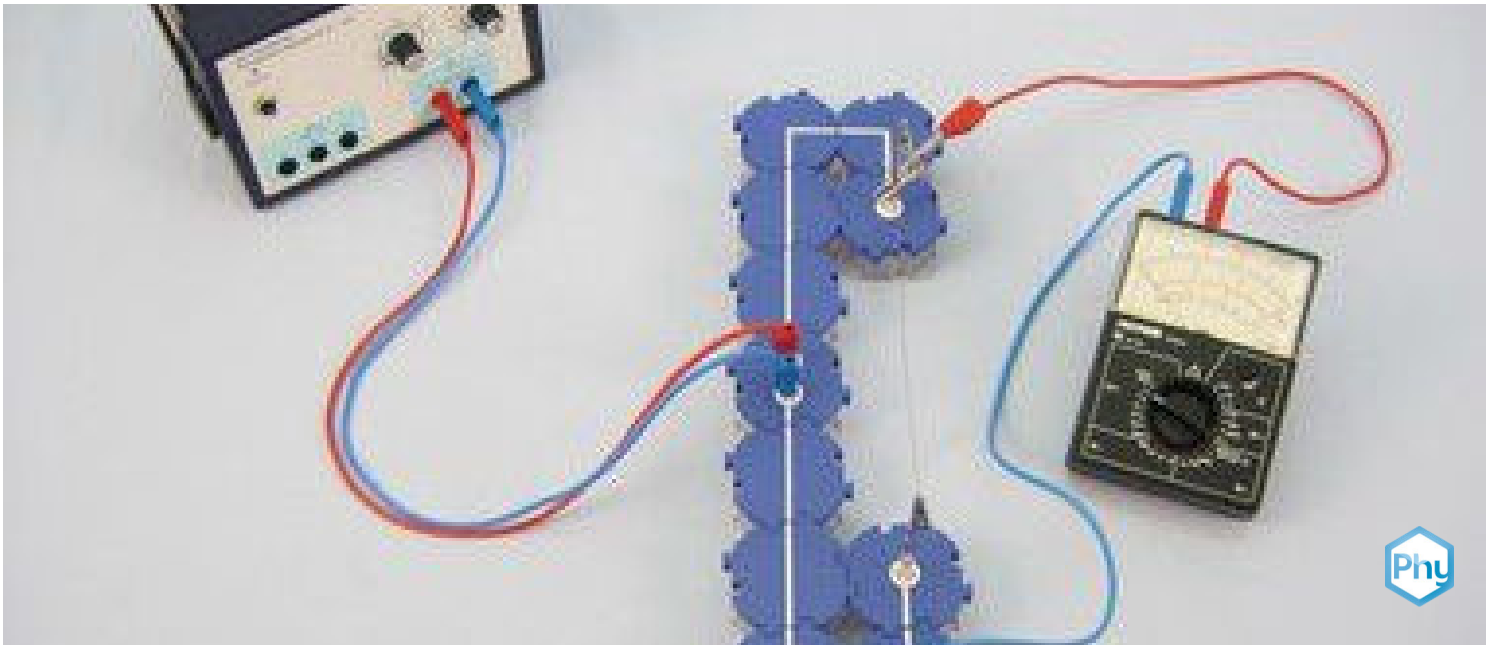
The potentiometer



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

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/630cf24b70919e00038fa0ea

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Teacher information

Application

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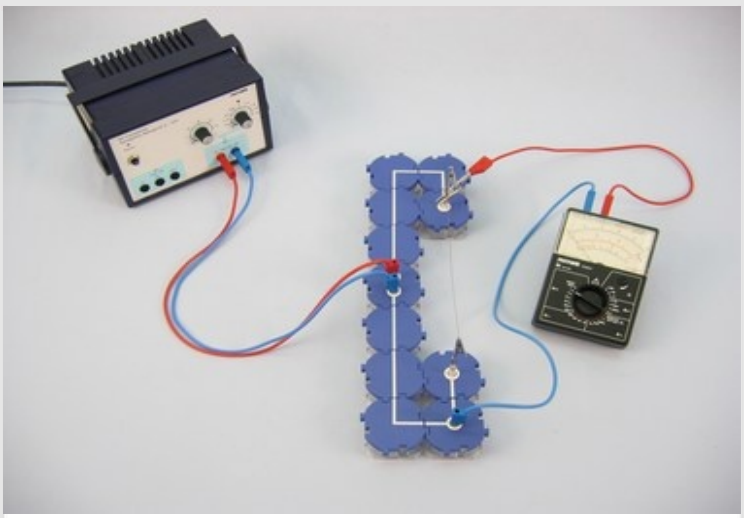

Experimental setup

Potentiometers are electrical resistance components whose resistance values can be changed mechanically (by turning or moving). It has at least three connections (two fixed contacts and a slider) and is mainly used as a continuously adjustable voltage divider. A variable resistance can be tapped via the wiper. Potentiometers are often used to control electronic devices, such as the setting of an amplifier, e.g. the volume setting of a sound amplifier, e.g. in a radio or television set.

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Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
Fax: 0551 604 - 107

info@phywe.de
www.phywe.de

Other teacher information (1/3)

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Prior knowledge

Students should be able to construct a simple circuit and be aware of what voltage and current are. In addition, the principle of resistance should be understood and the formula $R = U/I$ be known.

Learning

The students should understand the principle of a potentiometer by means of a model and experience its function in a vivid way with a technical potentiometer.

Other teacher information (2/3)

Task

Investigate the operating principle of a potentiometer using a potentiometer model. Then vary the brightness of a light bulb with the help of a technical potentiometer.

Principle

A potentiometer represents a voltage divider. If an electrically conductive resistor is tapped at evenly distributed sections with a wiper, it is in principle a series connection of many identical resistors for which applies: $U_1/R_1 = U_2/R_2 = ... = U_n/R_n$. Thus the wiper can change the resistance value and thus also the partial voltage dropping until then almost steplessly.

PHYWE

Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
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info@phywe.de
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Other teacher information (2/3)

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Task

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Other teacher information (3/3)

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Notes

For a homogeneous wire the folllowing applies; $I_1/R_1 = I_2/R_2 = ... = I_n/R_n$.

When dealing with the potentiometer, one should also use the descriptive term voltage divider.

The choice of lengths $l$in the first experiment is in itself arbitrary. The measured values for l and U but are better comparable with each other if the lengths of the wire pieces behave roughly like 4:3:2:1.

In the second experiment, care should be taken that the specified voltage at the power supply unit does not exceed 5 V because of the load capacity of the bulb. Potentiometers whose load is low have a carbon layer instead of resistance wires. If you connect the sliding contact of the potentiometer to one end of the resistance path, you can also use the potentiometer as a variable resistor.

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Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
Fax: 0551 604 - 107

info@phywe.de
www.phywe.de

Safety instructions

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

Student information

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Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
Fax: 0551 604 - 107

info@phywe.de
www.phywe.de

Equipment

Position	Material	Item 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 with sockets, 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, red	07361-01	2
12	Connecting cord, 32 A, 500 mm, blue	07361-04	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	PHYWE Analog multimeter, 600V AC/DC, 10A AC/DC, 2 MΩ, overload protection	07021-11	1
16	PHYWE Power supply, 230 V, DC: 0...12 V, 2 A / AC: 6 V, 12 V, 5 A	13506-93	1

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Robert-Bosch-Breite 10
37079 Göttingen
Tel.: 0551 604 - 0
Fax: 0551 604 - 107
info@phywe.de
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Motivation

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Control knobs of a sound mixer

Potentiometer Electrical component whose resistance values can be changed mechanically (by turning or moving). The resistance can be adjusted almost continuously from one end to the contact on the wiper.

Potentiometers are often used to control electronic devices, such as for setting an amplifier, e.g. the volume setting of a sound amplifier, e.g. in a radio, TV set or on a sound mixer.

In this experiment you will learn how exactly a potetiometer works.

Equipment

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Position	Material	Item No.	Quantity
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Robert-Bosch-Breite 10
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Set-up

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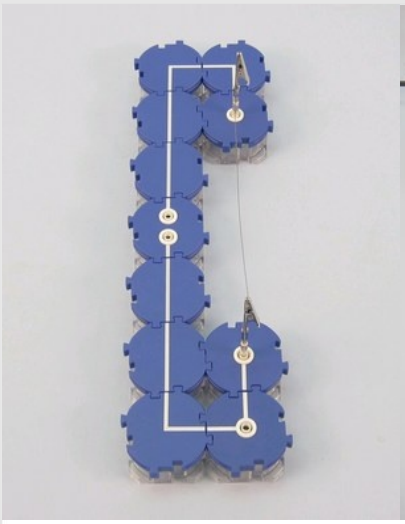
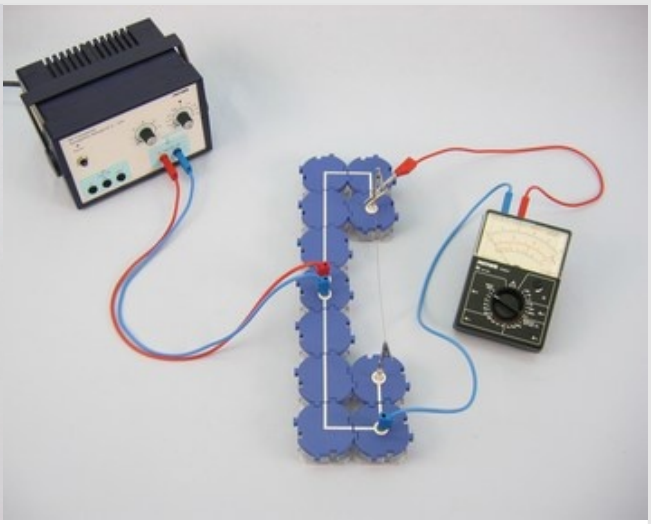
- Set up the experiment according to the photos.
- Clamp the constantan wire between two alligator clips (on connecting plugs) so that it does not sag.
- Connect the voltmeter on one side to the bottom corner of the circuit via a connecting cord.



Circuit



Experimental setup

Procedure (1/4) Part 1

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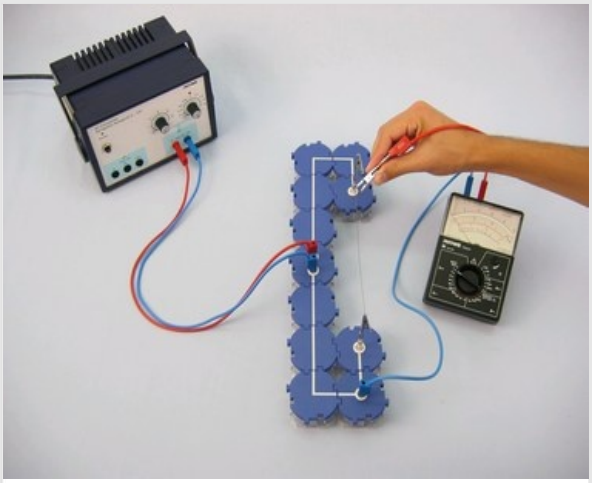

Experimental setup

- Connect a connecting cord with alligator clip to the other side of the voltmeter . First connect this alligator clip to the upper holder of the wire, cf. figure
- Select the measuring range 1V- and set the power supply unit to 0V and 2A (right stop) and switch on.
- Carefully increase the voltage at the power supply unit until the voltmeter shows 1V.
- Length l of the clamped wire and note the measured value.

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Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
Fax: 0551 604 - 107

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Procedure (2/4) Part 1

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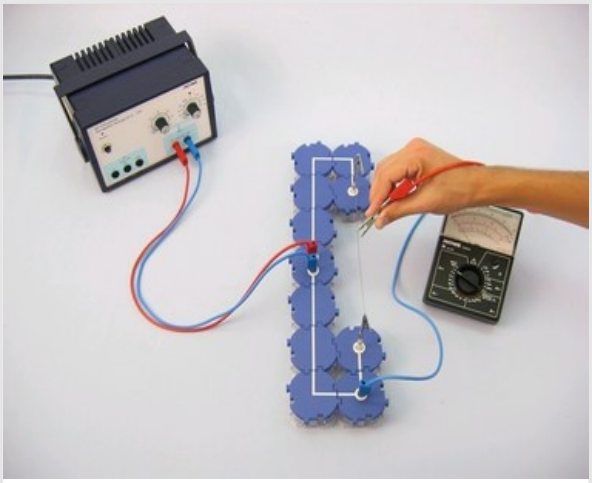

Ex. position for the alligator clip

- Using the alligator clip, connect the voltmeter successively at different points on the wire as shown in the illustration: e.g. at about ¾, ½, ¼ of the wire length.
- Measure the respective tapped length of the wire piece and the voltage across the wire piece. Write down your measured values for l and U in the table in the report.
- Set the power supply unit to 0V and switch it off.

Procedure (3/4) Part 2

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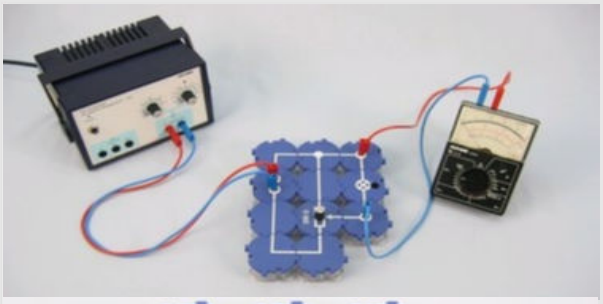

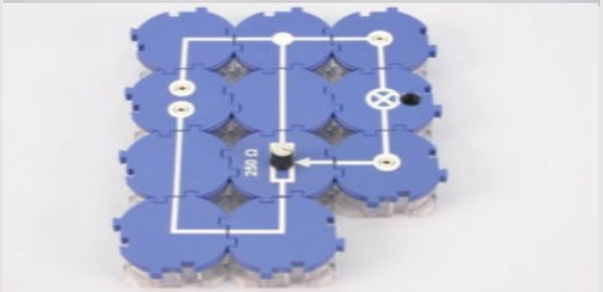

- Now build a circuit as shown in the illustrations opposite.
- Select the measuring range 10V-, switch on the power supply and set it to about 4V.
- Now slowly turn the knob of the potentiometer clockwise to the right stop and back again.
- Observe the deflection of the voltmeter.

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Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
Fax: 0551 604 - 107

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Procedure (4/4) Part 2

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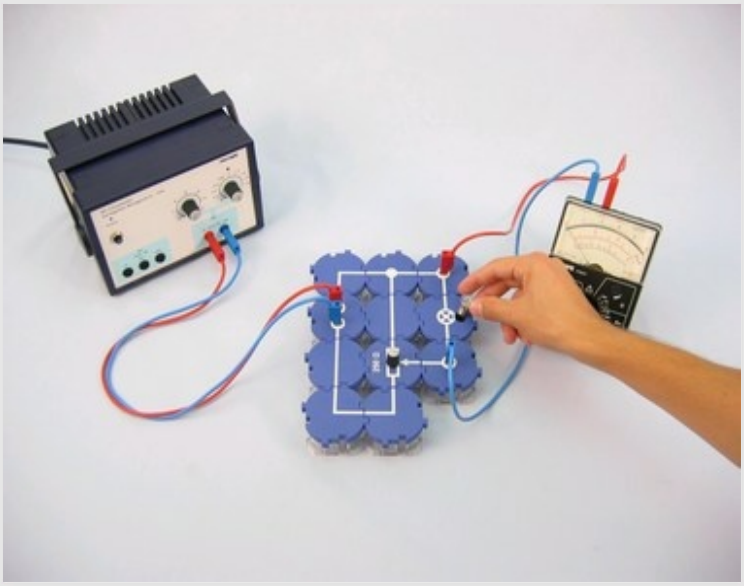

- Complete the circuit by installing the bulb. (cf. illustration).
- Turn the potentiometer knob slowly from the left stop to the right stop and then back again.
- Observe the brightness of the bulb in particular.
- Set the power supply unit to 0 V and switch it off.

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Report

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Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
Fax: 0551 604 - 107

info@phywe.de
www.phywe.de

Task 1

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Enter the measured values for the different positions of the crocodile clip of the execution of the first part of the experiment in the table.

Position	$l\,[m]$	$U\,[V]$	$U/l\,[V/m]$
1			
2			
3			
4			

What is the connection between U and l results from the table?

Tip: Carry U against I as a graph.

- $U \propto l$
- $U \propto \sqrt{l}$
- $U \propto l^2$
- $U \propto 1/l$

Task 2

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Remember the observations made during experiments 1 and 2 and also the connection from task 1. Using the gap fillers, describe how a potentiometer works.

A potentiometer consists of a _____ and (usually) a sliding _____, usually called a slider. With a _____, for example, turning the knob activates an electrical contact which is moved over this layer. This varies the _____ of the electrically conductive material, so to speak, which in turn changes the value of the _____.

- length
- contact
- resistor layer
- electrical resistance
- knob

Check

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Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
Fax: 0551 604 - 107

info@phywe.de
www.phywe.de

Task 3

Remember the observations made during experiments 1 and 2 and also the context from task 1. Using the gap fillers, describe what a potentiometer is used for.

A _____ is very suitable for _____ electronic devices. A simple example of this is the _____ of radios or televisions or the _____ of lamps. The _____ also has a potentiometer for adjusting the _____.

power supply
brightness
output voltage
adjusting
potentiometer
volume control

Check

PHYWE
Robert-Bosch-Breite 10
37079 Göttingen
Tel.: 0551 604 - 0
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info@phywe.de
www.phywe.de