SPECIFICATION USER GUIDE

IN SCIENCE TOGETHER

211-010
Calorimeter Set

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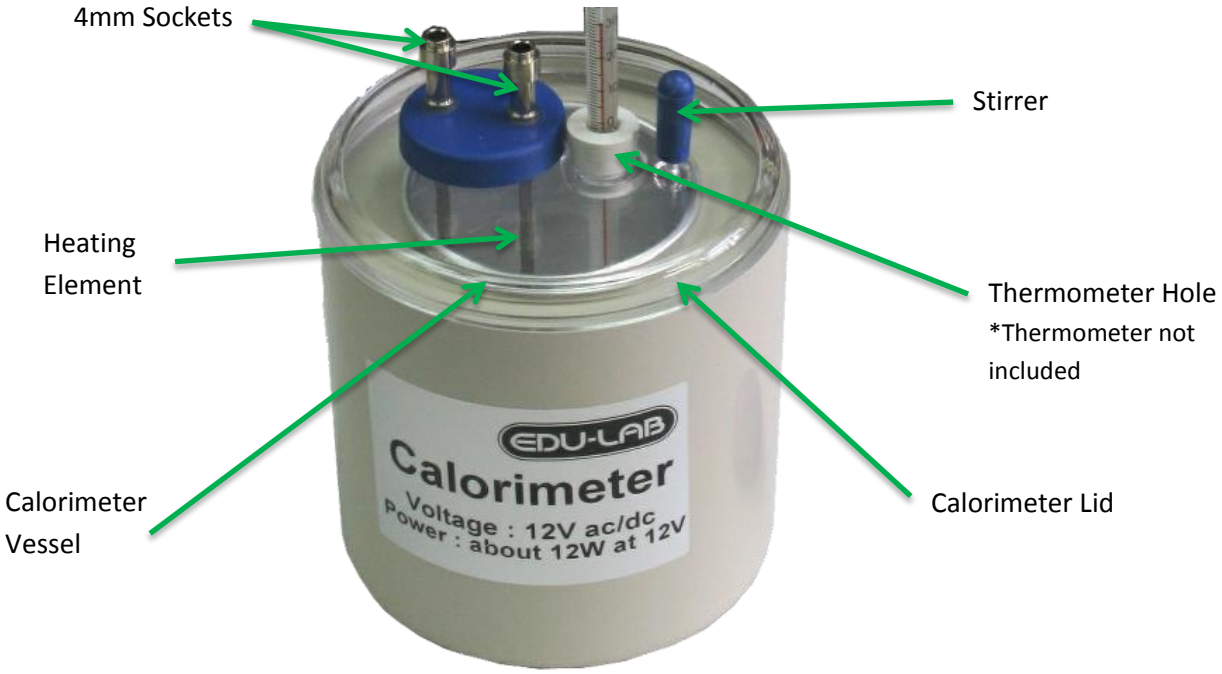

Introduction:

The calorimeter with heating coil is used for determining the specific heat capacity of solids and liquids and for measuring the electric heat equivalent.

The calorimeter consists of two mutually insulated aluminium beakers, a lid with rubber stop-per with boreholes for thermometer and stirrer, and a heating coil.

Technical Specifications:

Outer vessel:	Plastic ,110 x 100mm
Inner vessel:	Aluminium, 70 x 65mm.
Heater Power:	12W

Operation

- When in use, the heating filament must be immersed in the water to a depth of at least 2 cm.
- Never use the filament in the dry.
- Experiments should be conducted using distilled water.
- After each series of measurements, the calorimeter and heating filament should be cleaned and dried.

Safety

Experiments are conducted with hot liquid. Caution: danger of burns and scalding!

- In schools and educational institutions, operation of the apparatus must always be supervised by qualified personnel.
- Set up the experiment on an even surface.
- Take extreme care while emptying the calorimeter of its contents after conducting the experiment.

Additionally Required Equipment

- 300mm spirit thermometer or digital thermometer probe
- DC power supply, 6v
- Digital timer or stop watch

Sample Experiments

Specific Heat Capacity of Solids

- Find the mass m1 of the innermost aluminium beaker and make a note of it.
- Half fill the beaker with water and weigh it again, making a note of the mass of the water m2.
- Insert the beaker into the calorimeter and put on the lid without adding the heating coil to it.
- Slot an immersion sensor or a thermometer into the opening in the calorimeter, making sure that the tip of the instrument does not touch the bottom of the vessel.
- Make a note of the initial temperature $\vartheta 1$.
- Determine the mass m of the solid body and make a note of it.
- Heat the solid body in boiling water and make a note of the new temperature $\vartheta 2$.
- Quickly transfer the solid body into the calorimeter and close the lid.
- Move the stirrer up and down and then measure the temperature of the mixture ϑ.
- Calculate the specific heat capacity c of the solid body using the following equation:

$$c = \frac{(\vartheta - \vartheta_1) \cdot (m_1 \cdot c_1 + m_2 \cdot c_2)}{m \cdot (\vartheta_2 - \vartheta)}$$

c_1 = specific heat capacity of water

$$c_1 = 4{,}182 \ \frac{kJ}{kg \cdot K}$$

c_2 = specific heat capacity of aluminium

$$c_2 = 0{,}896 \ \frac{kJ}{kg \cdot K}$$

Determining Electrical Equivalent of Heat

- Slot an immersion sensor or a thermometer into the opening in the calorimeter. The tip of the instrument should be below the heating filament but must not touch the bottom of the vessel.
- Make a note of the initial temperature $\vartheta 1$.
- Connect up the power supply.
- Turn on the power supply and start measuring the temperature from that instant. Do not exceed a voltage of 6 V or a current of 2 A. Read off the values from the power supply itself and make a note of them.
- Heat the water for a maximum of 15 minutes. To make sure the heating is uniform, slowly move the stirrer up and down while the power is switched on.
- Turn off the power supply and halt the stop-watch at the same instant. Make a note of the time t.
- Measure the final temperature $\vartheta 2$ and make a note of it.

The electricity W that has been converted into heat is given by the following equation:

$W = I \cdot U \cdot t$

The quantity of heat absorbed Q can be calculated using the following equation:

$$Q = (m_1 \cdot c_1 + m_2 \cdot c_2) \cdot (\vartheta_2 - \vartheta_1)$$

c_1 = specific heat capacity of water

$$c_1 = 4{,}182 \ \frac{kJ}{kg \cdot K}$$

c_2 = specific heat capacity of aluminium

$$c_2 = 0{,}896 \ \frac{kJ}{kg \cdot K}$$

An approximate value for the electrical equivalent of heat is given by the following equation:

$$q = \frac{Q}{W}$$

Compare the amounts of electrical and thermal energy involved in the experiment.