Core 1

Fig. 1 shows a ring with gear teeth, which is to be fitted to a flywheel.

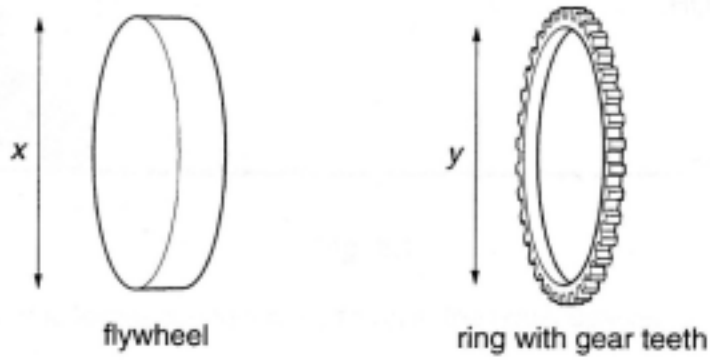


Fig. 1

The internal diameter, *y*, of the ring is slightly smaller than the diameter, *x*, of the flywheel.

The ring is heated to a high temperature.

(a) State why the ring will now fit on to the flywheel.

.....[1]

(b) State what will happen when the ring is allowed to cool.

.....

.....[1]

(c) Explain why diameter *y* is designed to be smaller than diameter *x*.

.....

.....[1]

Core 2

(a) Fig. 2 shows a liquid-in-glass thermometer.

Fig. 2

(i) Name a suitable liquid to use in the thermometer. .....

(ii) State the reading on the thermometer. ..... °C

(iii) Explain why a narrow capillary tube is used.

.....

.....[3]

(b) The thermometer bulb is put in melting ice.

(i) Explain why the liquid moves in the capillary tube.

.....

.....

.....

(ii) Mark on the diagram the new position of the liquid. [3]

Core 4

Fig. 4 shows an experiment to investigate the transfer of thermal energy.

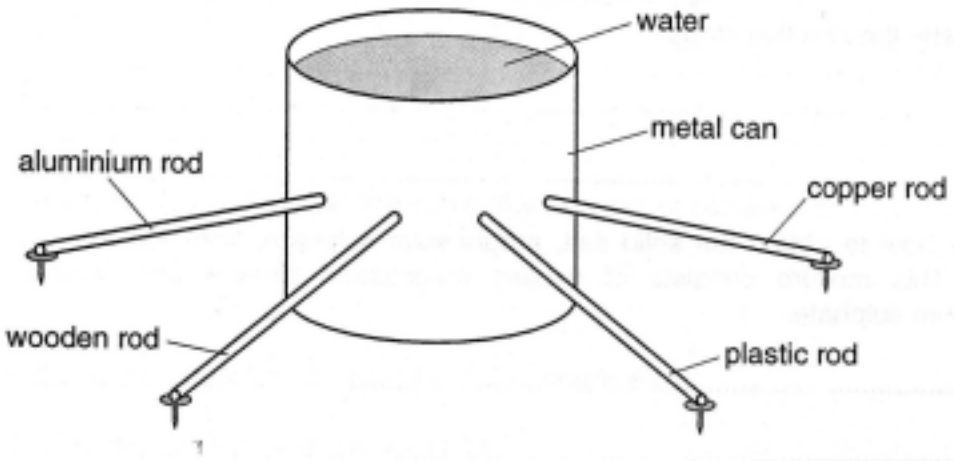


Fig. 4

A drawing pin is stuck on the end of each rod, using wax. After a short time, the wax on the copper rod melts and the drawing pin falls off.

(a) **(i)** What method of heat transfer does the experiment demonstrate?

.....[1]

(ii) From which rod would you expect the pin to fall next?

.....[1]

(iii) What does this demonstrate about the thermal properties of metals and non-metals?

.....

.....[2]

(b) When taking a cooking pot out of a hot oven, a cook will pick it up using a **thick cloth**.

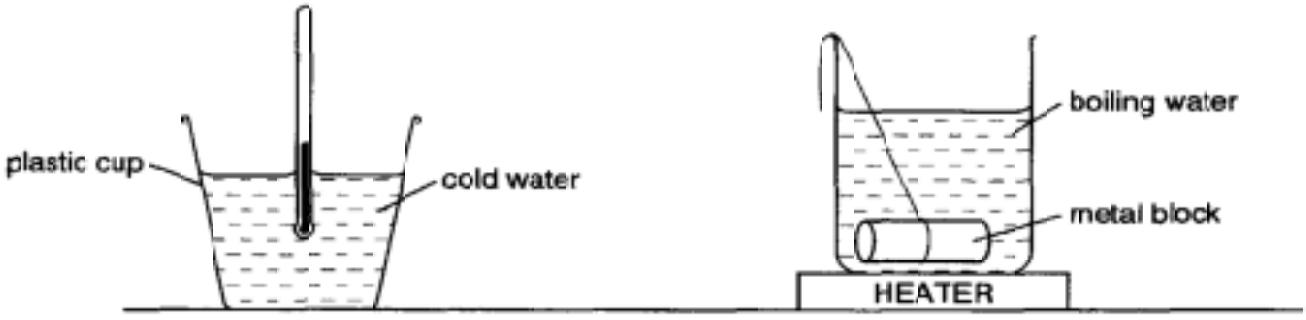
Explain why this stops the cook from getting burnt.

.....

.....

.....[2]

Alternative to practical



A piece of metal at the boiling temperature of water is transferred to a mass of cold water. Initially, the cold water is at a temperature of T_C. The hot metal raises the temperature of this water to T_H. The rise in temperature, θ, is determined from the relation $\theta = T_H - T_C$. The experiment is repeated so as to obtain five sets of readings for different masses of cold water.

(a) Draw up a table, for use in your laboratory notebook, in which you can record

m, the mass of cold water used,
T_C, the temperature of the cold water,
T_H, the maximum temperature reached by the cold water,
θ, the rise in temperature of the cold water.

[3]

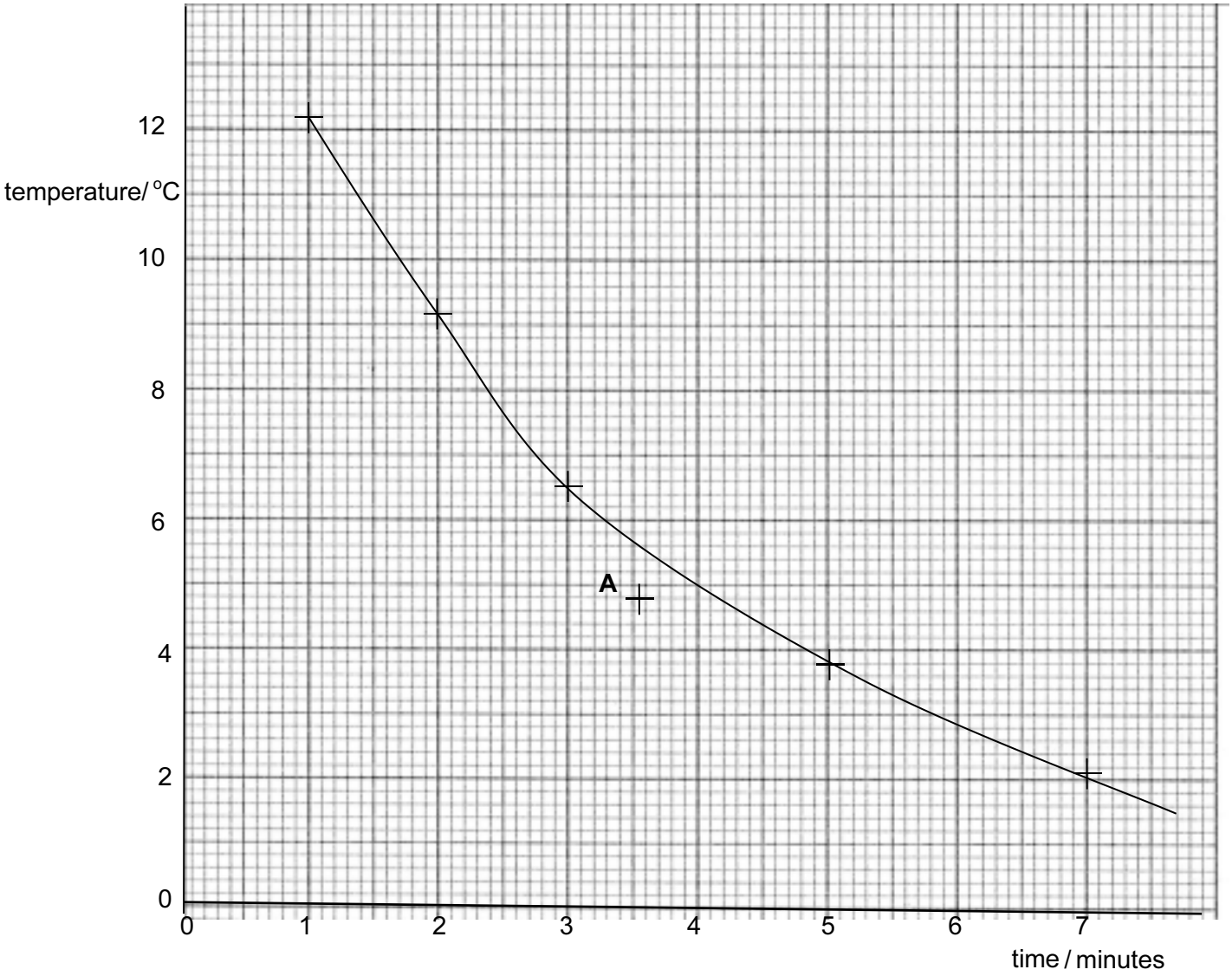
(b)

(i) Why has a smooth line been drawn through the points?

.....

.....

.....



(ii) The graph point that is labelled **A** does not lie on the graph line. (You can assume that the graph line is correctly drawn.) Complete the following statements about the value of θ and of m at the point A.

1. If the value of θ were ..... °C smaller the point **A** would lie on the line.

2 If the value of m were ..... g smaller the point **A** would lie on the line.

In **(ii)** above, which is the most likely reason, 1 or 2, for the point **A** not being on the line? Give a reason for your choice.

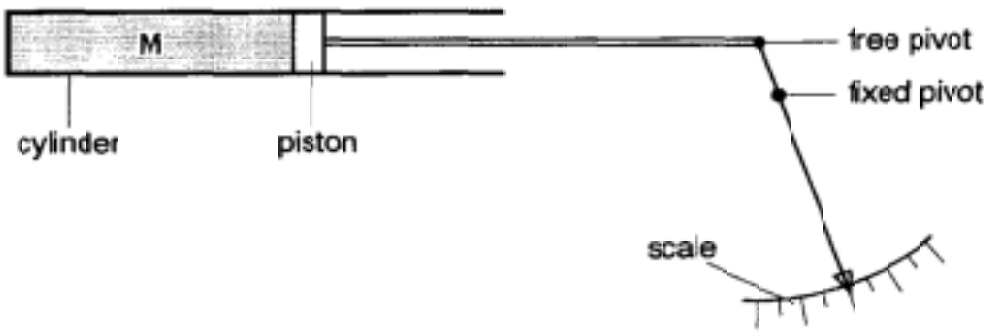
choice .....

reason .....

..... [4]

Extension 1

Fig. shows a student's design for a thermometer. The student stated that the material labelled M could be a copper rod, alcohol or nitrogen gas.



(a) Explain what is meant by the term *sensitivity of the thermometer.*

.....

.....[1]

(b) **(i)** State which of the three suggested materials would give a thermometer of greatest sensitivity.

.....

(ii) Explain your answer.

.....

.....

[2]

(c) **(i)** State which of the three materials would allow the thermometer to measure the largest range of temperature.

.....

(ii) Explain your answer.

.....

.....

[2]

(d) The student found that the temperature scale of this thermometer was *non-linear.* Explain what this means.

.....

[2]

Answers

Core 1

(a) ring expands ✓

(b) ring contracts again ✓

(c) tight fit ✓

Core 2

(a) mercury / alcohol ✓

(b)(i) Ice is colder than the thermometer ✓

liquid cools ✓

and contracts ✓

(ii) At 0 ^{o}C mark ✓

Core 4

(a)(i) radiation ✓

(ii) auminium ✓

metals good conductors ✓

non-metals poor conductors ✓

(b) reduces energy transfer to hand ✓

cloth is a poor conductor / good insulator ✓

Alternative to Practical

(a) a suitable table showing units for both mass and temperature

(b)(i) it is a way of taking an average
it is a way of showing up unexpected results

(ii) 1 0.8 ^{O}C

2 3 g

(iii) 0.7 / 0.8 celsius

0.6 minutes

temperature
difficult to measure temperature to $1^{o}C$
or heat losses involved
or easy to measure mass to better than 1 g

Extension 1

(a)(i) change in property / length / volume per degree

(b)(i) nitrogen

(ii) gases expand more / most

(**c)(i)** copper

(ii) a small increase in length per degree / high melting point etc

(d) the pointer movement is not the same for all degrees or the effect is different at different parts of the scale