Conversion of electrical energy into thermal energy

In this experiment it is important that the students are aware that in all these processes electrical energy is converted into thermal energy in the form of heat.

Physics > Energy > Energy forms, conversion & conservation

Difficulty level	Group size	Preparation time	Execution time
medium	-	-	-

This content can also be found online at:

http://localhost:1337/c/6167df192d1cf30003518c2d

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

PHYWE

Teacher information

Application

PHYWE

Test setup

The heat and light effects of electric current are familiar to the pupils from everyday life, and they have also experimented with light bulbs and used their luminous or light effects as a measure of electric current intensity.

PHYWE

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)

PHYWE

Previous

No prior knowledge is necessary for this experiment.

Principle

Depending on the previous knowledge of the students, the evaluation can focus on the phenomenon in the simplest case or on the energy balance in the case of a higher theoretical requirement. (E_{el} = Q or $U \cdot I \cdot t = c \cdot m \cdot \Delta$ Tif the heat dissipation to the environment can be neglected).

Other teacher information (2/2)

PHYWE

Learning

In this experiment it is important that the students are aware that in all these processes electrical energy is converted into thermal energy in the form of heat.

Tasks

Investigate what the switching delay of a transistor depends on.

PHYWE

Robert-Bosch-Breite 10
37079 Göttingen

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

info@phywe.de
www.phywe.de

PHYWE

Student Information

Motivation

PHYWE

The heat and light effects of electric current are already known from everyday life, and the luminous or light effects of light bulbs can be used as a measure of electric current intensity.

This principle can be extended to the general behaviour of electric current.

Light from a light bulb

PHYWE

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	Plug-in board, for 4 mm plugs	06033-00	1
2	on-off switch, G1	39139-00	1
3	Wire building block, housing G1	39120-00	1
4	Universal holder, G1 housing	39115-02	2
5	Trough, grooved, w/o lid	34568-01	1
6	Connecting cord,15A,25cm, red	07313-01	2
7	Constantan wire, 15.6 Ohm/m, d = 0.2 mm, l = 100 m	06100-00	1
8	PHYWE Power supply, 230 V, DC: 0...12 V, 2 A / AC: 6 V, 12 V, 5 A	13506-93	1

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

Structure and implementation

PHYWE

- Set up the experiment as shown in Fig.1, placing the grooved trough under the clamping screws of the universal holders.
- Shape the constantan wire into a coil using a round pin and clamp it between the universal holders so that the coil extends into the grooved trough.
- Fill the grooved trough with tap water until the constantand wire helix is completely suspended in the water.
- Feel the water temperature with your fingers or measure it with the thermometer and note the value.
- Switch on the power supply and note the time of switching on.

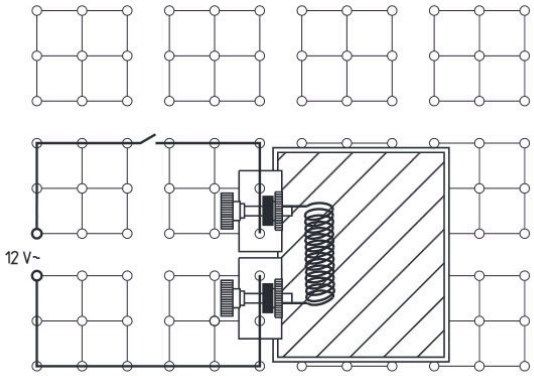

Fig. 1

Structure and implementation

PHYWE

- After about 5 minutes, carefully move the grooved trough aside and watch the wire coil.
- Turn off the power supply.
- Write down your observations.
- Measure and record the water temperature.

Attention! Don't touch the hot coil!

PHYWE

Robert-Bosch-Breite 10
37079 Göttingen

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

info@phywe.de
www.phywe.de

PHYWE

Report

Observation

PHYWE

Which observations apply?

- ☐ The wire helix becomes very hot.
- ☐ The wire helix glows red.
- ☐ The wire helix remains cold.
- ☐ The wire helix glows white.

Check

Enter the temperature of the water [°C]:

before switching on

after switching off

PHYWE

Robert-Bosch-Breite 10
37079 Göttingen

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

info@phywe.de
www.phywe.de

Task (1/4)

PHYWE

How did the water temperature change during the time the immersion heater was in the water?

- The temperature of the water has remained constant.
- The temperature of the water has dropped by 7 - 10°C.
- The temperature of the water has risen by 7 - 10°C.

How can this be explained?

- The wire through which the current has flowed has absorbed heat from the water.
- The wire through which the current flows has no effect on the water.
- The wire through which the current has flowed has given off heat to the water.

Task (2/4)

PHYWE

From the observation noted in (1), a rule can be derived that must be observed when working with an immersion heater. What is it?

- An immersion heater may only be connected outside the water.
- An immersion heater must not be connected if it is not immersed in water.
- There is no rule.

PHYWE

Robert-Bosch-Breite 10
37079 Göttingen

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

info@phywe.de
www.phywe.de

Task (3/4)

PHYWE

Give examples of electrical appliances that make use of the thermal effect of electric current.

Task (4/4)

PHYWE

Drag the words into the correct boxes!

When a strong _____ of freely moving _____ flows in the conductor, the lattice constituents of the metallic _____ are excited into stronger _____, and that means the conductor has a higher _____.

temperature
vibrations
electrons
current
conductor

Check

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

Slide	Score / Total
Slide 11: Observations	0/2
Slide 12: Multiple tasks	0/2
Slide 13: Safety rule	0/1
Slide 15: Principle	0/5

Total score 0 / 10

Show solutions | Repeat | Export text

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