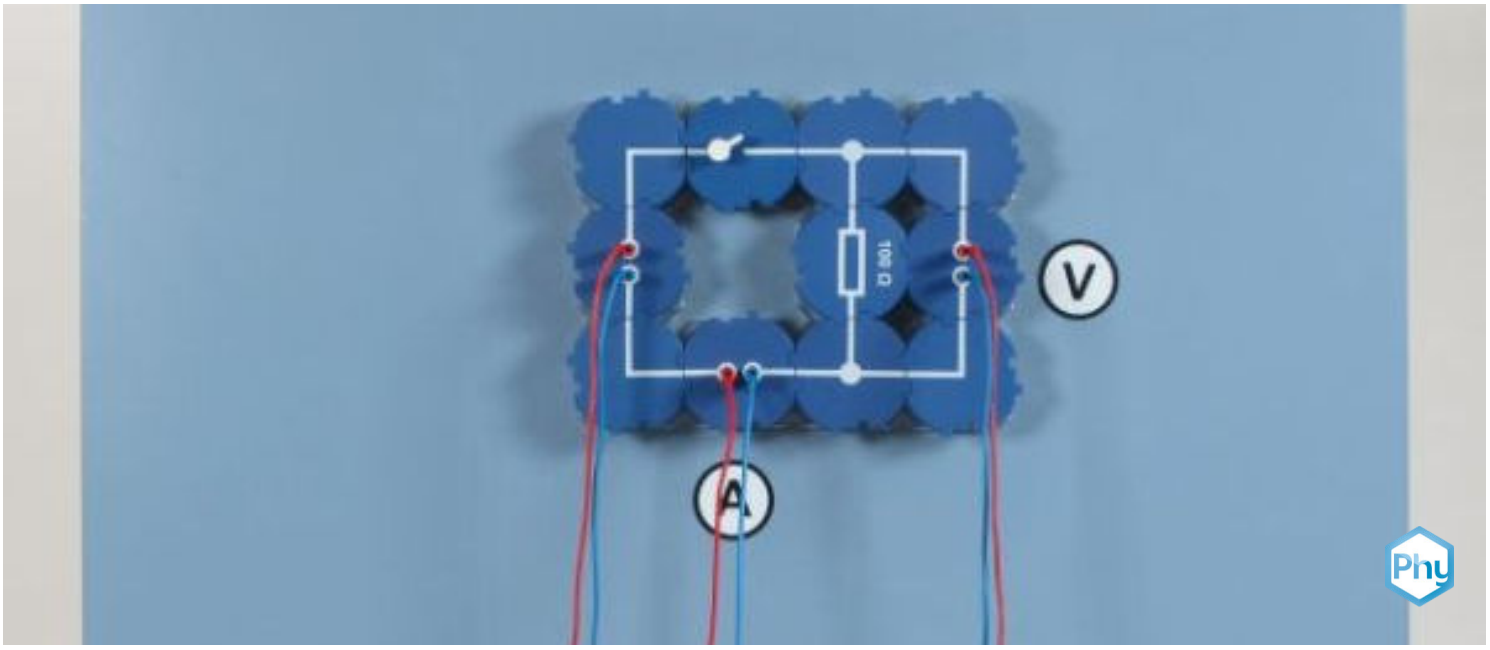
Ohm's law



Students should recognise the proportional relationship between voltage and amperage and develop an understanding of the concept of resistance.

Physics > Electricity & Magnetism > Simple circuits, resistors & capacitors

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

This content can also be found online at:

http://localhost:1337/c/6474e16c21530f000293d973

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General information

Application

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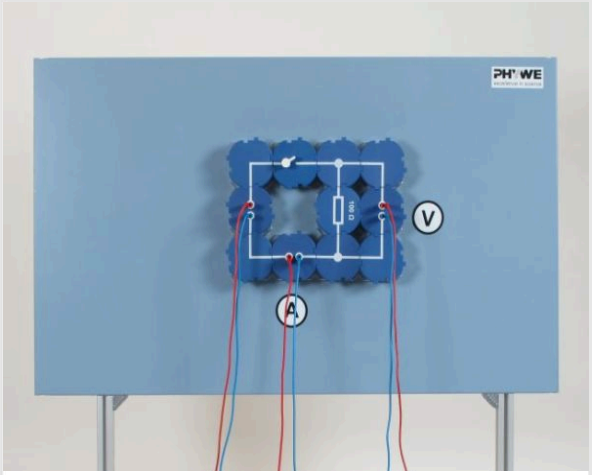

Experimental setup

This experiment is about the experimental derivation of Ohm's law. The law was named after Georg Simon Ohm. In 1825, he was looking for a mathematical relationship to calculate the "effect of flowing electricity" (current strength) as a function of the dimension and material of the electrical conductor.. After many experiments, he was able to establish the connection between electrical voltage U, electrical current I and electrical resistance R, by means of $U = R \cdot I$.

This experiment is about the experimental derivation of Ohm's law. The law was named after Georg Simon Ohm. In 1825 he was looking for a mathematical connection to calculate the "effect of flowing electricity" (current

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Other information (1/2)

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Prior knowledge

The students should be familiar with the functioning of the simple electric circuit and know the terms voltage and amperage.

Principle

By means of simple experiments, it can be demonstrated that the electric voltage is proportional to the electric current.

Other information (2/2)

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Learning objective

Students should recognise the proportional relationship between voltage and amperage and develop an understanding of the concept of resistance.

Tasks

First, the current intensity is measured for two concrete resistors, at different voltages. In the second part, the resistor is replaced by an incandescent lamp.

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Safety instructions

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

Theory

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Ohm's law states that the electrical voltage U which decreases across an object is proportional to the electrical current intensity I . The proportionality factor is the material-specific resistance R.

The following therefore applies: $U = R \cdot I$.

The assumption of a constant resistance is only correct in certain cases, especially for metals of constant temperature. In this experiment, however, it is sufficient to consider the resistance as ideal and thus cosntant. In order to avoid irritations when using the word resistance before defining the physical term resistance, the components R_1 and R_2 should be first discussed. The evaluation should then clarify the function of the resistance (inhibiting or impeding the current).

The set of magnetic electrical symbols for the demo board is used for demonstrative labelling of the circuit.

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Equipment

Position	Material	Item No.	Quantity
1	PHYWE Demo Physics board with stand	02150-00	1
2	Connector, angled, module DB	09401-02	4
3	Connector, T-shaped, module DB	09401-03	2
4	Connector interrupted, module DB	09401-04	3
5	Switch on/off, module DB	09402-01	1
6	Socket for incandescent lamp E10 ,module DB	09404-00	1
7	Resistor 50 Ohm,module DB	09412-50	1
8	Resistor 100 Ohm,module DB	09413-10	1
9	Electr.symbols f.demo-board,12pcs	02154-03	1
10	Connecting cord, 32 A, 1000 mm, red	07363-01	3
11	Connecting cord, 32 A, 1000 mm, blue	07363-04	3
12	PHYWE Power supply, universal, analog display DC: 18 V, 5 A / AC: 15 V, 5 A	13503-93	1
13	PHYWE Demo Multimeter ADM 3: current, voltage, resistance, temperature	13840-00	2
14	Filament lamps 12V/0.1A, E10, 10 pieces	07505-03	1
15	G-clamp	02014-01	2

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Set-up and Procedure

Set-up

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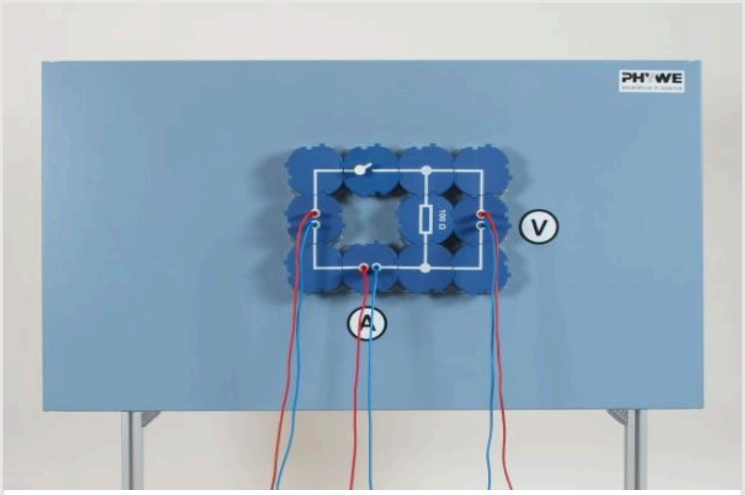

Experimental setup

- Set up the experiment as shown in the illustration on the left and first adjust the resistance to $R_1 = 50\Omega$. Set the measuring ranges to $10V$ and $300mA$.

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Procedure

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- Close the switch, switch on the power supply unit and - starting from $0V$ - increase the voltage in $2V$ steps; measure the respective amperage and note down the measured values.
- Voltage to $0V$ and instead of R_1, put the resistance $R_2 = 100\Omega$ into the circuit.
- Repeat as before and note it down.

- Switch the power supply unit to $0V$ and install the incandescent lamp in the circuit instead of the technical resistor.
- As with the 1st attempt, starting from $0V$ - increase the voltage in $2V$ steps, measure the current reached in each case and note it down; observe the bulb during the series of measurements.

Evaluation (1/5)

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Based on the test series for the first part of the test, the following table of measured values can be drawn up as an example:

$\frac{U}{\mathrm{V}}$	$\frac{I}{\mathrm{A}}$		$\frac{U/I}{\mathrm{V/A}}$	
	(R_1)	(R_2)	(R_1)	(R_2)
0	0	0	-	-
2	0,039	0,020	51	100
4	0,079	0,039	51	102
6	0,120	0,060	50	100
8	0,161	0,081	50	98
10	0,201	0,100	50	100

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Evaluation (2/5)

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If you now replace the resistor with the glow lamp, you will get the following measured values:

$\frac{U}{\mathrm{V}}$	$\frac{I}{\mathrm{A}}$	$\frac{U/I}{\mathrm{V/A}}$
0	0	-
2	0,037	54
4	0,053	75
6	0,069	87
8	0,082	98
10	0,093	108

The brightness of the light bulb increases with increasing voltage or current.

○ True ○ False

Check

Evaluation (3/5)

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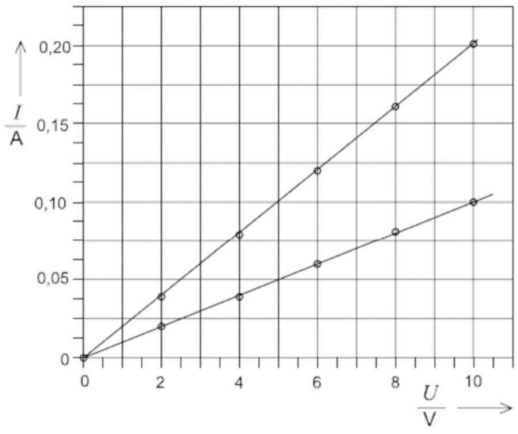
What can be seen from the graph of the measured values from the 1st part of the experiment?

There is a linear relationship between voltage and amperage $U \sim I$.

There is an exponential relationship between voltage and current.

This relationship is called Ohm's law. After the introduction of the term electrical resistance, it is obvious to use the quotient U/I to define resistance R.



Graphical representation of the measured values for the resistors R_1 and R_2

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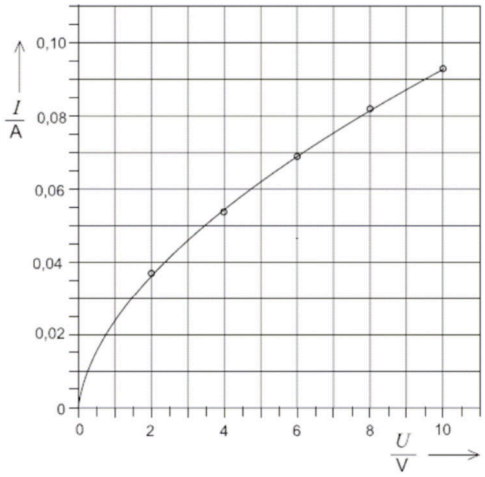
Evaluation (4/5)

What does the graph on the right show?

Ohm's law does [ ] apply to the incandescent lamp. The resistance of the incandescent lamp [ ] with an increase in current, which causes an increase in temperature. Obviously, the resistance of the incandescent lamp is temperature-dependent.

not | grows

Check



Graphical representation of the measured values with incandescent lamp

Evaluation (5/5)

So what is Ohm's law?

- $U = R \cdot I$
- $R = U \cdot I$
- $R = I/U$
- $U = R/I$

What other insight was gained during the experiment?

- Ohm's law is universally valid.
- The resistance is not temperature-dependent.
- Ohm's law only applies to components whose resistance is constant. $R = constant$ is the validity condition for Ohm's law.

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Slide	Score / Total
Slide 12: Proportionality of light bulb brightness and voltage	0/1
Slide 13: Proportionality between voltage and current	0/1
Slide 14: Measurement with incandescent lamp	0/2
Slide 15: Multiple tasks	0/2

Total score 0 / 6

Show solutions Repeat

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