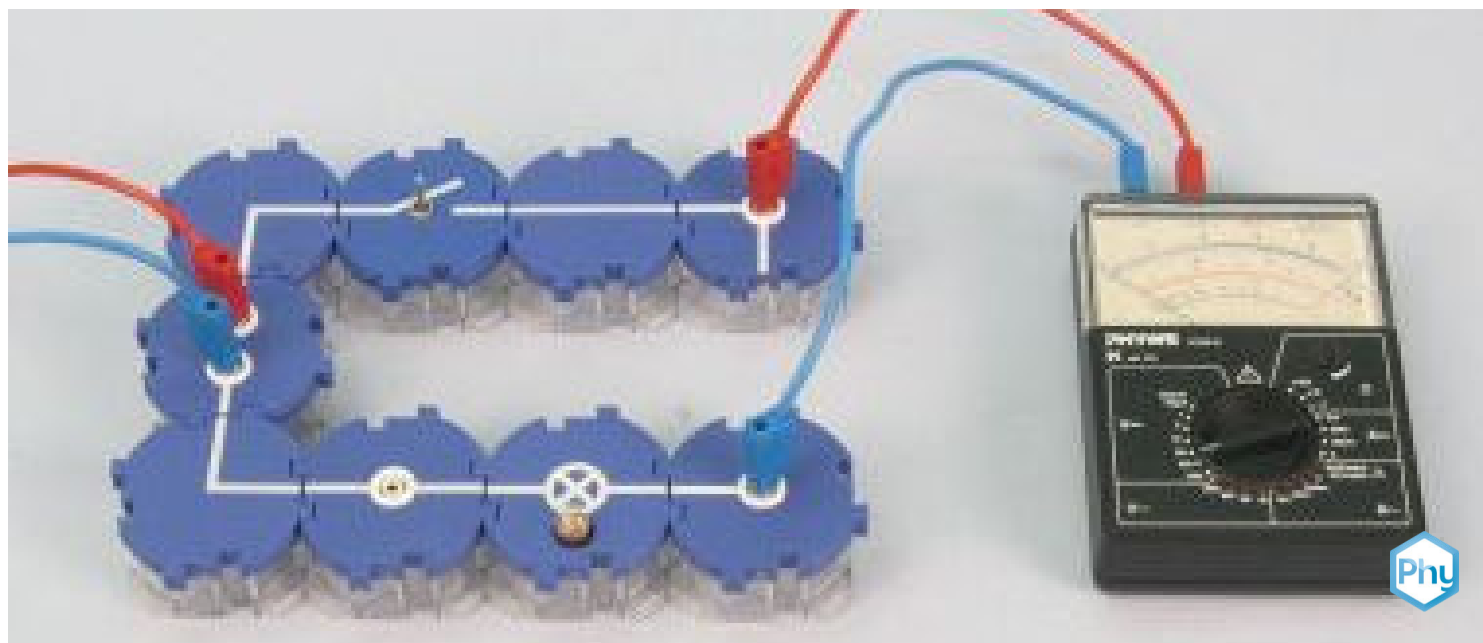


Measurement of voltage



Physics

Electricity & Magnetism

Simple circuits, resistors & capacitors



Difficulty level

easy



Group size

2



Preparation time

10 minutes



Execution time

10 minutes

This content can also be found online at:

<http://localhost:1337/c/5f4e9f0938db8d0003265be1>

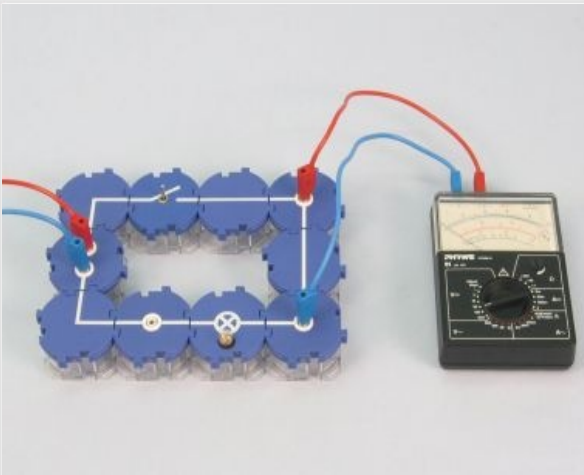
PHYWE

Teacher information



Application

PHYWE



Experiment set-up

The electrical voltage U is a fundamental variable in electrical engineering. The voltage characterizes the current source. The higher the voltage, the higher the resulting current.

Other teacher information (1/2)

PHYWE

Prior knowledge



The students should be familiar with the components and the interaction of the individual components of the simple circuit.

Scientific principle



The voltage between two points is defined as follows:

$$U = \int_A^B \vec{E} \cdot d\vec{s}$$

...and he's willing to submit to Ohm's law... $U = R \cdot I$ from the resistance R and the amperage I calculate.

Other teacher information (2/2)

PHYWE

Learning objective



After the students have become familiar with the concept of electric voltage and its unit, they should learn how to switch a voltmeter and what has to be considered when taking measurements. They should also recognise that the proper operation of an electrical device requires its rated voltage.

Tasks



The students build a simple electric circuit with a light bulb and become familiar with the measurement of an electric voltage.

In connection with this experiment, the term operating voltage can also be introduced. It should also be noted that red or blue connecting lines are connected with + or - according to the convention.

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



Motivation

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High voltage lines

Electricity is needed to operate electrical devices, such as a smartphone. For a current to flow, there must be an imbalance of electrical charge: An electrical voltage must be created. In our everyday life, this voltage is generated by power plants and made available via power lines in the sockets.

In this experiment you will study the electric voltage and learn how to measure the voltage.

Tasks

PHYWE



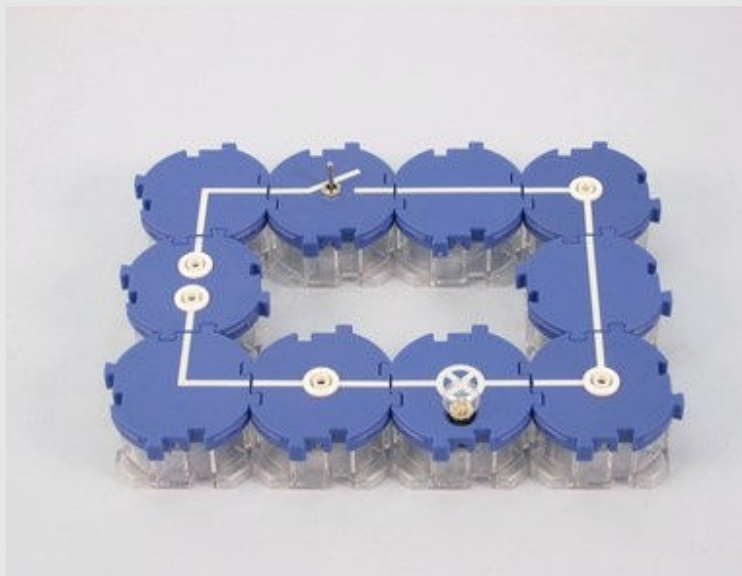
Build a simple electric circuit with a light bulb and learn how to measure electric voltage.

Equipment

Position	Material	Item No.	Quantity
1	Straight connector module, SB	05601-01	2
2	Angled connector module, SB	05601-02	2
3	Angled connector module with socket, SB	05601-12	2
4	Straight connector module with socket, SB	05601-11	1
5	Interrupted connector module with sockets, SB	05601-04	1
6	On-off switch module, SB	05602-01	1
7	Socket module for incandescent lamp E10, SB	05604-00	1
8	Connecting cord, 32 A, 250 mm, red	07360-01	1
9	Connecting cord, 32 A, 250 mm, blue	07360-04	1
10	Connecting cord, 32 A, 500 mm, red	07361-01	1
11	Connecting cord, 32 A, 500 mm, blue	07361-04	1
12	Filament lamps 4V/0.04A, E10, 10	06154-03	1
13	Filament lamp 6 V/3 W, E10, 10 pcs.	35673-03	1
14	Filament lamps 12V/0.1A, E10, 10 pieces	07505-03	1
15	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

Set-up (1/4)

PHYWE



- Set up the circuit as shown in the adjacent figure.

Set-up (2/4)

PHYWE



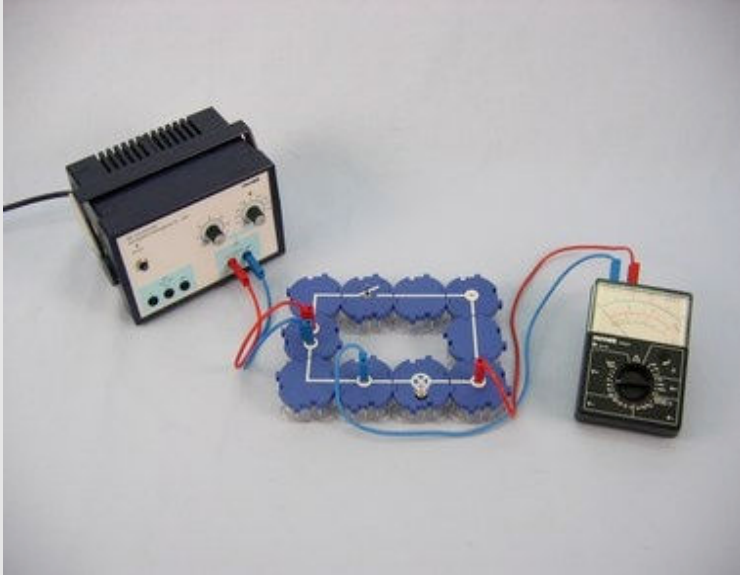
Measuring device



- Select the measuring range 10 V (voltage type: direct voltage; V-) on the measuring instrument.
- Plug a red connecting cable into the socket marked + marked socket and a blue connecting cable to the earth socket.

Set-up (3/4)

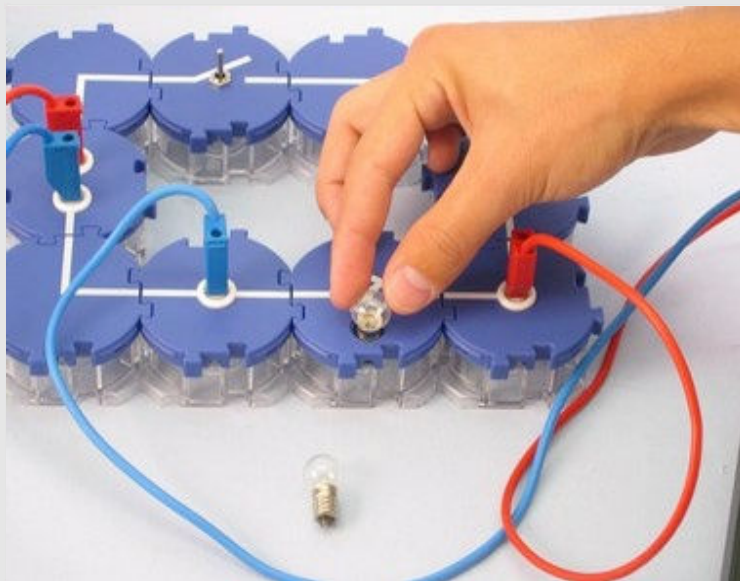
PHYWE



- Connect the power supply unit and the measuring device to your circuit as shown in the illustration.
- Connect the red connecting cable to the cable marked + and the blue connecting cable to the socket marked with – marked socket of the power supply unit.

Set-up (4/4)

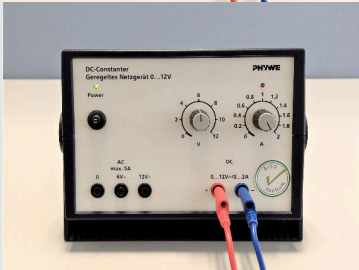
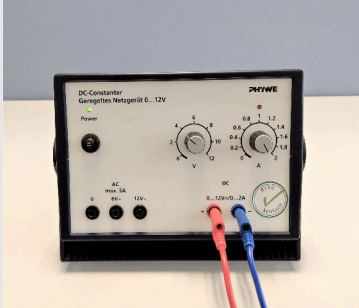
PHYWE



- Screw the bulb, which is intended for a rated voltage of 4 V, into the lamp socket. The switch is initially still open.
- Turn the controller for the voltage at the power supply unit to 0 V, the controller for the current limitation at the power supply unit to maximum (2 A) and switch on the power supply unit.

Procedure (1/4)

PHYWE



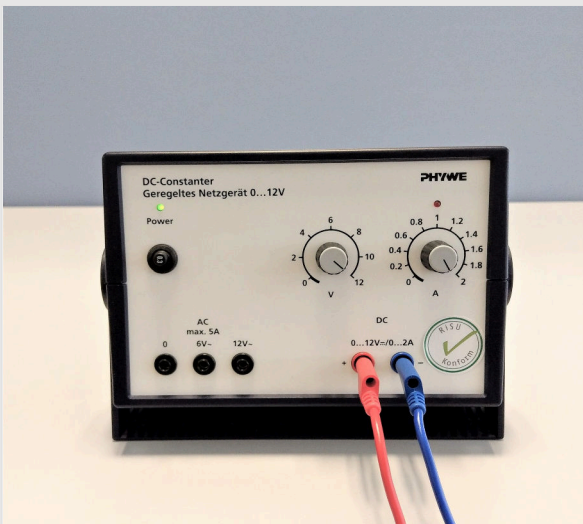
- Close the circuit with the switch and increase the voltage U on the power supply unit by slowly turning the knob to 4 V (according to the scale on the power supply unit).
- Read the voltage U_L which is applied to the bulb and note the measured value in the protocol.

The voltage at the power supply unit remains set to 4 V:

- Unscrew the 4 V bulb and replace it with the 6 V bulb. Observe the brightness of the bulb in comparison.
- Now set the voltage U the power supply unit to 6 V, measure the voltage U_L again and note the measured value in the protocol.

Implementation (2/4)

PHYWE



Power supply unit with adjusted 12 V

The voltage at the power supply unit remains at 6 V:

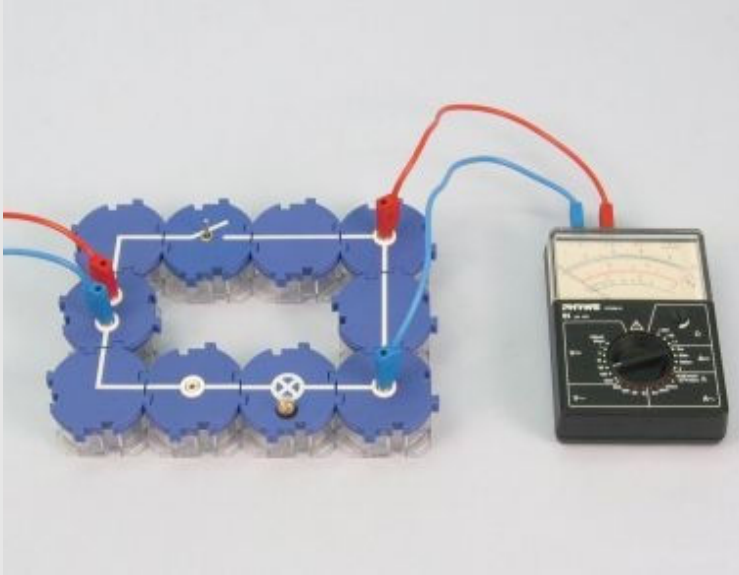
- Screw in the bulb for 12 V and observe the brightness of the lamp.
- Now first select a suitable measuring range on the measuring instrument (e.g. up to 30 V).

Note Before each measurement you should always consider whether the measuring range of the instrument is sufficient. In case of uncertainty, always select the largest possible measuring range first. Then you can switch to the smaller measuring range.

- Voltage U at the power supply unit to 12 V, again U_L measure (read correct scale!) and note the measured

Procedure (3/4)

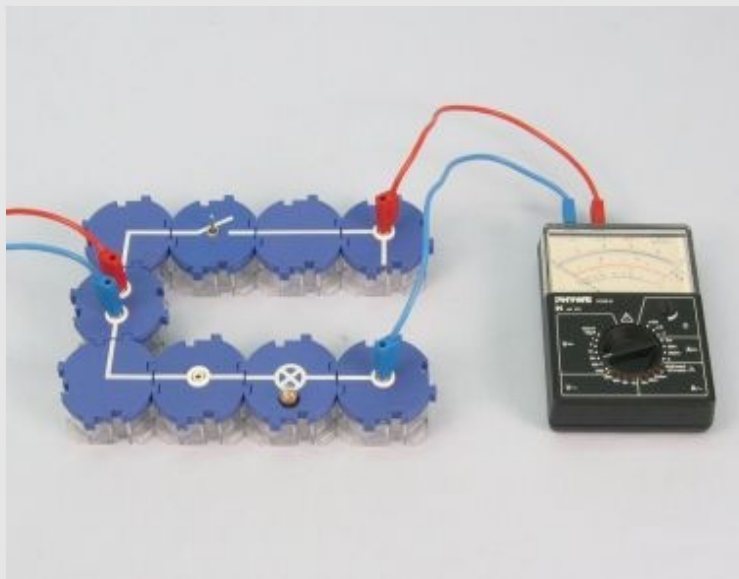
PHYWE



- Now connect the measuring instrument to the circuit according to the illustration parallel to the line module.
- Observe the measured value on the voltmeter and the condition of the bulb.

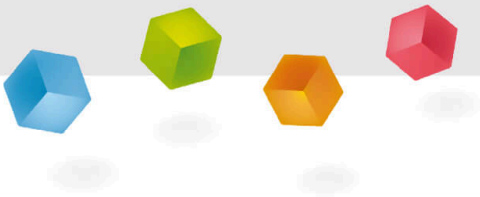
Procedure (4/4)

PHYWE



- Remove the straight line component between the connections of the measuring instrument.
- Observe again the measured value on the voltmeter and the condition of the bulb.
- Set the power supply unit to 0 V and switch it off.

PHYWE



Report

Table

PHYWE

Measurement $U[V]$	$U_L [V]$
14	
26	
312	

Carry the corresponding measured value for the voltage at the lamp for each test part U_L one.

Task 1

If electrical devices are to be operated properly, they must be connected to the voltage intended for their operation, the nominal voltage.

☐ True☐ False☒ Check

No voltage can be measured via connecting lines.

☐ True☐ False☒ Check

Task 1

PHYWE

If electrical devices are to be operated properly, they must be connected to the voltage intended for their operation, the nominal voltage.

☐ True☐ False☒ Check

No voltage can be measured via connecting lines.

☐ True☐ False☒ Check

Task 2

PHYWE

Paste the words in the right places.

A must not be connected in an electric circuit. It must be connected with the device on which the is to be measured.

☒ Check

Task 3

PHYWE

Paste the words in the right places.

When measuring the voltage, you must ensure that: the voltmeter is connected , its connections are correctly selected and thus correctly , the existing is set when selecting the measuring range and the correct is selected.

☒ Check