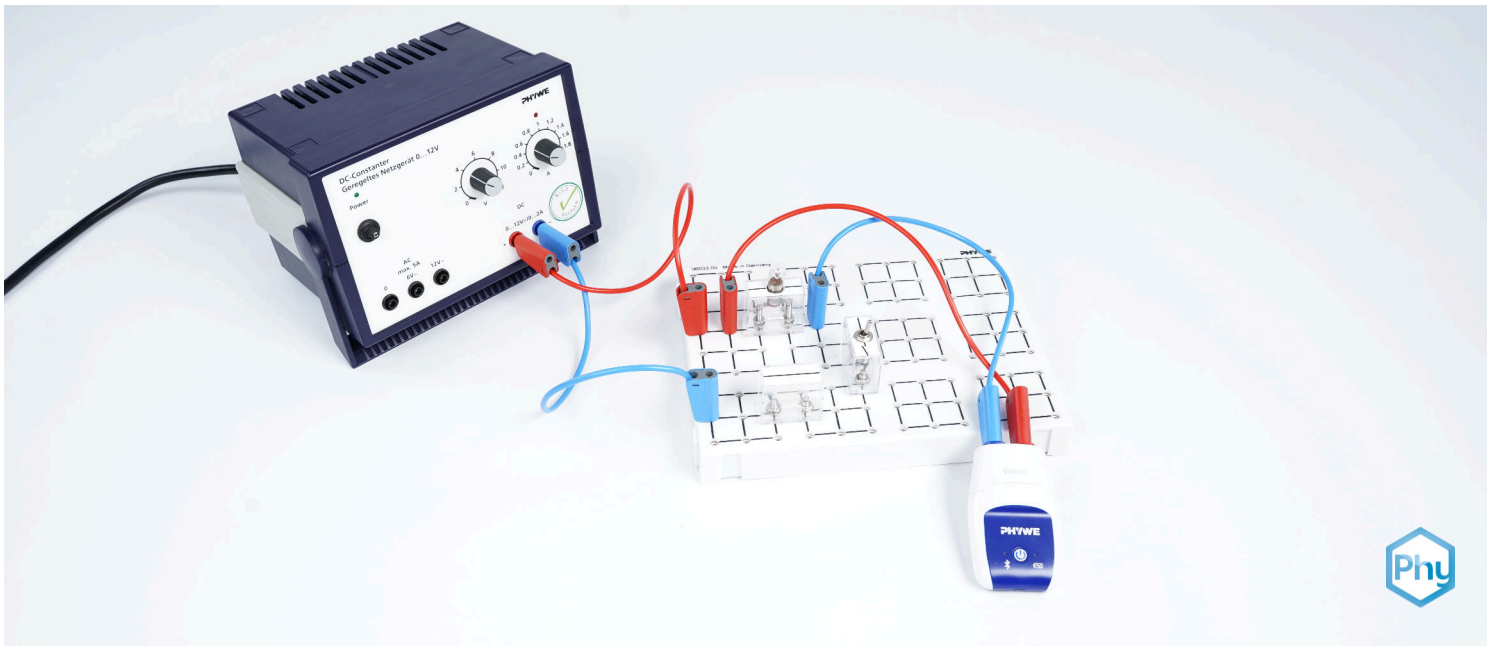
Voltage measurement with Cobra SMARTsense



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

Difficulty level	Group size	Preparation time	Execution time
easy	2	10 minutes	20 minutes

This content can also be found online at:

https://www.curriculab.de/c/686511b0fa2a620002485d70

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Teacher information

Application

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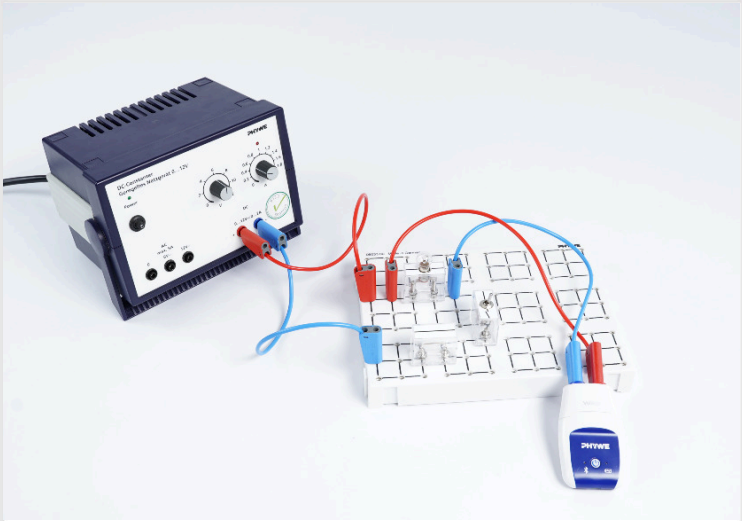

Experimental setup

Once the students have understood how a simple circuit works and how it is constructed, they should now learn how to measure one of the most fundamental quantities in electricity: voltage.
Building on this knowledge, the students will then be able to independently connect a voltmeter in later experiments and measure the voltage of various components using the measureAPP.

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Other teacher information (1/2)

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Prior knowledge

Pupils should be able to build an electrical circuit independently and know what a parallel and a series circuit is.

Principle

A simple circuit with a light bulb is set up. The voltage across the light bulb is measured for different mains voltages, and the bulbs are exchanged depending on the mains voltage to prevent them from breaking. The voltage is then measured across the bulb to demonstrate that voltage must always be measured in parallel.

Other teacher information (2/2)

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Learning objective

The students learn how the voltage is measured on a device and that the measured voltage can deviate from the mains voltage.

Tasks

The students first set up the circuit according to the provided diagrams and pictures. They then connect the Cobra SMARTsense to the measureApp and measure the voltage across the lamp. This measurement is repeated for different mains voltages and lamps. Finally, the setup is modified to demonstrate what happens if the voltage is incorrectly measured in series with the lamp.

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Safety instructions

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

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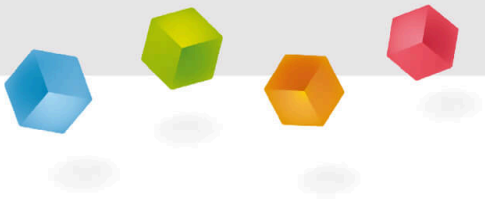

Student information

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Motivation

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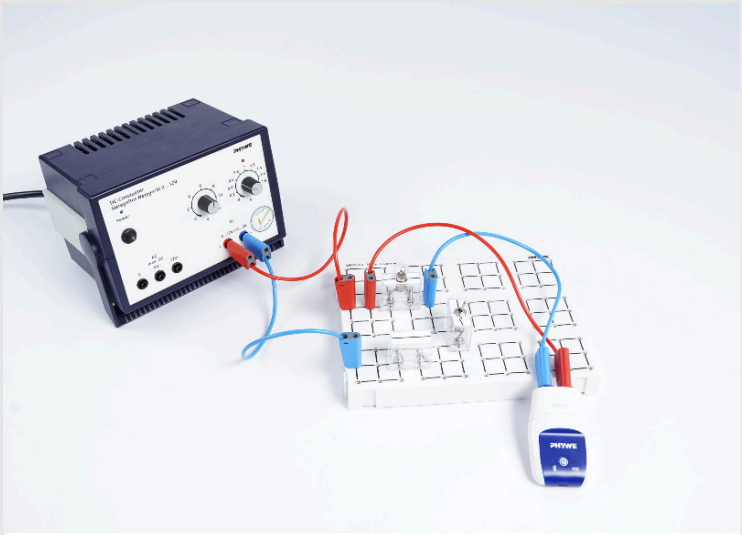

Experimental setup

One of the most fundamental quantities in electricity is voltage. Some of you may have already seen voltage values printed on sockets or chargers. Among other things, voltage plays an important role in our everyday lives — for example, to ensure that devices don't get damaged by too much current.

But how do you actually measure voltage? That's exactly what you'll find out in this experiment!

Tasks

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1. First build the setup according to the pictures and circuit diagrams.
2. Then connect the Cobra SMARTsense Voltage to the measureAPP and measure the voltage at the lamp.
3. Carry out the measurement for different voltages and lamps.
4. Connect the Cobra SMARTsense Voltage in series with the lamp and observe the measured voltage.

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Equipment

Position	Material	Item No.	Quantity
1	Cobra SMARTsense Voltage - Sensor for measuring electrical voltage ± 30 V (Bluetooth + USB)	12901-02	1
2	Plug-in board, for 4 mm plugs	06033-00	1
3	on-off switch, G1	39139-00	1
4	Wire building block, housing G1	39120-00	1
5	Lampholder E10, case G1	17049-00	1
6	Connecting cord,19 A,25cm, red	07313-01	1
7	Connecting cord,19 A,25cm, blue	07313-04	1
8	Connecting cord, 19A ,50 cm, red	07314-01	1
9	Connecting cord,19A,50cm, blue	07314-04	1
10	Filament lamps 4V/0.08A, E10, 10	06154-03	1
11	Filament lamp 6 V/3 W, E10, 10 pcs.	35673-03	1
12	Filament lamps 12V/0.1A, E10, 10 pieces	07505-03	1
13	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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Setup (1/4)

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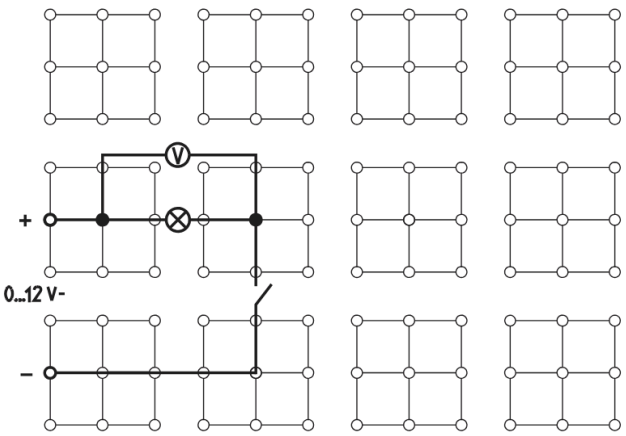

Circuit diagram of the assembly

Build the circuit as shown in the sketch on the left. The Cobra SMARTsense Voltage sensor is marked with a circled "V".

When connecting the Cobra SMARTsense Voltage, make sure that the red lead is attached to the side of the lamp that is closer to the positive terminal. The blue lead should be connected to the side closer to the negative terminal.

To avoid confusion, it's best to use consistent cable colours (red for positive, blue for negative). You can see what the completed setup should look like by pressing the blue button.

Setup (2/4)

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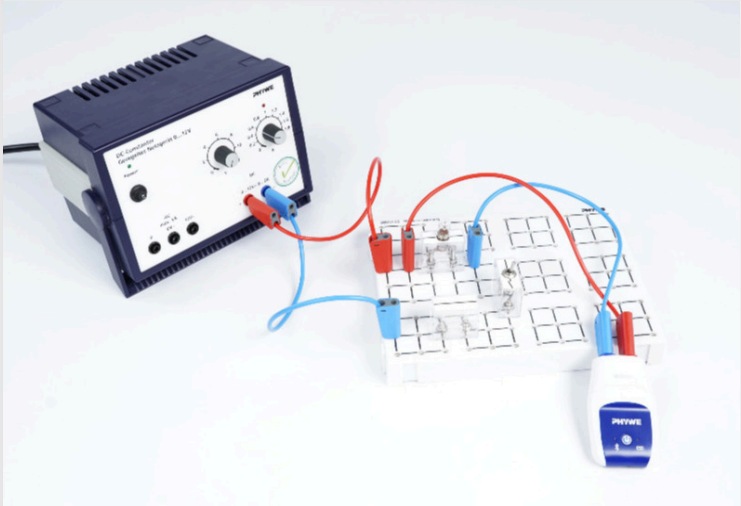

Experimental setup

- Make sure that the light bulb for $4\ \mathrm{V}$ is installed. Look for the value engraved on the bulb — that's how you can identify it.
- Now switch on the Cobra SMARTsense by pressing the on/off button for three seconds.

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Setup (3/4)

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To measure with the **Cobra SMARTsense sensors**, the **PHYWE measureAPP** is required. The app can be downloaded free of charge from the respective app store (QR codes below). Please check that **Bluetooth is enabled** on your device (smartphone, tablet, desktop PC) before starting the app.

iOS

Android

Windows

Setup (4/4)

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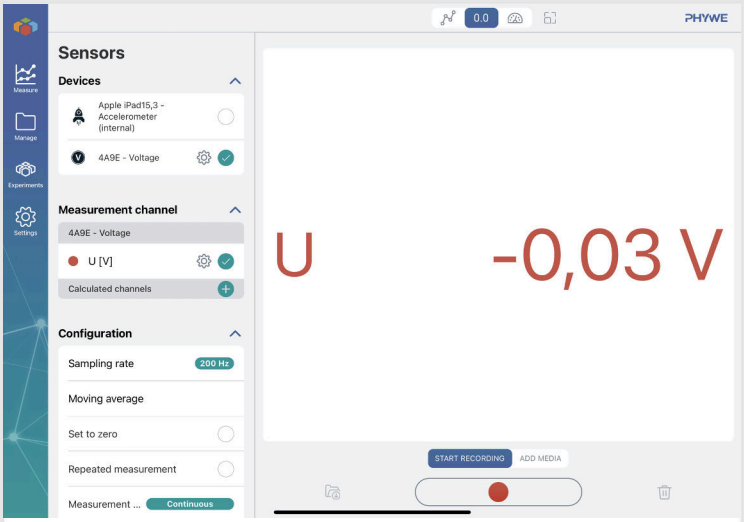

Example screenshot of the measureAPP

- Now open the measureAPP and connect to the Cobra SMARTsense Voltage by clicking on its name.
- Tap on "0.0" at the top of the app to show the measured values in digital format.

The power supply remains switched off but you might still see fluctuating readings. This is caused by small measurement errors in the device. These kinds of fluctuations are normal and always occur to some extent. They only matter when extremely precise measurements are required — but for today's experiment, you can simply ignore them.

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Procedure (1/5)

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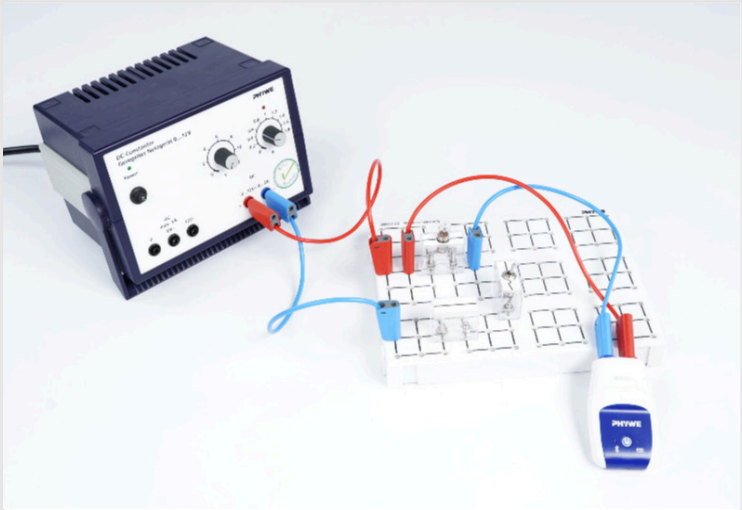

The complete experimental setup

- Switch on the power supply unit while the rotary head for the voltage is set to $0\ \mathrm{V}$.
- Now slowly turn the rotary knob to $4\ \mathrm{V}$ and then note the measured voltage in Table 1 in the Report section.

Procedure (2/5)

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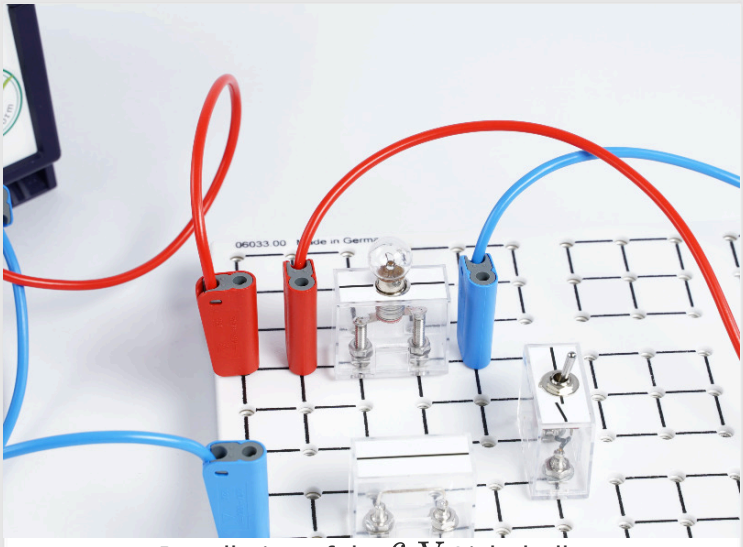

Installation of the $6\ \mathrm{V}$-Light bulb

- Turn the voltage back to $0\ \mathrm{V}$ and switch off the power supply unit.
- Unscrew the light bulb from the socket and replace it with a new one for $6\ \mathrm{V}$.
- Switch the power supply on again, turn the voltage up to $6\ \mathrm{V}$ and note the measured voltage in Table 1 in the Report section.

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Procedure (3/5)

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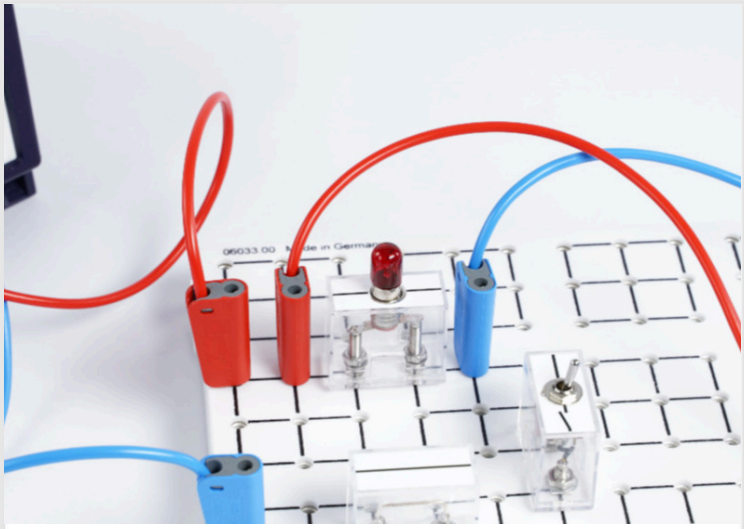

Installation of the 12 V-Light bulb

- Repeat the steps from the last slides, but this time with a 12 V light bulb.
- Turn up the voltage accordingly at the end to 12 V. Note the measured voltage again in table 1 in the Report section.

Procedure (4/5)

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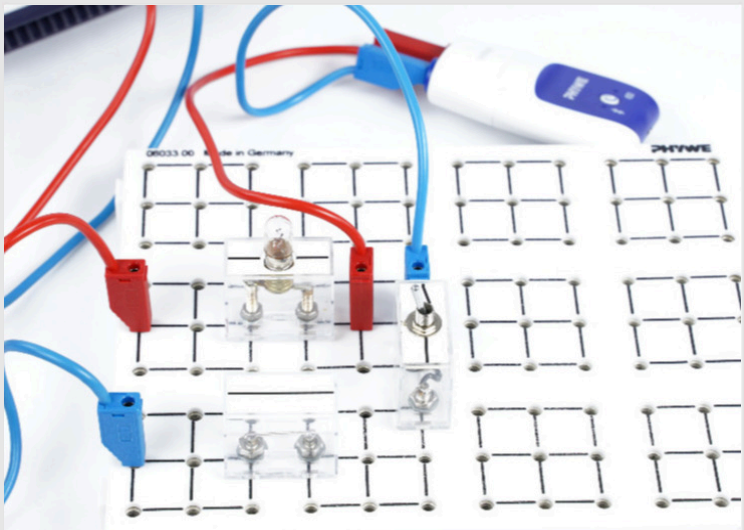

Measuring the voltage in series

- Switch off the power supply.
- Now connect the voltmeter in series with the light bulb. You can see what connecting "in series" means in the photo on the left.
- Switch the power supply on again and observe the measured voltage. What do you notice?

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Procedure (5/5)

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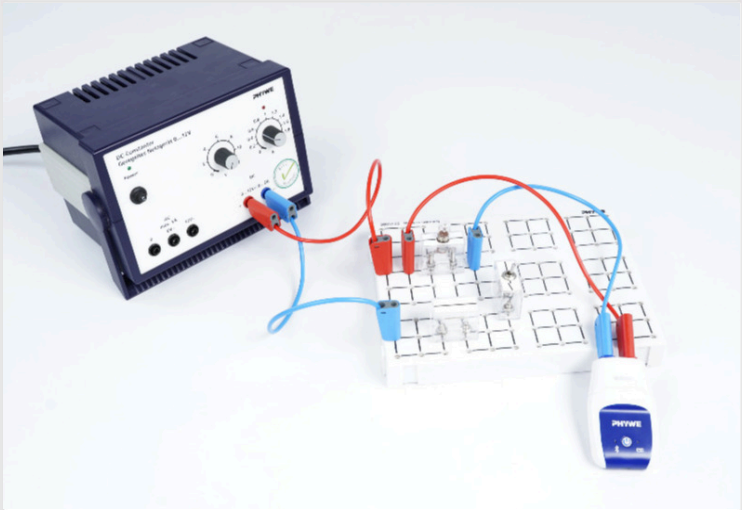

Experimental setup

- Now connect the voltmeter in the same way as you did at the beginning of the experiment.
- Open the switch so that the circuit is interrupted and observe the measured voltage.

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Report

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Table 1

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Make a note of the voltage you measured at the lamp under the respective mains voltages.

4 V	6 V	12 V

Can the voltage be measured by connecting the voltmeter in series with the lamp?

- It can be measured in this way, you just have to multiply the measurement result by two to get the correct result.
- Yes, it makes no difference where the voltmeter is plugged in.
- No, then you measure 0 V

Task 1

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What effect did the removal of a line module have?

- The light bulb has stopped lighting up, but the mains voltage was still measured.
- The light bulb continued to light up, but no voltage was measured.
- No voltage was measured, nor did the light bulb light up.

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Slide	Score / Total
Slide 20: Result series connection	0/1
Slide 21: Removing the line module	0/1

Total amount 0 / 2

Solutions Repeat Export text

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