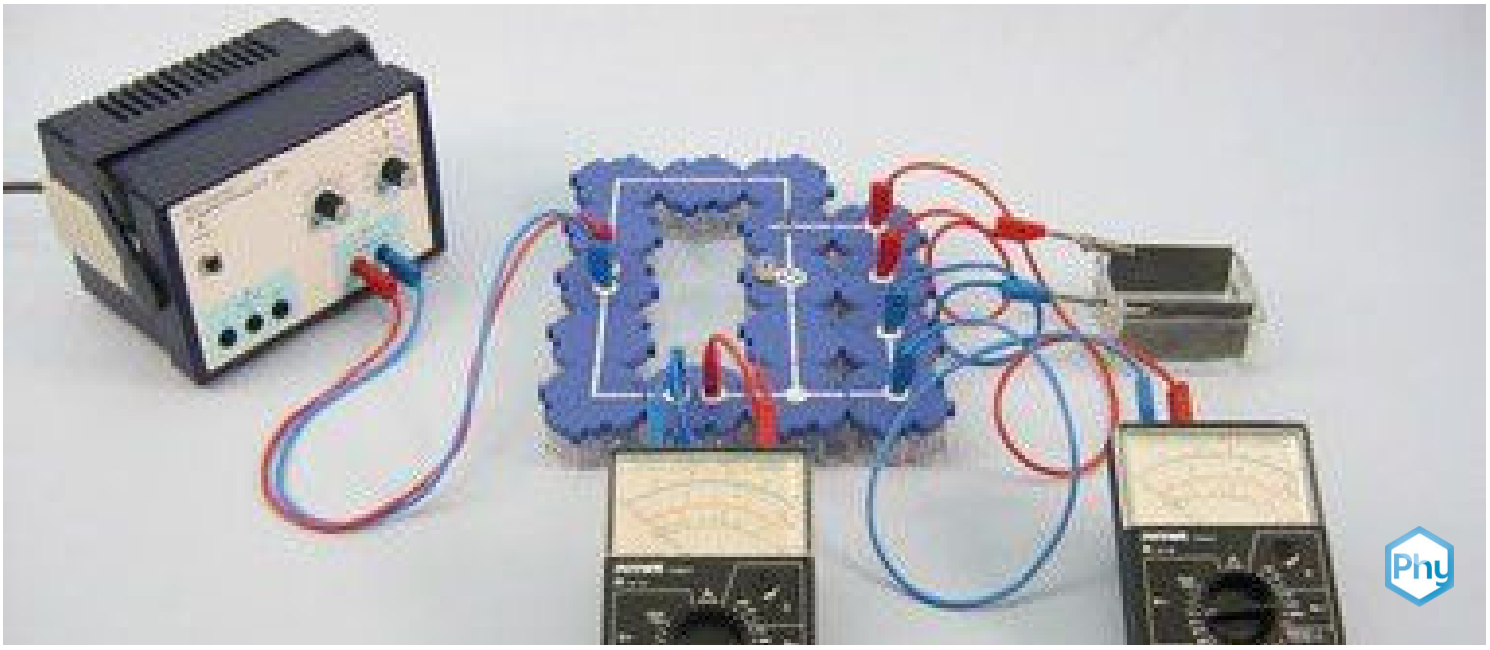
# The lead accumulator



This experiment is intended to show the students the basic structure and mode of operation of a lead accumulator.

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/6310c66741925f0003a835f5

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# Teacher information

## Application

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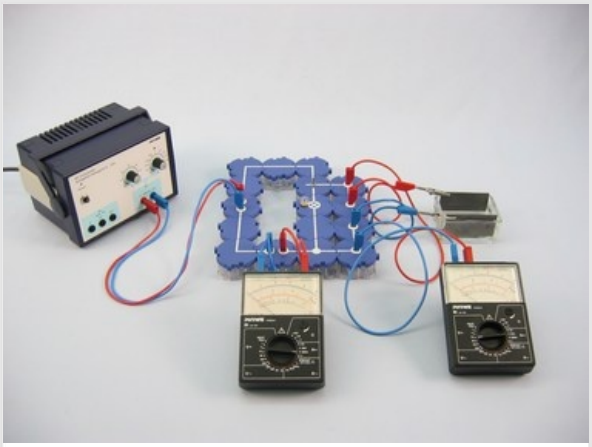

Experimental setup

The storage of electrical energy is a significant problem of energy supply, especially since the energy of alternating current provided in power plants cannot be stored directly.

Direct current can be stored by converting electrical energy into chemical energy. The device suitable for this is called an accumulator. In practice, several accumulator cells are generally connected in series to form a battery.



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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**

The chemical reactions that take place during charging and discharging are complicated, but can be covered if the students have the appropriate prior knowledge:

Before a voltage is applied, the two lead electrodes become coated with lead sulphate (PbSO4) after being immersed in the aqueous solution in which sulphuric acid has dissociated $\mathrm{H_2SO_4} \rightarrow 2\mathrm{H^+} + \mathrm{SO_4^{2-}}$

## Other teacher information (2/2)

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**Learning objective**

This experiment is intended to show the students the basic structure and mode of operation of a lead accumulator.

**Tasks**

Using a lead accumulator model as an example, show how electrical energy can be stored and reused chemically.



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## Safety instructions

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- Wear protective gloves and goggles.
- For the H and P phrases, observe 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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# Motivation

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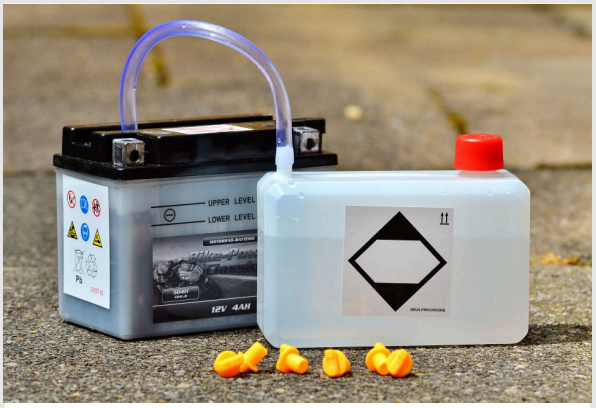
The storage of electrical energy is a significant problem of energy supply, especially since the energy of alternating current provided in power plants cannot be stored directly.

Direct current can be stored by converting electrical energy into chemical energy. The device suitable for this is called an accumulator. In practice, several accumulator cells are generally connected in series to form a battery.




In practice, several accumulator cells are generally connected in series to form a battery.



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# Equipment

| Position | Material | Item No. | Quantity |
|---|---|---|---|
| 1 | Straight connector module, SB | 05601-01 | 4 |
| 2 | Angled connector module, SB | 05601-02 | 3 |
| 3 | T-shaped connector module, SB | 05601-03 | 1 |
| 4 | Interrupted connector module with sockets, SB | 05601-04 | 2 |
| 5 | Junction module, SB | 05601-10 | 2 |
| 6 | Angled connector module with socket, SB | 05601-12 | 2 |
| 7 | Change-over switch module, SB | 05602-02 | 1 |
| 8 | Socket module for incandescent lamp E10, SB | 05604-00 | 1 |
| 9 | Trough, grooved, w/o lid | 34568-01 | 1 |
| 10 | Lead electrode, 76 mm x 40 mm | 45215-00 | 2 |
| 11 | Alligator clips, bare, 10 pcs | 07274-03 | 1 |
| 12 | Connecting cord, 32 A, 250 mm, red | 07360-01 | 2 |
| 13 | Connecting cord, 32 A, 250 mm, blue | 07360-04 | 2 |
| 14 | Connecting cord, 32 A, 500 mm, red | 07361-01 | 2 |
| 15 | Connecting cord, 32 A, 500 mm, blue | 07361-04 | 2 |
| 16 | Filament lamps 4V/0.04A, E10, 10 | 06154-03 | 1 |
| 17 | PHYWE Power supply, 230 V, DC: 0...12 V, 2 A / AC: 6 V, 12 V, 5 A | 13506-93 | 1 |
| 18 | PHYWE Analog multimeter, 600V AC/DC, 10A AC/DC, 2 MΩ, overload protection | 07021-11 | 2 |
| 19 | Sulphuric acid, 10%, tech.gr., 1000 ml | 31828-70 | 1 |
| 20 | Water, distilled 5 l | 31246-81 | 1 |
| 21 | Emery paper, medium | 01605-00 | 1 |



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## Set-up and Procedure (1/3)

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- Fill the grooved trough with diluted sulphuric acid (approx. 5 %) and put the lead electrodes, cleaned with emery paper, into the trough.
- Set up the experiment as shown in Fig. 1, Fig. 2 and Fig. 3. The change-over switch is set to 1 (charging). Select the measuring range 300 mA- and 10 V-.
- Set the power supply unit to 0 V and switch it on.
- Adjust the voltage at the power supply so that the ammeter reads about 200 mA.

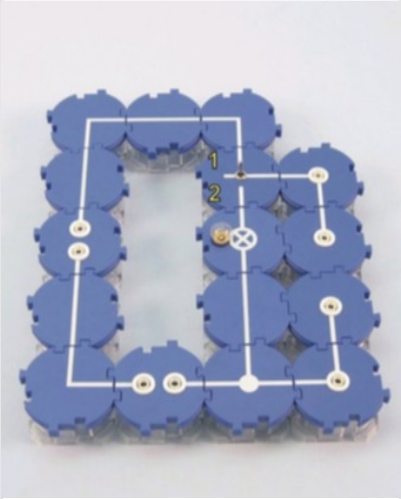


Fig. 1

## Set-up and Procedure (2/3)

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- Adjust the voltage at the power supply so that the ammeter reads about 200 mA.
- Observe the voltmeter and the light bulb for a few minutes and record your observations in the report under "Result - Observations 1".
- Select the measuring range 10 V again and set the changeover switch to 1. Set the (charging) current to approx. 200 mA.
- After about half a minute, set the switch to position 2 (discharge). Observe the bulb and measure the voltage. To do this, temporarily select the measuring range 3 V- .

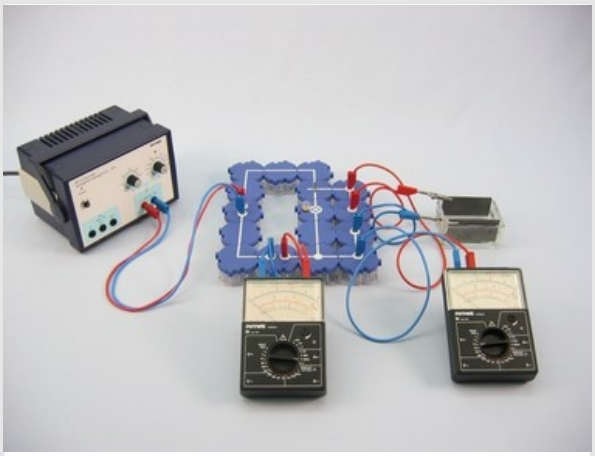

Fig. 2



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## Set-up and Procedure (3/3)

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- Compare your readings with those recorded in the previous part of the experiment and record your observations in the report under "Result - Observations 2".
- Set the power supply unit to 0 V and switch it off.
- Take the electrodes out of the solution, rinse them with water and look at them carefully. Note any changes in the report.
- Dispose of the aqueous solution properly, clean the grooved trough and wash your hands with soap!

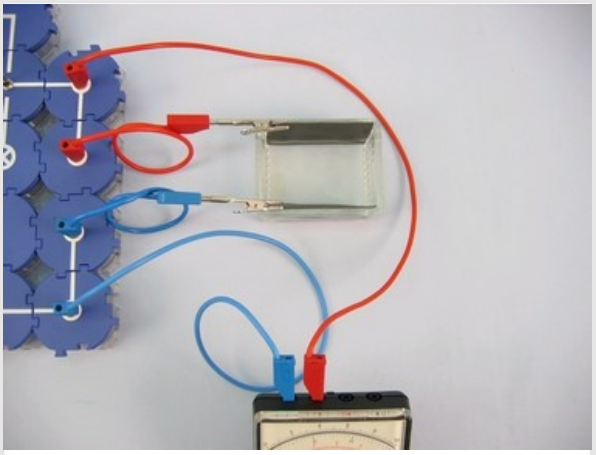

Fig. 3

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# Report



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## Observation (1/3)

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Write down your observations and measurements for the first part of the experiment. What is the voltage between the electrodes?

## Observation (2/3)

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Write down your observations of the second part of the experiment. Compare your observations with the first part of the experiment.



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## Observation (3/3)

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Write down your observations about the electrodes.

## Task (1/2)

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Describe the construction and mode of operation of a lead-acid battery cell, taking into account the facts noted under "Result - Observations 1".



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# Task (2/2)

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Drag the words into the correct boxes!

In general, the removable capacity of a battery decreases with increasing _____. One of the reasons for this is the increasing _____ at the internal resistance of the battery with increasing current, which causes the output voltage to drop accordingly, so that the final discharge voltage is reached earlier. In addition to the _____, the limited _____ of the electrochemical processes and charge transport processes in the battery is also responsible for its decreasing capacity with increased discharge current.

- voltage drop
- internal resistance
- discharge current
- speed

Check

| Slide | Score / Total |
|---|---|
| Slide 17: Capacity | 0/4 |

**Total score** 0 / 4

Show solutions | Repeat | Export text



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