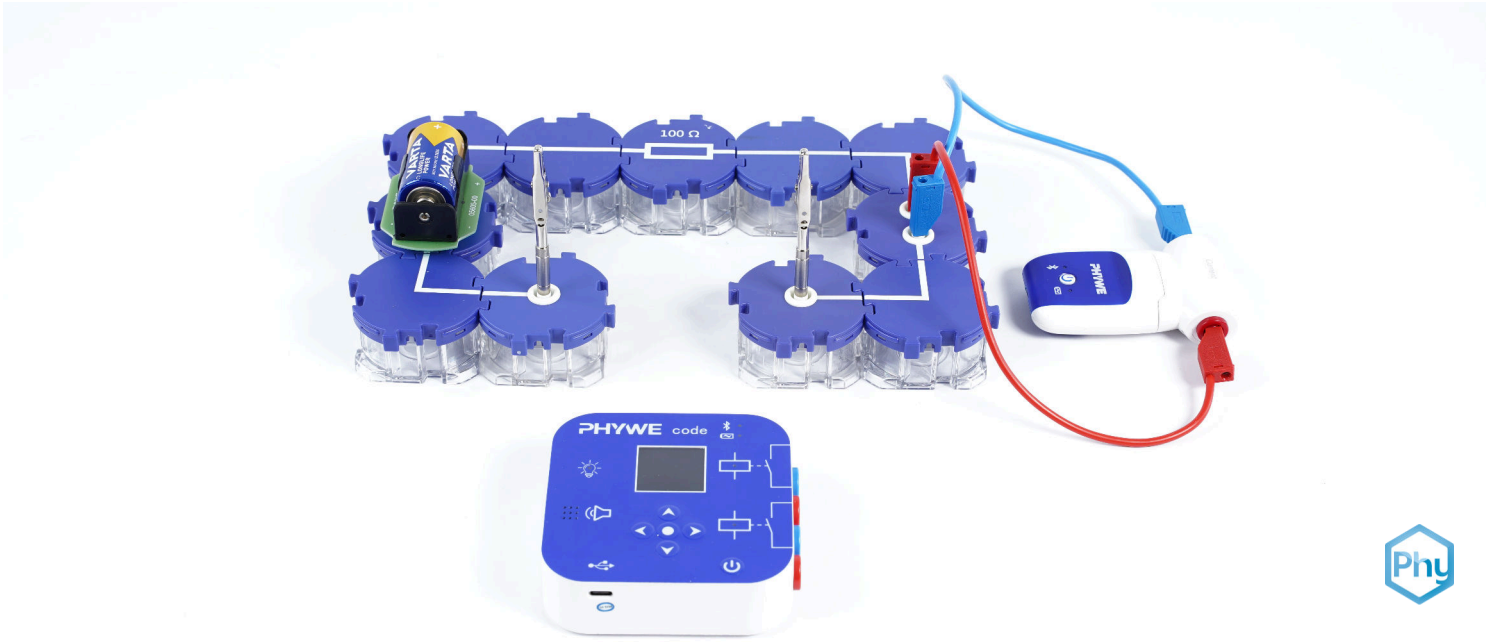
Conductors and non-conductors with Cobra SMARTsense Code



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

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

This content can also be found online at:

https://www.curriculab.de/c/67f4db730a02b100026b8c40

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Teacher information

Application

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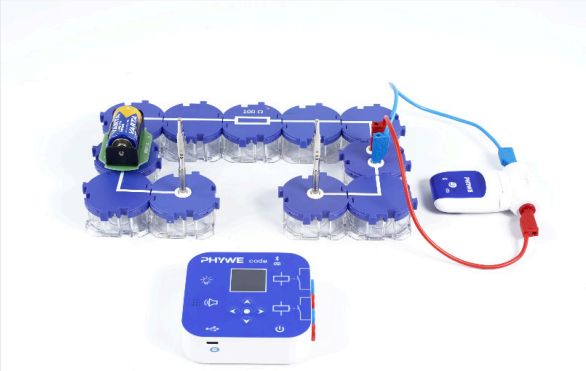

Experimental setup

Electrical conductors are essential components in electrical engineering, as they allow the flow of electric current. In contrast, non-conductors (or insulators) play a crucial role in insulating and protecting us from electrical currents.

The specific conductivity of a material primarily depends on its intrinsic properties. However, temperature also influences conductivity. In this experiment, the temperature dependence of conductivity is not investigated.

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Other teacher information (1/2)

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Prior knowledge

Students should know from everyday life that, for example, the wires for electrical cables in the home are surrounded by insulating layers to protect people from dangerous contact with live parts.

Principle

Conductivity depends on the material, hence the term specific conductivity. Depending on the material, the electrons are more or less free and therefore more or less mobile. In conductive materials (mainly metals), several electrons occupy the so-called conduction band and can move more or less freely through the material, depending on the level of conductivity.

Other teacher information (2/2)

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Learning objective

Pupils should recognise which materials conduct and which do not conduct. They recognise this by measuring the current in series with a resistor. At the same time, they learn how to work with the Cobra SMARTSense code in this experiment.

Tasks

Pupils should incorporate metallic and non-metallic materials into a simple circuit and analyse their conductivity.

The students program the Cobra SMARTsense code so that it gives symbolic feedback as to whether the substances are conductors or non-conductors.

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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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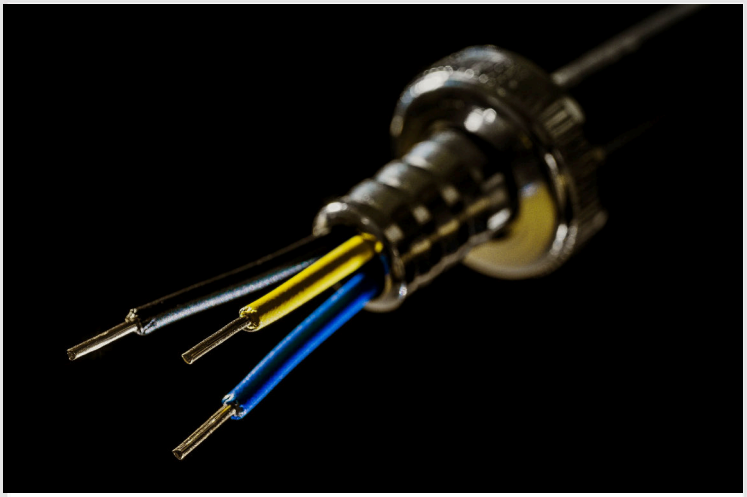

Cable with insulation

To charge your smartphone, for example, you need a charging cable that connects the smartphone's battery to the mains. But why don't you get an electric shock when you touch the cable while plugging it into the socket? As you may know, this is because the conductive wires inside the cable are surrounded by insulation.

In this experiment, you will learn what conductivity is and which common materials can or cannot conduct electricity.

Tasks

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1. Build an open circuit with crocodile clips.
2. Program the Cobra SMARTsense Code so that it indicates whether there is a current flow or not by displaying smileys.
3. Investigate which materials conduct electricity and which do not.

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Equipment

Position	Material	Item No.	Quantity
1	Cobra SMARTsense Code - Output device for switching relays, LEDs, display	12953-00	1
2	Cobra SMARTsense Current - Sensor for measuring electrical current ± 1 A (Bluetooth + USB)	12902-01	1
3	Straight connector module, SB	05601-01	2
4	Angled connector module, SB	05601-02	4
5	Interrupted connector module with sockets, SB	05601-04	2
6	Junction module, SB	05601-10	2
7	Resistor module 100 Ohm, SB	05613-10	1
8	Battery holder module (C type), SB	05605-00	1
9	Conductors/non-conductors, l = 150 mm	06107-15	1
10	Alligator clips, bare, 10 pcs	07274-03	1
11	Connecting plug, 2 pcs.	07278-05	1
12	Connecting cord, 32 A, 250 mm, red	07360-01	1
13	Connecting cord, 32 A, 250 mm, blue	07360-04	1
14	Battery Type C 1.5 V - Pack of 2 pieces	07400-00	1
15	measureAPP - the free measurement software for all devices and operating systems	14581-61	1

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Setup (1/9)

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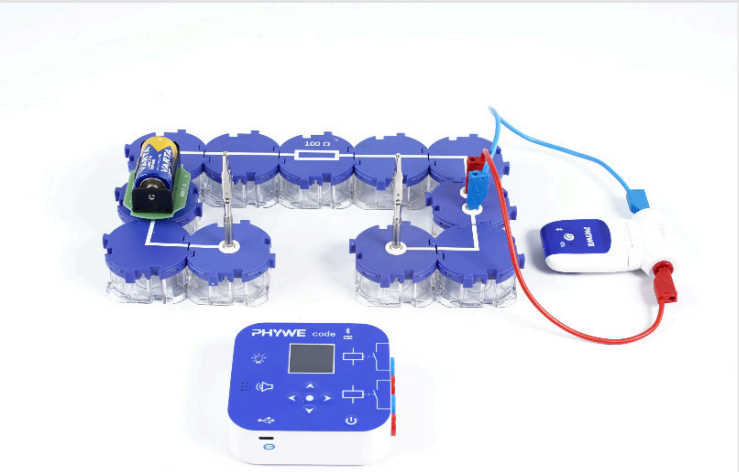

Fig. 1 Experimental setup

- Set up the experiment as shown in the illustrations on the left. To do this, insert the $1.5\ \mathrm{V}$ battery and the $100\,\Omega$-resistor. Plug the crocodile clips into the connection sockets using connecting plugs.

Setup (2/9)

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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

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Setup (3/9)

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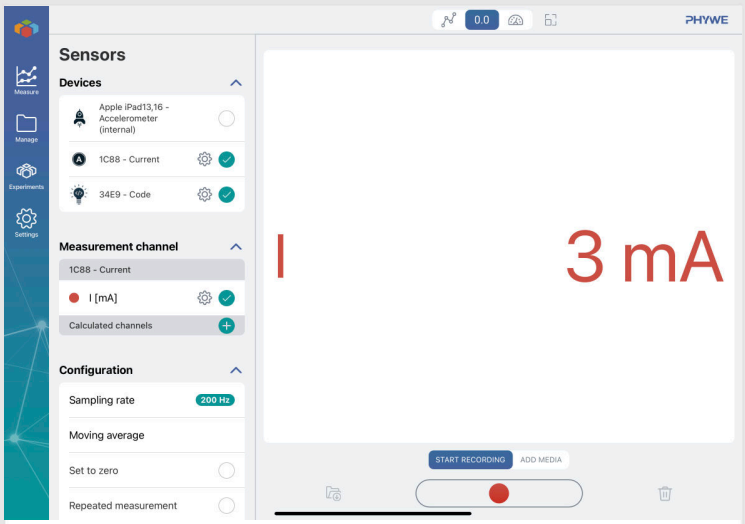

Fig. 2 Connecting to the sensors

- Start the Cobra SMARTsense Current and the SMARTSsense Code by pressing the on/off button for three seconds.
- Open the measureAPP and connect to the Cobra SMARTsense Current and the SMARTsense Code. Then switch to the digital display of the measured values. You can see what the display should look like in the photo on the left.

Setup (4/9)

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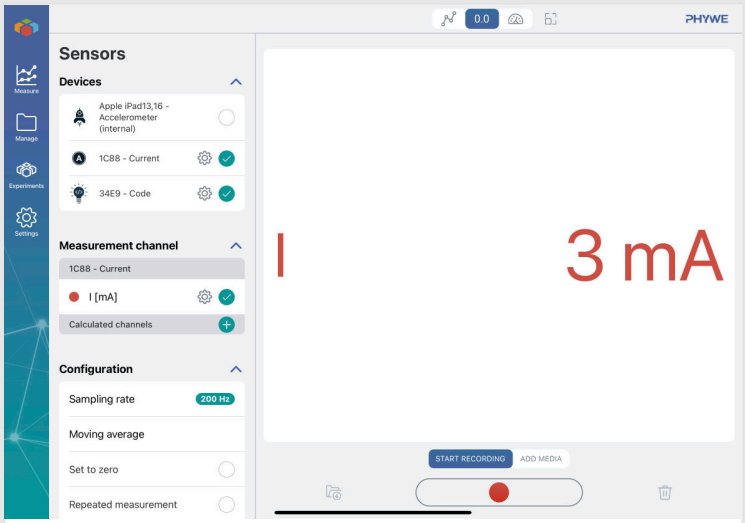

Example screenshot with fluctuations

- Observe the current values and estimate the maximum value of the fluctuations with no current connected. Make a note of the value, but first add approx. $2\ \mathrm{mA}$.

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Setup (5/9)

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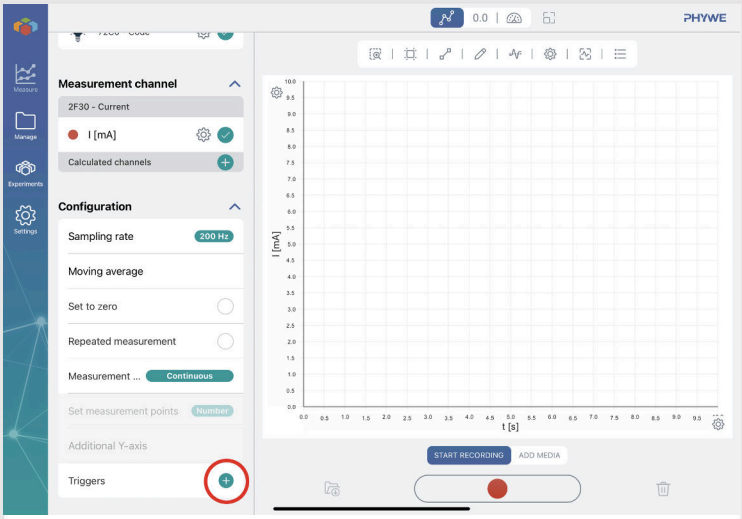

Adding a trigger

- Now programme the Cobra SMARTsense Code.
- To do this, add a trigger for the SMARTsense Code by pressing the plus button provided.
- If you set a trigger, this means that the Cobra SMARTsense code triggers a specific action as soon as a measured value fulfils a condition that you define.

Setup (6/9)

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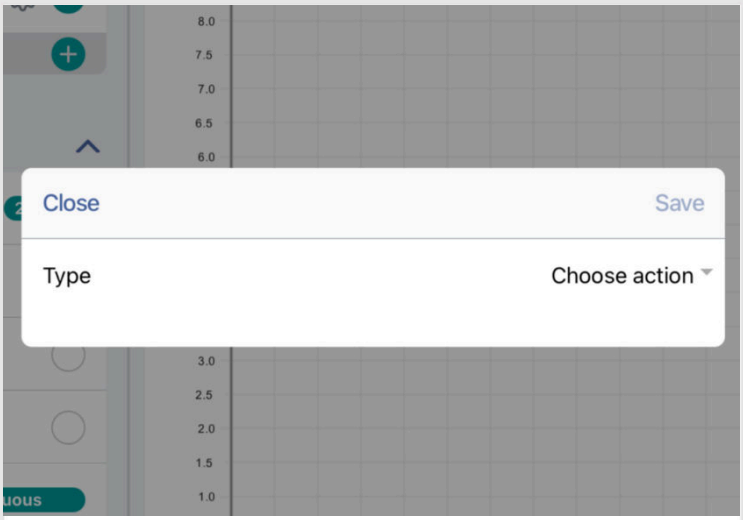

Adding an action

- A window will now appear in which you can select an action that you want to trigger. For our first trigger, we want the SMARTsense Code to display a sad smiley. Therefore, select this action by clicking on "Choose action".

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Setup (7/9)

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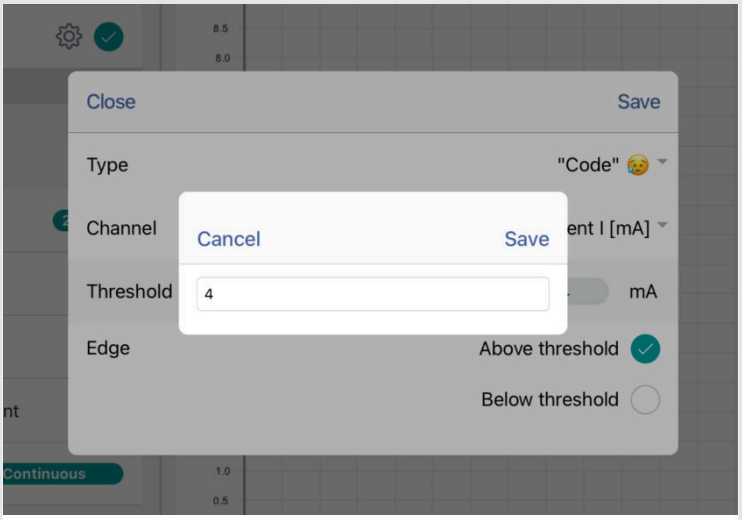

Adding a threshold value

- There are two options for when the action is triggered: Either it is triggered as soon as the threshold value is exceeded or when it falls below it. In the next step, you select which of the two cases applies to this trigger. Now you must first define exactly how high the threshold value is by clicking on the corresponding text field.
- To do this, look back at the value that was measured when no current was applied. Add a few mA and enter this value as the threshold value. This ensures that the background noise of the sensor does not trigger the action.

Setup (8/9)

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Fig. 3 Setting a trigger for a sample value

- You can now select whether the action should be executed when the current exceeds or falls below the threshold value. For this trigger, the action should be triggered when the current falls below the threshold value.
- Then click on save.
- Now create a trigger in the same way that triggers a happy smiley when the current rises above the threshold value.

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Setup (9/9)

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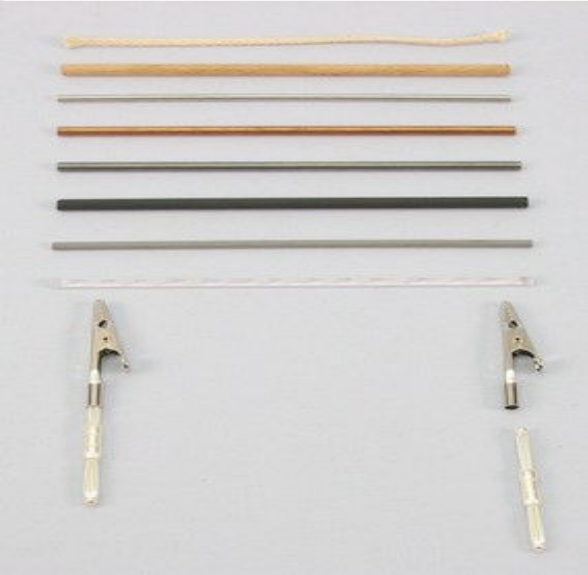

- The materials (conductors and non-conductors) are analysed one after the other. These are the following materials (from top to bottom as shown in the adjacent figure):
  - A cord made of cotton, wood, aluminium (silvery), copper (reddish), steel (like aluminium but heavier and darker), coal (black), PVC (plastic) and glass.

Procedure

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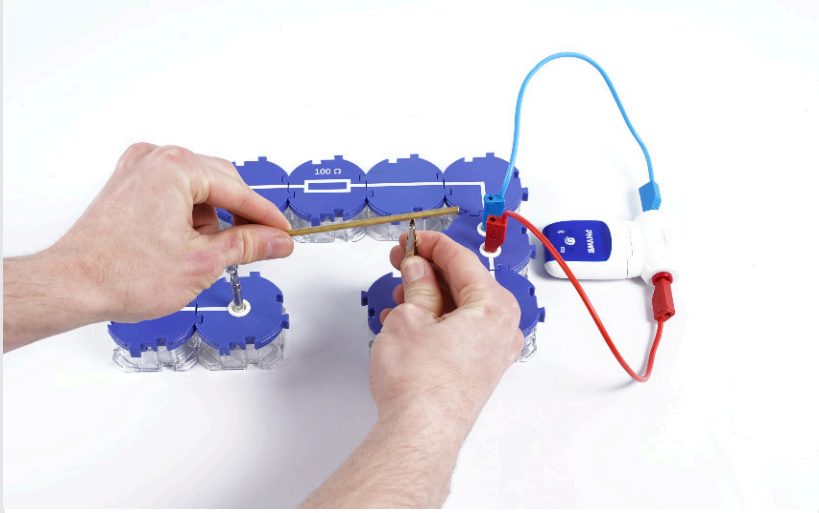

Fig. 4 Inserting a new (non-)conductor

- Clamp the individual rods of the conductor and non-conductor set into the two crocodile clips at both ends one after the other.
- The following applies to each rod: Observe the reaction of the code and measure the current strength I.
- Note your measured values in the log.

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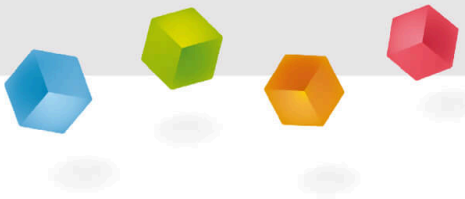

Report

Table 1

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Material	I [m A]	Material	I [m A]
Steel		Glass	
Aluminium		Wood	
Cupper		Coal	
PVC		Cotton	

Enter your measured values in the table.

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Task 1

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Metals conduct electricity.

○ True ○ False

Check

The following substances are non-conductors:

- ☐ Cotton
- ☐ Steel
- ☐ Glass
- ☐ PVC
- ☐ Copper

Check

Task 2

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Which of the following examples are insulators to protect against electric shocks?

- ☐ Rubber sole for safety shoes
- ☐ Plastic handles for voltage testers and screwdrivers
- ☐ Plastic sheathing of cables

Check

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Slide	Score / Total
Slide 22: Multiple tasks	0/4
Slide 23: Mark the insulators	0/3

Total amount 0 / 7

Solutions | Repeat | Export text

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