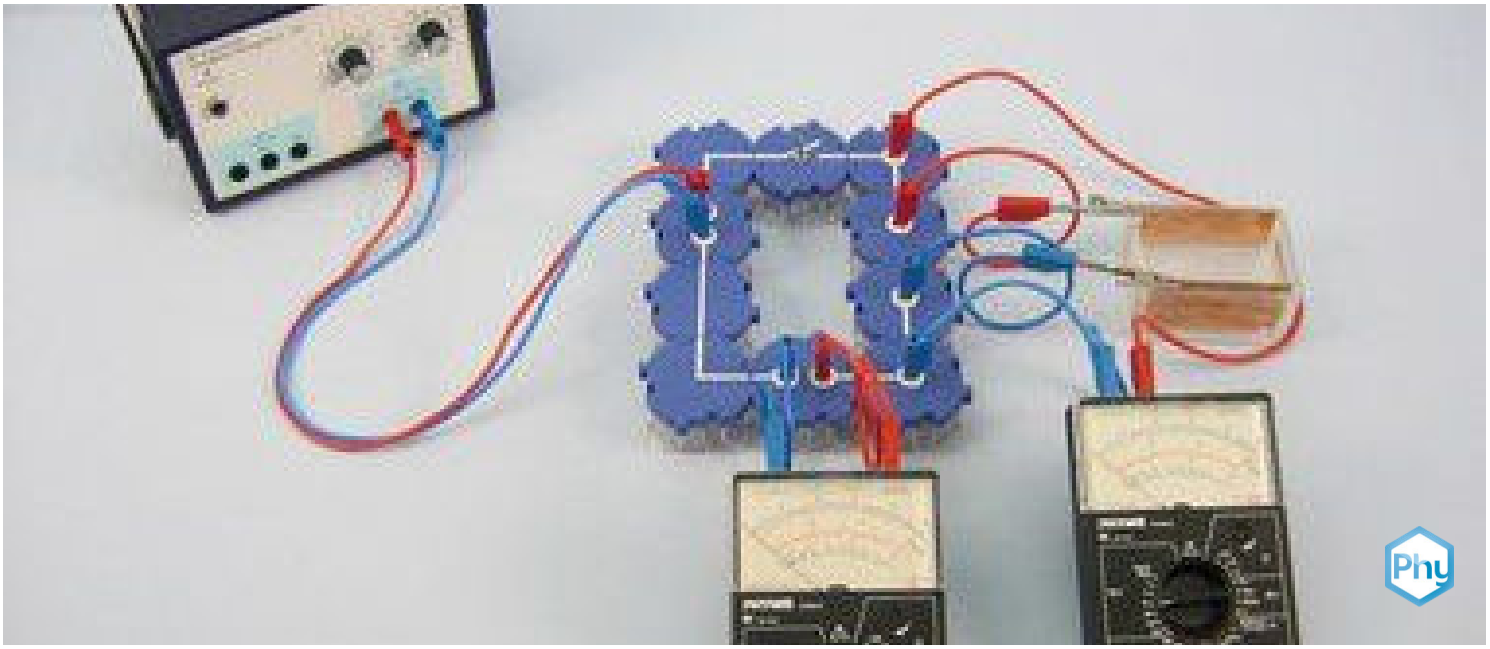
Connection between voltage and current in conductive proces-ses in liquids



In the experiment, the students are to discover whether Ohm's law applies to aqueous solutions.

Physics > Electricity & Magnetism > Electric current & its effects

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

This content can also be found online at:

http://localhost:1337/c/630cf2a670919e00038fa0f2

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Teacher information

Application

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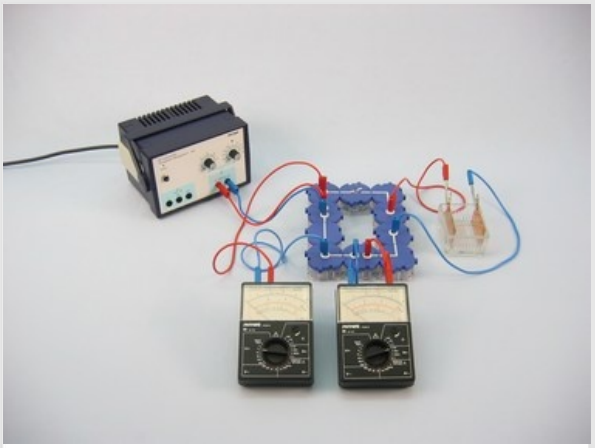

Experimental setup

Salts, acids and bases are electrolytes. In their purest form, they (almost) do not conduct electricity because they contain no (or only very few) free ions.

Electrolytes dissolved in water break down (dissociate) into positive and negative ions.

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Other teacher information (1/2)

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Prior knowledge

For this experiment, students should be familiar with the fact that aqueous solutions conduct electricity.

Principle

If a voltage is applied to two electrodes immersed in the aqueous solution of an electrolyte, the ions each migrate in the direction of the electrode with the opposite electrical polarity. Aqueous solutions of electrolytes are therefore electrically conductive.

Other teacher information (2/2)

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Learning objective

In the experiment, the students are to discover whether Ohm's law applies to aqueous solutions.

Tasks

Prepare an aqueous solution of copper sulphate and investigate the relationship between voltage and current as the current passes through the solution.

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Safety instructions

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- Diluted sulphuric acid and sodium hydroxide solutions are highly corrosive to skin, eyes and mucous membranes. Spray mist irritates the respiratory organs.
- Put on protective goggles and wear protective gloves.

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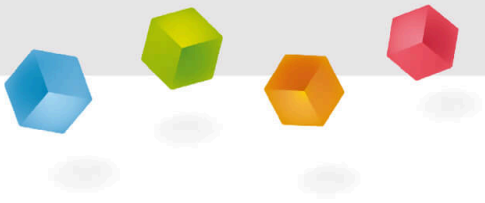

Student information

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Motivation

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Why is it so dangerous to go swimming during a thunderstorm?

Now that this question has been answered, we can check whether Ohm's law also applies to conductive liquids.

Lightning over the sea.

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Equipment

Position	Material	Item No.	Quantity
1	Straight connector module, SB	05601-01	1
2	Angled connector module, SB	05601-02	2
3	Interrupted connector module with sockets, SB	05601-04	2
4	Junction module, SB	05601-10	2
5	Angled connector module with socket, SB	05601-12	2
6	On-off switch module, SB	05602-01	1
7	Trough, grooved, w/o lid	34568-01	1
8	Copper electrode, 76 mm x 40 mm	45212-00	2
9	Alligator clips, bare, 10 pcs	07274-03	1
10	Connecting cord, 32 A, 250 mm, red	07360-01	2
11	Connecting cord, 32 A, 250 mm, blue	07360-04	2
12	Connecting cord, 32 A, 500 mm, red	07361-01	2
13	Connecting cord, 32 A, 500 mm, blue	07361-04	2
14	PHYWE Power supply, 230 V, DC: 0...12 V, 2 A / AC: 6 V, 12 V, 5 A	13506-93	1
15	PHYWE Analog multimeter, 600V AC/DC, 10A AC/DC, 2 MΩ, overload protection	07021-11	2
16	Water, distilled 5 l	31246-81	1
17	Emery paper, medium	01605-00	1
18	Copper-II sulphate,cryst. 250 g	30126-25	1
19	Spoon, with spatula end, 180 mm, plastic	38833-00	1

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Set-up and Procedure (1/3)

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- Set up the experiment according to Fig. 1 and Fig. 2, first with the switch open. Clean the grooved trough and the copper electrodes carefully if necessary, then insert the electrodes into the trough with maximum spacing and connect them to the (short) connecting leads using the alligator clips.
- Fill the grooved trough about halfway with distilled water, add half a spoonful of copper sulphate to the water and stir until the salt is completely dissolved.
- Select the 10 V and 300 mA measuring range and close the switch.

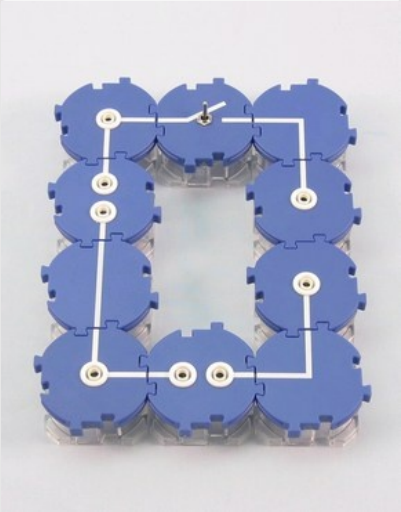

Fig. 1

Set-up and Procedure (2/3)

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- Set the power supply unit to 0 V and switch it on.
- Increase the voltage in steps of 2 V, measure the respective current and note the measured value in Table 1 in the report.
- Now set a voltage of 4 V, open the switch and roughly halve the distance between the electrodes.
- Close the switch, measure the current and note the reading.

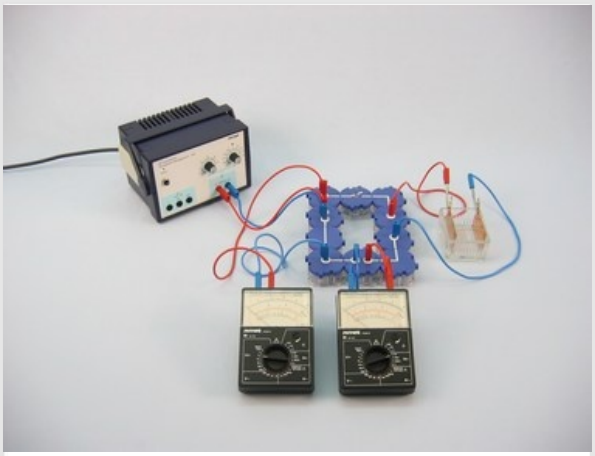

Fig. 2

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Set-up and Procedure (3/3)

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- Open the switch, restore the previous electrode gap, sprinkle some more copper sulphate into the solution, stir it and, when everything is dissolved, close the switch again, measure the current (again at 4 V) and note the reading.
- Set the power supply unit to 0 V and switch it off.
- Dry the electrodes and dispose of the aqueous solution properly, clean the grooved trough and wash your hands with soap.

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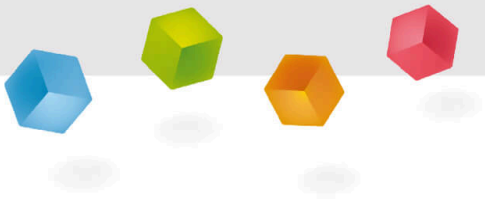

Report

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Observation (1/2)

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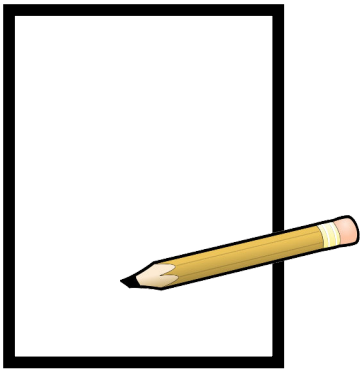
Voltage U [V]	Current I [mA]	Resistance R [Ω]
2		
4		
6		
8		
10		

Plot the current as a function of the voltage.



Observation (2/2)

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Voltage U [V]	Current I [mA]	Resistance R [Ω]
4 (with reduced electrode gap)		
4 (with increased concentration)		

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Task (1/3)

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What is the relationship between current and voltage?

- There is linear growth between current and voltage.
- There is exponential growth between current and voltage.
- There is a constant relationship between current and voltage.
- There is antiproportional growth between current strength and voltage.

Task (2/3)

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Compare the current in line 2 of Table 1 with the currents you measured at the same voltage but under different conditions (lines 6 and 7 of Table 1). What can be determined from this comparison regarding the resistance of aqueous solutions of electrolytes?

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Task (3/3)

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What other conditions influence the resistance of a conductive liquid?

The _____ of the ions is hindered by collisions with the other particles of the liquid. The higher the _____ of the liquid, the more the ions are hindered. This converts _____ into thermal energy. This _____ is released into the environment in the form of heat.

thermal energy
electrical energy
temperature
directed movement

Check

Slide	Score / Total
Slide 15: Current-voltage ratio	0/1
Slide 17: Influencing the resistance	0/4

Total score 0 / 5

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