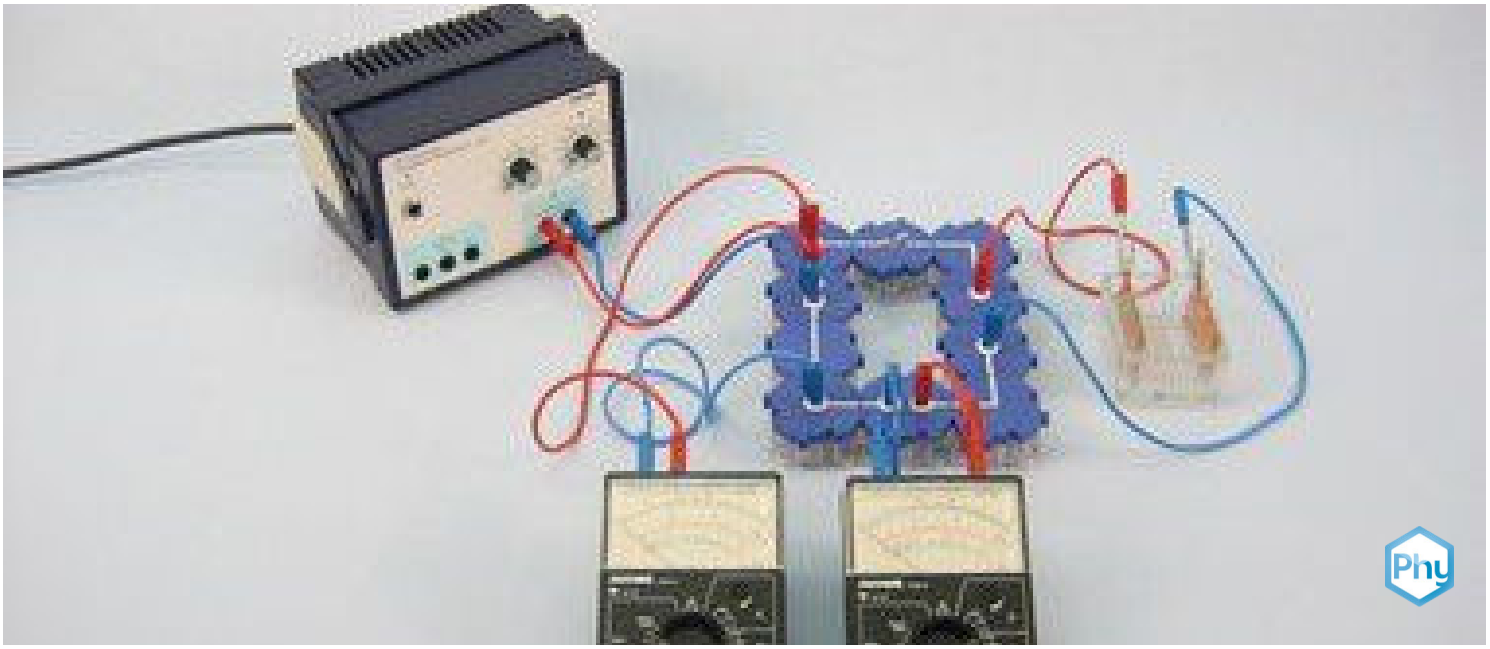
Conductivity of aqueous solutions of electrolytes



In this experiment, the students are to find out why an electrolyte that is not dissolved (or not melted) and distilled water are not or almost not conductive.

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/630cf28d46511f0003903e4f

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Teacher information

Application

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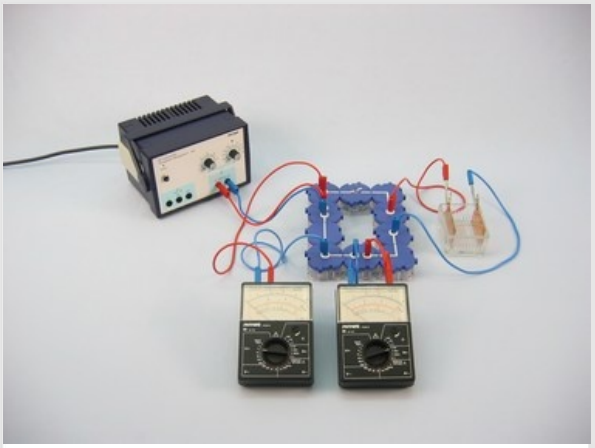

Experimental setup

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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Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
Fax: 0551 604 - 107

info@phywe.de
www.phywe.de

Other teacher information (1/2)

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Prior knowledge

No prior knowledge is necessary for this experiment.

Principle

If a voltage is applied to two electrodes immersed in the aqueous solution of an electrolyte, the ions 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 this experiment, the students are to find out why an electrolyte that is not dissolved (or not melted) and distilled water are not or almost not conductive.

Tasks

Investigate whether water in which substances are dissolved conducts electricity.

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Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
Fax: 0551 604 - 107

info@phywe.de
www.phywe.de

Safety instructions

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- Put on protective goggles!
- Wear gloves!
- For the H- and P-phrases please refer to the corresponding safety data sheets.
- The general instructions for safe experimentation in science lessons apply to this experiment.

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Student information

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Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
Fax: 0551 604 - 107

info@phywe.de
www.phywe.de

Motivation

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As soon as a thunderstorm is approaching, the water in the outdoor pool should be exited. It is also said that it is not safe to swim in another body of water when thunder and lightning are in the air.

But why is it so dangerous to go swimming during a thunderstorm? This experiment examines the conductivity of substances dissolved in water and thus allows conclusions to be drawn about the answer to this question.

Thunderstorm over the sea

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Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
Fax: 0551 604 - 107

info@phywe.de
www.phywe.de

Equipment

Position	Material	Item No.	Quantity
1	Angled connector module, SB	05601-02	2
2	Straight connector module, SB	05601-01	1
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	Sulphuric acid, 10%, tech.gr., 1000 ml	31828-70	1
17	Sodium hydroxide sol.,10%, 1000ml	31630-70	1
18	Water, distilled 5 l	31246-81	1
19	Emery paper, medium	01605-00	1
20	Spoon, with spatula end, 180 mm, plastic	38833-00	1

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Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
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info@phywe.de
www.phywe.de

Set-up and Procedure (1/4)

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- Set up the experiment according to fig. 1 and 2. The switch is open. Clean the grooved trough and the copper electrodes carefully before inserting the electrodes into the outer grooves of the trough.
- Fill the grooved trough about halfway with distilled water. Select the measuring ranges 3 V- and 3 mA-.
- Set the power supply unit to 0 V and switch it on.
- Close the switch, increase the voltage at the power supply unit until the voltmeter reads 2 V. Measure the current and record the reading in Table 1 in the report.

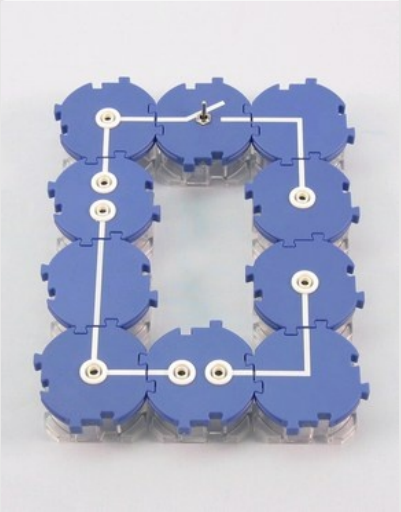

Fig. 1

Set-up and Procedure (2/4)

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- Open the switch, empty and dry the grooved trough.
- Replace electrodes in the grooved trough and fill the trough with a layer of saline about 2 cm high.
- Close the switch and measure the current at $U = 2$ V; note the measured value.
- Select a measuring range of 30 mA and then pour distilled water slowly onto the salt in the grooved trough; watch the ammeter and increase the measuring range if the current threatens to exceed 30 mA.

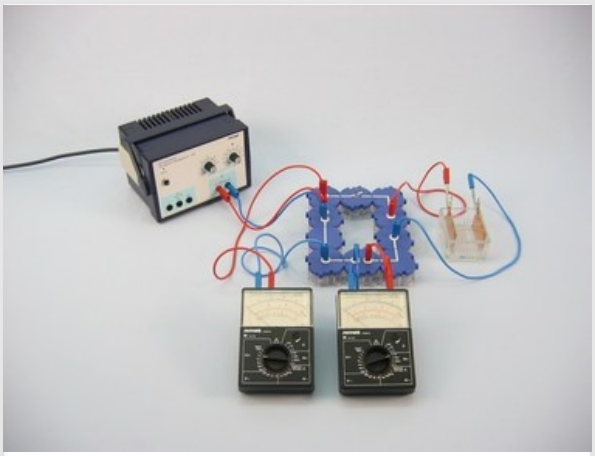

Fig. 2

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Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
Fax: 0551 604 - 107

info@phywe.de
www.phywe.de

Set-up and Procedure (3/4)

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- Stir the saline solution with the spoon and measure the current strength that has been established at the end.
- Open the switch and note the measured value for I.
- Empty the grooved trough and wash thoroughly - as well as the electrodes - and dry; put electrodes back into the grooved trough.
- Select measuring range 30 mA- and fill the grooved trough about half full with drinking water.
- Close the switch and measure the current again at $U = 2$ V; note the measured value.
- Empty the grooved trough with the switch open.
- Select measuring range 300 mA-, close the switch, carefully pour diluted acid into the grooved trough, measure the current and note the measured value.

Set-up and Procedure (4/4)

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- Open the switch, properly dispose of aqueous solution, rinse and dry the grooved trough and electrodes with water.
- Proceed in the same way with diluted base.
- Set the power supply unit to 0 V and switch it off.
- Dispose of aqueous solution properly, rinse and dry the grooved trough and electrodes with water and finally wash your hands.

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Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
Fax: 0551 604 - 107

info@phywe.de
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Report

Observation

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Test part no.	Substance in the grooved trough	Current I [mA]
1	distilled water	
2	Salt	
3	aqueous solution of a salt	
4	Drinking water	
5	aqueous solution of an acid	
6	aqueous solution of a base	

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Robert-Bosch-Breite 10
37079 Göttingen

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Fax: 0551 604 - 107

info@phywe.de
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Task (1/4)

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Summarise the results of the individual parts of the experiment in words.

Task (2/4)

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Drag the words into the correct boxes!

In liquids, a _____ only takes place if freely mobile (migratable) _____ are present due to dissociation. When a voltage is applied and thus when an _____ is present, the ions move in a directed manner. Electrical energy is converted into _____. A special feature of conduction processes in liquids that is important for applications is that not only charges are transported with the ions, but also substances.

- ions
- conduction process
- thermal energy
- electric field

Check

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Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
Fax: 0551 604 - 107

info@phywe.de
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Task (3/4)

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Why, for example, does table salt not conduct electricity, nor does distilled water (almost), and why does normal drinking water conduct electricity - although not well?

To conduct electricity, moving charged particles such as ions are necessary. _____ does not have these, which is why it does not conduct electricity. Although _____ consists of electrically charged ions, these are not freely mobile. In contrast, _____ contains small amounts of dissolved salts, which now contribute freely moving ions and thus lead to electrical conductivity.

drinking water

table salt

Distilled water

Check

Task (4/4)

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In electrical engineering, the earth is often used as a conductor. How can this be explained?

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Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
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info@phywe.de
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Slide	Score / Total
Slide 16: How it works	0/4
Slide 17: Reason for conductivity	0/3

Total score 0 / 7

Show solutions | Repeat | Export text

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Robert-Bosch-Breite 10
37079 Göttingen
Tel.: 0551 604 - 0
Fax: 0551 604 - 107
info@phywe.de
www.phywe.de