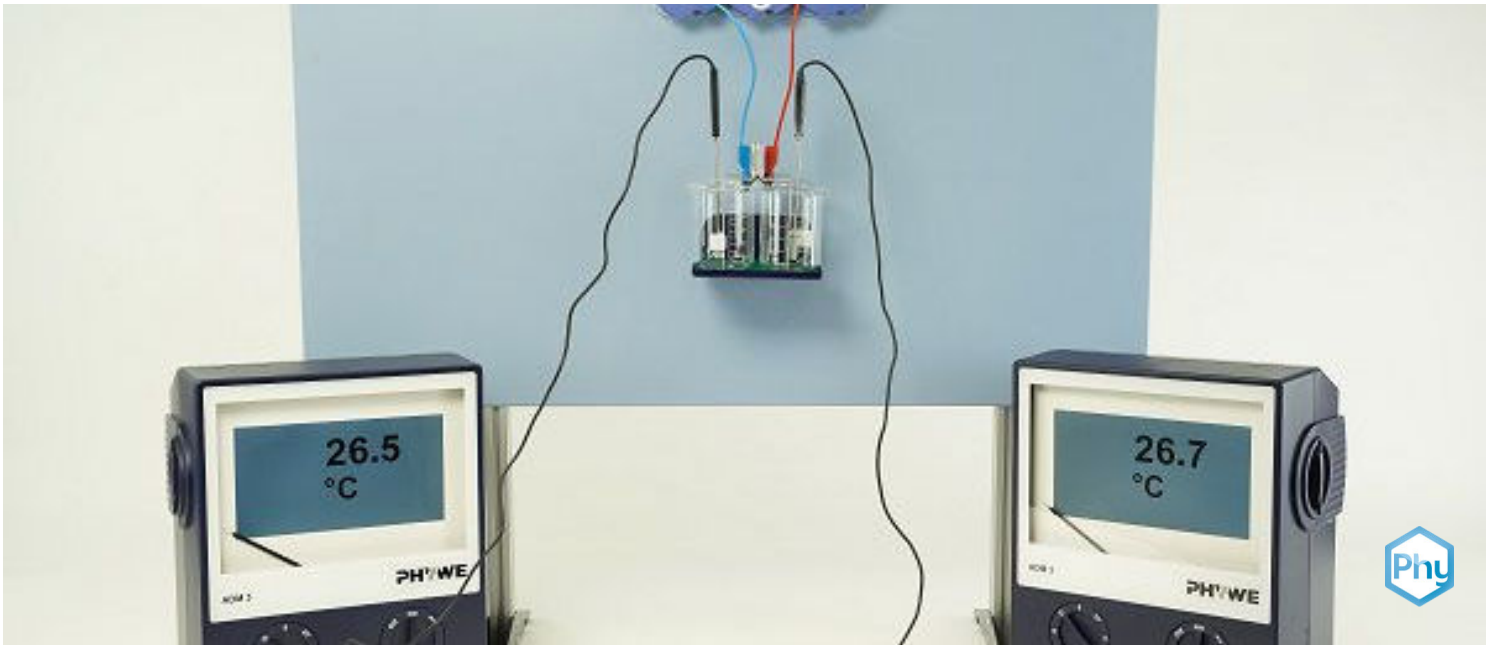
Conversion of thermal energy into electrical energy and motion with ADM3



Physics > Energy > Energy forms, conversion & conservation

Difficulty level	Group size	Preparation time	Execution time
easy	1	10 minutes	20 minutes

This content can also be found online at:

http://localhost:1337/c/6167de292d1cf30003518bf3

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

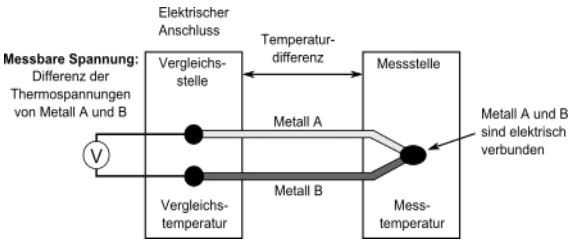
PHYWE

General information

Application

PHYWE

Thermoelment



Source photo: wikipedia

Thermocouples are used to measure temperature and generally consist of two different metals (or semiconductors) that are electrically connected at one point.

A reference junction is required for this measuring point so that a thermoelectric voltage is produced by the temperature difference.

In most cases, the reference junction is located at the input of the temperature measuring device. Since the thermocouple itself only measures temperature differences, the temperature of the reference junction is measured with electronic thermometers to determine the absolute temperature.

PHYWE

Robert-Bosch-Breite 10
37079 Göttingen

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

info@phywe.de
www.phywe.de

Other information (1/2)

PHYWE

Previous

The thermogenerator consists of a block with many thermocouples. These are connected electrically in series and thermally in parallel, so that their thermoelectric voltages add up.

Principle

With the help of water baths, the two sides of the thermogenerator can be brought to different temperatures. Thermal energy is converted into electrical energy. This is used to operate a small motor.

Other information (2/2)

PHYWE

Learning

In the experiment, the conversion of thermal energy into electrical energy and motion is to be taught. For this purpose, a motor with a disc is driven by a thermogenerator. Through 2 temperature sensors in cold and warm water, statements can be made about the alignment of the poles.

Tasks

After setting up and carrying out the test, the direction of the running motor should be observed and the polarity determined. After approx. 2 min, the thermogenerator should be removed, turned over and placed back into the beakers with the sides reversed.

PHYWE

Robert-Bosch-Breite 10
37079 Göttingen

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

info@phywe.de
www.phywe.de

Safety instructions

PHYWE

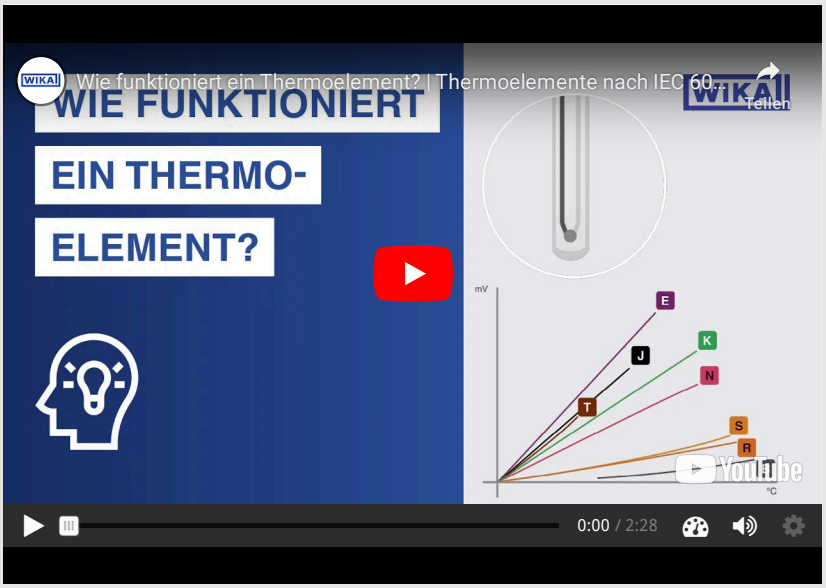
The general instructions for safe experimentation in science lessons apply to this experiment.

For H- and P-phrases please refer to the safety data sheet of the respective chemical.

Theory

PHYWE excellence in science

- The thermoelectric voltage represents a temperature difference between the measuring point and the reference junction.
- To determine the temperature at the measuring point, the temperature of the reference junction must be known.
- A thermocouple always measures the difference between the measuring point and the connection point.



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	PHYWE Demo Physics board with stand	02150-00	1
2	PHYWE Demo Multimeter ADM 3: current, voltage, resistance, temperature	13840-00	1
3	Connector, straight, module DB	09401-01	2
4	Motor with indicating disc, 5 V, module DB	09469-00	1
5	Thermogenerator, Peltier element	04374-00	1
6	Heat insulating sheet, felt, 100 mm x 135 mm	04375-00	1
7	Apparatus carrier w. fix. magnet	45525-00	1
8	Beaker, Borosilicate, low-form, 400 ml	46055-00	2
9	Immersion probe NiCr-Ni, steel, -50...400 °C	13615-03	2
10	Connecting cord, 32 A, 500 mm, red	07361-01	1
11	Connecting cord, 32 A, 500 mm, blue	07361-04	1

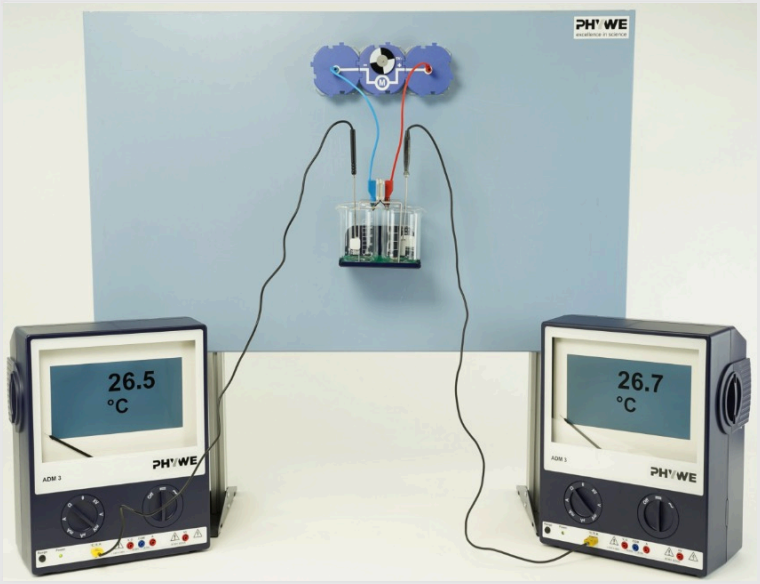
PHYWE
Robert-Bosch-Breite 10
37079 Göttingen
Tel.: 0551 604 - 0
Fax: 0551 604 - 107
info@phywe.de
www.phywe.de

PHYWE

Structure and implementation

Set-up

PHYWE



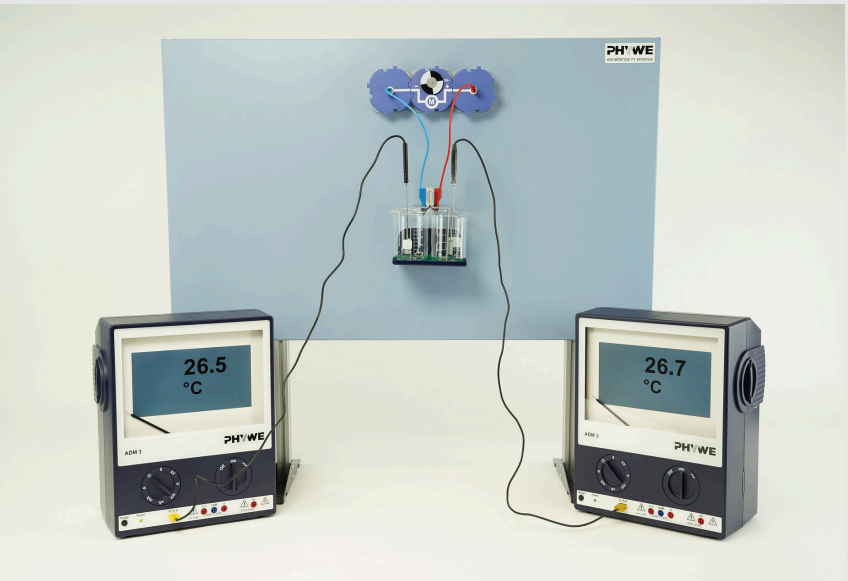
- Set up the circuit according to the illustration.
- Connect the immersion sensors to the two ADM3 multimeters.
- Place the heat insulation plate on the equipment rack and place the two 250 ml beakers on top.
- Do not place the thermogenerator in the

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

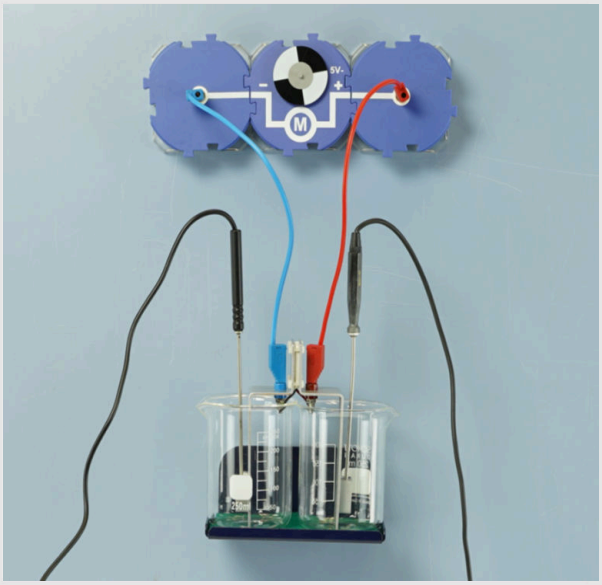
Procedure (1/3)

PHYWE excellence in science

- Fill the left beaker with cold water and the right beaker with water heated to approx. 80 °C.
- Connect the thermogenerator to the motor, connecting the red socket to the positive pole of the motor.
- Place the thermogenerator connected to the motor in the beakers, the leg with the red socket in the cold water.



Procedure (2/3)

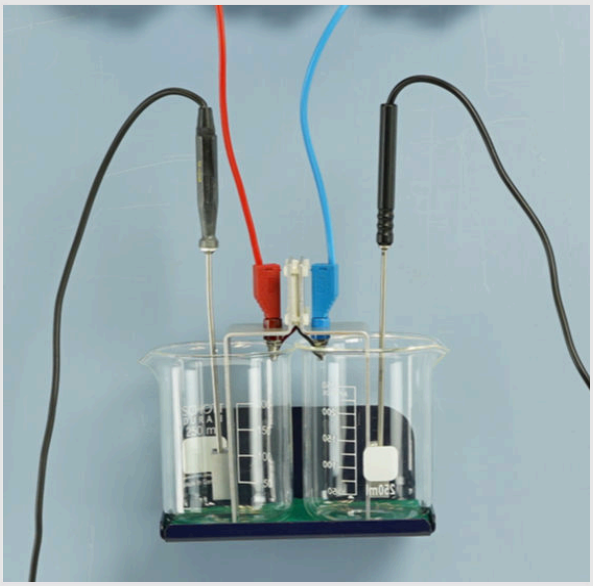


- Insert the two temperature sensors into the holes provided in the thermogenerator. T1 should be the temperature of the leg with the red socket.
- Observe the motor (direction of rotation and speed).
- Take readings at approx. 70 °C for 2 minutes.

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

Procedure (3/3)

PHYWE excellence in science



- After about 2 min, remove the thermogenerator, turn it over and place it back into the beakers with the sides reversed.
- Observe the engine, possibly nudge it to get it running again after temperature equalization.
- Stop the measurement after 4 minutes.

Evaluation (1/2)

PHYWE excellence in science

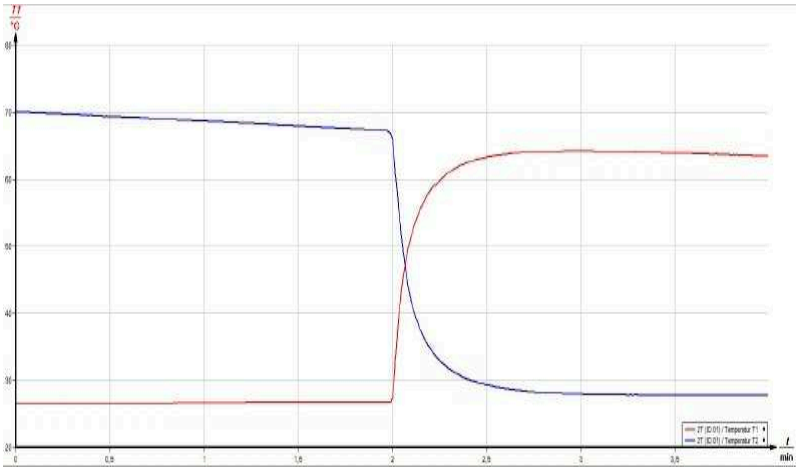
Drag the words into the correct boxes!

The motor turns _____ at first, then _____ after the exchange. It gets _____ towards the end of the measurement.

left | slower and slower | right

Check

Example of a recording with 2 temperature sensors



PHYWE

Robert-Bosch-Breite 10
37079 Göttingen

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

info@phywe.de
www.phywe.de

Evaluation (2/2)

PHYWE excellence in science

The cold side is always

- the neutral pole of the thermogenerator.
- the negative pole of the thermogenerator.
- the positive pole of the thermogenerator.

Slide	Score / Total
Slide 13: Correlation of motor direction of rotation	0/3
Slide 14: Context experiment	0/3

Total score 0 / 6

Show solutions Repeat

PHYWE

Robert-Bosch-Breite 10
37079 Göttingen

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

info@phywe.de
www.phywe.de