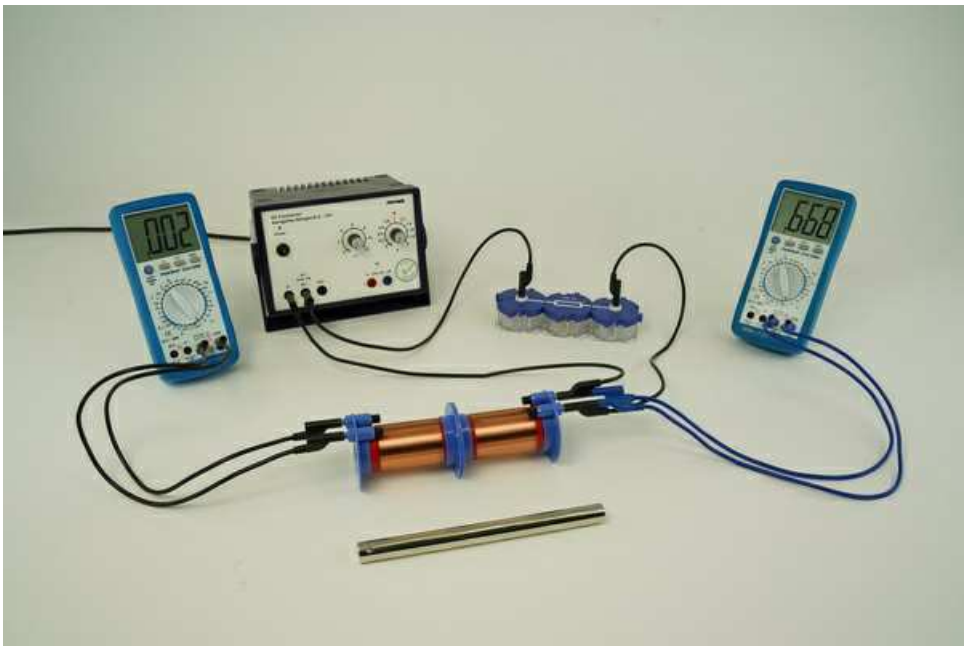

fig. 1

Set up the experiment as shown in fig 1. For the primary circuit, build the power supply, the resistor 10Ω and one of the short coils with a number of turns of $N = 100$ in series. It is important that you connect the experiment setup to the $6V$ AC voltage of the power supply. Build a voltmeter parallel to the primary coil to measure the voltage.
The secondary circuit consists of the second short coil with the same number of turns of $N = 100$ and a voltmeter, which measures the voltage at the secondary coil.
Both coils are placed as close as possible.

Procedure

1. Turn on the power supply.
2. Note the primary voltage and the secondary voltage.
3. What do you expect for the secondary voltage, when you put the iron core in both coils.
4. Switch off the power supply, place the iron core in both coils and switch on the power supply again.
5. Note the primary voltage and the secondary voltage with the iron core between the two coils.

Remark: Measure range for the primary voltage: 0V-2V AC; Measure range for the secondary voltage: 0V-0.2V AC.