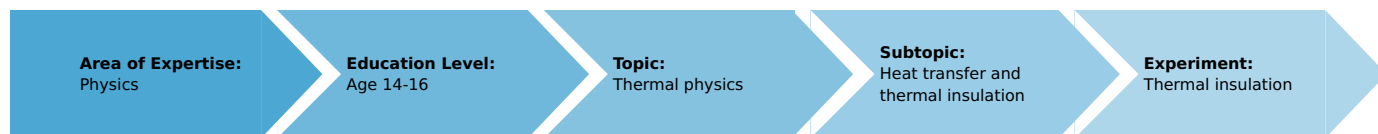


Thermal insulation (Item No.: P1043600)

Curricular Relevance



Difficulty



Intermediate

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
- Boiling beads, 200 g 36937-20
- Matches

Experiment Variations:

- Demonstration experiments with high insulation house

Keywords:

Task and equipment

Information for teachers

Additional Information

The cooling rate of water in a simple glass beaker and in an insulated calorimeter are compared.

Remarks

1. In each partial experiment the water should be brought to a boil so that the initial temperatures are exactly the same. The universal clamp is used to pour the hot water out of the Erlenmeyer flask.
2. The measurements in the glass beaker are performed without a lid. With the lid the difference between the two vessels would only be half as large since the lid prevents the cooling of the hot water at its surface.

For additional student experiments to comprehensive investigation of the insulating properties of various materials, the testing unit for thermal insulation (Order No. 04505-00) is recommended. With it wall materials such as (wood) chipboard, sand, aluminium foil, mineral wool, styrofoam or air can be investigated.

For demonstrations the high insulation house (Order No. 04507-93) is available; it is especially suitable for quantitative investigations. Experimental options are, e.g., as follows

- measurements of wall and room temperature;
- determination of the k-value of various wall construction;
- temperature course for multilayer wall construction;
- calorific output as a function of room temperature;
- reduction of the calorific output through insulation.

All student and demonstration experiments on thermal insulation are thoroughly described in the series: Experimental Subjects Energy, Use of Solar Energy and Environmental Warmth, Volume 3: Thermal Insulation (Order No. 16630-31 [German version only]).

Thermal insulation (Item No.: P1043600)

Task and equipment

Task

How is water kept warm?

Measure the cooling rate of hot water in two different vessels:

1. in a complete calorimeter;
2. in a simple beaker.



Equipment



Position No.	Material	Order No.	Quantity
1	Support base, variable	02001-00	1
2	Support rod, stainless steel, l = 600 mm, d = 10 mm	02037-00	1
3	Boss head	02043-00	1
4	Ring with boss head, i. d. = 10 cm	37701-01	1
5	Universal clamp	37715-00	1
6	Wire gauze with ceramic, 160 x 160 mm	33287-01	1
7	Lid for student calorimeter	04404-01	1
8	Felt sheet, 100 x 100 mm	04404-20	2
9	Stop watch 4	03078-00	1
10	Glass beaker DURAN®, short, 250 ml	36013-00	1
11	Glass beaker DURAN®, short, 400 ml	36014-00	1
12	Erlenmeyer flask, wide neck, 250ml	36134-00	1
13	Pipette with rubber bulb	64701-00	1
14	Graduated cylinder 100 ml, PP transparent	36629-01	1
15	Students thermometer, -10...+110°C, l = 230 mm	38005-10	1
Additional material:			
16	Butane burner, Labogaz 206 type	32178-00	1
17	Butane cartridge C206, without valve	47535-01	1
18	Boiling beads, 200 g	36937-20	1
19	Matches		
As an alternative	(Additional Information on the Information for teachers page)		
	Testing unit for thermal insulation	04505-00	1
	High insulation house	04507-93	1
	Book: Energie, Teil 3: Wärmedämmung [German version only]	16630-31	1

Set-up and procedure

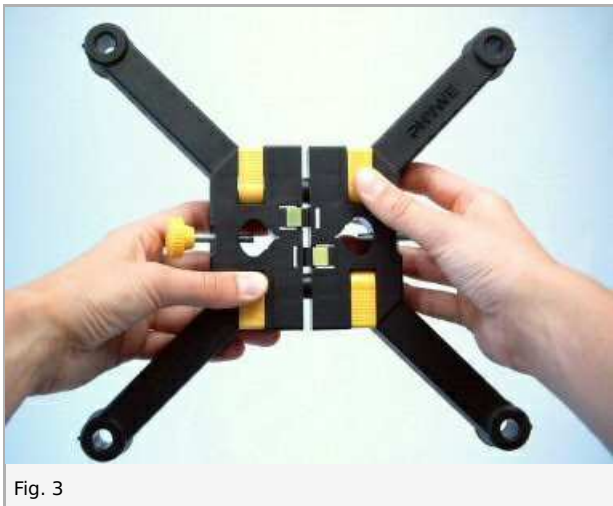
Set-up

Attention!

1. During heating of the water the support ring and the wire gauze become extremely hot!
2. When the hot water is to be poured, use the universal clamp to move the Erlenmeyer flask.

Setup

- Set up the support stand according to the following pictures:



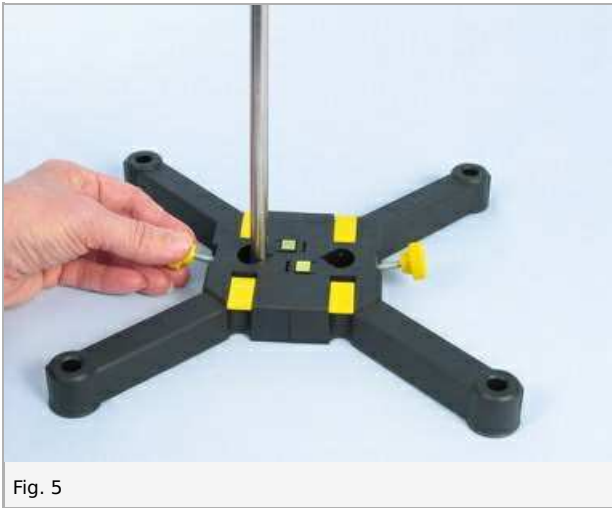


Fig. 5



Fig. 6

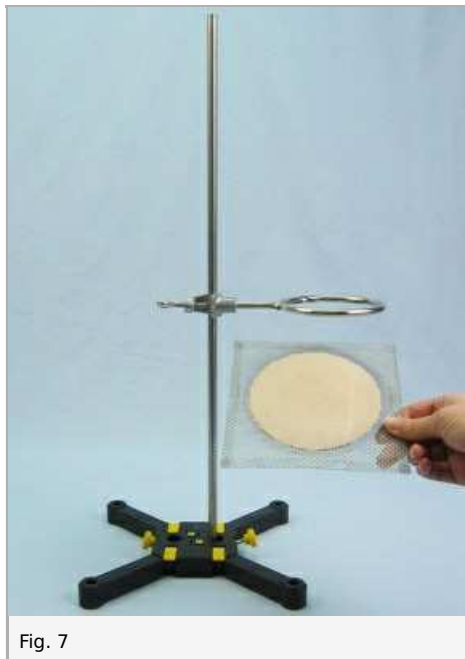


Fig. 7



Fig. 8

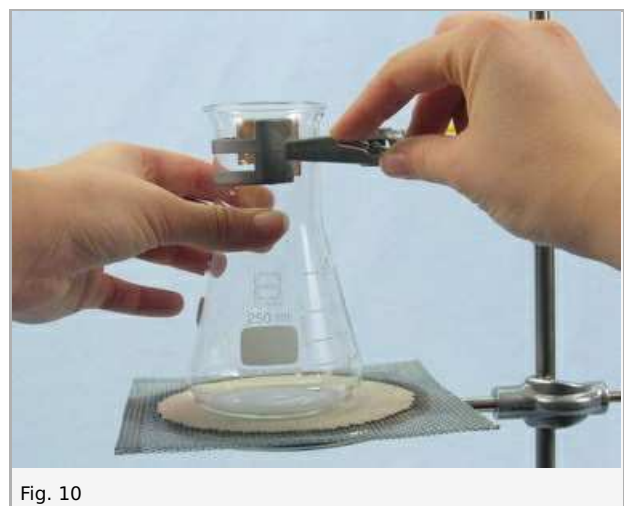


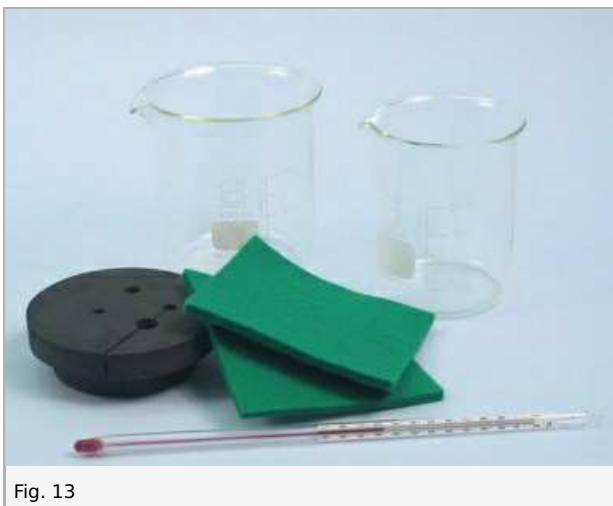
Fig. 10



- Pour 200 ml of water and a few beads into the Erlenmeyer flask.



- Using two beakers (250 and 400 ml) and two sheets of felt to assemble a thermally insulated vessel (calorimeter).



Procedure

- Bring the water in the Erlenmeyer flask to a boil.
- Pour the hot water from the Erlenmeyer flask into the calorimeter using the universal clamp as a handle.



Fig. 15

- Put the lid on the calorimeter. Push the thermometer through the 8-mm-hole in the lid and start the stop watch.
- Measure the temperature at one-minute intervals and record the values in Table 1 in the report.
- Repeat the experiment using only the inner beaker from the calorimeter without the lid (Table 2).
- Before starting, rinse the beaker with cold water and dry it. Place the thermometer in the beaker.



Fig. 16



Fig. 17

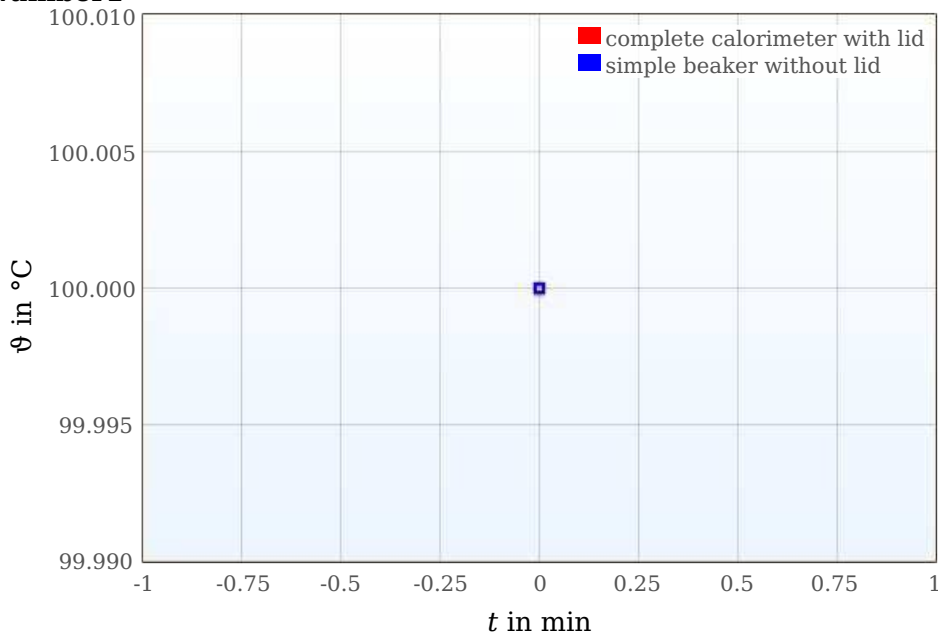
Report: Thermal insulation

Result - Table 1

Note your measured values in the table.

t in min	complete calorimeter with lid	simple beaker without lid
	ϑ in °C	ϑ in °C
0	100	100
1	1 ± 0	1 ± 0
2	1 ± 0	1 ± 0
3	1 ± 0	1 ± 0
4	1 ± 0	1 ± 0
5	1 ± 0	1 ± 0
6	1 ± 0	1 ± 0
7	1 ± 0	1 ± 0
8	1 ± 0	1 ± 0
9	1 ± 0	1 ± 0
10	1 ± 0	1 ± 0

Number1



Evaluation - Question 1

In which vessel does the temperature sink more slowly?

.....

.....

.....

.....

Evaluation - Question 2

Give examples for the use of thermal insulation.

.....

.....

.....

.....

Evaluation - Question 3

Name some materials which are suitable for thermal insulation in houses.

.....

.....

.....

.....