SPECIFIC HEAT CAPACITY

Specific heat capacity of an object: C:

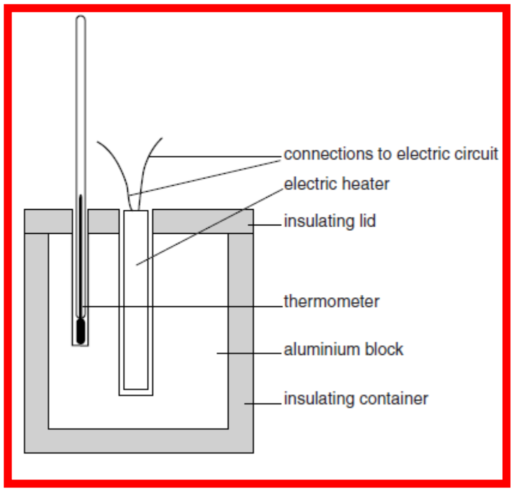
It is the energy required per unit mass per unit temperature increase.

Hence : $c = \frac{E}{m(\theta_2 - \theta_1)} \implies E = mc(\theta_2 - \theta_1)$ [OR] $c = \frac{\Delta E}{m\Delta\theta}$

Units: J/kg^0C

Experiment:

Suppose you need to find our specific heat capacity of aluminium.



Take the following measurements:

- mass of aluminium,
- initial temperature (θ_1)
- final temperature(θ_2) of the aluminium block
- Time (t) for which heat is supplied
- Voltage(V)
- Current(I)
- Note that the formula for specific heat capacity is: $c = \frac{E}{m(\theta_2 - \theta_1)}$; but since we do not have a joule meter we are calculating the value of E using the formula E=VIt

$$c = \frac{E}{m(\theta_2 - \theta_1)} = \frac{VIt}{m(\theta_2 - \theta_1)}$$

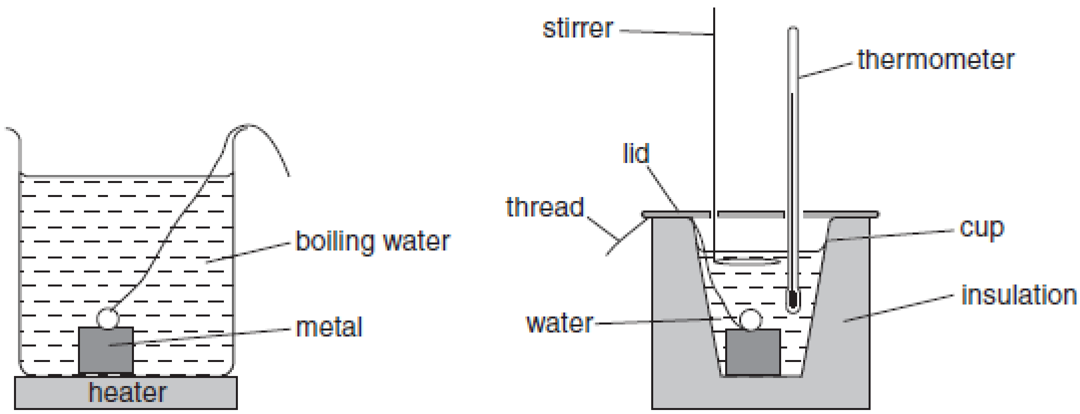
If heat losses occur:

If a lid is not present as shown in the above diagram then the value to specific heat capacity will be higher as more heat will be lost to the surroundings and hence the temperature rise will be less. So more heat will be needed to cause the same temperature rise.

Preventing heat losses:

- Care should be taken to prevent heat losses to the environment by using lagging or insulation around the block.
- By polishing the surface of the block or wrapping the block in a shiny material or it can be painted white
- Reduce draughts

If the following procedure is used to find the specific heat capacity of a given metal, then it will result in inaccuracy. This is because heat will be lost to the surroundings or the cup



Note:

Water has a very high specific heat capacity. This is a disadvantage for cooking because:

- It will take long time to heat up
- long time to cool down
- expensive as it takes lot of energy to heat up,

APPLICATION QUESTIONS-EXTENDED MCQ

138

4 **(a)** Define the *specific heat capacity* of a substance.

....

.... [2]

(b) Fig. 4.1 shows a cylinder of aluminium heated by an electric heater. M/J/14-P32

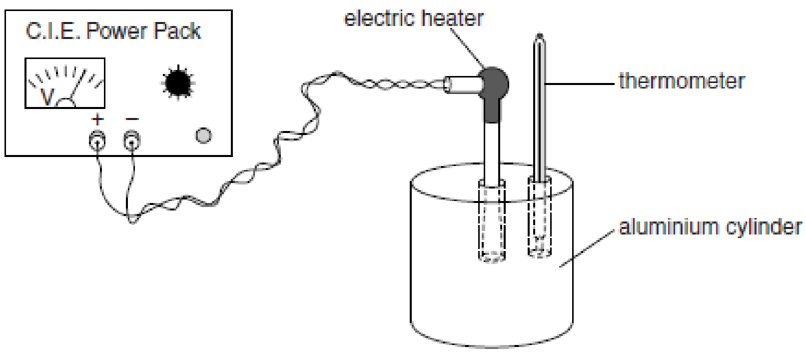


Fig. 4.1

The mass of the cylinder is 800 g. The heater delivers 8700 J of thermal energy to the cylinder and the temperature of the cylinder increases by 12 °C.

(i) Calculate a value for the specific heat capacity of aluminium.

specific heat capacity = ... [2]

(ii) Calculate the thermal capacity (heat capacity) of the aluminium cylinder.

thermal capacity = ... [2]

(c) State and explain a method of improving the accuracy of the experiment.

....

....

.... [2]

4 (a) State two differences between evaporation of water and boiling of water.

109

M/J/06-P3

1. ....

2. ....[2]

(b) The specific latent heat of vaporisation of water is 2260 kJ / kg.
Explain why this energy is needed to boil water and why the temperature of the water does not change during the boiling.

....

....

....

....[3]

(c) A laboratory determination of the specific latent heat of vaporisation of water uses a 120 W heater to keep water boiling at its boiling point. Water is turned into steam at the rate of 0.050 g / s.
Calculate the value of the specific latent heat of vaporisation obtained from this experiment. Show your working.

specific latent heat of vaporisation = ...[3]

5 A certain substance is in the solid state at a temperature of –36 °C. It is heated at a constant rate for 32 minutes. The record of its temperature is given in Fig. 5.1.

time / min	0	1	2	6	10	14	18	22	24	26	28	30	32
temperature / °C	–36	–16	–9	–9	–9	–9	32	75	101	121	121	121	121

Fig. 5.1

M/J/10-P31

(a) State what is meant by the term *latent heat*.

....

.... [2]

(b) State a time at which the energy is being supplied as latent heat of fusion.

.... [1]

(c) Explain the energy changes undergone by the molecules of a substance during the period when latent heat of vaporisation is being supplied.

....

....

.... [2]

(d) **(i)** The rate of heating is 2.0 kW.

Calculate how much energy is supplied to the substance during the period 18 – 22 minutes.

energy supplied = ... [2]

(ii) The specific heat capacity of the substance is 1760 J / (kg °C).

Use the information in the table for the period 18 – 22 minutes to calculate the mass of the substance being heated.

mass heated = ... [3]

[Total: 10]

4 Use the information in the table when answering this question.

specific heat capacity of ice	2.0 J/(g °C)
specific heat capacity of water	4.2 J/(g °C)
specific latent heat of fusion of ice	330 J/g
specific latent heat of vaporisation of water	2260 J/g

(a) Explain what is meant by the statement: 'the specific latent heat of fusion of ice is 330 J/g'.

....

....

....[1]

(b) A block of ice is taken from a freezer at –25 °C, placed in a metal container, and heated by a source of constant power.

The graph in Fig. 4.1 shows how the temperature of the contents of the container changes with time. At point E on the graph the container is empty.

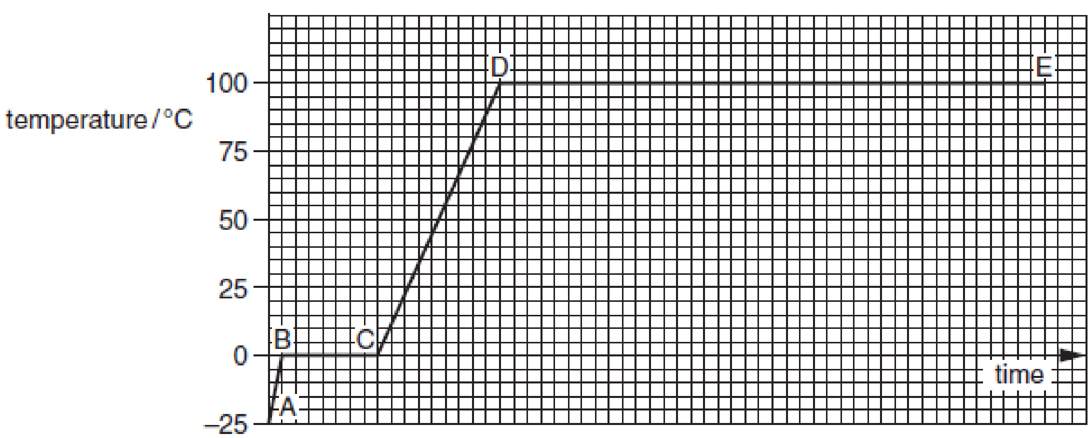


Fig. 4.1

(i) State what is taking place in the regions of the graph from B to C, and from D to E.

B to C ....

....

D to E ....

....[2]

(ii) Use the information in the table to explain why the line DE is longer than the line BC.

....

....

....[1]

(iii) Use the information in the table to explain why the graph is steeper from A to B than from C to D.

....

....

....[2]

[Total: 6]