

Required practical: specific heat capacity

- 1 Describe an experiment to determine the specific heat capacity of one or more materials.

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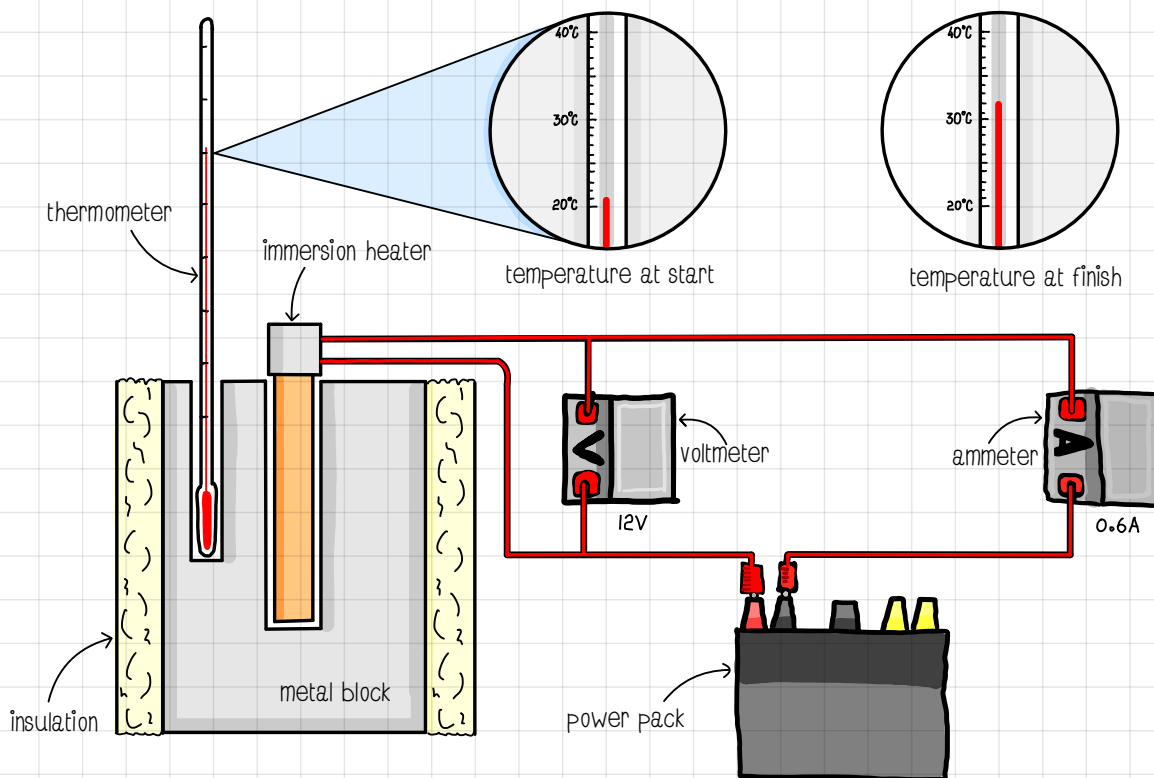
Review



The specific heat capacity of a substance is the amount of energy required to raise the temperature of 1 kg of the substance by 1 °C.

Experiment

1. Collect different metal blocks (e.g. copper, aluminium and iron). You could also use different liquids in a beaker (e.g. water, vegetable oil and coconut oil). The different type of material will be the independent variable.
2. Select the copper block. Weigh the mass of the copper block in kilograms.



4. Measure the starting temperature of the copper block. Then turn on the power pack to heat up the immersion heater. You need to measure how long the power pack is turned on for.
5. Use the ammeter and voltmeter to measure the current and volts. These will be used to calculate the energy transferred to the metal block.
6. After 10 minutes turn off the power pack. Read the thermometer to get the final temperature of the metal block. Calculate the change in temperature of the block.

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Data collection

metal	mass (kg)	start temp. (°C)	finish temp. (°C)	time (s)	current (A)	voltage (V)
copper	1	21	32	600	3.5	12

Processing data

Change in temperature = finish temp. - initial temp. = $32 - 21 = 11^{\circ}\text{C}$ $\Delta\theta$

Power = voltage x current = $12 \times 0.6 = 7.2 \text{ W}$

Energy = Power x time = $7.2 \times 600 = 4\,320 \text{ J}$ ΔE

Calculation of specific heat capacity

Change in thermal energy = mass x specific heat capacity x temperature change or $\Delta E = m \times c \times \Delta\theta$

θ means temperature
 Δ means change

joules (J) kilograms (kg) joules/kilograms celsius celsius

Rearrange the equation to calculate specific heat capacity

$$c = \frac{\Delta E}{m \times \Delta\theta} \quad c = \frac{4\,320}{1 \times 11} \quad c = 392.7 \text{ J/kg }^{\circ}\text{C}$$

Sources of inaccuracy

The literature value for specific heat capacity of copper is $385 \text{ J/kg }^{\circ}\text{C}$. There are a number of sources of error in the experiment which account for the difference between the theoretical value and the experimental value.

1. Thermal energy passes out of the metal into the air.

Use insulation to reduce the transfer of thermal energy to the air

2. Not all the thermal energy passes into the metal.

Ensure the immersion heater is completely inside the metal block

3. Thermometer divided in to 1°C sections, reducing its sensitivity.

Use a digital thermometer with a precision of 0.01°C

4. Thermal energy not spread throughout material.

If you are measuring the specific heat capacity of a liquid, then stirring the liquid is required.