**1** Fig. 4.1 shows some of the apparatus that a student uses to determine the specific heat 1 of aluminium.

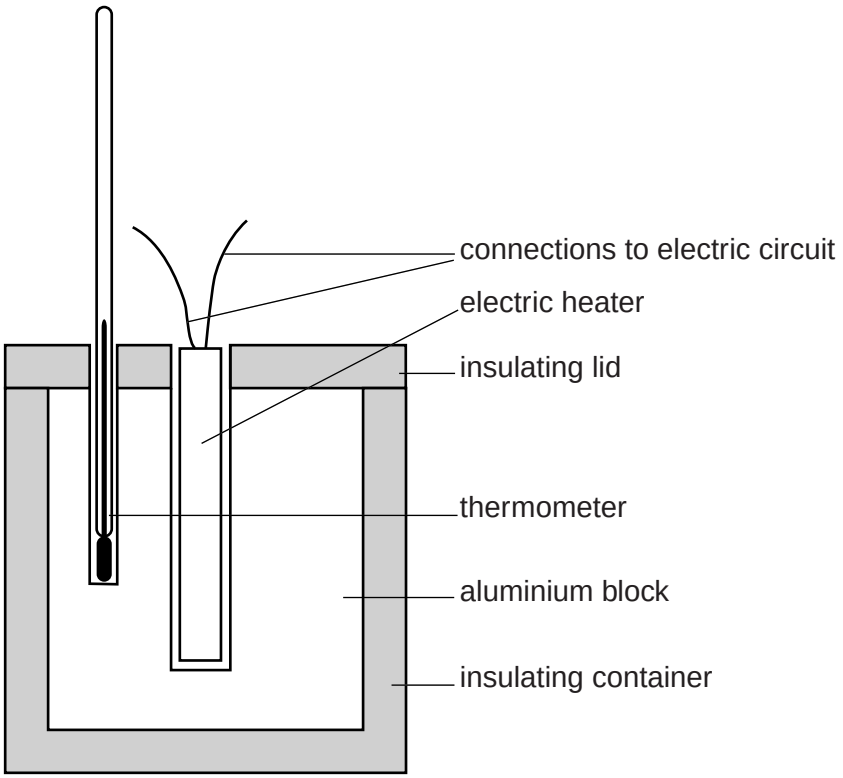


**Fig. 4.1**

**(a)** State the measurements the student needs to make, including those from the electric circuit. For each quantity measured, state a symbol.

.....

.....

.....

.....

.....

.....

.....[4]

**(b)** Use your symbols from **(a)** to complete the formula used to determine the specific heat capacity *c*.

specific heat capacity *c* =

.....[2]

**(c)** Another student performs the experiment without using insulation. He obtains a higher value for *c*.

Explain why this student's measurements lead to this higher value.

.....

.....[1]

[Total: 7]

**2** A technician is designing a liquid-in-glass thermometer. The following is a list of properties of the thermometer that she is considering.

sensitivity range speed of response linearity

**(a) (i) 1.** Which one of these properties is affected by the length of the stem of the thermometer?

.....

**2.** Explain your answer.

.....

.....

[2]

**(ii) 1.** Which property is affected by the diameter of the capillary?

.....

**2.** Explain your answer.

.....

.....

[2]

**(b)** The thermometer is to be used to measure temperatures between −10 °C and 50 °C. The technician considers using water or red-coloured alcohol as the liquid in the thermometer.

**(i)** Write down which liquid would be suitable.

.....

**(ii)** Give **two** reasons for your answer.

1. .....

.....

2. .....

.....

[2]

[Total: 6]

**3** A student uses a 2400 W electric kettle to obtain a value for the specific heat capacity of sunflower oil.

Fig. 6.1 shows the apparatus.

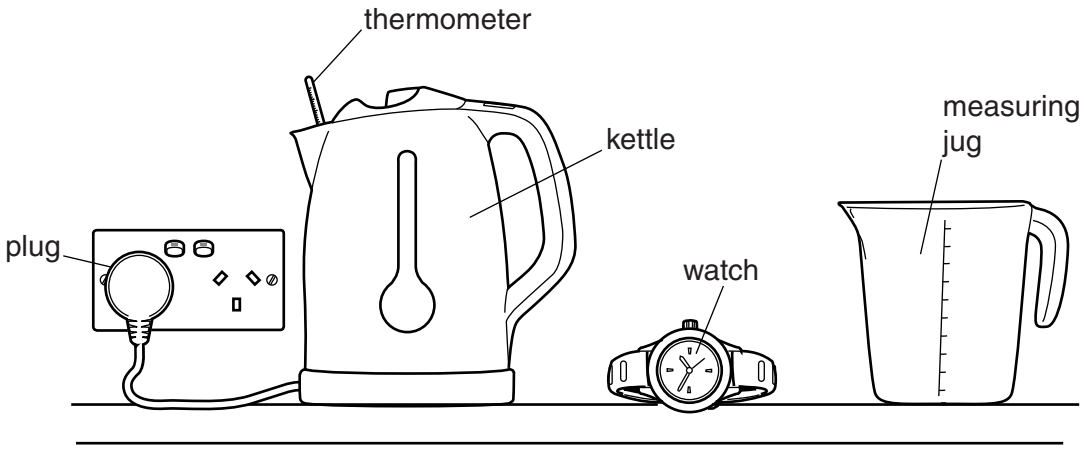


**Fig. 6.1**

The student uses a measuring jug and pours 1.5 kg of sunflower oil into the empty kettle. He uses a thermometer to measure the temperature of the oil.

The kettle is switched on and left on for 50 s. The temperature of the oil increases by 32 °C.

The student assumes that all the electrical energy is transferred as thermal energy to the oil.

**(a)** Calculate the value for the specific heat capacity of sunflower oil obtained by the student.

specific heat capacity = ..... [4]

**(b)** State and explain whether the value for the specific heat capacity obtained by the student is too large or too small.

.....

..... [1]

**4** **(a)** Suggest

**(i)** an example of a change of state resulting from the removal of thermal energy from a quantity of material,

..... [1]

**(ii)** the effect of this change of state on the temperature of the material.

..... [1]

**(b)** Define the *thermal capacity* of a body.

.....

.....

..... [2]

**(c)** A polystyrene cup holds 250 g of water at 20 °C. In order to cool the water to make a cold drink, small pieces of ice at 0 °C are added until the water reaches 0 °C and no unmelted ice is present.

[specific heat capacity of water = 4.2 J/(g °C), specific latent heat of fusion of ice = 330 J/g]

Assume no thermal energy is lost or gained by the cup.

**(i)** Calculate the thermal energy lost by the water in cooling to 0 °C.

thermal energy lost = ..... [2]

**(ii)** State the thermal energy gained by the ice in melting.

thermal energy gained = ..... [1]

**(iii)** Calculate the mass of ice added.

mass of ice = ..... [2]

[Total: 9]

**5** Fig. 6.1 shows a glass flask full of water at 10 °C and sealed with a bung. A long glass tube passes through the bung into the water. The water level in the tube is at X.

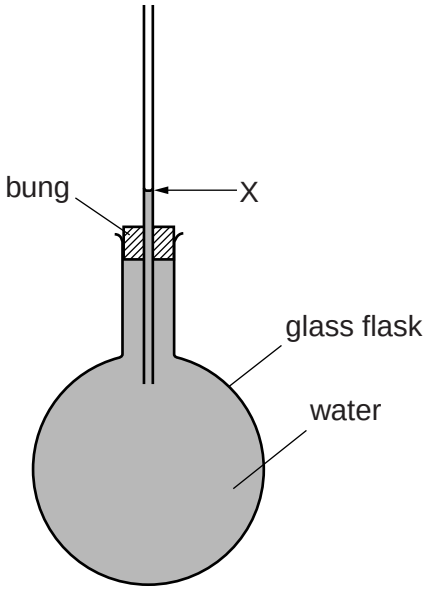


**Fig. 6.1**

When the flask is placed in hot water, the water level initially falls a little below X, and then rises some way above X.

**(a)** Suggest why

**(i)** the water level initially falls,

.....

..... [2]

**(ii)** the water level then rises,

.....

..... [2]

**(iii)** the rise is greater than the fall.

.....

..... [1]

**(b)** Suggest a change to the apparatus that would make the fall and rise of the water level greater.

.....

..... [1]

[Total: 6]

**6** **(a)** Define *specific latent heat of fusion*.

.....

.....

..... [1]

**(b)** **(i)** A tray of area 0.25 $m^2$, filled with ice to a depth of 12 mm, is removed from a refrigerator.

Calculate the mass of ice on the tray. The density of ice is 920 $kg/m^3$.

mass = ..... [2]

**(ii)** Thermal energy from the Sun is falling on the ice at a rate of 250 $W/m^2$. The ice absorbs 60 % of this energy.

Calculate the energy absorbed in 1.0 s by the 0.25 $m^2$ area of ice on the tray.

energy = ..... [2]

**(iii)** The ice is at its melting temperature.

Calculate the time taken for all the ice to melt. The specific latent heat of fusion of ice is $3.3 \times 10^5$ J/kg.

time = ..... [3]

[Total: 8]

**7** **(a)** Explain why a liquid cools when evaporation takes place from its surface.

.....

.....

..... [2]

**(b)** Fig. 7.1 shows five vessels each made of the same metal and containing water.

Vessels A, B, C and D are identical in size and shape. Vessel E is shallower and wider. The temperature of the air surrounding each vessel is 20 °C.

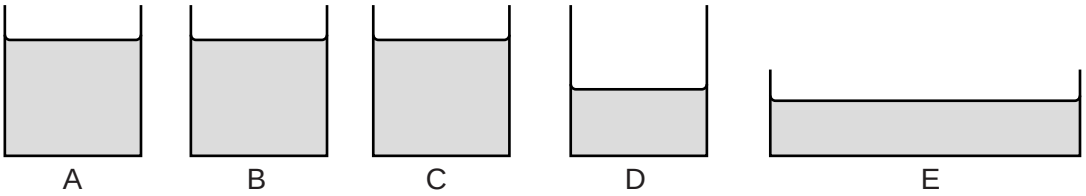


**Fig. 7.1**

The table shows details about each vessel and their contents.

| vessel | outer surface | volume of water / $cm^3$ | initial temperature of water / °C |
|---|---|---|---|
| A | dull | | 80 |
| B | shiny | 200 | 80 |
| C | dull | | 95 |
| D | dull | | 80 |
| E | dull | | 80 |

The following questions are about the time taken for the temperature of the water in the vessels to fall by 10 °C from the initial temperature.

**(i)** Explain why the water in B takes longer to cool than the water in A.

.....

..... [1]

**(ii)** Explain why the water in C cools more quickly than the water in A.

.....

..... [1]

**(iii)** Explain why the water in D cools more quickly than the water in A.

.....

..... [1]

**(iv)** Suggest **two** reasons why the water in E cools more quickly than the water in A.

1. .....

.....

2. .....

.....

[2]

[Total: 7]