# Measurement of voltage (Item No.: P1371700)

## Curricular Relevance

**Area of Expertise:** Physik
**Education Level:** Klasse 7-10
**Topic:** Elektrizitätslehre
**Subtopic:** Der einfache elektrische Stromkreis
**Experiment:** Messen der Spannung

| Difficulty | Preparation Time | Execution Time | Recommended Group Size |
|---|---|---|---|
| Easy | 10 Minutes | 10 Minutes | 2 Students |

**Additional Requirements:**

**Experiment Variations:**

**Keywords:**

## Task and equipment

## Information for teachers

## Additional information

After the students have become acquainted with the term voltage and its unit, they should learn how a voltmeter must be connected and what must be taken into consideration when making a measurement.
In addition, they should recognise that an electrical instrument or appliance must be supplied with its rated voltage for proper operation.

## Notes on setup and procedure

Before the students switch the power supply on, the teacher should check that the voltmeter is correctly connected and adjusted, and should also ensure that the red and blue cords are connected to + and - respectively, i.e. according to convention.

## Remarks

The term operating voltage can also be introduced here. The students can then use this term in their answer to Question 1.
When working with the multi range meter, the students must be repeatedly helped with calculating the measurement range and the scale end value.


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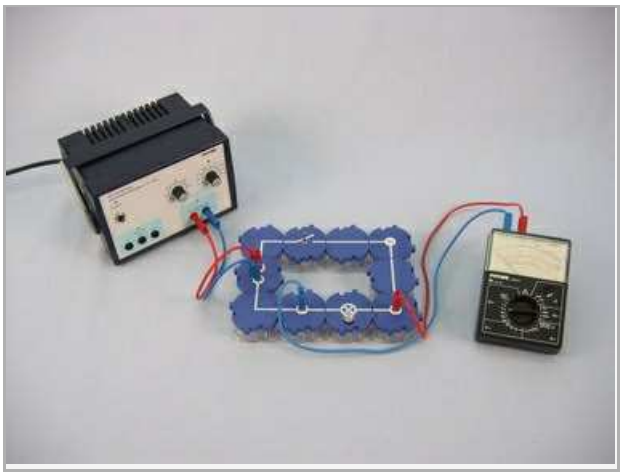
## Task and equipment

### Task

### How is electric voltage measured?

Set up a simple circuit including a filament lamp and familiarise yourself with the way electric voltage is measured.



## Equipment


| Position No. | Material | Order 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, 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 12V/0.1A, E10, 10 | 07505-03 | (1) |
| 13 | Filament lamp 6 V/3 W, E10, 10 pcs. | 35673-03 | (1) |
| 14 | Filament lamps 4V/0.04A, E10, 10 | 06154-03 | (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 |

# Set-up and procedure

## Set-up

- Set up the circuit as shown in Fig. 1.

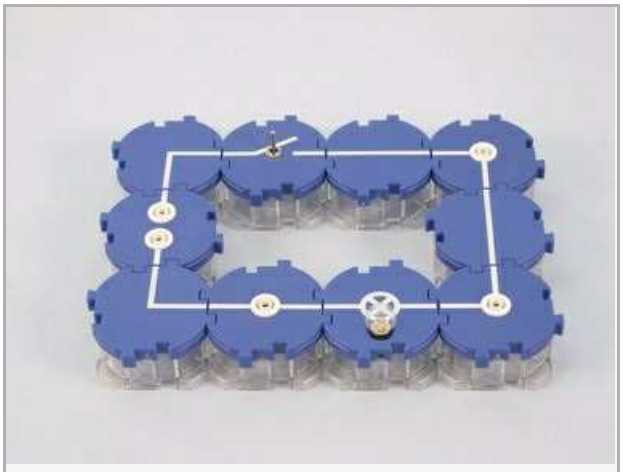


Fig. 1

- Set the voltage measuring instrument to measurement range 10 V (type of voltage: direct voltage; V−) (Fig. 2). Connect a red cord to the +V socket and a blue one to the ground socket (Fig. 3).


Fig. 2

Fig. 3

- Connect the power supply and the voltmeter to your circuit as shown in Fig. 4. The red connecting cord should be connected to the socket of the power supply marked "+", and blue cord to the one marked "−".

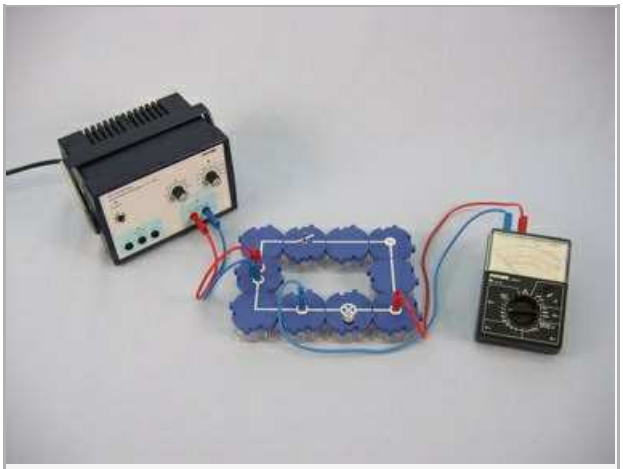


Fig. 4

- First screw the lamp whose rated voltage is 4 V in position (Fig. 5). Open the switch.

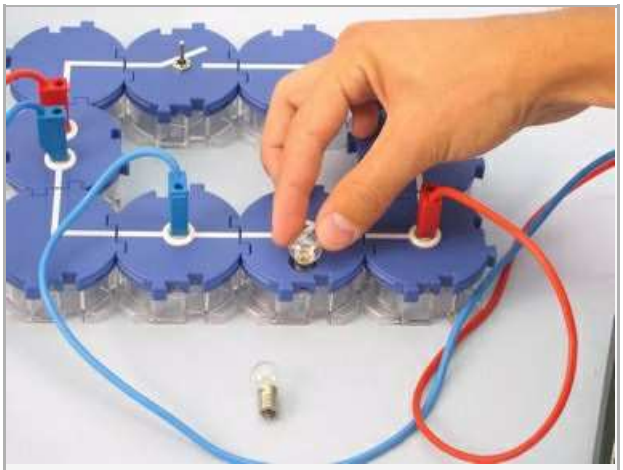


Fig. 5

## Procedure

- Close the switch and turn the rotary knob on the power supply to slowly increase the voltage $U$ to 4 V (as shown by the power supply scale).
- Read off the voltage $U_L$ across the filament lamp and note the measured value in Table 1 in the Report.

*Note*: Use the voltmeter's black scale which goes up to 10!

With the power supply still at 4 V:

- Screw out the 4 V lamp and replace it with the 6 V lamp; observe the brightness of the lamp and note it under (Observation 1) in the Report.
- Now adjust the power supply voltage $U$ to 6 V; measure voltage $U_L$ and note this value in Table 1 (Report).

With the power supply still at 6 V:

- Screw in the 12 V lamp; observe the brightness of the lamp and note it under (Observation 2) in the Report. Set the measurement range of the voltmeter to 30 V.

*Note*: Before a measuring instrument is to be used to carry out a measurement, it is always necessary to consider if the measurement range limit of the instrument is sufficiently high. When the size of the value to be measured cannot be estimated in advance, therefore, always select the highest possible measurement range and then switch progressively down to a smaller, more appropriate one.

- Adjust the power supply voltage $U$ to 12 V; again measure $U_L$ (read off from the black scale up to 30) and note the measured value in Table 1.
- Connect the voltmeter in parallel to the connector module (Fig. 6). Note your observation under (Observation 3) in the Report.

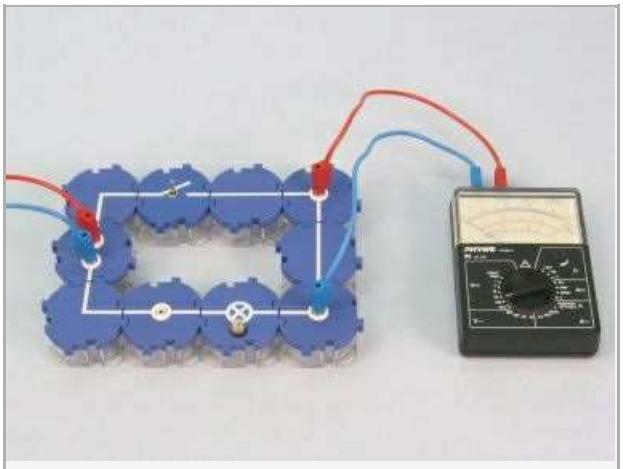


Fig. 6

- Now remove the connector module (Fig. 7). Measure voltage *U* and observe the lamp. Note the measured value and what you observe under (Observation 4) in the Report.

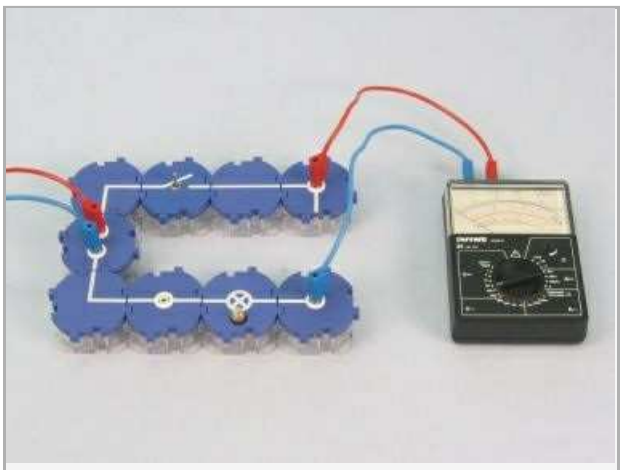


Fig. 7

- Set the power supply to 0 V and switch it off.

# Report: Measurement of voltage

## Results – Table 1

Record all the measured values in Table 1.

| $U$ in V | $U_L$ in V |
|---|---|
| 4 | $1 \pm 0.2$ |
| 6 | $1 \pm 0.4$ |
| 12 | $1 \pm 0.4$ |

## Results – Observation 1

Write down your observations of part 1 of the experiment.

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## Results – Observation 2

Write down your observations of part 2 of the experiment.

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## Results – Observation 3

Write down your observations of part 3 of the experiment.

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## Results – Observation 4

Write down your observations of part 4 of the experiment.

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## Evaluation – Question 1

Which perception on how to properly operate electrical appliances can you derive from the observations noted under (1) and (2)?

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## Evaluation – Question 2

Which perception follows from (3)?

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## Evaluation – Question 3

A rule how a voltmeter must be connected can be derived from your initial setup and from the observations noted under (3) and (4). How can this be formulated?

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## Evaluation – Question 4

Summarise everything which must be considered when one is to measure a voltage.

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