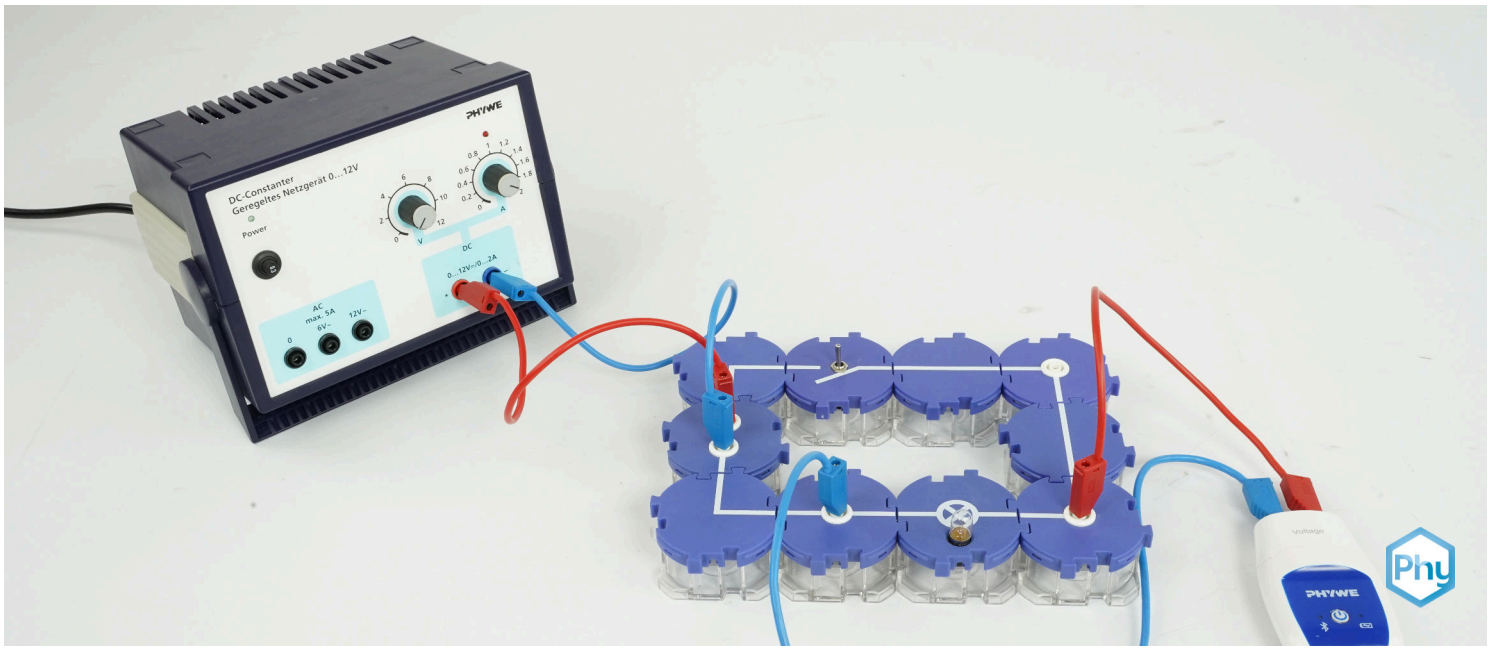
# Measuring the voltage with Cobra SMARTsense




| Difficulty level | Group size | Preparation time | Execution time |
|---|---|---|---|
| easy | - | 10 minutes | 10 minutes |

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# Teacher information

## Application

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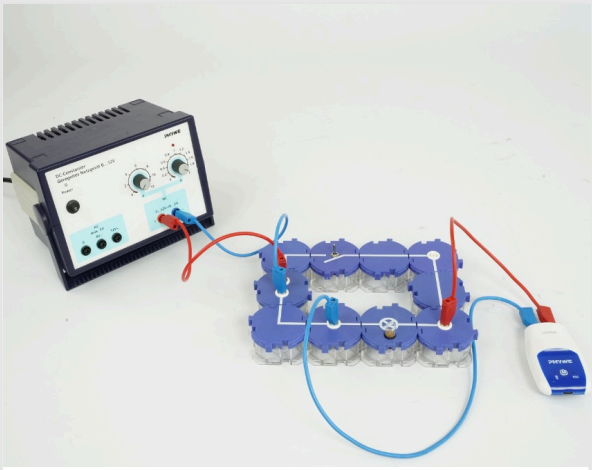

Experimental setup

The electrical voltage $U$ is a fundamental quantity in electrical engineering. The voltage characterises the current source. The higher the voltage, the higher the resulting current.



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## Other teacher information (1/2)

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### Prior

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

### Principle

The voltage between two points is defined as follows:

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

and follows Ohm's law $U = R \cdot I$ from the resistance $R$ and the current $I$ calculate.

## Other teacher information (2/2)

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### Learning

After the students have learnt the concept of electrical voltage and its unit, they should learn what needs to be observed when taking measurements. They should also recognise that the rated voltage of an electrical device is required for proper operation.

### Tasks

The students set up a simple circuit with a light bulb and familiarise themselves with measuring an electrical voltage.

The term operating voltage can also be introduced in connection with this experiment. It should also be noted that red and blue connecting leads are connected with + and - respectively according to convention.



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## Safety instructions

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

# Student information



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## Motivation

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High-voltage power lines

Electricity is required 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 generated. In our everyday lives, this voltage is generated by power stations and made available via power lines in the sockets.

In this experiment you will investigate electrical voltage and learn how to measure it.

## Tasks

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Build a simple circuit with a light bulb and familiarise yourself with how to measure electrical voltages.



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# Equipment

| Position | Equipment | Item no. | Quantity |
|---|---|---|---|
| 1 | Cable module, straight, SB | 05601-01 | 2 |
| 2 | Cable module, angled, SB | 05601-02 | 2 |
| 3 | Cable module, angled with socket, SB | 05601-12 | 2 |
| 4 | Cable module, straight with socket, SB | 05601-11 | 1 |
| 5 | Line module, interrupted with sockets, SB | 05601-04 | 1 |
| 6 | Off switch, SB | 05602-01 | 1 |
| 7 | Lamp socket E10, SB | 05604-00 | 1 |
| 8 | Connecting cable, 32 A, 250 mm, red Experiment cable, 4 mm plug | 07360-01 | 1 |
| 9 | Connecting cable, 32 A, 250 mm, blue Experimental cable, 4 mm plug | 07360-04 | 1 |
| 10 | Connecting cable, 32 A, 500 mm, red Experiment cable, 4 mm plug | 07361-01 | 1 |
| 11 | Connecting cable, 32 A, 500 mm, blue Experimental cable, 4 mm plug | 07361-04 | 1 |
| 12 | Bulbs 4 V/0.04 A/0.16 W, E10 base Set of 10 bulbs | 06154-03 | 1 |
| 13 | Bulb 6 V/0.5 A, E 10, 10 pieces | 35673-03 | 1 |
| 14 | Bulbs 12 V/0.1 A/ 1.2 W, E10 base Set of 10 bulbs | 07505-03 | 1 |
| 15 | Cobra SMARTsense Voltage - Sensor for measuring electrical voltage ± 30 V (Bluetooth + USB) | 12901-01 | 1 |
| 16 | PHYWE power supply unit, RiSU 2019 DC: 0...12 V, 2 A / AC: 6 V, 12 V, 5 A | 13506-93 | 1 |



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## Structure (1/4)

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For measurement with the **Cobra SMARTsense sensors** the **PHYWE measureAPP** required. The app can be downloaded free of charge from the relevant app store (see QR codes below). Before starting the app, please check whether your device (smartphone, tablet, desktop PC) is running **Bluetooth activated** is.

iOS

Android

Windows

## Structure (2/4)

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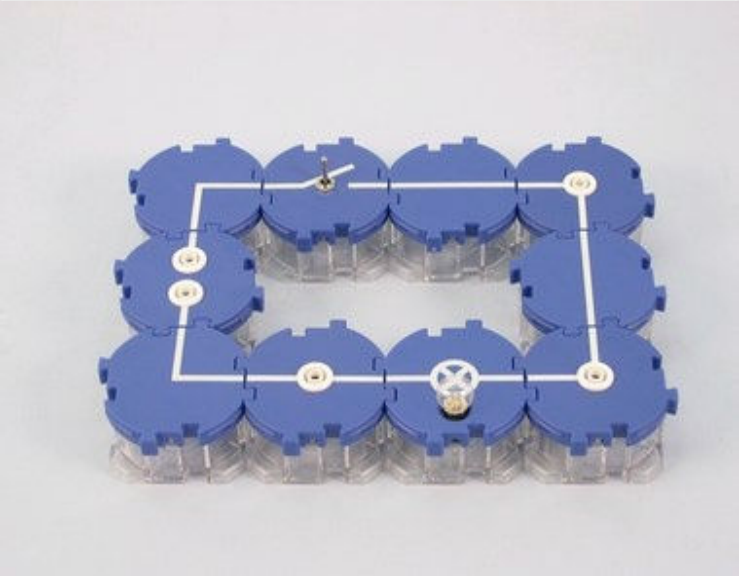

- Set up the circuit as shown in the diagram opposite.



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## Structure (3/4)

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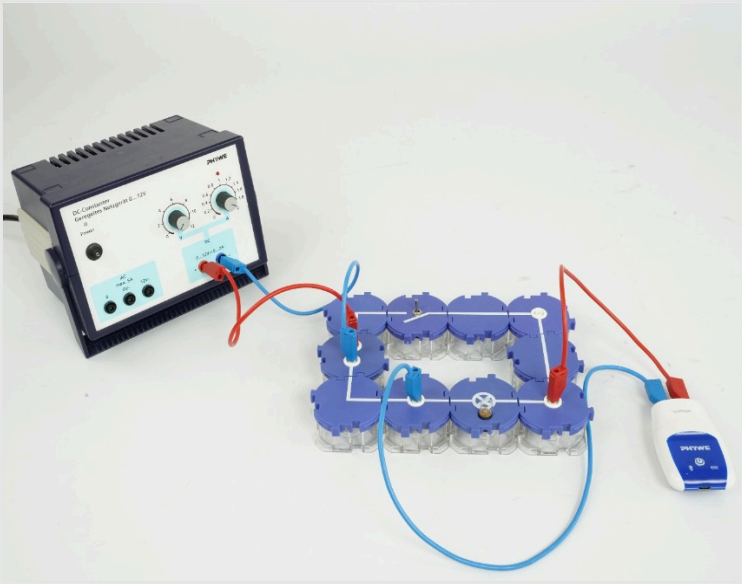

- Connect the power supply unit and the Cobra SMARTsense Voltage Sensor to your circuit as shown in the illustration.
- Connect the red connecting cable to the cable labelled + labelled socket and the blue connecting cable to the socket labelled — labelled socket on the power supply unit.

## Structure (4/4)

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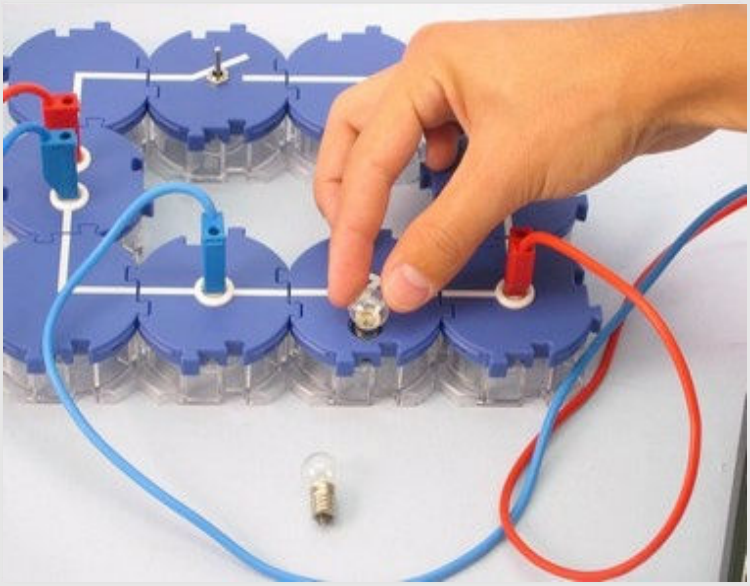

- Screw the bulb, which is designed for a rated voltage of 4 V, into the bulb holder. The switch is initially still open.
- Turn the voltage regulator on the power supply unit to 0 V.
- Use the current limit on the lamp as a guide for the current to be set on the power supply unit.
- Switch on the power supply unit and adjust the current if necessary.



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# Procedure (1/5)

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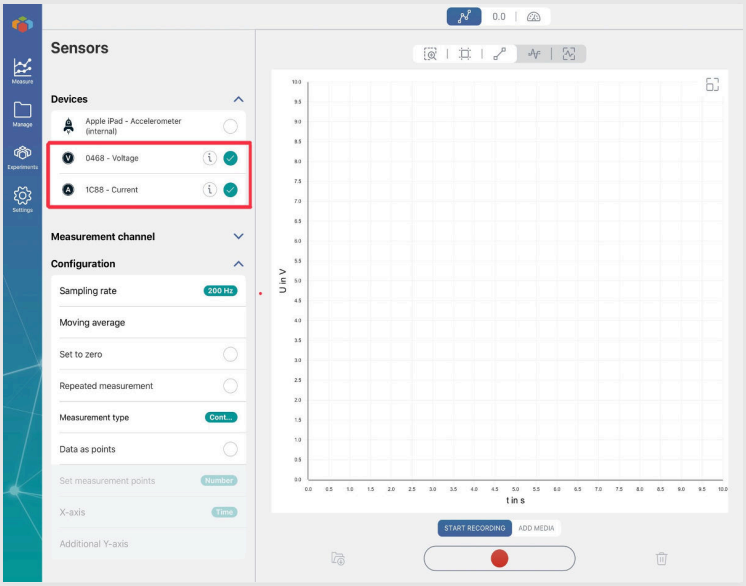
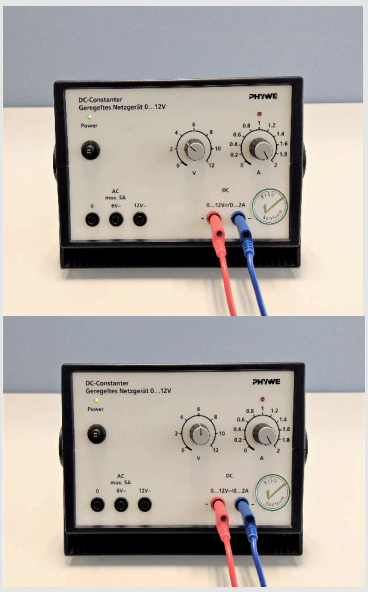



- Switch on the SMARTsense Voltage Sensor by pressing and holding the power button and ensure that the tablet can connect to Bluetooth devices.
- Open the PHYWE measure app and select the sensors "Voltage".
- The measurement can be saved after each of the following measurements. The measurement can be opened again at any time under "My measurements" for further analysis.

# Procedure (2/5)

PHYWE




- Close the circuit with the switch and increase the voltage $U$ on the power supply unit slowly to 4 V by pressing the rotary knob (according to the scale on the power supply unit).
- Read the tension $U_L$ that is applied to the light bulb and note the measured value in the log.
- The voltage on the power supply unit remains set to 4 V:
  - Unscrew the bulb for 4 V and replace it with the bulb for 6 V. Observe the brightness of the light bulb in comparison.
- Now set the voltage $U$ around the power supply unit to 6 V, measure the voltage $U_L$ again and note the measured value in the log.



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## Implementation (3/5)

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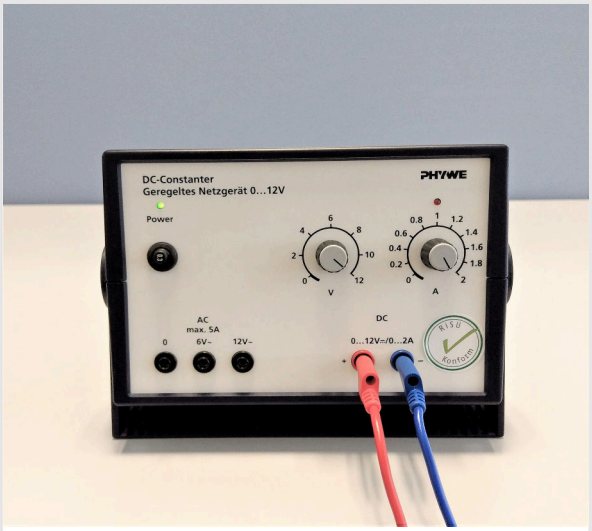


Power supply unit with set 12 V

- The voltage on the power supply unit remains at 6 V:
  - Screw in the bulb for 12 V and observe the brightness of the bulb.
- Tension $U$ set to 12 V on the power supply unit, again $U_L$ measure and note the measured value.

## Procedure (4/5)

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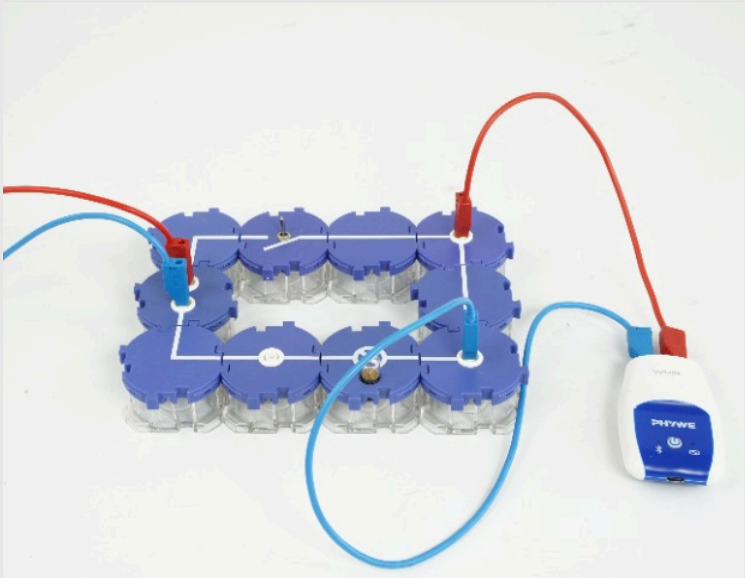

- Now connect the measuring device to the circuit in parallel with the line module as shown in the diagram.
- Observe the measured value and the condition of the light bulb.



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## Procedure (5/5)

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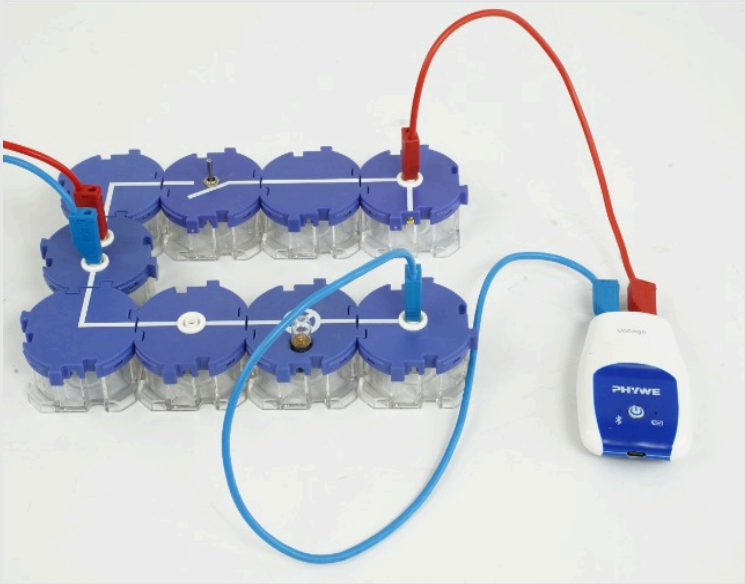

- Remove the straight line module between the connections of the meter.
- Observe the measured value on the voltmeter and the condition of the light bulb again.
- Set the power supply unit to 0 V and switch it off.

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# Report



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## Table

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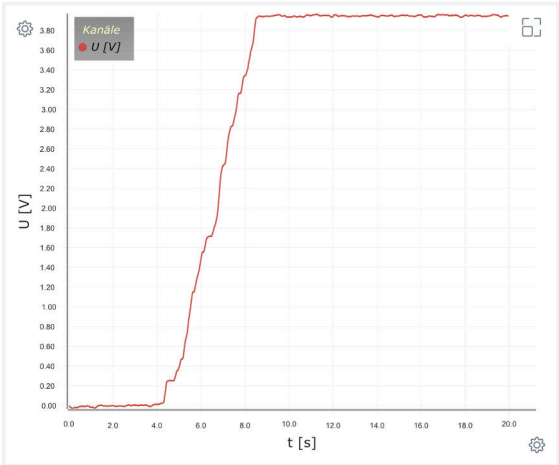
For each part of the experiment, enter the corresponding measured value for the voltage at the lamp $U_L$ in.

| Measurement $U[V]$ | $U_L$ $[V]$ |
|---|---|
| 1 4 | |
| 2 6 | |
| 3 12 | |




Voltage curve when slowly increasing the voltage to 4 V.

## Task 1

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If electrical appliances are to be operated properly, they must be connected to the voltage intended for their operation, i.e. the rated voltage.

○ True ○ False

Check

No voltage can be measured via connecting cables.

○ True ○ False

Check



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## Task 2

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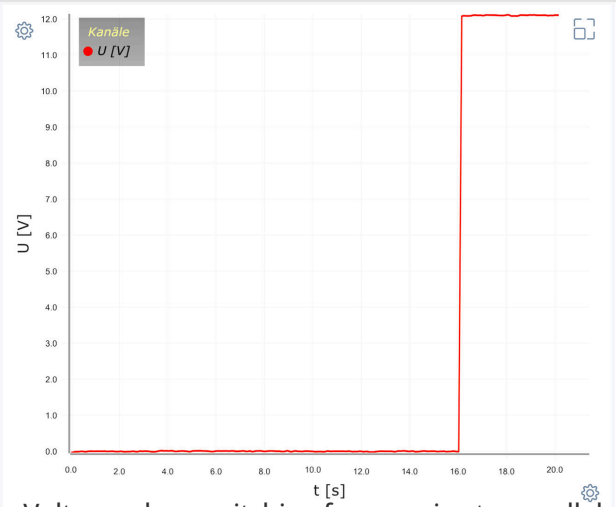
Insert the words in the correct places.

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

voltmeter | voltage | in series | in parallel

Check




Voltage when switching from series to parallel connection.

## Task 3

PHYWE

Insert the words in the correct places.

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

polarised | voltage type | in parallel

Check



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| Slide | Score / Total |
|---|---|
| Slide 21: Multiple tasks | 0/2 |
| Slide 22: Parallel connection of the voltmeter | 0/4 |
| Slide 23: Polarity of a voltmeter | 0/3 |

**Total amount** 0 / 9

Solutions Repeat Export text



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