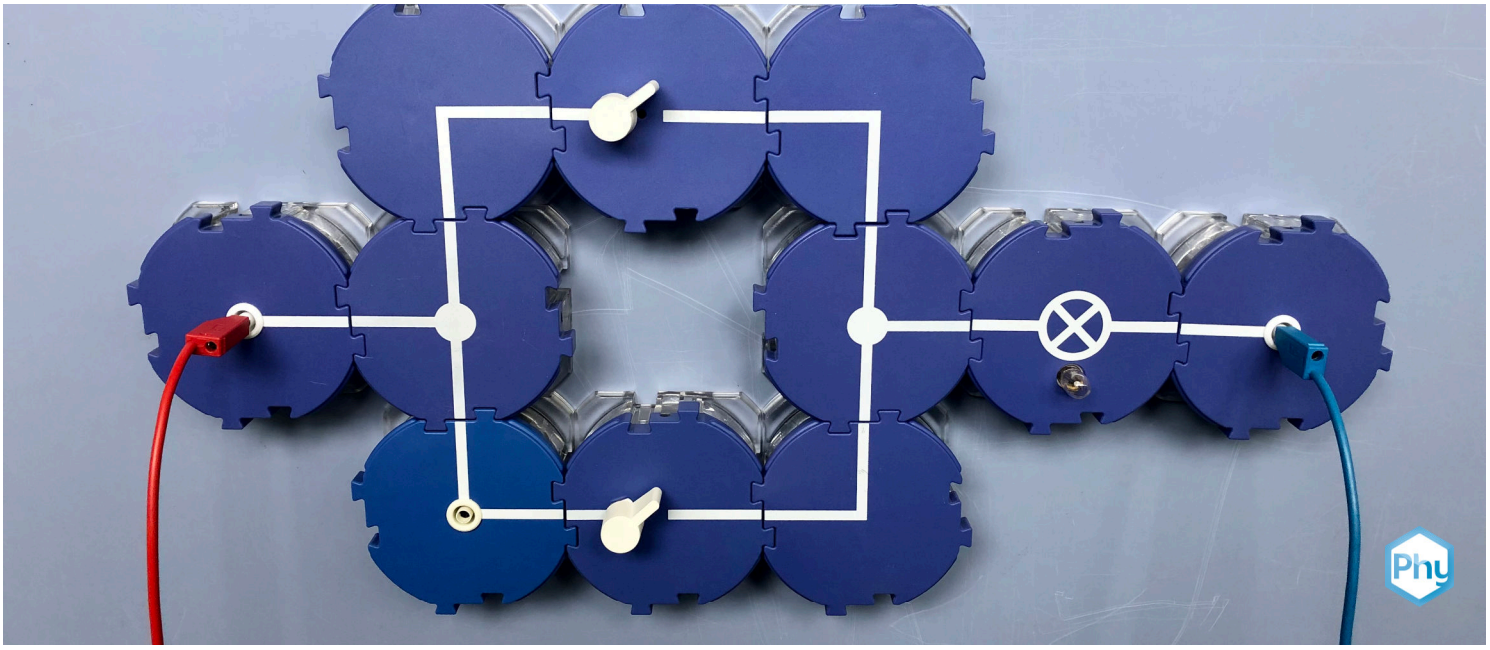
And- and Or circuit



This experiment consists of two sub-experiments. The first part of the experiment investigates the functioning of the \(AND-\) circuit and the second part investigates the functioning of the \(OR-\) circuit.

Physics > Electricity & Magnetism > Electronics

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

This content can also be found online at:

http://localhost:1337/c/6474c51521530f000293d8b6

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General information

Application

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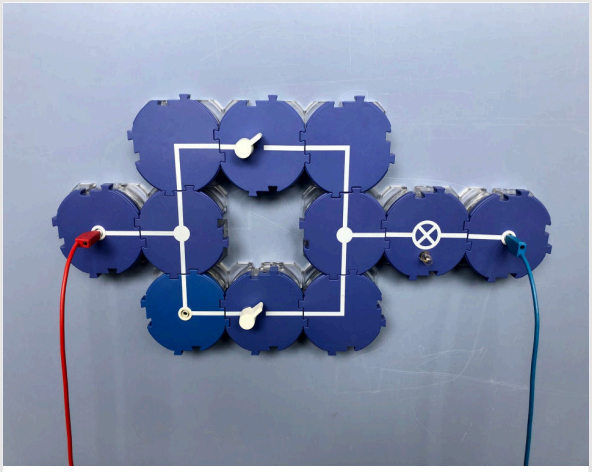

Experimental setup

This experiment will focus on the $AND-$ and the $OR-$ circuit. These two circuits are basic logic circuits, so-called "gates". In addition to the $NOT-$ and $EITHER-OR-$ circuits form the basis for binary digital technology.

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Other information (1/2)

Prior knowledge

The students should be familiar with the functioning of the simple electric circuit.

Principle

With the help of mechanical switches $UND-$ and $ODER-$ circuits are constructed. This demonstrates that it is possible to assign logical statements to electrical switching states.

Other information (1/2)

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Prior knowledge

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Principle

With the help of mechanical switches $UND-$ and $ODER-$ circuits are constructed. This demonstrates that it is possible to assign logical statements to electrical switching states.

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Other information (2/2)

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Learning objective

The students should be familiar with the principle of $AND-$ and $OR-$ circuits and thus be introduced to the basic principles of binary digital technology.

Tasks

This experiment consists of two sub-experiments. The first sub-experiment is about investigating the functioning of the $AND-$ circuit and in the second part around that of the $OR-$ Circuit.

Safety instructions

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The general instructions for safe experimentation in science lessons apply to this experiment.

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Theory (1/2)

$AND-$ and $OR-$ circuits form two cornerstones of basic logic circuits, which in turn form the basis for binary digital technology. They serve as the implementation for arithmetic operators of mathematical logic. These links can be realised by mechanical switches, for example. A distinction is made between two possible states:

- The condition $HIGH$ (1) corresponds to the concern of an electrical voltage, or the logical truth value "true".
- The condition LOW (0) corresponds to the absence of an electrical voltage, or the logical truth value "false".

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Equipment

Position	Material	Item No.	Quantity
1	PHYWE Demo Physics board with stand	02150-00	1
2	Connector, straight, module DB	09401-01	4
3	Connector, angled, module DB	09401-02	4
4	Connector, T-shaped, module DB	09401-03	2
5	Junction, module DB	09401-10	2
6	Switch on/off, module DB	09402-01	2
7	Socket for incandescent lamp E10 ,module DB	09404-00	1
8	Connecting cord, 32 A, 1000 mm, red	07363-01	1
9	Connecting cord, 32 A, 1000 mm, blue	07363-04	1
10	PHYWE Power supply, universal, analog display DC: 18 V, 5 A / AC: 15 V, 5 A	13503-93	1
11	Filament lamps 12V/0.1A, E10, 10 pieces	07505-03	1
12	Pointers f. Demonst.Board, 4 pcs	02154-01	1
13	G-clamp	02014-01	2

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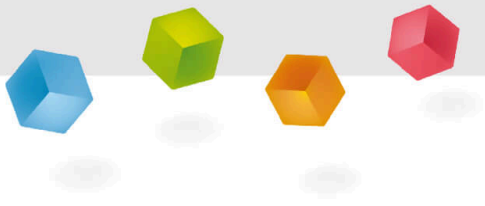

Set-up and Procedure

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Set-up

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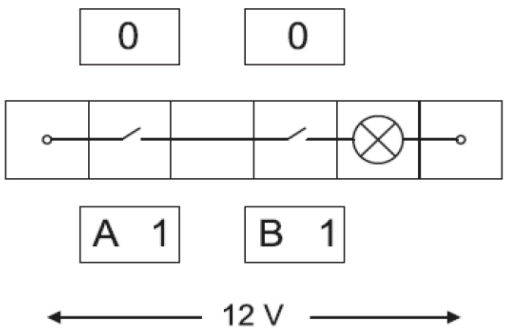

Experimental setup 1

- Set up the experiment according to the illustration on the left; the switches are initially open.
- Before the experiment, write on unlabelled strips from the set of electrical symbols the symbols $1, 0, A$ and B and attach according to the illustration.
- This is important in order to explicitly formulate the statements symbolised in the truth tables line by line. (Example table 1, line 3: If switch A is closed (1) and switch B is open (0), then the light bulb is not lit (0)).

Procedure (1/2)

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- Switch on the power supply unit and set the nominal voltage $12V$ for the incandescent lamp.
- The switches A and B close and open, making all possible switching combinations; while doing so, observe bulb and note observations in Table 1 using the following symbols:

Switch open: 0

Switch closed: 1

Bulb not lit: 0

Bulb lights: 1

Picture of a light bulb

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Procedure (2/2)

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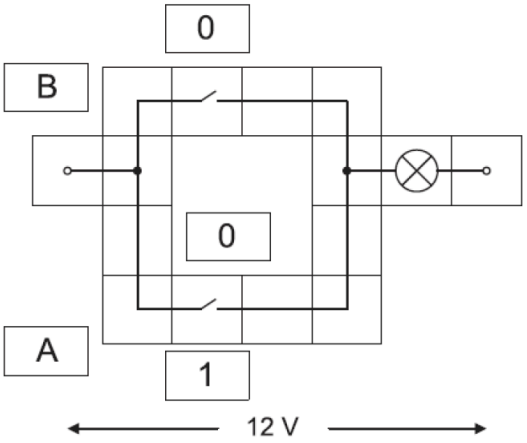
- Similarly, set up the experiment according to the illustration on the right with the symbols as shown in the illustration Experiment set-up 1 and switch the power supply unit back on to $12V$.
- The switches A and B close and open and observe the bulb during the individual switching states.
- Record observations in Table 2 using the same symbols as in the 1st experiment.



Experimental setup 2

Evaluation (1/5)

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Table 1

Switch states		Illumination of the bulb
Switch A	Switch B	

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Evaluation (2/5)

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Table 2

Switch states		Illumination of the bulb
Switch A	Switch B	

Evaluation (3/5)

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Which statements apply to the $AND-$ closed circuit?

- [ ] It is realised by a circuit with a power source, several on/off switches connected in series and a light bulb.
- [ ] It is realised by a circuit with a power source, several on/off switches connected in parallel and a light bulb.
- [ ] It is symbolised by the sign $\vee$.
- [ ] It is symbolised by the sign $\wedge$.

Check

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Evaluation (4/5)

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Which statements apply to the $OR-$ closed circuit?

- [ ] It is symbolised by the sign $\vee$.
- [ ] It is realised by a circuit with a power source, several on/off switches connected in series and a light bulb.
- [ ] It is symbolised by the sign $\wedge$.
- [ ] It is realised by a circuit with a power source, several on/off switches connected in parallel and a light bulb.

Check

Evaluation (5/5)

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Complete the paragraph:

$AND-$ Circuit: The bulb only lights up when all switches are closed. Designate the lamp with Y then with two switches $Y = 1$ exactly when A= ____ and B= ____ or A ____ B=1 .
Die AND -function: $Y = A \wedge B$.
$ODER-$ Circuit: It is indicated by the character ____ . With two switches the following applies $Y = 0$ if A=B= ____ ; in all other cases Y= ____ .
The $OR-$ is: $Y = A \vee B$.

0
1
1
1
$\vee$
$\wedge$

Check

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