

The relationship between voltage and current intensity in conduction processes in liquids (Item No.: P1375000)

Curricular Relevance



Difficulty



Intermediate

Preparation Time



10 Minutes

Execution Time



10 Minutes

Recommended Group Size



2 Students

Additional Requirements:

- Cloth or absorbent paper

Experiment Variations:

Keywords:

Task and equipment

Information for teachers

Additional information

After the students have recognised that there are also conducting liquids, namely aqueous solutions of electrolytes, the question whether Ohm's Law is also valid for them is to be answered.

The experimental results affirm that this is true. The students should be subsequently informed that, however, this is not the case for all solutions of electrolytes.

Safety measures



R: 22-36/38-50/53

S: 22-60-61

Copper(II) sulphate is harmful to health, irritating to eyes and skin. Do not inhale vapours or dusts.

Wear protective glasses and protective gloves.

Waste disposal

Collect solutions containing heavy metal ions or salts in an appropriately labelled container and subject them to proper disposal.

Notes on setup and procedure

No measurement should be made until the copper sulphate is completely dissolved, otherwise the value of the resistance will alter during the series of measurements. Should it begin to become evident in any of the groups that a higher current intensity than 300 mA will result at 10 V, then, for example, the last measurement can also be made at 9 V.

The teacher can avoid higher current intensity than 300 mA at 10 V, however, by portioning out appropriate quantities of copper sulphate to the groups.
The proper waste disposal of the aqueous solutions should be organised centrally and be superintended by the teacher himself.

Remarks

The students can themselves easily demonstrate that the resistance is also dependent on the size of the area of the immersed parts of the electrodes in lifting up an electrode and observe the ammeter while doing so.
The values entered in Table 1 are only approximate values, as different series of measured values are given according to the concentration of the solution.
The results of this experiment and the evaluation suggest a consideration of their analogy to the law of resistance $R = \rho \times l / A$ which is valid for metal wires.

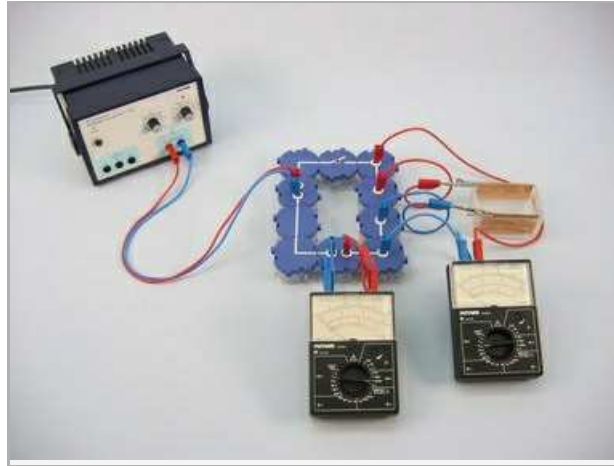
The relationship between voltage and current intensity in conduction processes in liquids (Item No.: P1375000)

Task and equipment

Task

Is Ohm's Law also valid for conduction processes in liquids?

Prepare an aqueous solution of copper sulphate and examine the relationship between voltage and current when current passes through it.



Equipment



Position No.	Material	Order No.	Quantity
1	Straight connector module, SB	05601-01	1
2	Angled connector module, SB	05601-02	2
3	Interrupted connector module, 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	(2)
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 DC: 0...12 V, 2 A / AC: 6 V, 12 V, 5 A	13506-93	1
15	Multi-range meter, analogue	07028-01	2
16	Water, distilled 5 l	31246-81	1
17	Emery paper, medium, 5 sheets	01605-02	(1)
18	Copper-II sulphate,cryst. 250 g	30126-25	1
	Spoon,w.spatula end,18 cm,plastic	38833-00	1
Additional material			
	Cloth or absorbent paper		

Set-up and procedure

Set-up

Safety measures



R: 22-36/38-50/53

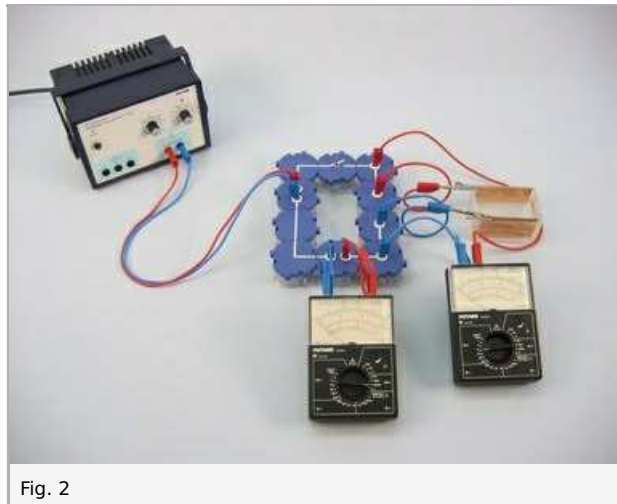
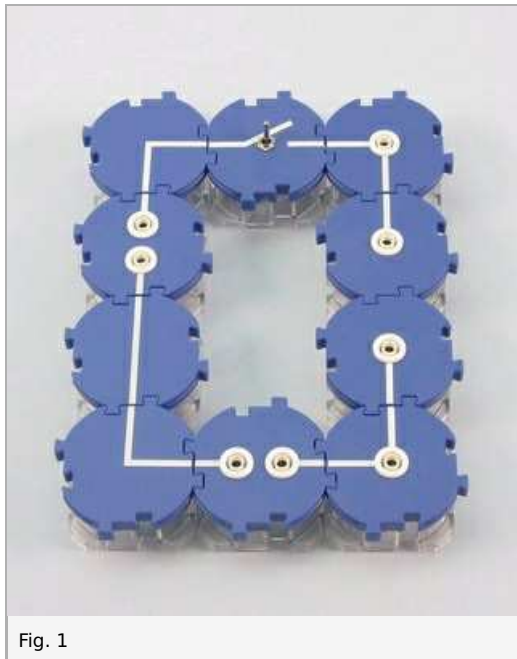
S: 22-60-61

Copper(II) sulphate is harmful to health, irritating to eyes and skin. Do not inhale vapours or dusts. Wear protective glasses and protective gloves.

Setup

Set up the experiment as shown in Fig. 1 and Fig. 2, with the switch first open. If necessary, thoroughly clean the trough and the copper electrodes, then plug the electrodes into the trough at the maximum distance from each other and use the crocodile clips to connect them to the (short) connecting cables.

Fill the trough half way with distilled water; add a half-spoonful of copper sulphate and stir the water until the salt is completely dissolved.



Procedure

- Select the 10 V- and 300 mA- measurement ranges, close the switch.
 - Set the power supply to 0 V and switch it on.
 - Increase the voltage in steps of 2 V; measure the current intensity at each step and note the measured values in Table 1 in the report.
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- Now set the voltage to 4 V, open the switch and roughly halve the distance of the electrodes from each other.
 - Close the switch, measure the current intensity and note the measured value.
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- Finally, open the switch, bring the electrodes back to their original positions, and then sprinkle a little more copper sulphate into the solution and stir until it is all dissolved. Close the switch, measure the current intensity (again at 4 V) and note the measured value.
 - Set the power supply to 0 V and switch it off.
 - Dry the electrodes and properly dispose of the aqueous solution; clean the trough and wash your hands with soap and water.

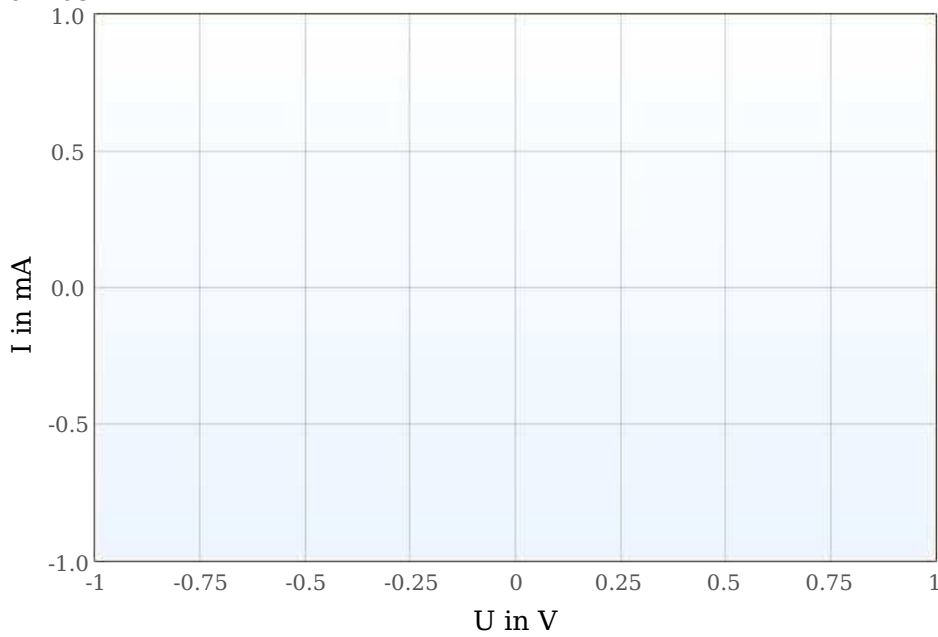
Report: The relationship between voltage and current intensity in conduction processes in liquids

Results - Table 1

Record the measured values in Table 1.

U in V	I in mA	R in Ω
2	1	1
4	1	1
6	1	1
8	1	1
10	1	1

Number1



Results - Table 2

Record the measured values for half distance of electrodes in Table 2.

U in V	I in mA	R in Ω
4 (with reduced distance between electrode)	0	0
4 (at a higher salt concentration)	0	0

Evaluation - Question 1

Refer to the chart. What is the relationship between U and I ? Calculate the quotient U / I and add the results to the third column of Table 1. What do you notice? Answer the question asked in "Task".

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Evaluation - Question 2

Compare the current intensity in line 2 of Table 1 with the current intensities which you measured at the same voltage but under changed conditions (lines 6 and 7 of Table 1). What can be concluded from this comparison with respect to the resistance of aqueous solutions of electrolytes?

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Evaluation - Question 3

Consider on what else the resistance of a conducting liquid could be dependent, and summarise the dependences which you have determined or presumed!

The resistance of a conducting liquid is dependent on:

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