Thermal Processes
Question Paper 3

Level	IGCSE
Subject	Physics
Exam Board	CIE
Topic	Thermal Physics
Sub-Topic	Thermal Processes
Paper Type	Alternative to Practical
Booklet	Question Paper 3

Time Allowed: **51 minutes**

Score: **/42**

Percentage: **/100**

1 A student carries out an experiment to compare how quickly thermal energy is conducted along rods made from different metals. Each rod is heated at one end with a Bunsen burner flame.

Each rod carries a marker held on the rod with a little wax. When the wax melts, the marker falls.
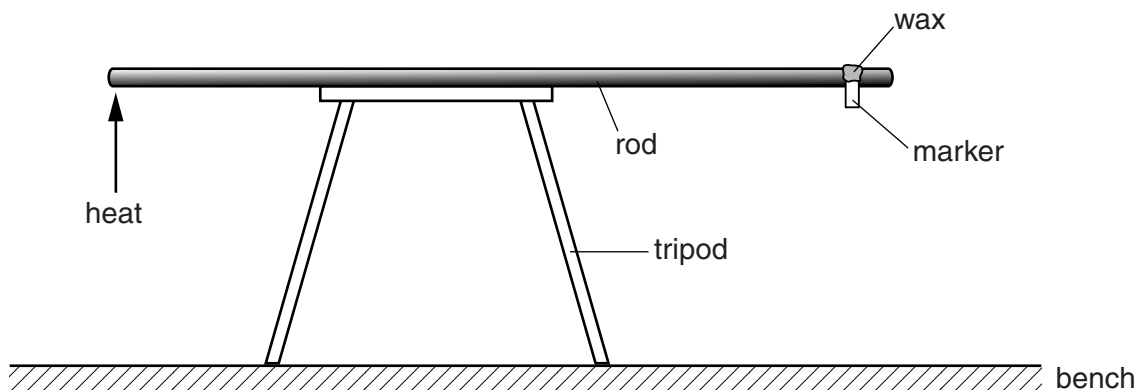

Fig. 2.1

(a) One other piece of equipment is required to compare how quickly thermal energy is conducted. Name this piece of equipment.

....[1]

(b) Suggest **three** possible variables that the student should keep constant in order to make a fair comparison between the different metals.

1. ....

2. ....

3. ....
[3]

(c) Another student suggests that it would be helpful to measure the temperatures at both ends of the rod. He suggests using a liquid-in-glass thermometer, normally used for measuring the temperature of hot water.

Suggest two reasons why a liquid-in-glass thermometer is **not** suitable.

1. ....

2. ....
[2]

[Total: 6]

2 Some IGCSE students are investigating the cooling of water.
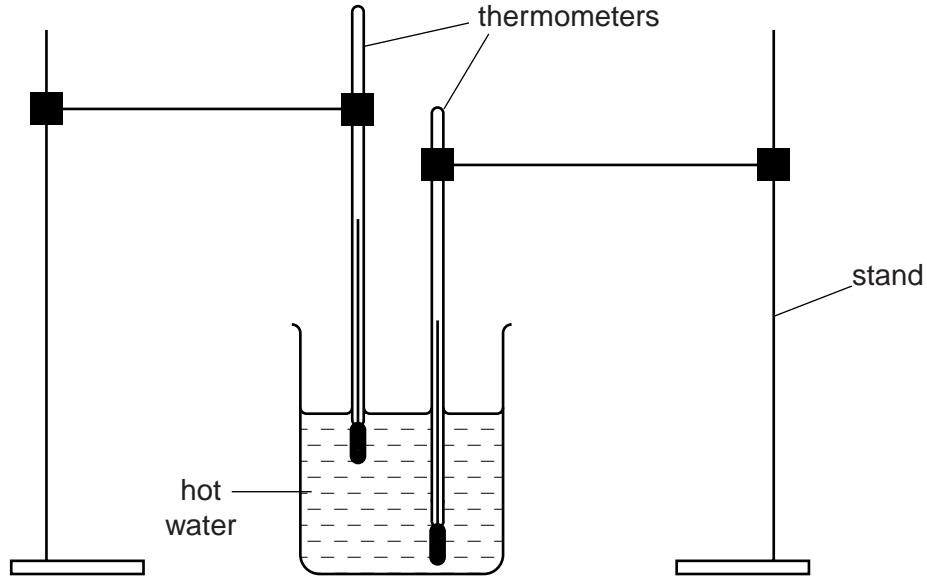
Fig. 1.1 shows how the apparatus is set up.

Fig. 1.1

(a) A thermometer is placed on the bench so that room temperature can be measured.

Read and record room temperature θ_R as shown on the thermometer in Fig. 1.2.

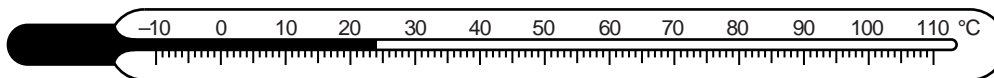θ_R = ...[1]

Fig. 1.2

(b) A student pours hot water into the beaker so that the level is as shown in Fig. 1.1.

In Table 1.1, he then records the temperatures θ every minute as the water cools until time t = 6 minutes.

Complete the column headings and complete the time column in Table 1.1.   [2]

Table 1.1

t /	thermometer bulb near the bottom of the beaker θ /	thermometer bulb near the surface of the water θ /
0	82.0	76.0
	79.5	74.0
	77.0	72.0
	75.0	70.0
	73.0	68.0
	70.5	66.0
	69.0	64.5

(c) State in which position of the thermometer bulb the average rate of cooling is the greater.

Justify your answer by referring to the results.

position ....

justification ....

....

....
[2]

(d) What precaution do the results suggest should be taken when measuring the temperature of a liquid?

Explain how the results show that this is a sensible precaution.

precaution ....

....

explanation ....

....

....
[2]

(e) A student in a different school wants to repeat the experiment in order to check the results.

Suggest two experimental conditions which should be kept the same.

1. ....

....

2. ....

....

[2]

[Total: 9]

3 An IGCSE student is investigating the cooling of a thermometer bulb.

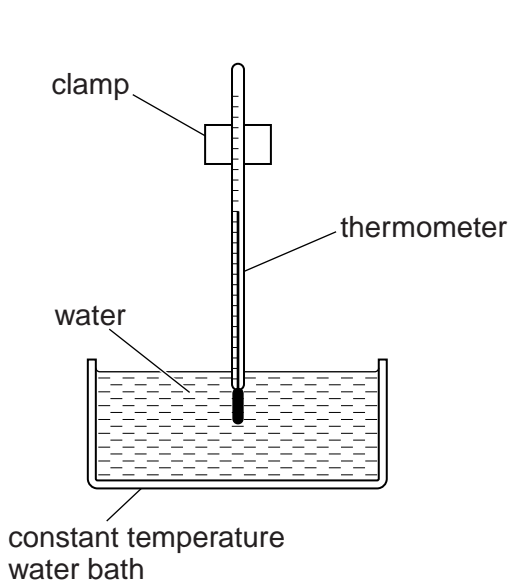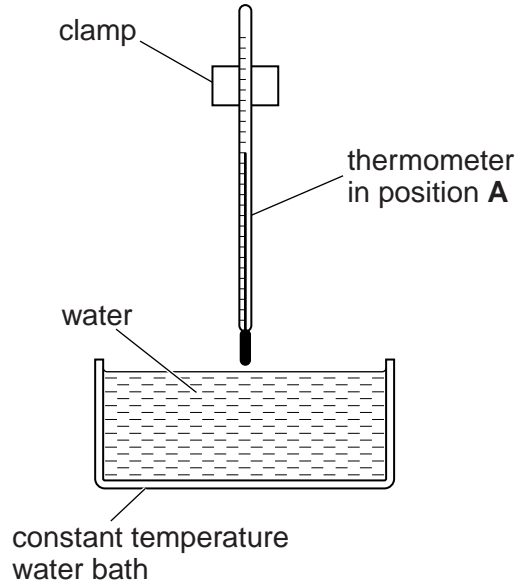The apparatus used is shown in Figs. 2.1, 2.2 and 2.3.

clamp

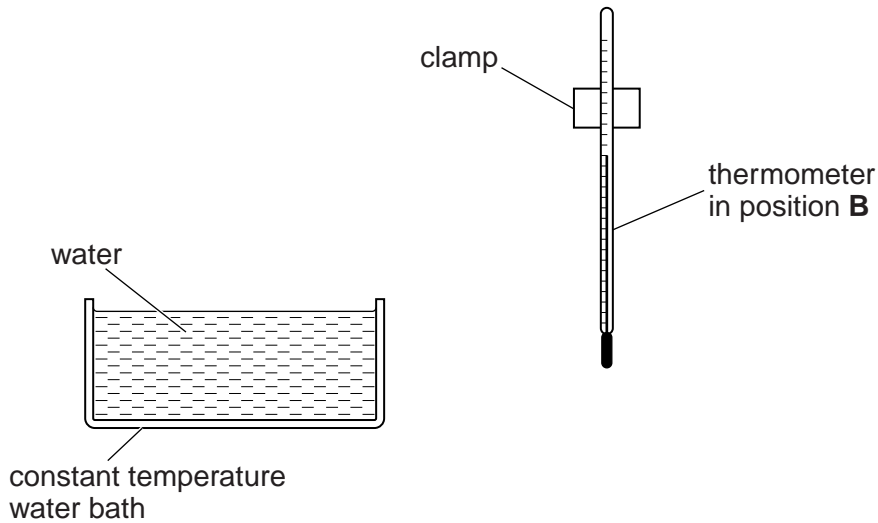thermometer
in position **A**

clamp

thermometer

water

water

constant temperature
water bath

constant temperature
water bath

Fig. 2.1

Fig. 2.2

clamp

thermometer
in position **B**

water

constant temperature
water bath

Fig. 2.3

(a) The student places the thermometer in the water bath, as shown in Fig. 2.1.
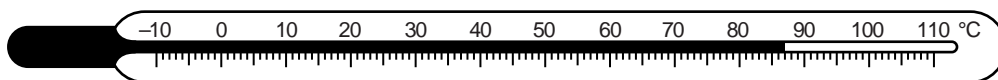
-10   0   10   20   30   40   50   60   70   80   90   100   110 °C

Fig. 2.4

Write down the temperature θ_H of the water bath, shown on the thermometer in Fig. 2.4.

θ_H = ... [1]

(b) The student moves the thermometer until the thermometer bulb is in position **A** above the surface of the water, as shown in Fig. 2.2. She starts a stopclock. She records the time and temperature readings every 30 s.

She replaces the thermometer in the water bath, still at temperature θ_H.

She then moves the thermometer to position **B**, as shown in Fig. 2.3. She records the time and temperature readings every 30 s.

All the readings are shown in Table 2.1.

Table 2.1

	position **A**	position **B**
$t/$		
30	79	66
60	74	42
90	70	29
120	66	27
150	61	26
180	56	26

(i) Complete the column headings in the table. [1]

(ii) State in which position, **A** or **B**, the thermometer has the greater rate of cooling **in the first 30 s**.

position ....

(iii) Explain briefly how you reached this conclusion.

....

....

....[1]

(iv) Calculate the temperature difference from 30 s to 180 s for each set of readings.

temperature difference for position **A** = ...

temperature difference for position **B** = ...
[1]

(v) Estimate room temperature θ_R.

θ_R = ... [1]

(c) Describe briefly a precaution you would take to make the temperature readings reliable.

....

....[1]

(d) A scientist is using this experiment as part of research into convection currents above hot water.

Suggest two conditions that should be kept constant when this experiment is repeated.

1. ....

2. ....

[2]

[Total: 8]

4 An IGCSE student is investigating methods of preventing loss of thermal energy.

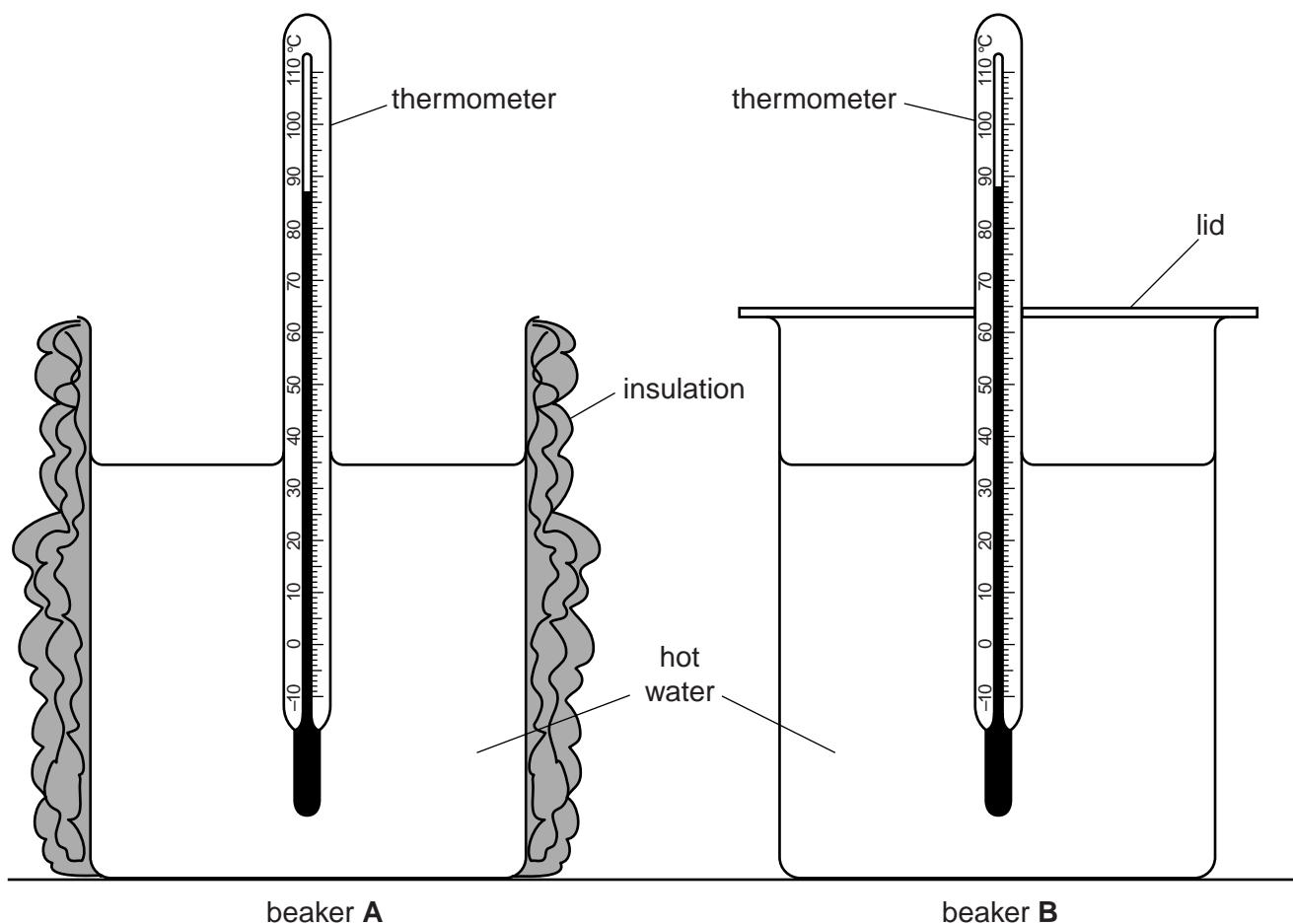The student is using two beakers labelled **A** and **B**, as shown in Fig. 2.1.

Fig. 2.1

Beaker **A** has a layer of insulation and beaker **B** has a lid but no insulation.

The beakers contain hot water at the start of the experiment. The initial temperatures are as shown in Fig. 2.1.

(a) Read, and record in the first row of Table 2.1, the temperatures of the water in beakers **A** and **B** at time $t = 0$. [1]

(b) The temperatures of the hot water after 30 s, 60 s, 90 s, 120 s, 150 s and 180 s are shown in Table 2.1.

Complete the column headings and enter the values of t in the table.
[2]

Table 2.1

	beaker **A**	beaker **8**
t/		
	85.0	87.0
	83.5	85.5
	82.0	84.5
	81.0	84.0
	79.5	83.0
	78.5	82.5

(c) State from which beaker, if either, the rate of loss of thermal energy is the greater. Justify your answer by referring to the results.

beaker ....

justification ....

....

....
[2]

(d) State one condition that should be controlled to ensure that the comparison between beaker **A** and beaker **B** is a fair one.

....

.... [1]

(e) A student points out that the experiment does not test the effectiveness of insulation in reducing thermal energy loss.

Suggest a change to this experiment which could be made so that the effect of insulation could be investigated. Explain why this change would help.

suggestion ....

....

explanation ....

....

....

[2]

[Total: 8]

5 The IGCSE class is investigating the rate of cooling of water.

The apparatus is shown in Fig. 2.1.

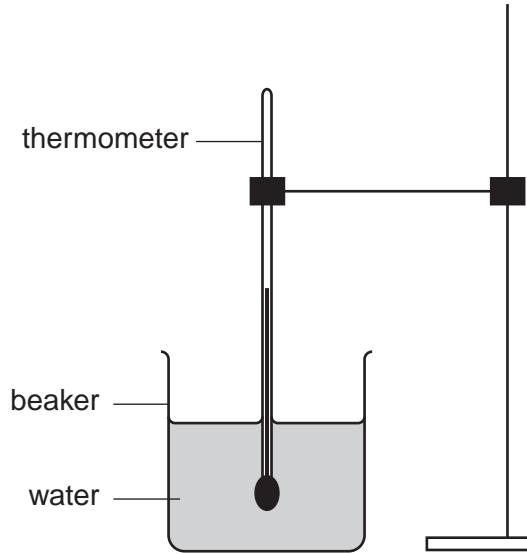**Fig. 2.1**

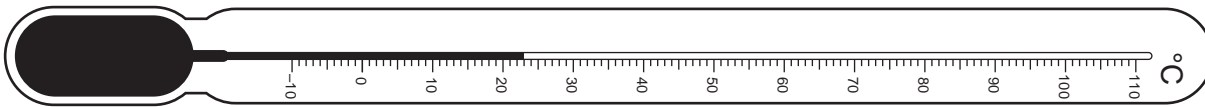**(a)** Record room temperature θ_R as shown on the thermometer in Fig. 2.2.

Fig. 2.2

$$\theta_R = \dots\dots\dots\dots\dots\dots\dots\dots[1]$$

(b) The beaker contains $200\,cm^3$ of hot water. A student takes temperature readings as the water cools, as shown in Table 2.1.

Table 2.1

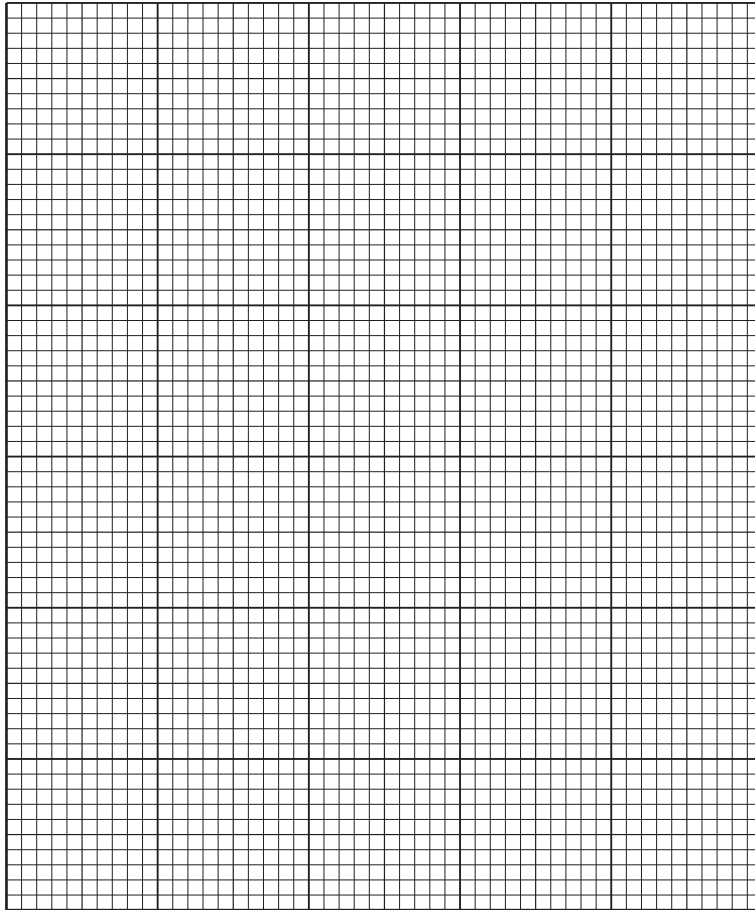| t/	θ/
0	79
30	65
60	58
90	55
120	53
150	52
180	51

(i) Complete the column headings in Table 2.1.

(ii) Calculate the temperature fall T_1 during the first 30 s of cooling.

$T_1 = $ ....

(iii) Calculate the temperature fall T_2 during the final 30 s of cooling.

$T_2 = $ ....[3]

(c) Plot the graph of temperature (*y*-axis) against time (*x*-axis).

[5]

(d) (i) State how the rate of cooling in the first 30 s differs from that in the final 30 s.

....

....

(ii) Explain how the graph line shows this difference.

....

....[2]

[Total: 11]