Lenz's law (Item No.: P1399300)

Curricular Relevance

Area of Expertise:	Education Level:	Topic:	Subtopic:	Experiment:
Physics	Age 14-16	Electricity	Electromagnetism	Lenz's law

Difficulty	Preparation Time	Execution Time	Recommended Group Size
Intermediate	10 Minutes	10 Minutes	2 Students

Additional Requirements:

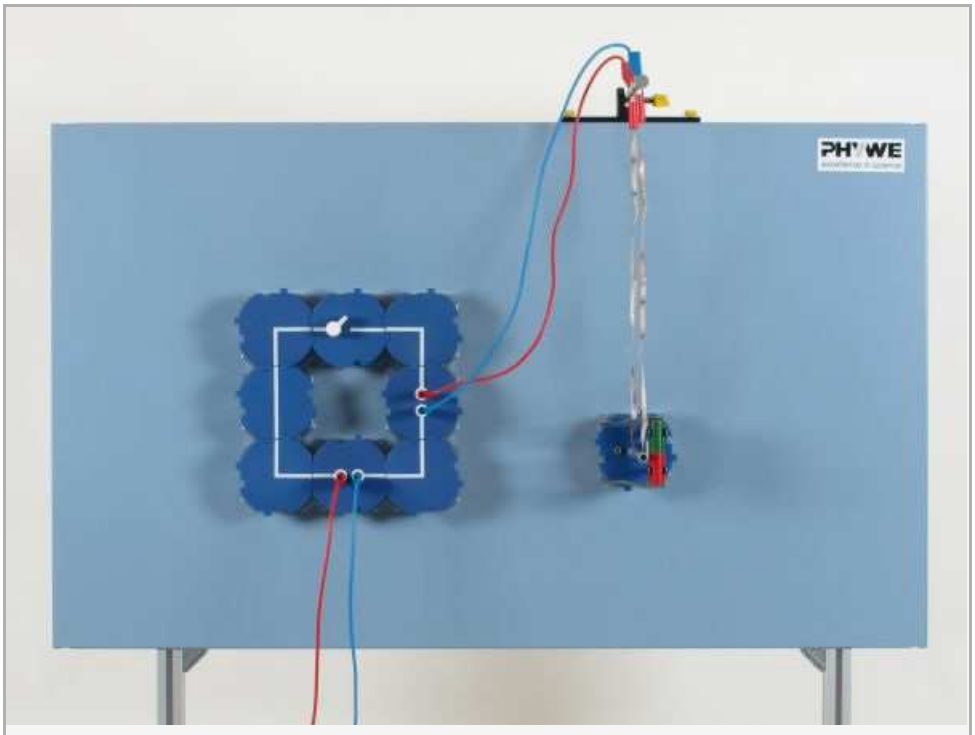
Experiment Variations:

Keywords:

Principle and equipment

Principle

A conductor swing that is moved in the field of a permanent magnet is to be used to derive Lenz's law.



Experimental set-up

Equipment

Position No.	Material	Order No.	Quantity
1	Multimeter ADM2, demo., analogue	13820-01	1
2	PHYWE power supply, universal DC: 0...18 V, 0...5 A / AC: 2/4/6/8/10/12/15 V, 5 A	13500-93	1
3	Demo Physics board with stand	02150-00	1
4	Holder for U-magnet, module DB	09476-00	1
5	Switch on/off, module DB	09402-01	1
6	Insulating support, l = 235 mm	07924-00	1
7	Conductor swing	06412-00	1
8	Clamp on holder	02164-00	1
9	Connector interrupted, module DB	09401-04	2
10	Magnet holder,d=18mm	09476-10	1
11	Connector, straight, module DB	09401-01	1
12	Connector, angled, module DB	09401-02	4
13	Magnet, bar-shaped, d = 18 mm, l = 70mm	06318-00	1
14	Pole shoes,1 pair (18x4x70)mm	09476-11	1
15	Connecting cord, 32 A, 1000 mm, red	07363-01	1
16	Connecting cord, 32 A, 1000 mm, blue	07363-04	1
17	Connecting cord, 32 A, 750 mm, red	07362-01	1
18	Connecting cord, 32 A, 750 mm, blue	07362-04	1

Robert-Bosch-Breite 10
D - 37079 Göttingen

Tel: +49 551 604 - 0
Fax: +49 551 604 - 107

info@phywe.de
www.phywe.com

Set-up and procedure

- Set up the experiment as shown in Fig. 1; fix the insulating support to the upper edge of the demo board with the clamp on holder, hang the conductor swing on the insulating support
- Connect the connecting cables so that, when the switch is closed, current can flow through the horizontal part of the conductor swing to the board; fix the magnet so that its north pole points downwards
- Switch on the power supply, set the voltage to approx. 5 V- and select the 3 A current limit
- Make the students aware of the current direction that is to be expected and the positions of the poles of the magnet!
- Close the circuit briefly several times and observe the conductor swing (1)
- With the switch open, reverse the polarity of the applied voltage
- Again close the circuit briefly several times and observe the conductor swing (2)
- Restore to the original polarity; briefly close the circuit once and notice the expected deflection of the conductor swing
- With the switch open, connect the ADM 2 in place of the power supply and set the polarity as it was as the power supply was connected; set the 1 µA- measurement range
- Close the switch and move the condutor swing smartly to the right a few times; observe the ADM 2 deflection (3)
- Move the conductor swing smartly to the left a few times; observe the ADM 2 deflection (4)

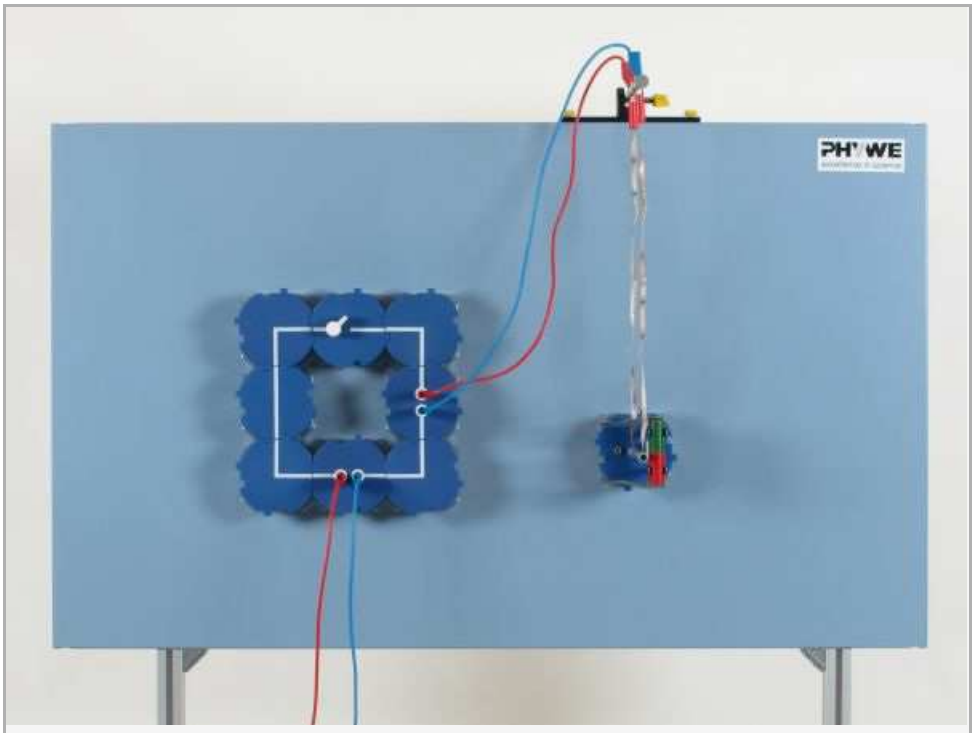


Fig. 1

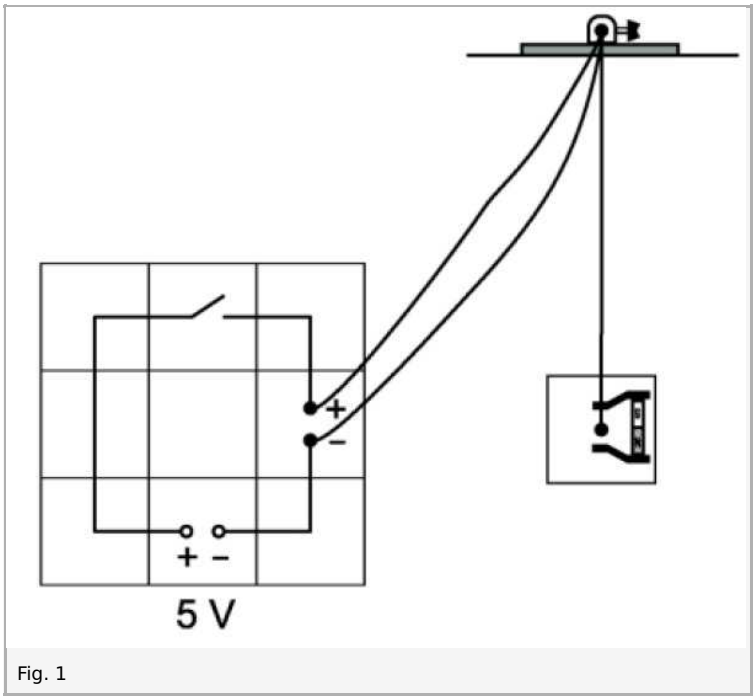


Fig. 1

Observation and evaluation

Observation

1. The conductor swing is deflected to the right, as long as current flows through the conductor swing to the board.
2. When the current flows from the board onwards, the deflection is to the left.
3. When conductor swing is moved to the right, an induction current is generated that flows from the board onwards.
4. When the movement is to the left, then the induction current flows towards the board.

Evaluation

As long as electric current flows through the conductor swing, a force is exerted which moves it to the left or the right.

When the conductor swing is moved to the right or the left, then the magnetic field that it spans is changed and an induction current is generated, that has the opposite direction to the current that caused the corresponding movement.

It is generally valid, that the induction current is always so directed, that it opposes its cause (Lenz's law).

Remarks

The proposed directions of the current and the movement have been purposely selected so that Figs. 2 and 3 can be related to as the experimental steps are carried out.
This is a good opportunity to again refer to Fleming's right-hand rule for determining the direction in which the conductor swing moves (Fig. 2), or the direction of the induced current (Fig. 3). For Fig. 2:
Extend the thumb, forefinger and second finger of the right hand mutually at right angles. Point the forefinger in the direction of the field and the thumb in the direction of the motion. The second finger now points in the direction of the induced current. To help remember this:

Thu**M**b = Direction of **M**ovement (here, of the conductor swing)

Forefinger = Direction of the magnetic **F**ield lines

Se**C**ond finger = Direction of the induced **C**urrent.

All of these directions are at right-angles to each other. The induced current is directed to act against its cause. Current l_{ind} in Fig. 3 therefore has the opposite direction to current I in Fig. 2. Should a power supply with automatic current limitation not be available, then the voltage must be previously so set that the current does not go above 3 A, to avoid overloading of the conductor swing.

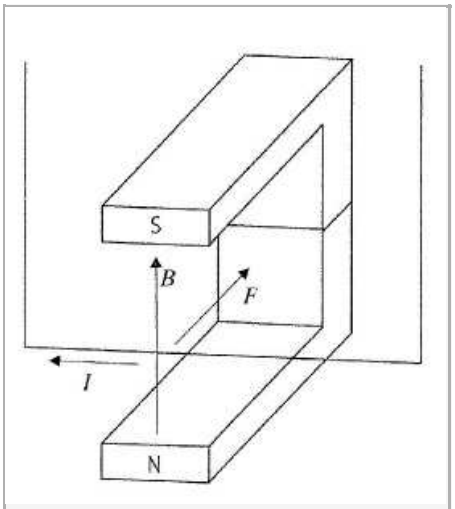


Fig. 2

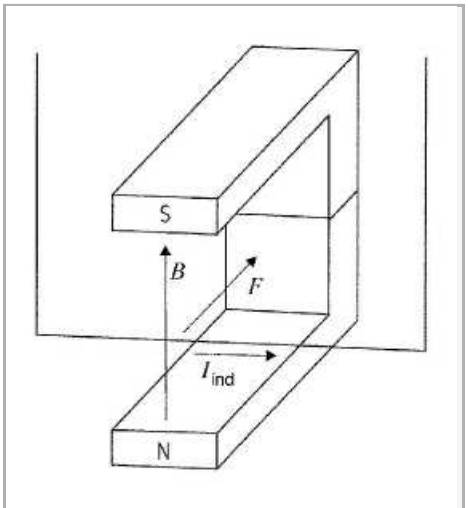


Fig. 3