Pilot experiment for the use of ambient heat with the help of the Peltier-heat pump

Task and equipment

Information for teachers

Additional information

If an electric current flows through the Peltier element, then one side will heat up, the other will cool down. In the process, the temperature of the warm side has an influence on the temperature of the cold side.

This can be used, e.g., for cooling with ambient heat: If the warm side is held at a constant temperature by air, water or earth (geothermal energy), the cold side cools down stronger than without storage. The aluminium block of the thermo generator is used as storage in this experiment.

Notes on the Set-up and Procedure

The experiment consists of two smaller experiments. It is important to take into account that between the two experiments enough time must pass in order for both sides of the thermo generator to acclimatise again to the room temperature. The heated side of the thermo generator can be placed on the table to cool.

The water in the beaker should have the same temperature at the beginning of both experiments.

The results depend on the ambient temperature; therefore, the measuring values may deviate from the examplar solution.

Moreover, pay attention that the power supply is switched off, in any case, after 5 minutes. Otherwise, the thermo generator can overheat, particularly without the aluminium block as a cooling.

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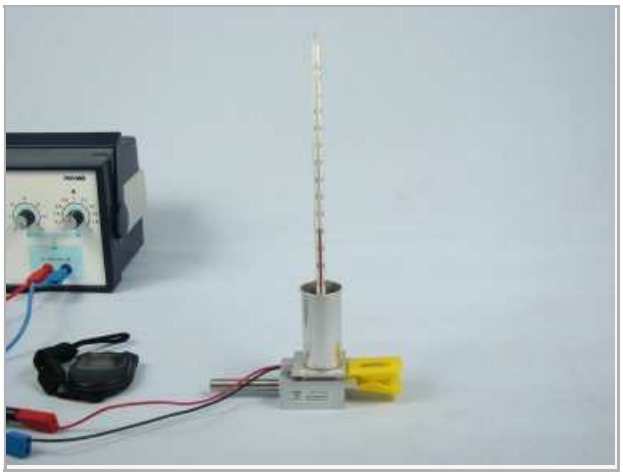
Task and equipment

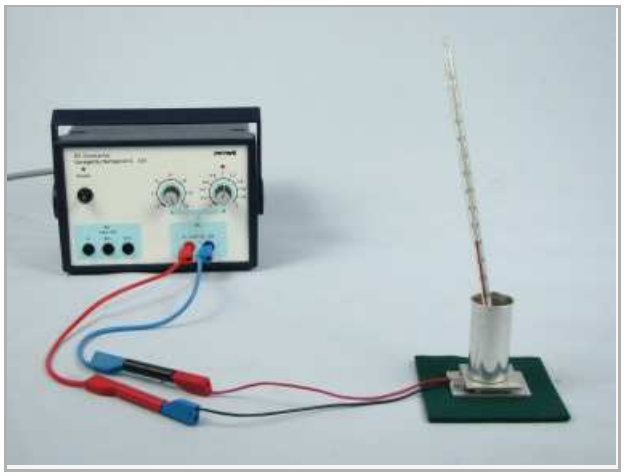
Task

What effect does the ambient temperature have on the cooling with the Peltier element?

Change the ambient temperature by heating the Peltier element

- with an aluminium block as a base.
- with a felt plate as a base.





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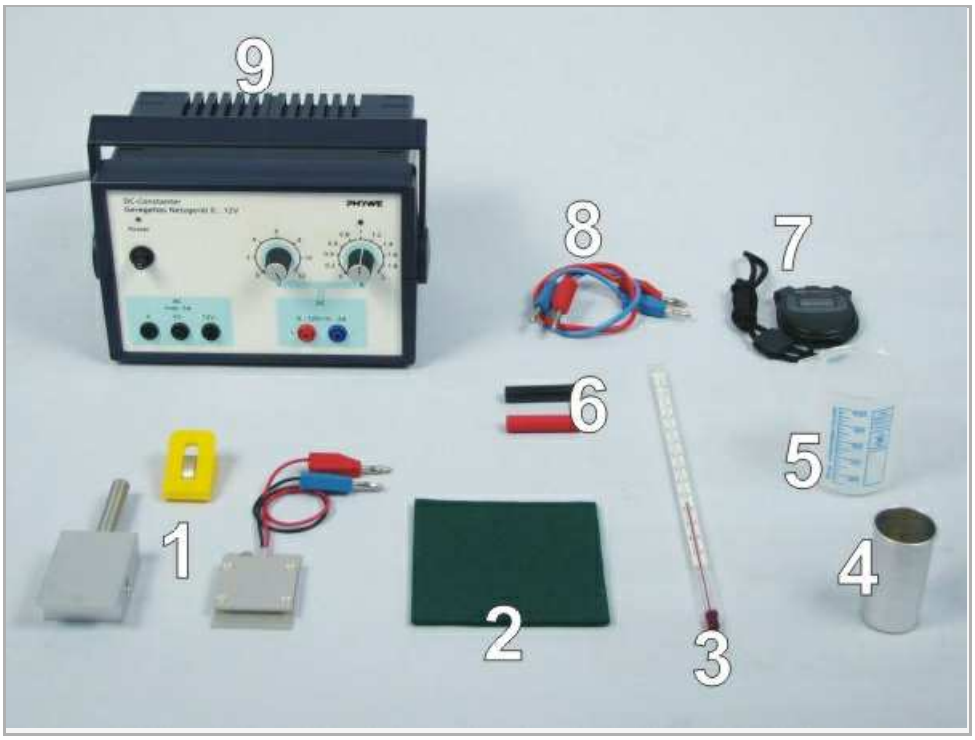
Equipment



Position No.	Material	Order No.	Quantity
1	Thermal generator for student experiments	05770-00	1
2	Felt sheet, 100 x 100 mm	04404-20	1
3	Lab thermometer,-10..+100 °C	38056-00	1
4	Beaker, aluminum, polished	05903-00	1
5	Beaker, low form, plastic, 100 ml	36011-01	1
6	Double sockets,1 pair,red a.black	07264-00	1
7	Digital stop watch, 24 h, 1/100 s & 1 s	24025-00	1
8	Connecting cord, 32 A, 250 mm, blue	07360-04	1
8	Connecting cord, 32 A, 250 mm, red	07360-01	1
9	PHYWE power supply DC: 0...12 V, 2 A / AC: 6 V, 12 V, 5 A	13506-93	1
Additional material			
	Water		

Set-up and procedure

Set-up

Place the small side of the aluminium block down on the table.
Fasten the Peltiermodul on the aluminium block using the clip, so that its larger side is directed downwards (Fig. 1).

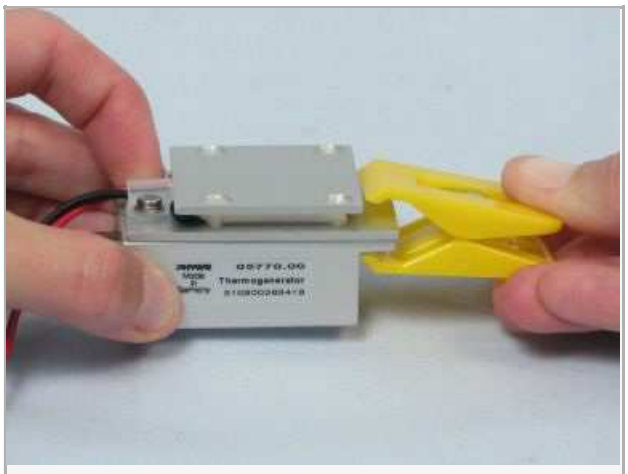


Fig. 1

Connect the thermo generator to the power supply with the help of both double sockets (Fig. 2).

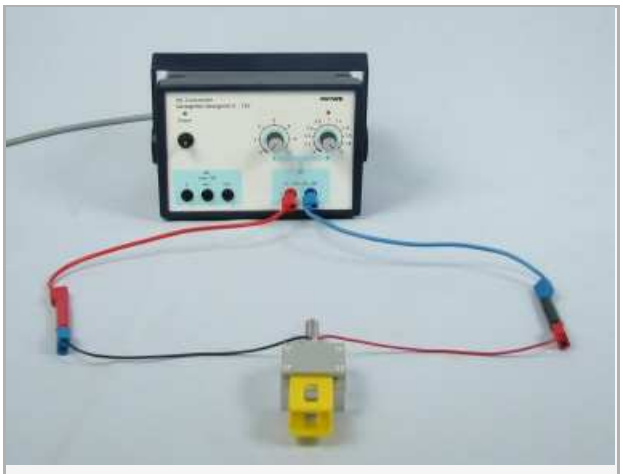


Fig. 2

Pay attention that the blue connection cord of the power supply is connected to the red connection cord of the thermocouple (Fig. 3) and vice versa.

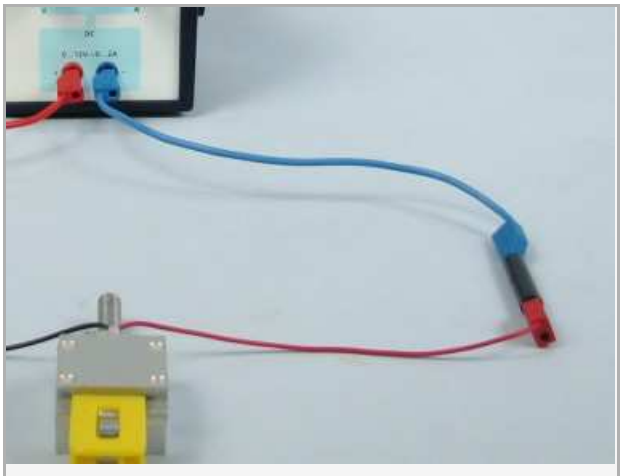


Fig. 3

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Procedure

1. First part of the experiment

Fill the polished beaker with 30 ml water and place it on the thermo generator (Fig. 4).

Fig. 4

Put the thermometer into the polished beaker. (Fig. 5).
Wait briefly until the temperature of the water acclimatises to the ambient temperature.

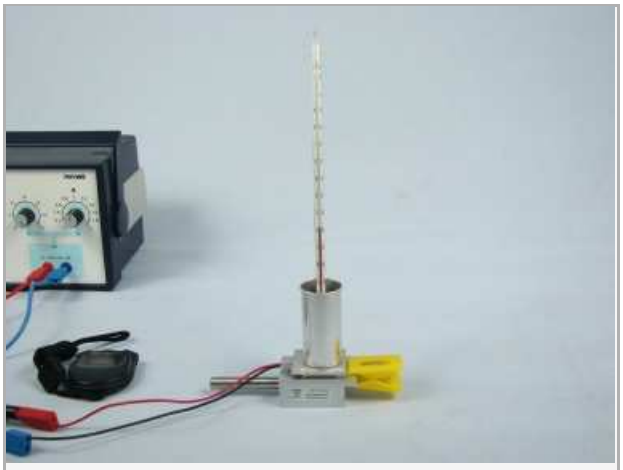

Fig. 5

Turn the adjusting knob for the electric current to 1 A. Turn the voltage to 12 V (Fig. 6).

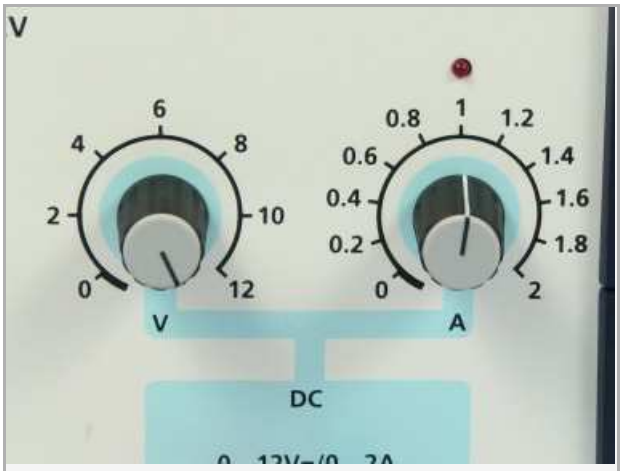

Fig. 6

Measure the initial temperature of the water and write down it in the result table under ϑ_1 and at $t = 0$.

Switch on the power supply. Simultaneously track the time with the stopwatch.
Measure the temperature every 30 seconds and write them down in the result table under ϑ_1.

Finish the measurement after 4 minutes (240 seconds) and switch off the power supply.
Touch the lower plate of the thermo generator (Fig. 7). How do you perceive the temperature? Take down the result under Result - Observations 1.

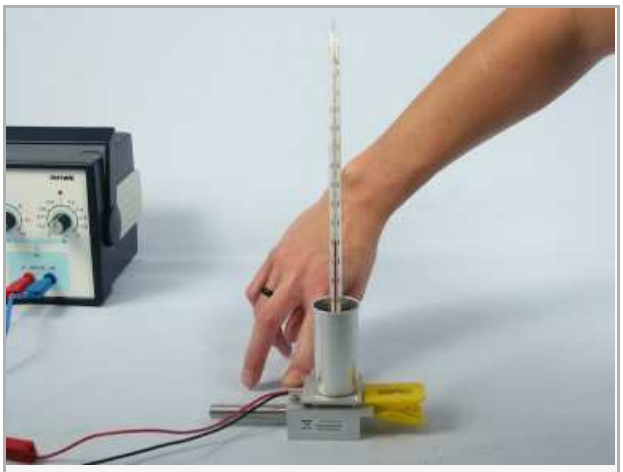

Fig. 7

2. Second part of the experiment

Pour fresh water in the polished beaker.
Remove the thermo generator from the aluminium block and put its warm side on the table.
Wait until both sides of the thermo generator have acclimatised to the room temperature.
Put the thermo generator on the felt plate (Fig. 8).

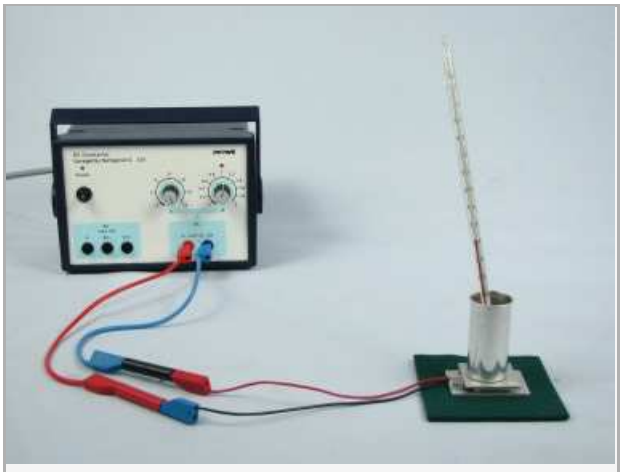

Fig. 8

Wait until the temperature of the water has the same beginning temperature as in the 1st part of the experiment and write it down unter ϑ_2 at t=0.

Repeat the experiment like in the 1st part.
Write down your measured values in the table of results under ϑ_2.

Touch the lower plate of the thermo generator again. How do you perceive the temperature? Take down the result under Result - Observations 2.

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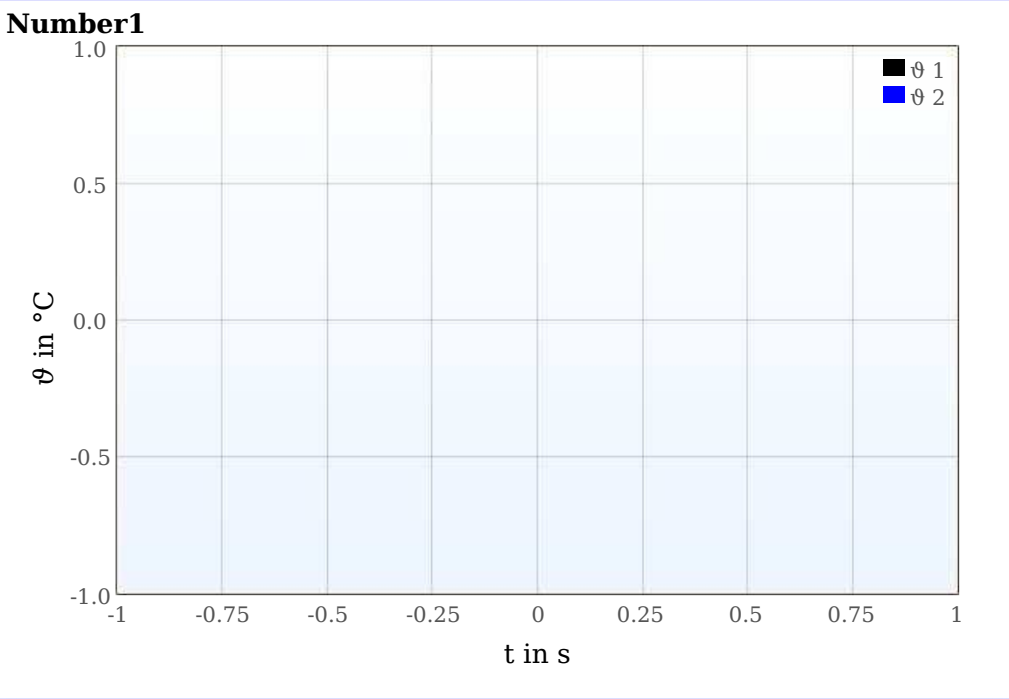
Result - Table 1

Record your measured values.

t in s	ϑ_1 in °C	ϑ_2 in °C
0	1 ±1	1 ±1
30	1 ±1	1 ±1
60	1 ±1	1 ±1
90	1 ±1	1 ±1
120	1 ±1	1 ±1
150	1 ±1	1 ±1
180	1 ±1	1 ±1
210	1 ±1	1 ±1
240	1 ±1	1 ±1



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Result - Observations 1

Is the lower plate of the thermo generator cold, warm or hot?

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Result - Observations 2

Is the lower plate of the thermo generator cold, warm or hot?

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Evaluation - Question 1

Describe the behaviour of the temperature over time with and without aluminium block.

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Evaluation - Question 2

What does the aluminium block cause? Include your results under (Observations 1 and 2) in your reflections.

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