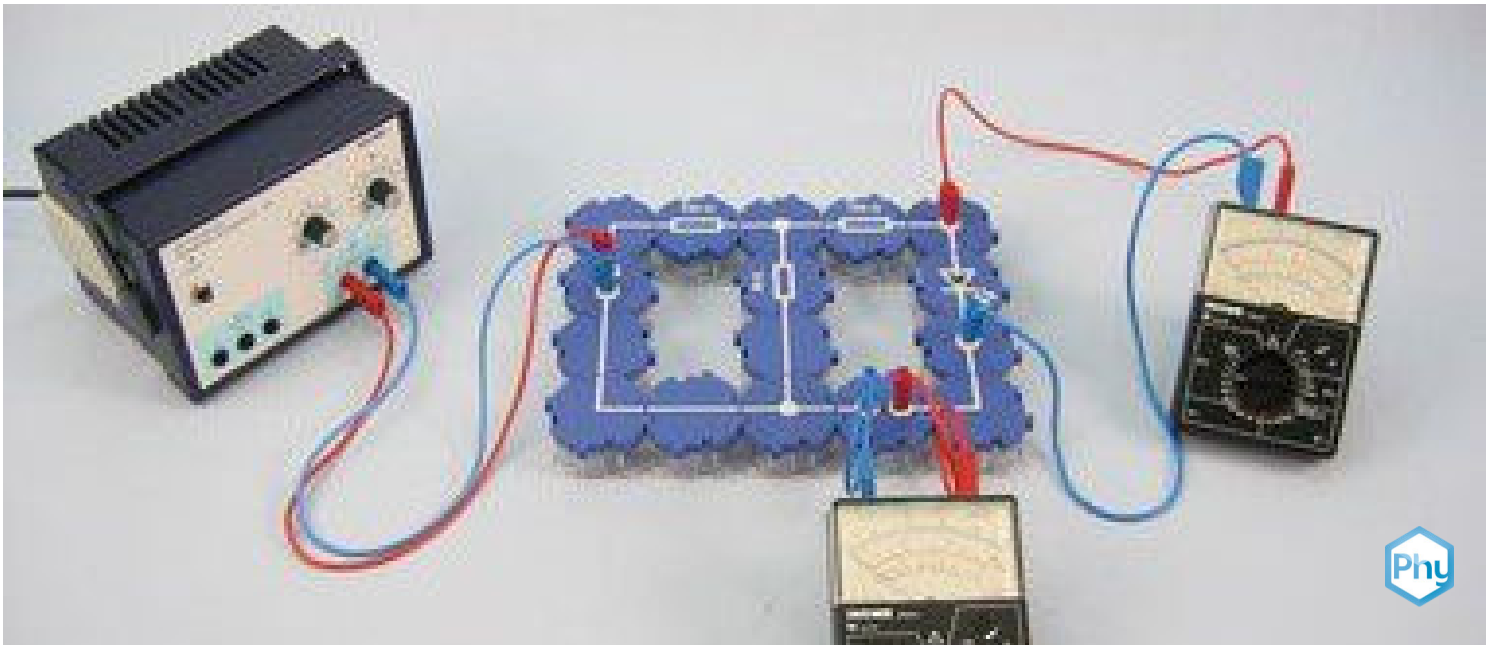
Light-emitting diodes



The students should recognise how a light-emitting diode works by means of the experiment.

Physics > Electricity & Magnetism > Electronics

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

This content can also be found online at:

http://localhost:1337/c/631714879ebaee00039a3d96

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Teacher information

Application

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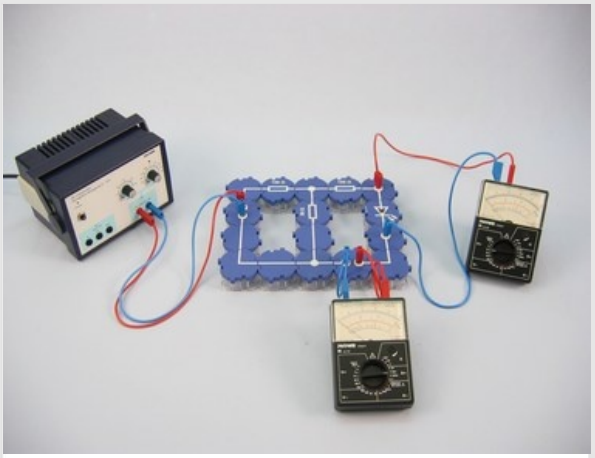

Experimental setup

Light emitting diodes (LEDs) are pn junctions made of GaAs or GaP. Depending on the desired wavelength of the light, the substrates are doped with different elements.

If the pn junctions are connected to a current source in the forward direction, electrons and holes flood the boundary layer and recombine there. The energy expended is released in the form of visible or infrared light.

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Other teacher information (1/2)

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Prior knowledge

Students should be familiar with how an ordinary diode works.

Principle

When operated in the reverse direction, a light-emitting diode behaves like an ordinary diode. However, the maximum reverse voltage is quite low. In some cases it is less than 10 V.

Other teacher information (2/2)

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Learning objective

The students should recognise how a light-emitting diode works by means of the experiment.

Tasks

1. Investigate the dependence between current and voltage on a light-emitting diode in the forward and reverse directions and the electrical power absorbed by the diode.
2. Test the suitability of light-emitting diodes for determining the type of current and the polarity of current sources.

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Safety instructions

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

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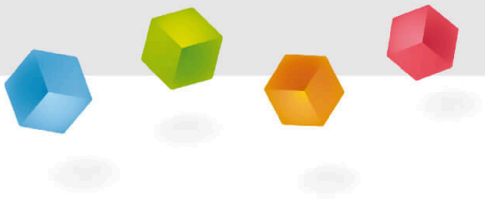

Student information

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Motivation

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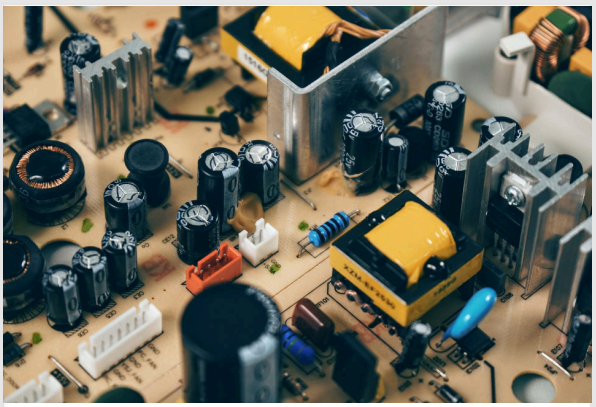
A diode is an electronic component that allows current to pass in one direction and blocks the flow of current in the other direction.

Light emitting diodes (LEDs) are pn junctions made of GaAs or GaP. Depending on the desired wavelength of the light, the substrates are doped with different elements. If the pn junctions are connected to a current source in the forward direction, electrons and holes flood the boundary layer and recombine there. In the process, the energy expended is released in the form of visible or infrared light.



Electronic components

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Equipment

Position	Material	Item No.	Quantity
1	Straight connector module, SB	05601-01	3
2	Angled connector module, SB	05601-02	4
3	T-shaped connector module, SB	05601-03	2
4	Interrupted connector module with sockets, SB	05601-04	2
5	Straight connector module with socket, SB	05601-11	1
6	Angled connector module with socket, SB	05601-12	1
7	Resistor module 50 Ohm, SB	05612-50	1
8	Resistor module 100 Ohm, SB	05613-10	2
9	Light emitting diode module red , SB	05654-00	1
10	Connecting cord, 32 A, 250 mm, red	07360-01	1
11	Connecting cord, 32 A, 250 mm, blue	07360-04	1
12	Connecting cord, 32 A, 500 mm, red	07361-01	2
13	Connecting cord, 32 A, 500 mm, blue	07361-04	2
14	PHYWE Power supply, 230 V, DC: 0...12 V, 2 A / AC: 6 V, 12 V, 5 A	13506-93	1
15	PHYWE Analog multimeter, 600V AC/DC, 10A AC/DC, 2 MΩ, overload protection	07021-11	2

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Equipment

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Position	Material	Item No.	Quantity
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9	Light emitting diode module red , SB	05654-00	1
10	Connecting cord, 32 A, 250 mm, red	07360-01	1
11	Connecting cord, 32 A, 250 mm, blue	07360-04	1
12	Connecting cord, 32 A, 500 mm, red	07361-01	2

Set-up

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1st experiment

- Set up the experiment according to Fig. 1 and Fig. 2. Set the measuring ranges 10 V- and 30 mA-.

2nd experiment

- Set up the experiment according to Fig. 3 and Fig. 4 and set the DC voltage to 6 V.

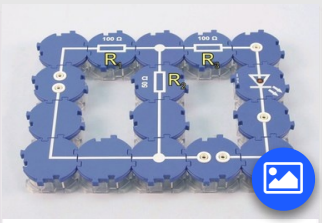

Fig. 1

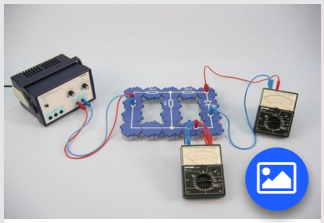

Fig. 2

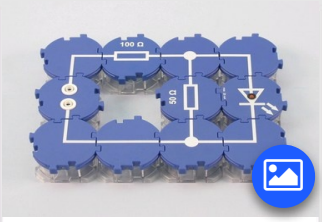

Fig. 3

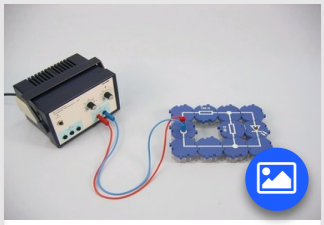

Fig. 4

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Procedure (1/2)

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1st experiment

- Switch on the power supply unit and increase the voltage step by step from 0 V. Enter the measured values for current and diode voltage in the table in the report.
- Switch off the power supply unit. Insert the LED with opposite polarity into the circuit as in Fig. 5 and Fig. 6.
- Switch on the power supply unit and determine measured values for current and voltage in the same way. Enter the values in Table 1. Since you have changed the polarity of the diode, enter the values for the voltage as negative values in the table. Switch off the power supply unit.

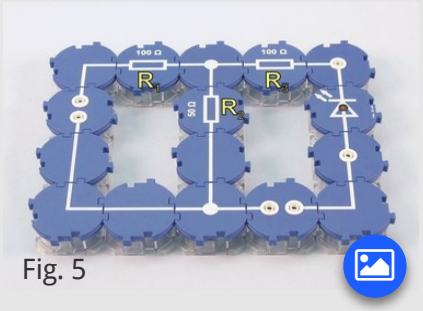

Fig. 5

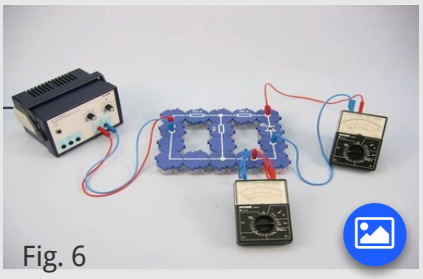
Fig. 6

Procedure (2/2)

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2nd experiment

- **Task 1**: Set the DC voltage to 6 V and switch on the power supply unit.
- Observe the light-emitting diode, then turn it 180° (Fig. 7 and Fig. 8) and observe it again. Write down your observations.
- Change the connection cables on the power supply unit to AC voltage 6 V.
- **Task 2:** Carry out the observations and reconnect the light-emitting diode in the same way as for the DC voltage. Make a note of your observations. Switch off the power supply.

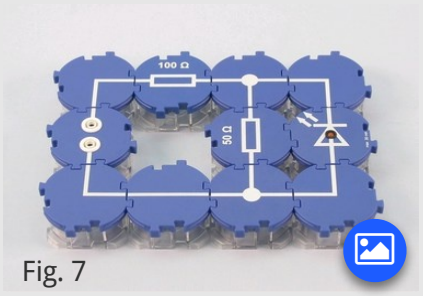

Fig. 7

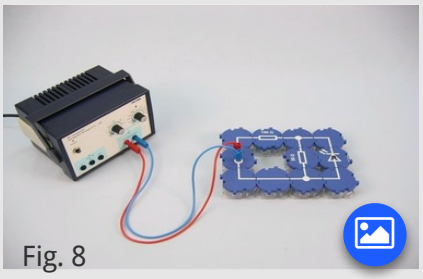
Fig. 8

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Report

Table

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U_N [V]	U_D [V]	I_D [V]	U_N [V]	U_D [V]	I_D [V]	U_N [V]	U_D [V]	I_D [V]
-12			-2			8		
-10			0			10		
-8			2			12		
-6			4					
-4			6					

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Observation (1/2)

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Write down your observations on the 1st task of the 2nd experiment.

Observation (2/2)

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Write down your observations on the 2nd task of the 2nd experiment.

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Task (1/5)

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Describe the characteristic curve and its relationship to the diode's glow. Compare the characteristic curve with that of a normal silicon diode.

Task (2/5)

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What is the maximum electrical power absorbed by the light-emitting diode? Make a comparison with the electrical power of an incandescent lamp for low voltages.

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Task (3/5)

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Explain the behaviour of the light emitting diode when connected to DC voltage (Result - Observations 1).

Task (4/5)

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How can the observation in Result - Observations 2 be explained?

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Task (5/5)

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Drag the words into the correct boxes!

With the help of a light-emitting diode, _____ can be distinguished from DC voltage, since the diode _____ at the _____ of the AC voltage when operated with AC voltage, while it lights up _____ when operated with DC voltage. The polarity of the DC voltage can also be determined, as the diode only lights up in the direction of the _____ of the DC voltage.

- polarity
- flickers
- AC voltage
- frequency
- constantly

Check

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