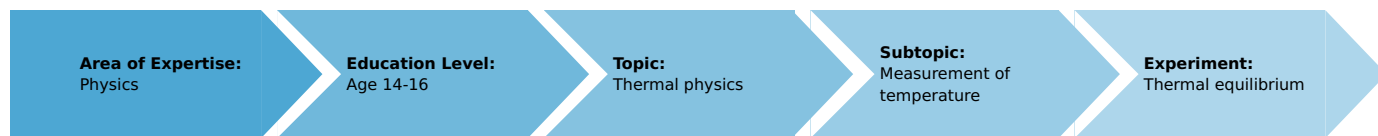


Thermal equilibrium (Item No.: P1042200)

Curricular Relevance



Difficulty



Easy

Preparation Time



10 Minutes

Execution Time



10 Minutes

Recommended Group Size



2 Students

Additional Requirements:

- Butane burner, Labogaz 206 type 32178-00
- Butane cartridge C206, without valve 47535-00
- Matches

Experiment Variations:

Keywords:

Task and Equipment

Information for teachers

Additional Information

When two bodies with different temperatures contact each other, a process of temperature equalisation takes place until both bodies have the same temperature (thermal equilibrium). The students should measure the temporal course of the temperatures of such two bodies and, thus, determine that the temperature changes are larger for larger temperature differences. The process can also be described with the aid of the energy concept (supplementary problem in the report).

Remark

In this experiment the water is not stirred, as this is not necessary for qualitative observations of the course of the temperature. With stirring temperature equalisation would occur more rapidly.

Thermal equilibrium (Item No.: P1042200)

Task and Equipment

Task

Is a temperature difference long lasting?

When a vessel with cold water is immersed in a warm water observe the temperature changes.



Equipment



Position No.	Material	Order No.	Quantity
1	Support base, variable	02001-00	1
2	Support rod, stainless steel, l = 250 mm, d = 10 mm	02031-00	1
3	Support rod, stainless steel, l = 600 mm, d = 10 mm	02037-00	1
4	Boss head	02043-00	1
5	Glass tube holder with tape measure clamp	05961-00	1
6	Ring with boss head, i. d. = 10 cm	37701-01	1
7	Wire gauze with ceramic, 160 x 160 mm	33287-01	1
8	Glass beaker DURAN®, short, 250 ml	36013-00	1
9	Glass beaker DURAN®, short, 400 ml	36014-00	1
10	Erlenmeyer flask 100 ml, wide-neck SB 29	36428-00	1
11	Students thermometer, -10...+110°C, l = 180 mm	38005-02	1
12	Students thermometer, -10...+110°C, l = 230 mm	38005-10	1
13	Stop watch 4	03078-00	1
Additional material:			
14	Butane burner, Labogaz 206 type	32178-00	1
15	Butane cartridge C206, without valve	47535-01	1
16	Matches		

Set-up and procedure

Set-up

Warning!

During heating of the water, the support ring and the wire gauze become extremely hot! When the hot water is being transferred to another container, the beaker can only be held by its upper flanged rim.

Setup

- Set up the experiment according to the following pictures.



Fig. 1



Fig. 2

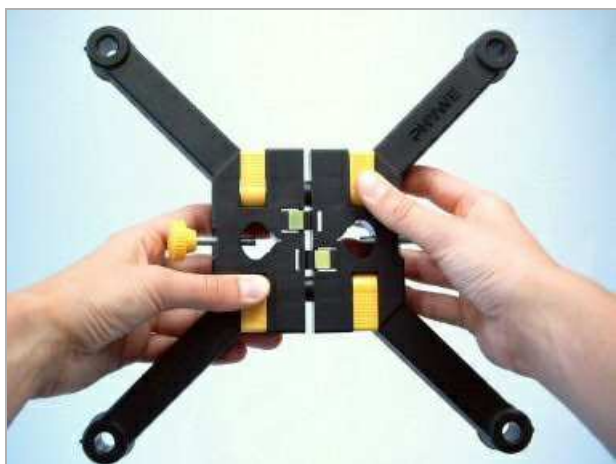
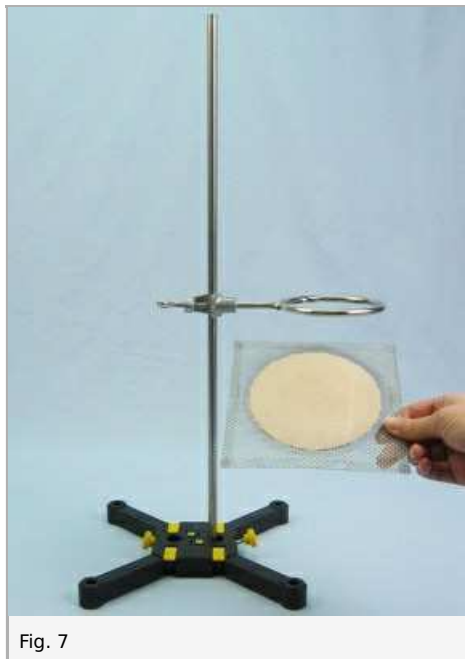
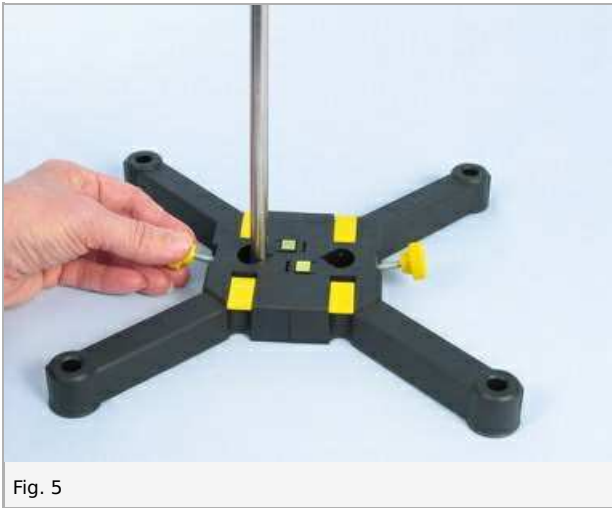


Fig. 3



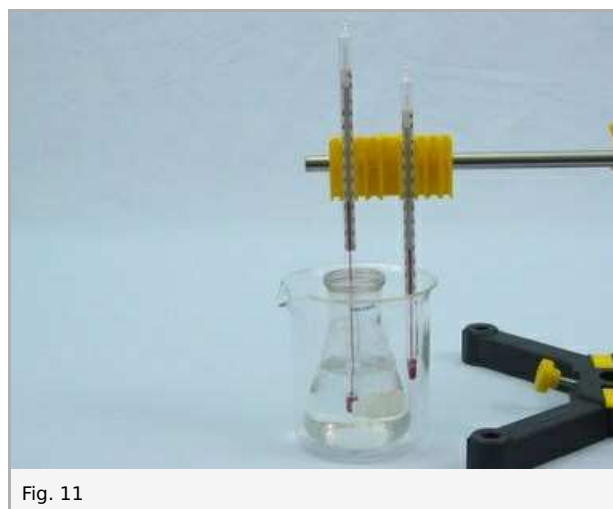
Fig. 4



- Place the Erlenmeyer flask into the empty 400 ml beaker and fill it with 100 ml of cold water.



- Both thermometers are fixed in the glass tube holder. The one with the longer immersion stem should be immersed in the Erlenmeyer flask. The other should be attached so that it extends as deeply as possible into the beaker - but it should not touch the flask.



Procedure

- Heat about 160 ml of water to about 80 °C in the 250 ml beaker.
- Pour the hot water into the 400 ml beaker.



Fig. 12

- Check the immersion depth of both thermometers and start the stop watch.



Fig. 13

- At 30 second intervals determine the water temperature in both containers and record them in the table (until $t = 5$ min).
- A final value for both temperatures is recorded after 10 min.

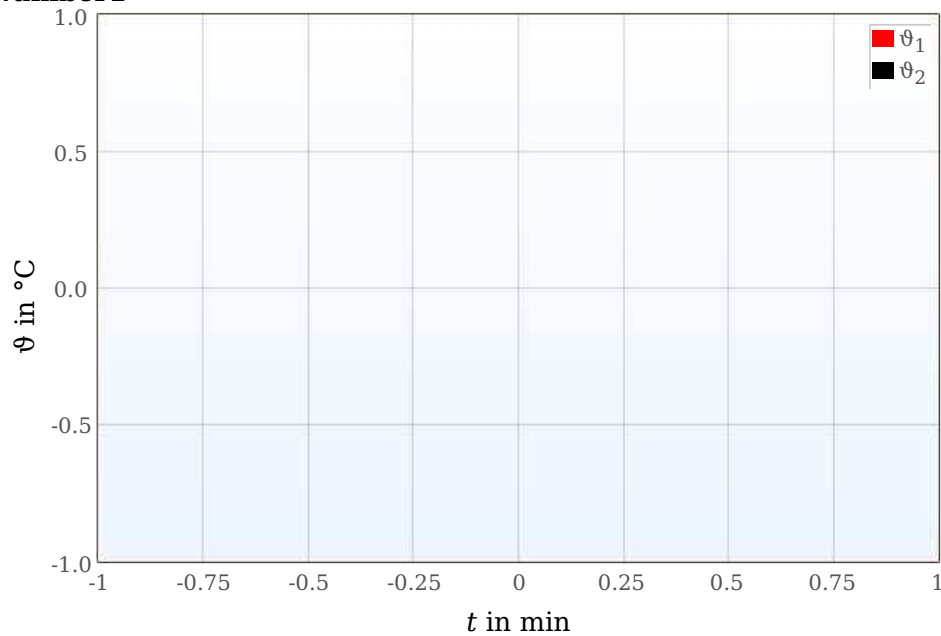
Report: Thermal equilibrium

Result - Table 1

Note your measured data.

t in min	θ_1 in °C	θ_2 in °C
0.5	1 ±0	1 ±0
1.0	1 ±0	1 ±0
1.5	1 ±0	1 ±0
2.0	1 ±0	1 ±0
2.5	1 ±0	1 ±0
3.0	1 ±0	1 ±0
3.5	1 ±0	1 ±0
4.0	1 ±0	1 ±0
4.5	1 ±0	1 ±0
5.0	1 ±0	1 ±0
10.0	1 ±0	1 ±0

Number1



Evaluation - Question 1

Describe the course of the temperature curves in the chart on the Results page.

.....

.....

.....

.....

Evaluation - Question 2

How large is the temperature difference after a long time?

.....

.....

.....

.....

Evaluation - Question 3

What does the speed of the temperature change depend on?

.....

.....

.....

.....

Evaluation - Supplementary problem 1

Describe the measured course of the temperatures using the terms "heat" and "internal energy".

.....

.....

.....

.....

Evaluation - Supplementary problem 2

Would the measured course of the temperatures be different if the water in one or both vessels had been stirred during the series of measurements?

.....

.....

.....

.....