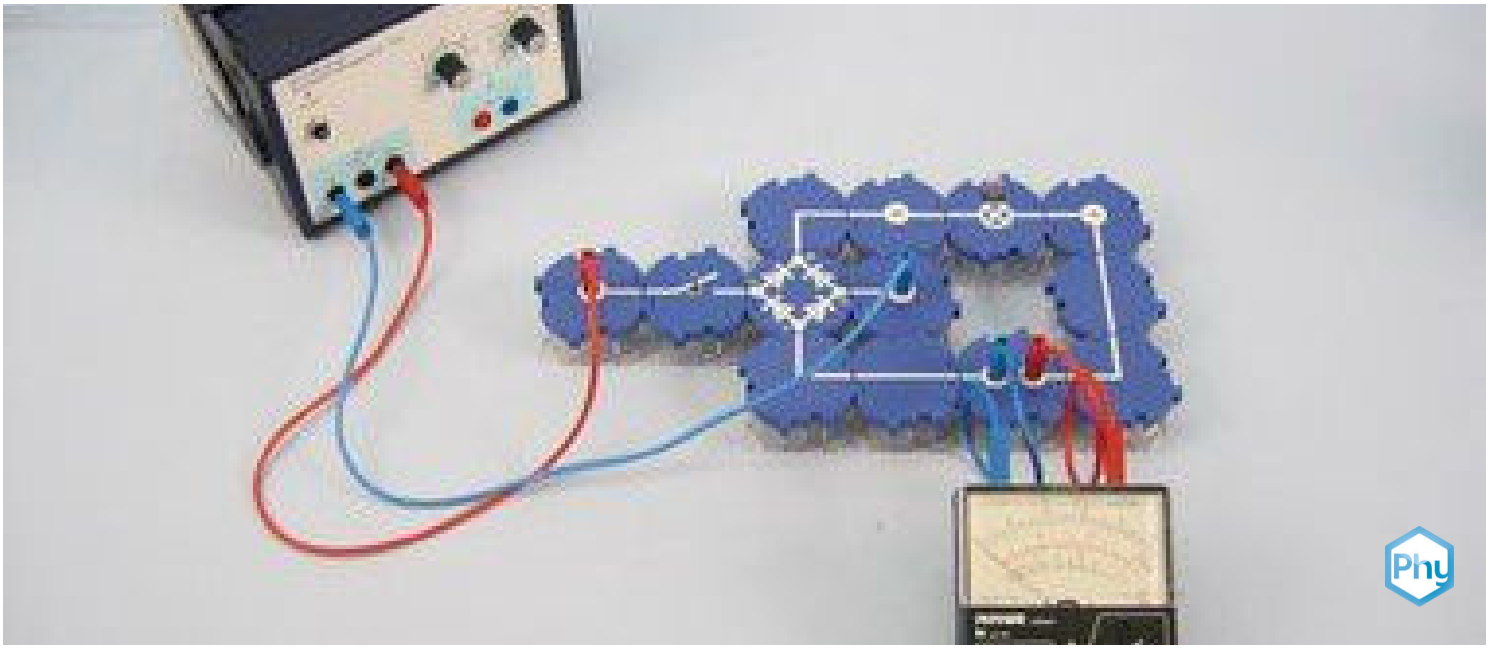
Bridge rectifiers



Physics | Electricity & Magnetism | Electronics

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/63177a87594e9900030f8d90

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Teacher information

Application

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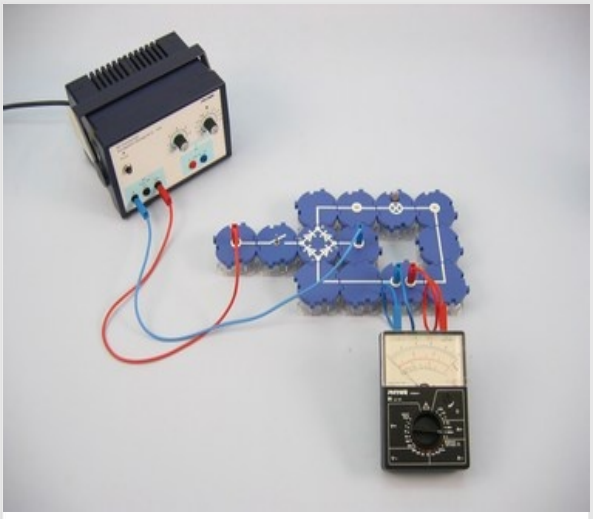

Experimental setup

A bridge rectifier is an efficient type of rectifier for converting AC to DC voltage. It is used in many power supplies where the AC voltage from the wall socket can be converted to DC voltage.

Ordinary rectifier circuits with individual diodes can only use one half-wave at a time for alternating current. The bridge rectifier avoids this problem by connecting four diodes in such a way that one current path is open for each half-wave.

In this experiment, the function of a bridge rectifier is investigated.

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Other teacher information (1/3)

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Prior knowledge

The students should be able to construct and understand a simple current circuit. They should also already have a basic understanding of half-waves and pulsating direct current. Ideally, students are already familiar with the operation of a single diode.

Principle

In a bridge rectifier, four diodes are connected so that the polarity of the output voltage is independent of the polarity of the input voltage. This allows an alternating voltage to be changed.

Other teacher information (2/3)

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Learning objective

After the students have learned about the rectifying effect of a diode, this experiment is intended to help them understand how the bridge circuit, which is primarily used in practice, works. They should understand that by using a bridge circuit, the current flows through the working resistor in the same direction during each half-cycle of the alternating current.

Tasks

First, the effect of the polarity of DC voltage on the bridge rectifier is investigated and it is found that it makes no difference.

Then switch to AC voltage and observe that the current still flows through the circuit in the same direction.

Finally, the pitches produced by the connected loudspeaker are examined once with direct voltage and once with alternating voltage.

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Other teacher information (3/3)

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Notes on set-up and procedure

Checking the ripple voltage superimposed on the DC voltage with the headphones should make the difference between the frequencies of the AC mains voltage and the ripple voltage clear.

Students should be advised to choose the correct measuring range and connections on the measuring instrument.

Since an oscilloscope and an alternating voltage generator with an extremely low frequency are generally not available for student experiments to make the direction of the current clear, the behaviour of the bridge circuit in the alternating current circuit is simulated by reversing the polarity of a direct current source. It is recommended to encourage the students to predict the behaviour of the circuit after the polarity of the current source has been reversed.

Safety instructions

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

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Student information

Motivation

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Power supply unit - application example of a rectifier

A bridge rectifier is an efficient type of rectifier for converting AC to DC voltage. It is used in many power supplies where the AC voltage from the wall socket is to be converted into DC voltage.

In this experiment you will learn how the bridge rectifier converts the respective half-periods of the alternating current into a direct current.

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Tasks

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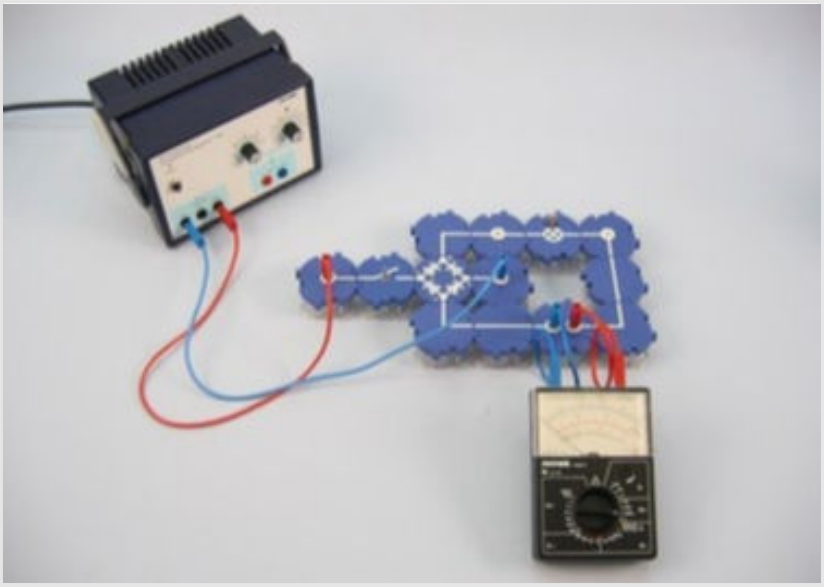
How can both half-cycles of alternating current be used to generate direct current?

Investigate the mode of operation of a bridge rectifier by trying out different polarities for direct and alternating current.



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Equipment

Position	Material	Item No.	Quantity
1	Straight connector module, SB	05601-01	2
2	Angled connector module, SB	05601-02	3
3	Interrupted connector module with sockets, SB	05601-04	1
4	Junction module, SB	05601-10	2
5	Straight connector module with socket, SB	05601-11	1
6	Angled connector module with socket, SB	05601-12	1
7	On-off switch module, SB	05602-01	1
8	Socket module for incandescent lamp E10, SB	05604-00	1
9	Bridge rectifier module, SB	05655-00	1
10	Earphones with 4mm-plugs	06811-01	1
11	Connecting cord, 32 A, 250 mm, red	07360-01	1
12	Connecting cord, 32 A, 250 mm, blue	07360-04	1
13	Connecting cord, 32 A, 500 mm, red	07361-01	1
14	Connecting cord, 32 A, 500 mm, blue	07361-04	1
15	Filament lamps 12V/0.1A, E10, 10 pieces	07505-03	1
16	PHYWE Power supply, 230 V, DC: 0...12 V, 2 A / AC: 6 V, 12 V, 5 A	13506-93	1
17	PHYWE Analog multimeter, 600V AC/DC, 10A AC/DC, 2 MΩ, overload protection	07021-11	1

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Set-up

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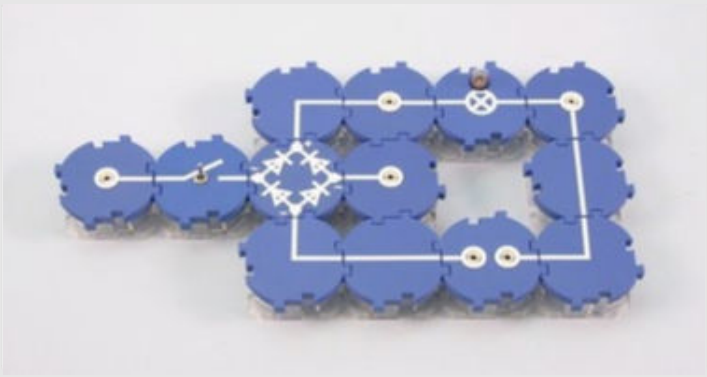
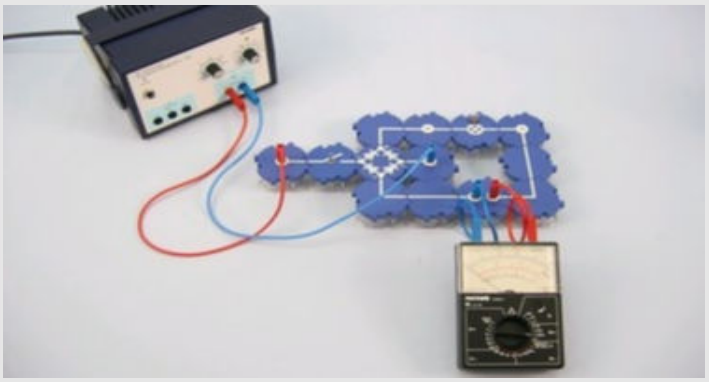
Build the experiment according to the illustrations.

Measuring range $300\,mA$- and make sure that the polarity of the measuring instrument is correct.





Procedure (1/3)

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Switch on the power supply unit and apply DC voltage $12\,V$-

1st task: Close the circuit with the switch. Observe the bulb and the deflection of the ammeter. Disconnect the circuit with the switch. Reverse the connection line to the power source so that the voltage is applied with the opposite polarity.

2nd task: Make a prediction about the behaviour of the bulb and the direction of the meter's deflection after switching on.

3rd task: Close circuit with switch. Compare bulb and ammeter deflection with prediction and behaviour at original voltage polarity.

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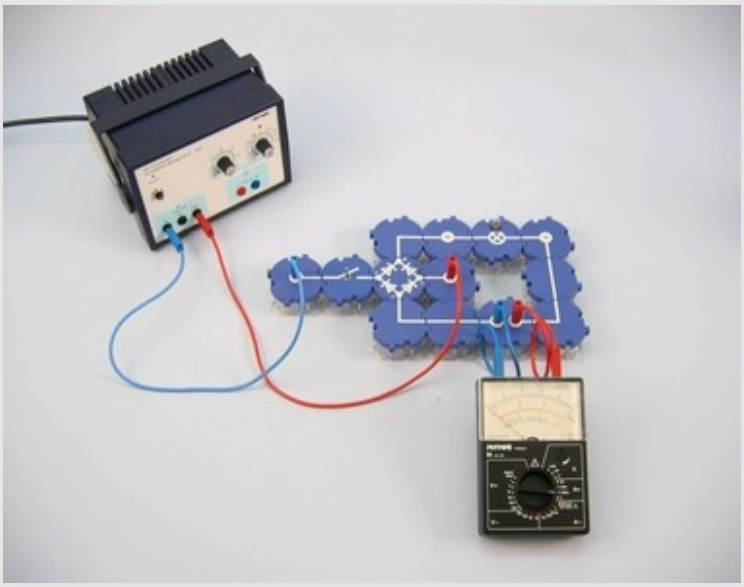
Procedure (2/3)



Connect the connection cable on the power supply unit as shown in the illustration from the DC voltage connection to the connection for $12\,V$~ .

Close the circuit with the switch.

4th task: Observe light bulb and ammeter.

Procedure (3/3)

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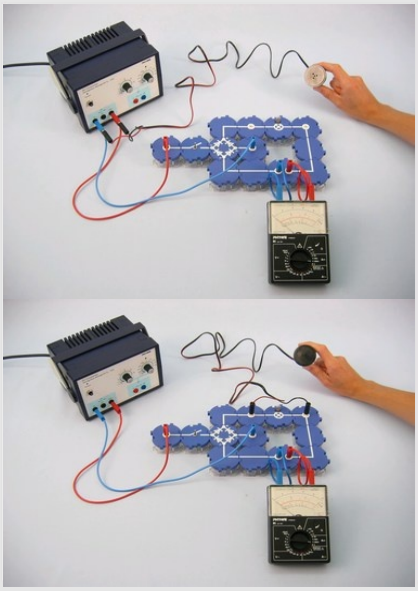

First connect the headphones directly to the connection for 12 V~ (fig. above) and then parallel to the bulb (fig. below).

5th task: Compare the pitches.

6th task: Connect the circuit again with the connection for $12\,V$-. Press the switch several times and listen for signals in the headphones.

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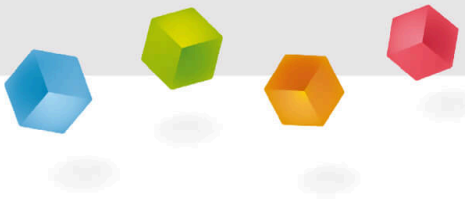

Report

Task 1

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What follows from the comparison of the observations for the 1st and 3rd task?

Since the ammeter deflected in two different directions, it can be concluded that the polarity has an influence on the direction of flow in the consumer circuit and is not influenced by the bridge rectifier.

Since the current meter again deflected in the same direction, it can be concluded that the bridge rectifier only allows the current to flow through the load circuit in one direction, regardless of the polarity.

Since the ammeter did not deflect after the polarity reversal, it can be concluded that the bridge rectifier only allows the current to flow in one pole direction.

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Task 2

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What effect of the bridge rectifier component can be seen from the observation for the 4th task?

- The bridge rectifier blocks the current flow in one direction so that only half of the AC signal arrives.
- The bridge rectifier converts AC voltage into DC voltage by directing both flow directions of the polarities in the same direction.
- The bridge rectifier amplifies the voltage of the AC voltage so much that it acts like DC voltage.
- The bridge rectifier is damaged by AC voltage.

Task 3

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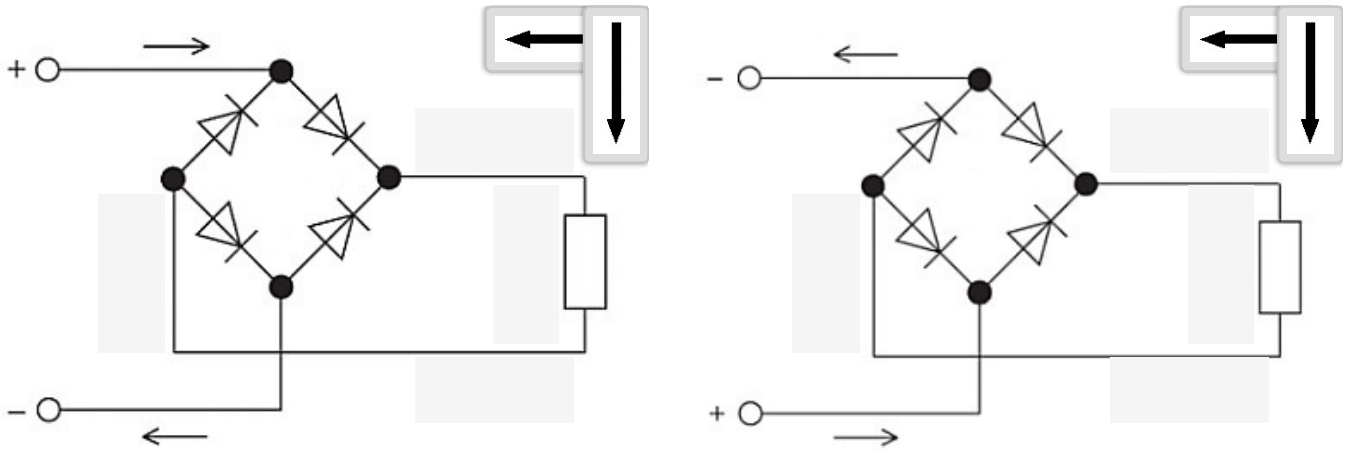
Use arrows to mark the current paths in the bridge rectifier for both poles of the voltage.



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Task 4

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How do you explain the difference between the two pitches in the performance Task 5?

- The direct current generated by a bridge rectifier pulses at twice the mains frequency.
- The direct current generated by a bridge rectifier pulses at half the mains frequency.
- There was no difference between the pitches.

What conclusion can you draw about the DC voltage characteristic of the power supply unit from the observation in task 6? Discuss with the person sitting next to you.

Task 5

PHYWE

What is the advantage of a bridge rectifier compared to a simple diode? Drag the words into the correct boxes!

With a bridge rectifier, the current flow is _____ in the same direction _____ of the polarity. With a simple diode, the current flow is _____ in one direction and thus only half of the voltage signal is transmitted. In an I-t diagram, you can think of it like this: With _____, the lower half-wave in each case is folded upwards. With _____, however, this is simply set to zero.

- independently
- bridge rectifiers
- blocked
- diodes
- directed

Check

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Slide	Score / Total
Slide 16: Explanation observation 1 and 3	0/1
Slide 17: Explanation observation 4	0/1
Slide 18: Multiple tasks	0/8
Slide 19: Explanation Observation 5	0/1
Slide 20: Difference between bridge rectifier and diode	0/5

Total 0 / 16

Solutions Repeat

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