

Thermal energy

Changes in thermal energy

Thermal energy and materials
Universal physics measuring instrument

Object of the experiment

1. Investigate the relationship between rise in temperature and the material when an equal amount of thermal energy is supplied

Setup



Settings for Joule and wattmeter:

- Use the U, I, P button to set the measured variable to be work and its value to 0.00 kW.
- Press button t START/STOP such that the red LED comes on.
- If necessary, press the OUTPUT button so that the left-hand LED lights up (no voltage at plug socket).

Apparatus

1 Temperature sensor S, NTC.....	524 044
1 Universal physics measuring instrument.....	531 835
1 Immersion heater.....	303 25
1 Plastic beaker.....	590 06
1 Joule and wattmeter.....	531 831
1 Stand base, V-shaped, small.....	300 02
1 Stand rod, 25 cm, 12 mm diam.....	300 41
1 Universal clamp, 0...80 mm.....	666 555
1 Leybold multiclamp.....	301 01

Additionally recommended:

Other liquids, such as white spirit, vegetable oil and milk.

Procedure

- Initially fill the measuring beaker with 0.6 kg (600 ml) of water.
- Determine the temperature of the water ϑ_0 .
- Press the OUTPUT button of the Joule and wattmeter so that the right-hand LED lights up.
- Wait till the immersion heater has done about 10 kW of electrical work.
- Then press the OUTPUT button of the Joule and wattmeter so that the left-hand LED lights up.
- Briefly stir the water in the measuring beaker with the immersion heater.
- When the system has settled to a constant temperature, read this temperature ϑ from the universal measuring instrument and enter it into the table.
- Repeat the measurement with 0.6 kg (600 ml) of vegetable oil.

Measuring example

$m = 0.6 \text{ kg}$

Liquid	ϑ_0 in $^{\circ}\text{C}$	ΔE in kJ	ϑ in $^{\circ}\text{C}$	$\Delta\vartheta$ in K
Water	26.2	10	32.2	6.0
Vegetable oil	22.6	10	31.4	9.4

Evaluation

If various liquids are supplied with equal amounts of thermal energy, they do not experience the same rise in temperature. The rise in temperature is dependent on the materials from which the liquids are made.

The amount of thermal energy which needs to be supplied to 1 kg of a liquid to raise its temperature by 1 K is described by a constant for the material. This material constant is known as the specific heat capacity c .

The specific heat capacity c for a liquid is higher if the rise in temperature is smaller after the supply of a given amount of energy.

Specific heat capacities of various liquids:

Liquid	Specific heat capacity c in $\frac{\text{kJ}}{\text{kg}\cdot\text{K}}$
White spirit	2.43
Vegetable oil	1.97
Milk	3.90
Water	4.19