The potentiometer (Item No.: P1373100)

Curricular Relevance

Area of Expertise: Physik
Education Level: Klasse 7-10
Topic: Elektrizitätslehre
Subtopic: Der elektrische Widerstand
Experiment: Das Potentiometer

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

Additional Requirements:

Experiment Variations:

Keywords:

Task and equipment

Information for teachers

Additional information

The students should first recognize from the model that a given voltage can be divided with a potentiometer (voltage divider), and that the dividing function is based on the law for the series connection of resistances $U_1/R_1 = U_2/R_2 = ... = U_n/R_n$. For a homogenous wire, we accordingly have $l_1/R_1 = l_2/R_2 = ... = l_n/R_n$. The potentiometer must hereby not be under load. The students should then use a technical potentiometer, so that they can clearly understand how it functions by working with it.

Notes on setup and procedure

In the first experiment, the lenghts *l* can be freely chosen. The measured values for *l* and *U* can be best compared with each other, however, when the lenghts of wire are in the ratio of approximately 4:3:2:1.
In the second experiment it must be ensured that the preset power supply voltage does not exceed 5 V−, because of the load-carrying ability of the lamp.

Remarks

Potentiometers of low load have a carbon layer instead of a resistor wire.
We suggest you also use the clarifying term "voltage divider" during your introduction to the potentiometer.
When the sliding contact of the potentiometer is connected to the end of the resistor path, then the potentiometer can also be used as a component for changing resistance.

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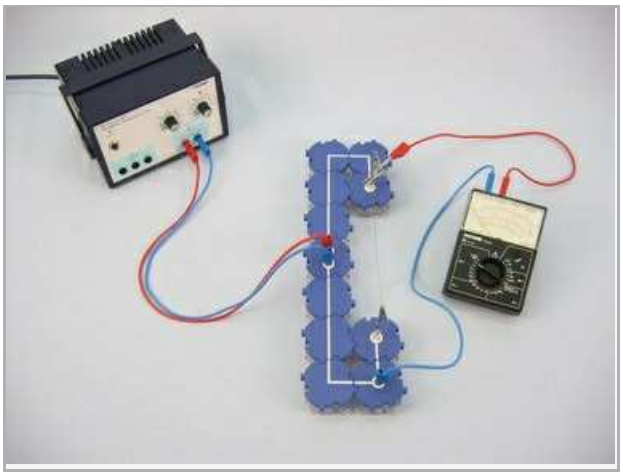
Task and equipment

Task

How does a potentiometer function?

Determine the working principle of a potentiometer from a model of a potentiometer and subsequently use a technical potentiometer to vary the brightness of a filament lamp.



Equipment

Position No.	Material	Order No.	Quantity
1	Straight connector module, SB	05601-01	4
2	Angled connector module, SB	05601-02	3
3	T-shaped connector module, SB	05601-03	1
4	Interrupted connector module, SB	05601-04	1
5	Junction module, SB	05601-10	2
6	Angled connector module with socket, SB	05601-12	2
7	Socket module for incandescent lamp E10, SB	05604-00	1
8	Potentiometer module 250 Ohm, SB	05623-25	1
9	Alligator clips, bare, 10 pcs	07274-03	1
10	Connecting plug, 2 pcs.	07278-05	1
11	Connecting cord, 32 A, 500 mm, blue	07361-04	2
12	Connecting cord, 32 A, 500 mm, red	07361-01	2
13	Filament lamps 4V/0.04A, E10, 10	06154-03	1
14	Constantan wire, 15.6 Ohm/m, d = 0.2 mm, l = 100 m	06100-00	1
15	Multi-range meter, analogue	07028-01	1
16	PHYWE power supply DC: 0...12 V, 2 A / AC: 6 V, 12 V, 5 A	13506-93	1

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Set-up and procedure

Set-up

First experiment

Set up the circuit as shown in Fig. 1 and Fig. 2.

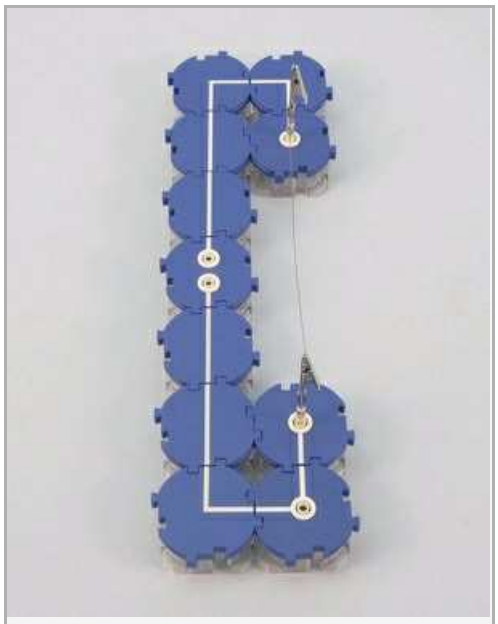


Fig. 1

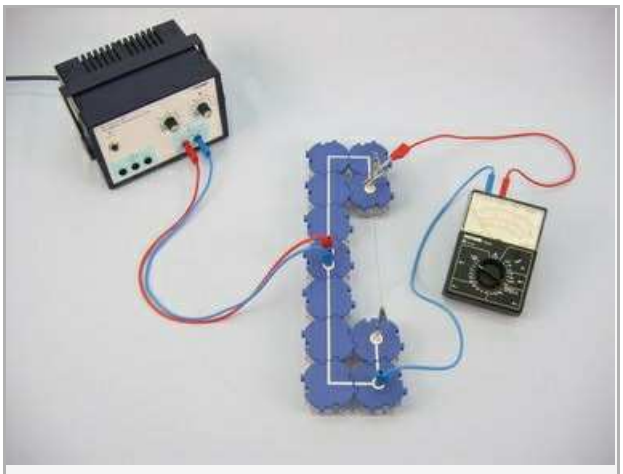


Fig. 2

Second experiment

Set up the experiment as shown in Fig. 3 and Fig. 4; turn the rotary knob of the potentiometer anti-clockwise to the left stop; do not insert the filament lamp yet.

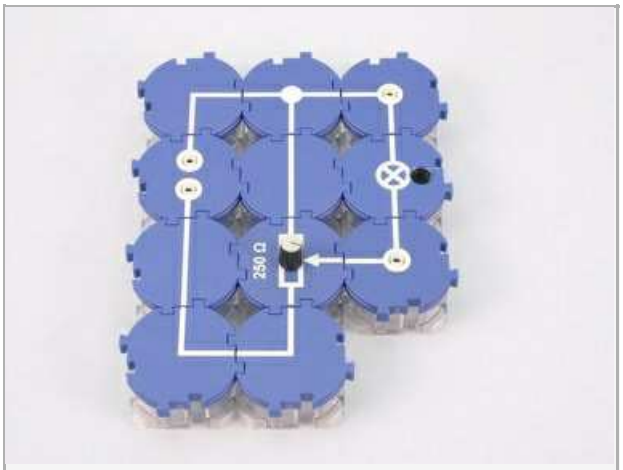


Fig. 3

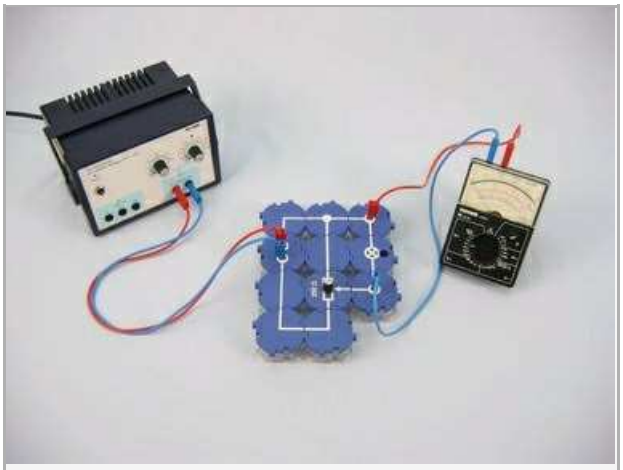


Fig. 4

Procedure

First experiment

- Fix the constantan wire so between two crocodile clips (on connecting plugs) that it does not sag.
- Connect one side of the voltmeter to the lower corner of the circuit with a connecting cable.

- Connect a connecting cable with crocodile clip to the other side of the voltmeter. First attach this crocodile clip to the upper wire connection, as shown in Fig. 5.
- Select the 1 V− measurement range.
- Set the power supply to 0 V, then switch it on.
- Carefully increase the power supply voltage until the voltmeter shows 1 V−.
- Measure the length l of the inserted piece of wire and note the measured value in table 1 in the report.
- Move the crocodile clip successively to connect the voltmeter to different positions on the wire (e.g. about ¾, ½, ¼ along the length of the wire), as shown in Fig. 6. At each position measure the length of wire held and the voltage across this length of wire. Note the measured values for *I* and *U* in table 1.
- Set the power supply back to 0 V and switch it off.

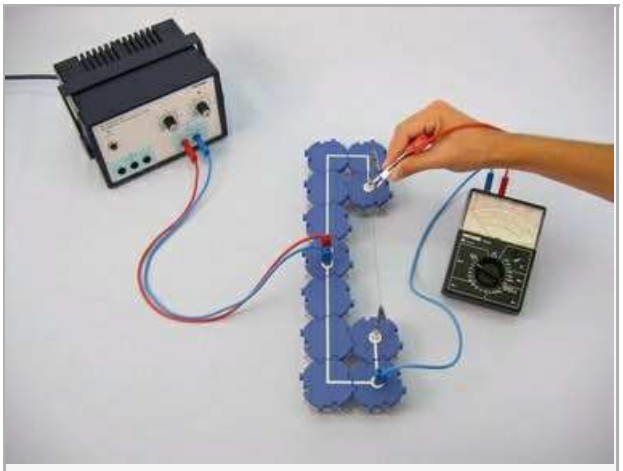


Fig. 5

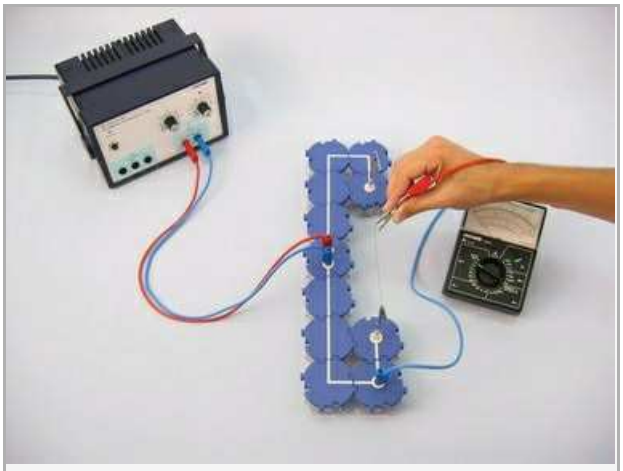


Fig. 6

Second experiment

- Select the 10 V− measurement range.
- Switch on the power supply and set it to about 4 V−.
- Slowly turn the potentiometer knob fully clockwise to the right stop and then back again; observe the deflection of the voltmeter while doing this.
- Note your observation in the report.
- Complete the circuit by fitting in the filament lamp (Fig. 7).
- Slowly turn the potentiometer knob clockwise from the left stop to the right stop and then back again, and observe the lamp while doing so.
- Note your observation in the report.
- Set the power supply to 0 V, then switch it off.

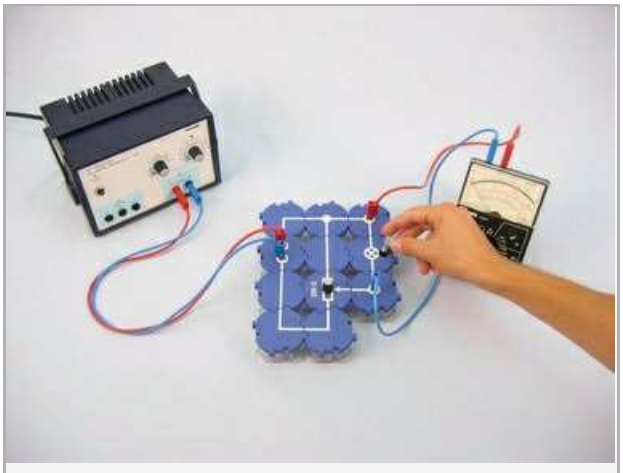


Fig. 7

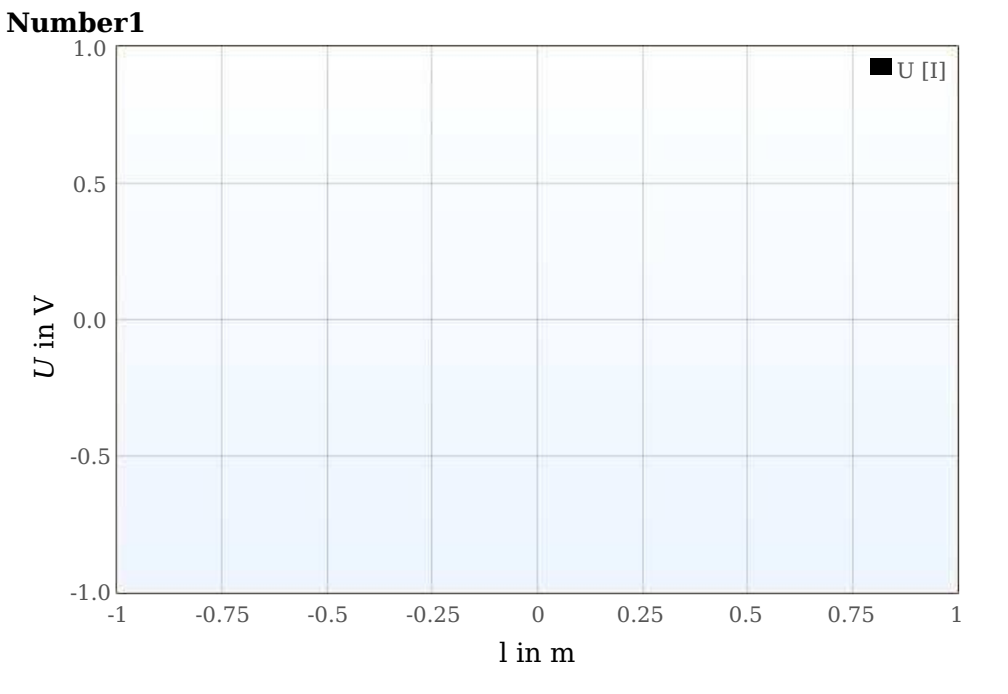
Report: The potentiometer

Result – Table 1

Record the measured values in table 1.

Calculate the quotient *U* / *I* for each pair of measured values obtained and enter the values in column 3 of table 1, too.

I in m	*U* in V	*U* / *I* in *V* / *m*
1	1	1
1	1	1
1	1	1
1	1	1



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Result – Observations

Write down your observations about second experiment:

a) without filament lamp

b) with filament lamp

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Evaluation – Question 1

Refer to the chart showing the dependence of the voltage *U* on the lengths *l* of the wire held. Which relationship between *U* and *l* can you derive from it?

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Evaluation – Question 2

Formulate the mathematical relationship between *U* and *I* in table 1.

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Evaluation – Question 3

The function of a potentiometer is given by the relationship determined under Evaluation – Question 2 and the observations noted under a) and b). Describe what a potentiometer can be used for.

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Evaluation – Question 4

Give examples of where a potentiometer is used in practice.

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