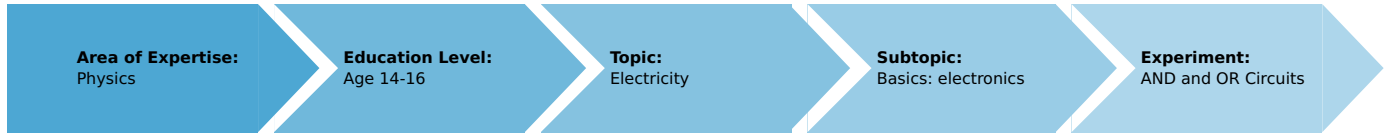


# AND and OR Circuits (Item No.: P1380900)

## Curricular Relevance



### Difficulty



Intermediate

### Preparation Time



10 Minutes

### Execution Time



10 Minutes

### Recommended Group Size



2 Students

### Additional Requirements:

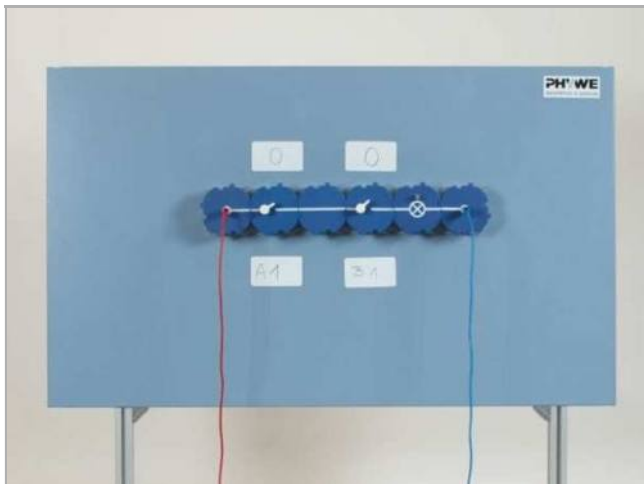
### Experiment Variations:

### Keywords:

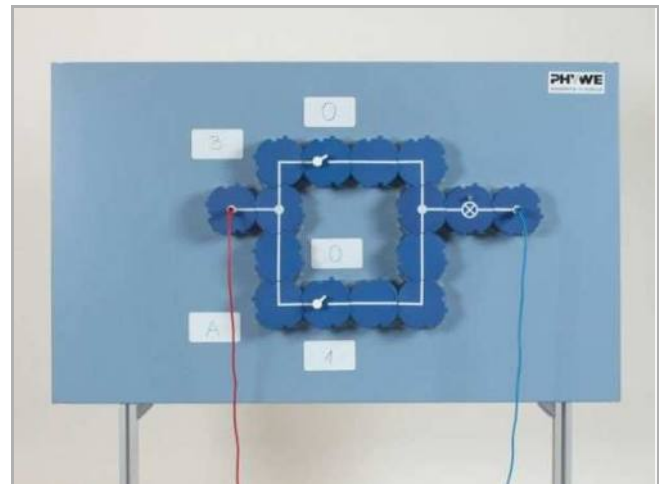
## Principle and equipment

### Principle

An AND circuit and an OR circuit are to be connected up, using mechanical switches, and each of these circuits is to be used to demonstrate that logical statements can be assigned to the electrical switching conditions.



Experimental set-up Part 1



Experimental set-up Part 2

**Equipment**

<b>Position No.</b>	<b>Material</b>	<b>Order No.</b>	<b>Quantity</b>
1	PHYWE power supply, universal DC: 0...18 V, 0...5 A / AC: 2/4/6/8/10/12/15 V, 5 A	13500-93	1
2	Demo Physics board with stand	02150-00	1
3	Switch on/off, module DB	09402-01	2
4	Socket for incandescent lamp E10 ,module DB	09404-00	1
5	Junction, module DB	09401-10	2
6	Connector, straight, module DB	09401-01	4
7	Connector, angled, module DB	09401-02	4
8	Connector, T-shaped, module DB	09401-03	2
9	Filament lamps 12V/0.1A, E10, 10 pieces	07505-03	1
10	Pointers f. Demonst.Board, 4 pcs	02154-01	1
11	Connecting cord, 32 A, 1000 mm, red	07363-01	1
12	Connecting cord, 32 A, 1000 mm, blue	07363-04	1

## Set-up and procedure

### 1st. Experiment

- Connect up the circuit as shown in Fig. 1; the switches are opened to start with.
- Prior to starting the experiment, mark the symbols 1, 0, A and B on blanks from the electrical symbol set, and fix them in position as shown in Fig. 1.
- Switch on the power supply and adjust it to the 12 V rated voltage of the lamp.
- Close and open switches A and B, so that all possible switching conditions are given; while doing so, observe the lamp and note your observations in Table 1, using the following symbols (see Fig. 1):

Switch open: 0

Switch closed: 1

Lamp does not light up: 0

Lamp lights up: 1

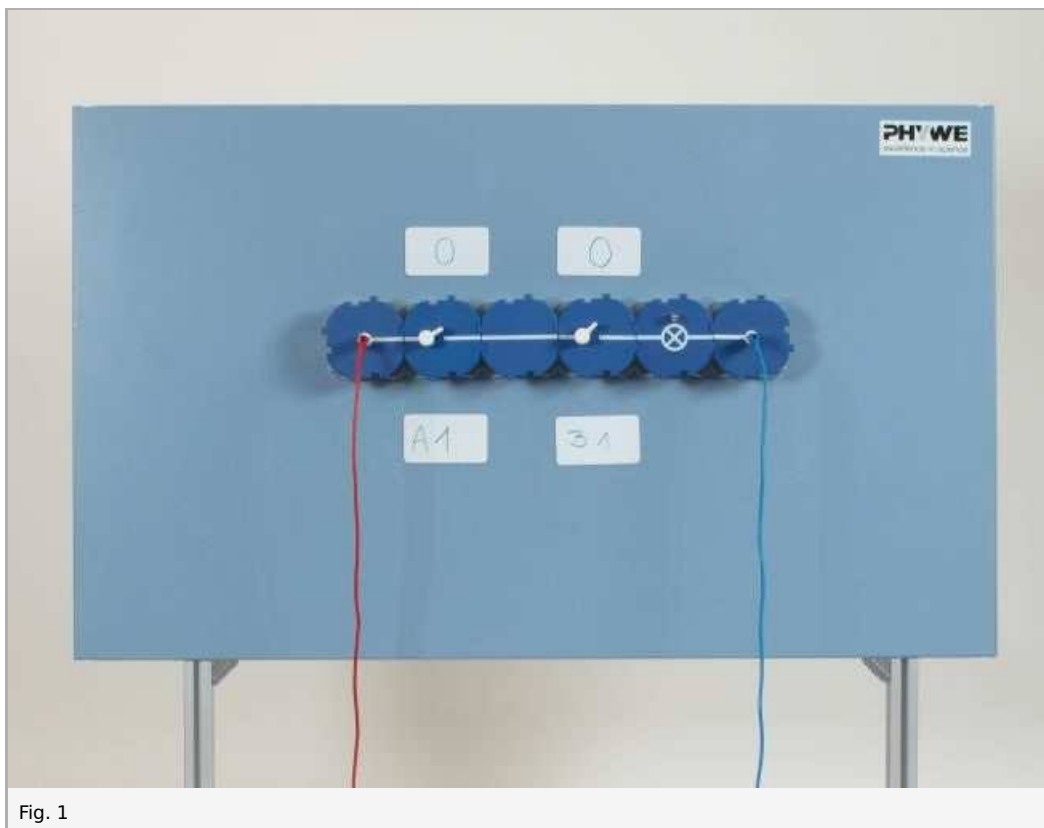


Fig. 1

### 2nd. Experiment

- Connect up the circuit as shown in Fig. 2; here again, use the symbols as in Fig 1.
- Switch on the power supply and again adjust it to 12 V.
- Close and open switches A and B and observe the lamp at each different switching condition; note your observations in Table 2, using the same symbols as in the first experiment (see Fig. 2).

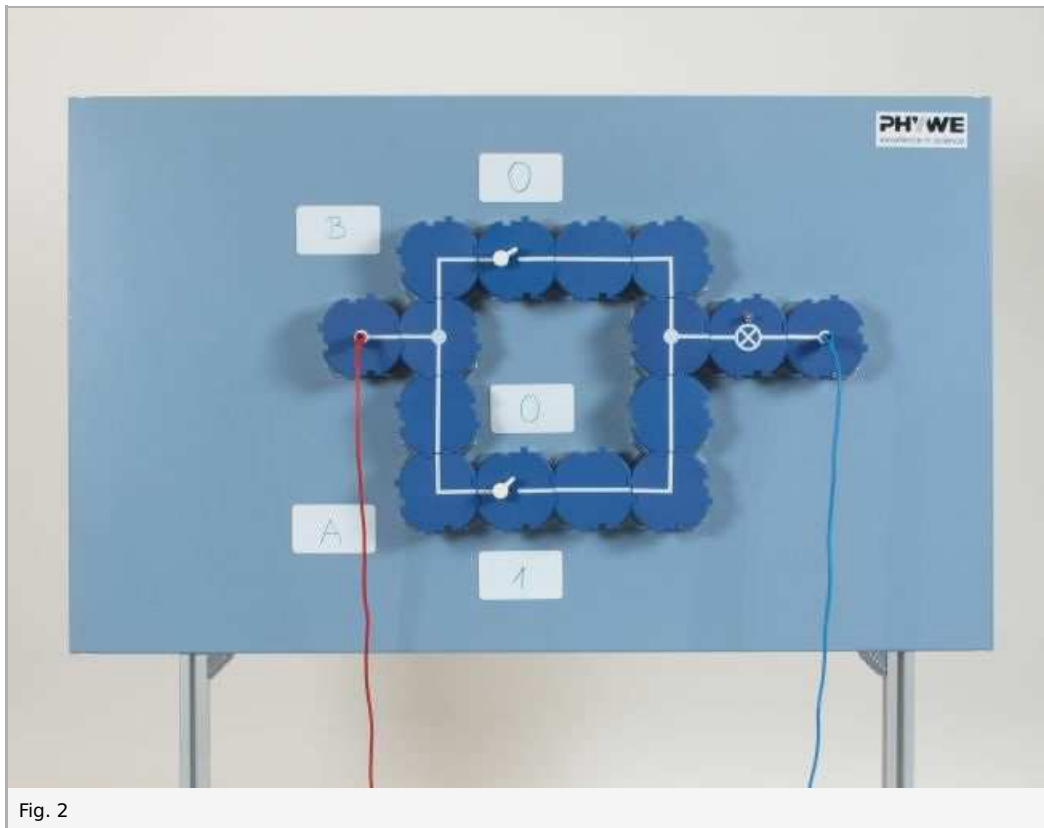


Fig. 2

## Observation and evaluation

### Observation

Switching conditions		Table 1	
Switch A		Switch B	Lighting up of the lamp
0		0	0
0		1	0
1		0	0
1		1	1

Switching conditions		Table 2	
Switch A		Switch B	Lighting up of the lamp
0		0	0
0		1	1
1		0	1
1		1	1

### Evaluation

When a number of on/off switches are connected in series in a circuit from a current source, and a lamp connected in, then the logical operation AND can be carried out. This operation has been given the symbol  $\wedge$ . The lamp lights up only when all the switches are closed. If we call the lamp  $Y$ , then we have, with two switches,  $Y = 1$  exactly when  $A = 1$  und  $B = 1$  oder  $A \wedge B = 1$ .

The AND function is:  $Y = A \wedge B$ .

When a number of on/off switches are connected in parallel in a circuit from a current source, and a lamp connected in, then the logical operation OR can be carried out. This operation has been given the symbol  $\vee$ . With two switches, we have  $Y = 0$  if  $A = B = 0$ ; in all other cases  $Y = 1$ .

The OR function is:  $Y = A \vee B$ .

### Remarks

It must be made clear to the students, that the switching condition of AND and OR circuits can be assigned statements whose linkage can be true or false.

For this they should, for example, look carefully at the circuit diagrams and at the truth tables (Tables 1 and 2), and explicitly formulate the symbolized statements in the truth tables line by line (e.g. Table 1, line 3: When switch A is closed (1) and switch 2 is open (0), then the lamp does not light up (0).) To avoid students getting mixed up with the operation AND and the addition and, we recommend the indication that the "AND" cannot be considered as being equal to the "+" (plus) sign.