

3.3 Specific heat capacity

When an object is heated, the mean kinetic energy of its particles increases. We record this as a rise in temperature. For some materials, the temperature rise is large for the amount of heat energy added. For other materials, the temperature rise is small. The specific heat capacity (c) of a material is a measure of how the temperature of a material responds to heating:



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$$c = \frac{\Delta E}{m \times \Delta T}$$

where ΔE =energy added in joules, m =mass of material in kilograms, ΔT =temperature change in degrees Celsius (or kelvin)

We can describe the specific heat capacity as:

“the energy required to raise the temperature of 1 kilogram of a material by 1 degree Celsius”

(1) Looking at the equation, above, what are the units for specific heat capacity?

(2) 21000J of energy was used to heat 1 litre (mass=1kg) of water. This raised the temperature of the water by 5°C. Use the equation, above, to calculate the specific heat capacity of water.

Using an electric heater

A common practical is to use an electric (immersion) heater to heat a material. The energy supplied (ΔE) can be worked out from the power (P) of the heater and the time (Δt) it is switched on for:

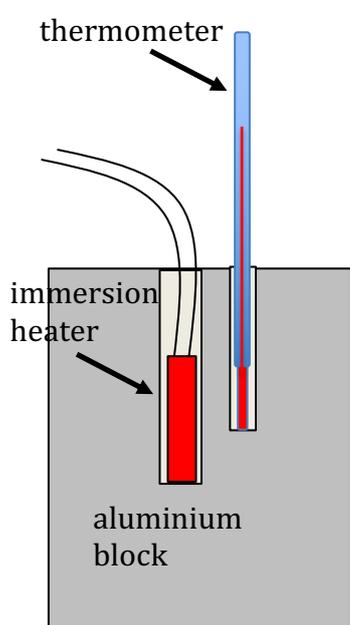
$$\Delta E = P \times \Delta t$$

The power is usually monitored by measuring the current (I) supplied to the heater and the potential difference (V) dropped across the heater:

$$P = I \times V$$

(3) Substitute for P in the first equation to get an expression for the energy supplied to the heater in terms of I , V and Δt .

(4) *Draw a circuit diagram to show the position of the voltmeter and ammeter. What device could be used to adjust the power supplied to the heater? Show this in your circuit diagram.*



In the experiment, left, an immersion heater is inserted into a 1kg block of aluminium. A thermometer is inserted into an adjacent slot to monitor the temperature at different times after the heater has been switched on. The following results were obtained:

time (s)	potential difference (V)	current (A)	temperature (°C)
0	12.0	2.0	21.0
60	12.0	2.0	22.5
120	12.0	2.0	24.0
180	12.0	2.0	26.0
240	12.0	2.0	27.5
300	12.0	2.0	29.0

(5) *Using the equation from question (3), above, work out the total energy (ΔE) supplied to the heater?*

(6) *What is the rise in temperature (Δt) of the aluminium block?*

(7) *Using the equation (from the start of the worksheet), calculate the specific heat capacity of aluminium?*

(8) *Why is the value obtained using this method likely to be an over estimate of the true value?*