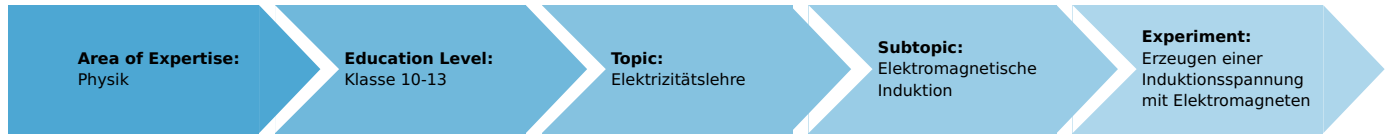


# Generation of an induction voltage with electromagnets (Item No.: P1376600)

## Curricular Relevance



### Difficulty



Easy

### Preparation Time



10 Minutes

### Execution Time



10 Minutes

### Recommended Group Size



1 Student

**Additional Requirements:**

**Experiment Variations:**

**Keywords:**

## Task and equipment

## Information for teachers

## Additional information

It is assumed that the students know that a voltage is induced in a coil, as long as the magnetic field contained by the coil changes.

When the induction process can be triggered by a permanent magnet, then this must also be possible with an electromagnet. The students should check this practically. They should thereby consolidate their knowledge, that the change in the field must not necessarily be brought about by a (mechanical) movement of the magnet and the coil relative to each other.

## Notes on setup and procedure

Long connecting cords are recommended as connections between the induction coil and the galvanometer, as then the galvanometer is not twisted round during the experimental work.

Prior to each experimental step, the students should bring the galvanometer pointer, which swings for a relatively long time, to rest so that the size and direction of the next deflection can be better observed.

## Remarks

The two known, principally different possibilities for inducing a voltage are included in the induction law

$$U_{\text{ind}} = -N \frac{\Delta\Phi}{\Delta t} = -N \frac{\Delta(B \times A)}{\Delta t}$$

where B is the magnetic induction and A the effective cross-sectional area; N is the number of turns on the induction coil. B can be changed by changing the field current strength, A can be changed, e.g., by turning the induction coil in a (homogenous) magnetic field.

On a technical scale, both possibilities are used in transformers or in generators.

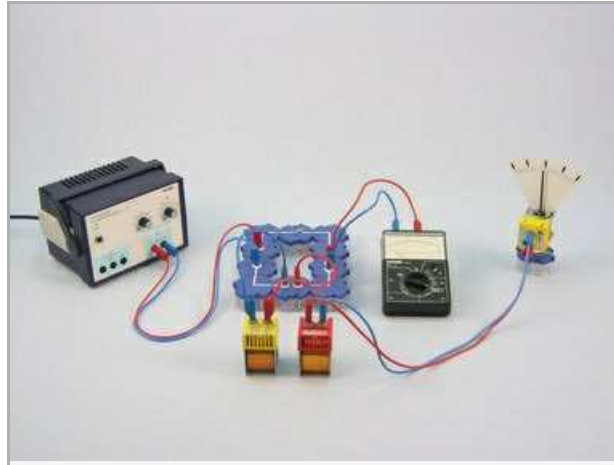
# Generation of an induction voltage with electromagnets (Item No.: P1376600)

## Task and equipment

### Task

#### Can a voltage be induced by means of an electromagnet?

Determine if a voltage can be induced by an electromagnet and examine in which way this is possible.



Equipment



Position No.	Material	Order No.	Quantity
1	Straight connector module, SB	05601-01	1
2	Angled connector module, SB	05601-02	4
3	Interrupted connector module, 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	U-core	07832-00	1
10	Yoke	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 DC: 0...12 V, 2 A / AC: 6 V, 12 V, 5 A	13505-93	1
19	Multi-range meter, analogue	07028-01	1

## Set-up and procedure

### Set-up

- Assemble the galvanometer model as shown in Fig. 3, Fig. 4 and Fig. 5, and plug it in a connector building block with socket.
- Set up the circuit as shown in Fig. 1 and Fig. 2, first with the switch open and without the yoke in the field coil (400 turns); use two 50 cm cords to connect the galvanometer to the induction coil (1600 turns); position the induction coil and the field coil in front of the circuit.

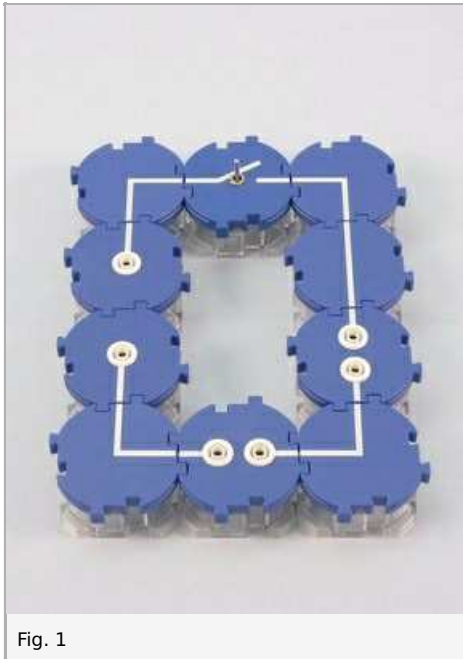


Fig. 1

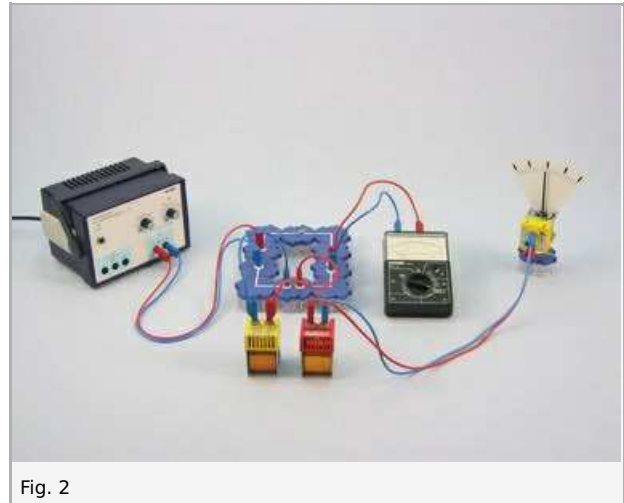


Fig. 2



Fig. 3

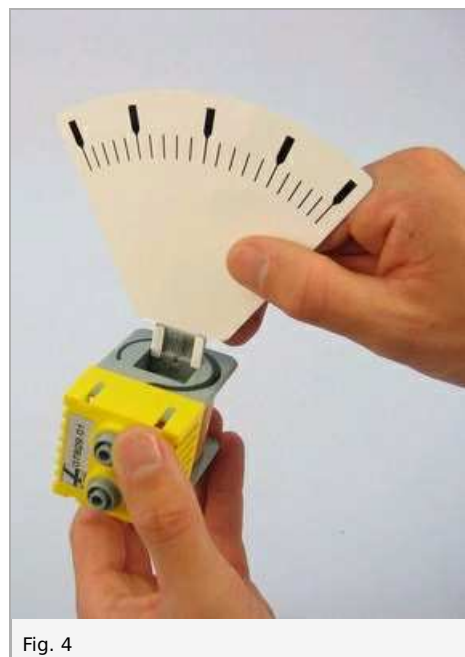


Fig. 4



Fig. 5

## Procedure

- Select the 3 A- measurement range; set the power supply to 4 V- and switch it on; close the switch.
- Move the field and induction coils as quickly as possible to and away from each other (along the coil axes and also vertically to them), while observing the galvanometer deflection and note what you observe under Result - Observations 1 in the report; also note the current strength in the field coil.
- Push the yoke (I-core) into the field coil (see Fig. 6) and make the same movements of the coils relative to each other as previously; note what you observe under Result - Observations 2.
- Position the coils next to each other as shown in Fig. 6, and open and close the switch; note what you observe under Result - Observations 3.
- Push the yoke into both coils to the same distance, again open and close the switch and note what you observe under Result - Observations 4.
- Plug the field and induction coils onto the U-core (see Fig. 7); open and close the switch; note what you observe under Result - Observations 5; observe and note the size of the pointer deflection.
- With the switch closed change the power supply voltage between 0 V and 4 V; note what you observe under Result - Observations 6.
- Set the power supply to 0 V and select the 300 mA measurement range; lay the yoke on the U-core.
- Adjust the voltage so that the ammeter shows 100 mA, then open and close the switch; observe the pointer deflection and compare it with that noted under Result - Observation 5; note your result under Result - Observations 7.
- Adjust the voltage so that the ammeter shows 200 mA, then open and close the switch; observe the pointer deflection and compare it with the previous one; note your result under Result - Observations 8.
- Set the power supply to 0 V and switch it off.

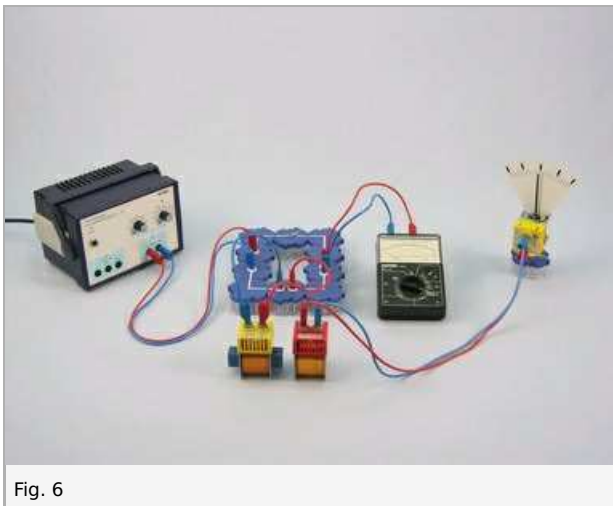


Fig. 6

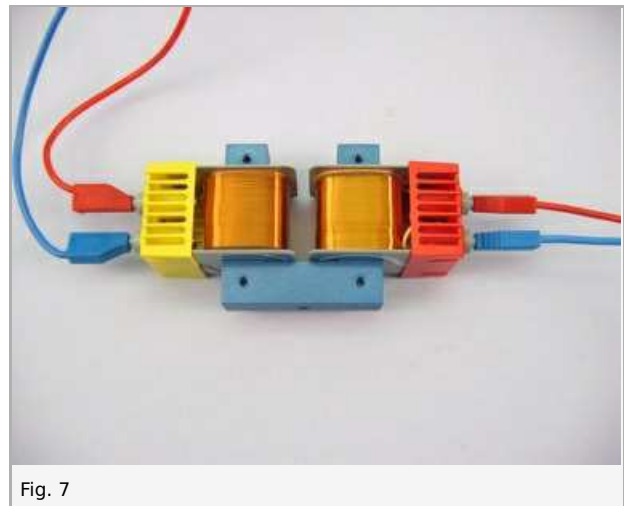


Fig. 7

# Report: Generation of an induction voltage with electromagnets

## Result - Observations 1

Note your observations.

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## Result - Observations 2

Note your observations.

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### **Result - Observations 3**

Note your observations.

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### **Result - Observations 4**

Note your observations.

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### **Result - Observations 5**

Note your observations.

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### **Result - Observations 6**

Note your observations.

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### **Result - Observations 7**

Note your observations.

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### **Result - Observations 8**

Note your observations.

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### **Evaluation - Question 1**

In which principally different ways was an induction voltage generated in this experiment?

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### **Evaluation - Question 2**

What is therefore necessary for a voltage to be generated in the induction coil?

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### Evaluation - Question 3

What was achieved by the use of the yoke, the U-core and finally the U-core with yoke?

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### Evaluation - Question 4

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

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