Thermal Properties and Temperature

Question Paper 2

Level	IGCSE
Subject	Physics
Exam Board	CIE
Topic	Thermal Physics
Sub-Topic	Thermal Properties and Temperature
Paper Type	Alternative to Practical
Booklet	Question Paper 2

Time Allowed: **52 minutes**

Score: **/43**

Percentage: **/100**

1 The IGCSE class is investigating the cooling of water.

A student places a thermometer into a beaker containing 200 cm^3 of hot water, as shown in Fig. 2.1.

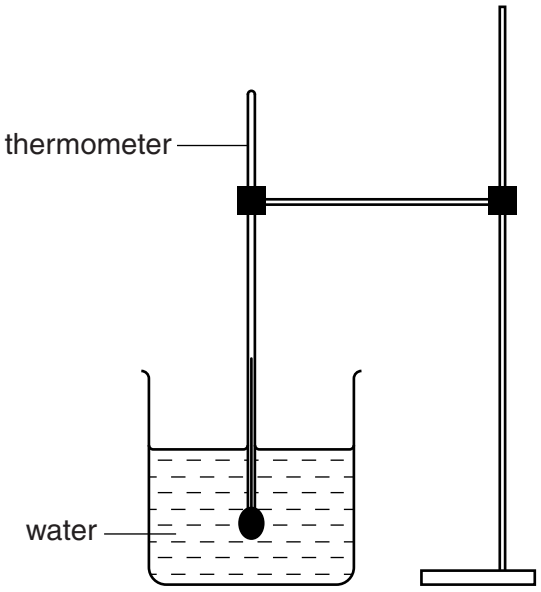


Fig. 2.1

(a) (i) Record the temperature θ_H of the hot water, shown on the thermometer in Fig. 2.2. Write the value in Table 2.1 for time $t = 0$ s.

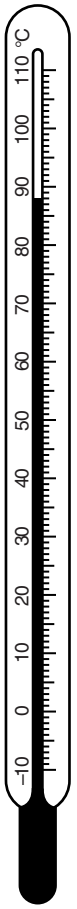


Fig. 2.2

(ii) The student leaves the thermometer in the hot water and records the temperature θ every 30 s. The readings are shown in Table 2.1.

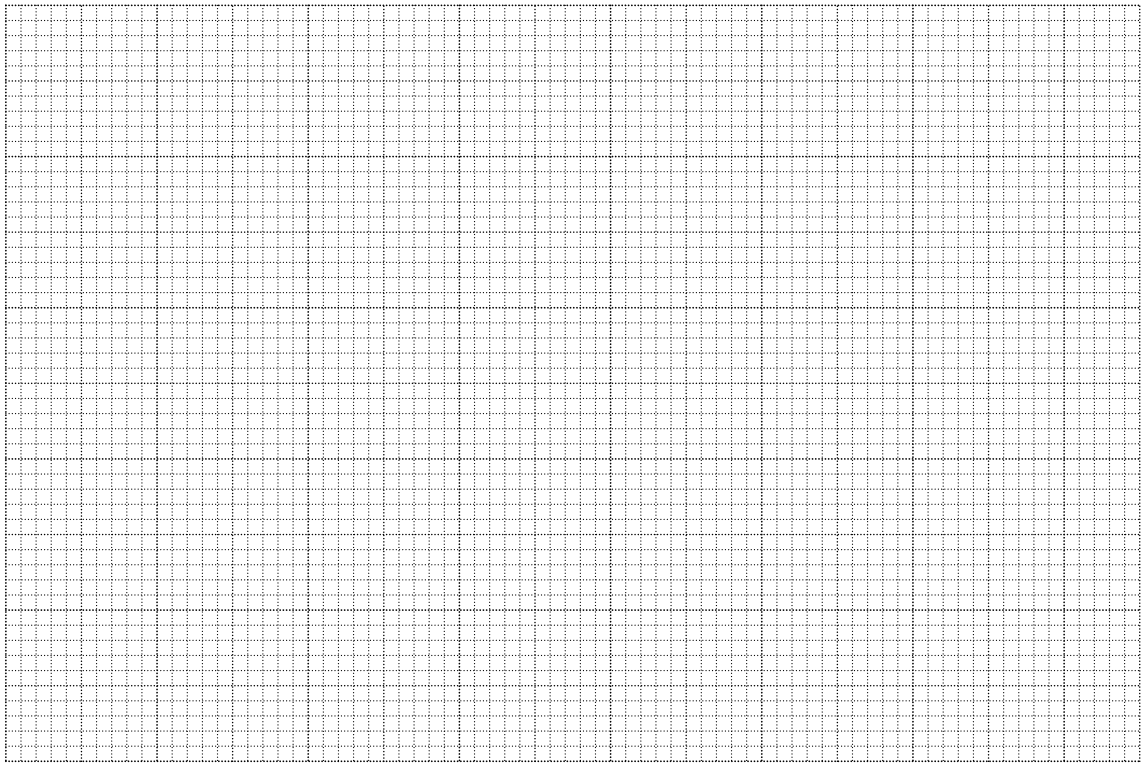
Table 2.1

t/	
0	
30	74
60	67
90	63
120	61
150	59

Complete the column headings in the table.

[2]

(b) Plot a graph of θ/ °C (*y*-axis) against *t*/s (*x*-axis).



[5]

(c) **(i)** Describe briefly the shape of the best-fit graph line that you have drawn.

.....

(ii) State what the shape of the graph line tells you about the change, if any, in the rate of cooling of the water during the experiment.

.....

.....

[2]

(d) Describe briefly how you would read a measuring cylinder to obtain an accurate value for the volume of water. You may draw a diagram.

.....

.....

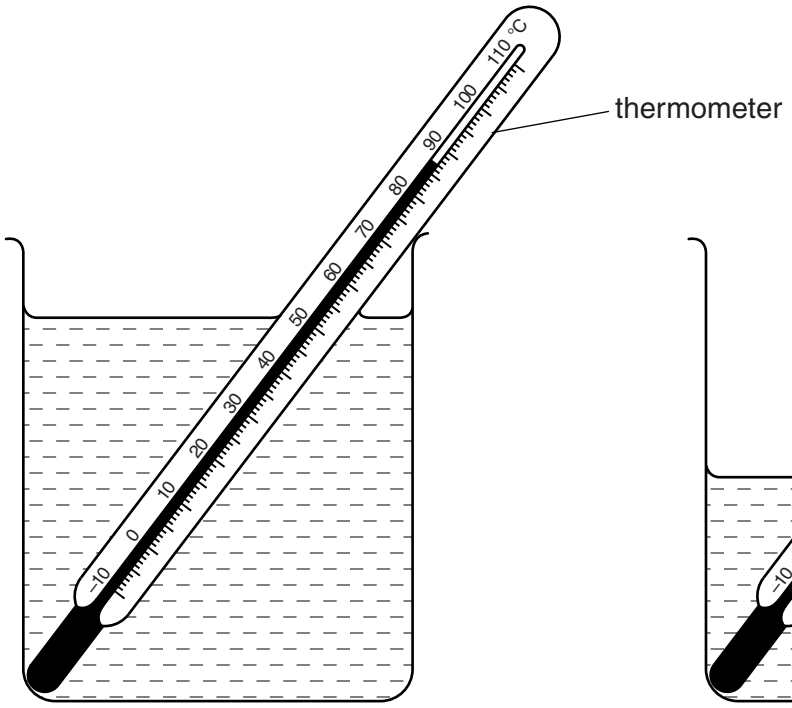
.....

.....[1]

[Total: 10]

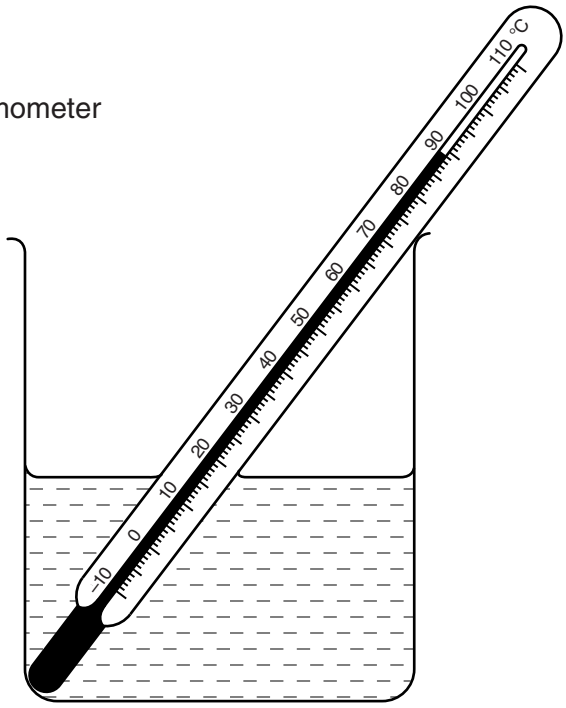
2 The IGCSE class is investigating the cooling of water.

The apparatus is shown in Figs. 2.1 and 2.2.



beaker A

Fig. 2.1



beaker B

Fig. 2.2

(a) Approximately 200 cm^3 of hot water is poured into beaker **A** and, after a short while, the thermometer reading rises to the value shown in Fig. 2.1.

Read, and record in the top row of Table 2.1, this temperature θ at time $t = 0$.

(b) Approximately 100 cm^3 of hot water is poured into beaker **B**. The thermometer reading rises to the value shown in Fig. 2.2.

Read, and record in the top row of Table 2.1, this temperature θ at time $t = 0$.

(c) The temperatures θ of the thermometer in each experiment at times $t = 30$ s, 60 s, 90 s, 120 s, 150 s and 180 s are shown in Table 2.1.

Complete the column headings and record the values of t in the table.

Table 2.1

	beaker **A** with approximately 200 cm^3 of water	beaker **B** with approximately 100 cm^3 of water
t /	θ /	θ /
	85.0	86.0
	83.0	83.0
	81.5	80.5
	80.0	78.0
	78.5	75.5
	77.5	74.0

[3]

(d) Describe a similarity in the patterns of temperature change of the two volumes of water, apart from the fact that the temperature of each decreases.

.....

.....

.....[1]

(e) A student suggests that the rate of cooling is less for a larger volume of water than for a smaller volume of water.

State whether the readings support this suggestion. Justify your answer by referring to the readings.

statement .....

justification .....

.....

.....

[2]

(f) Another IGCSE student wants to repeat the experiment in order to check the results. Suggest two factors that should be kept the same in order for the comparison to be fair.

1. .....

.....

2. .....

.....

[2]

[Total: 8]

3 The IGCSE class is investigating the cooling of hot water as cold water is added.

The apparatus is shown in Fig. 2.1.

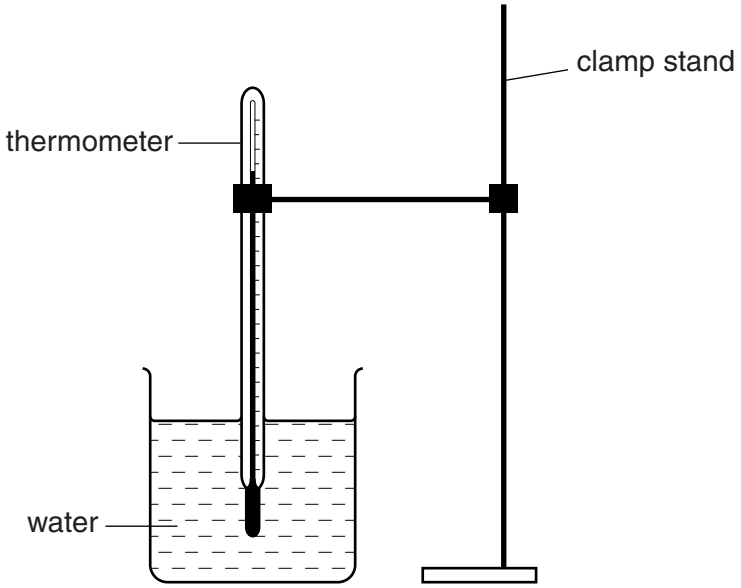


Fig. 2.1

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

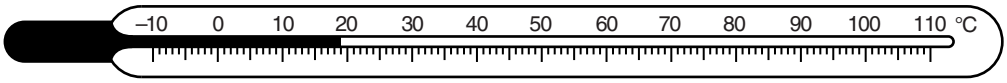


Fig. 2.2

θ_R = ... [1]

(b) A student pours approximately 150 cm^3 of hot water into a beaker. She measures the temperature θ of the water in the beaker.

She adds a volume V = 10 cm^3 of water at room temperature to the hot water in the beaker and stirs it briefly. She measures the temperature of the water in the beaker.

She adds a total of 50 cm^3 of cold water, 10 cm^3 at a time, stirring and measuring the temperature each time. The readings are shown in Table 2.1.

Table 2.1

V/	
0	82
	75
	69
	65
	61
	58

(i) The total volume of cold water added is *V*.

In Table 2.1, complete the volume *V* column.

(ii) Complete the column headings in the table.

[2]

(c) Suggest one way you could reduce the loss of thermal energy to the surroundings during the experiment.

.....

..... [1]

(d) The student has a drinks cup, held above a measuring cylinder, as shown in Fig. 2.3. The cup has a small hole in its base.

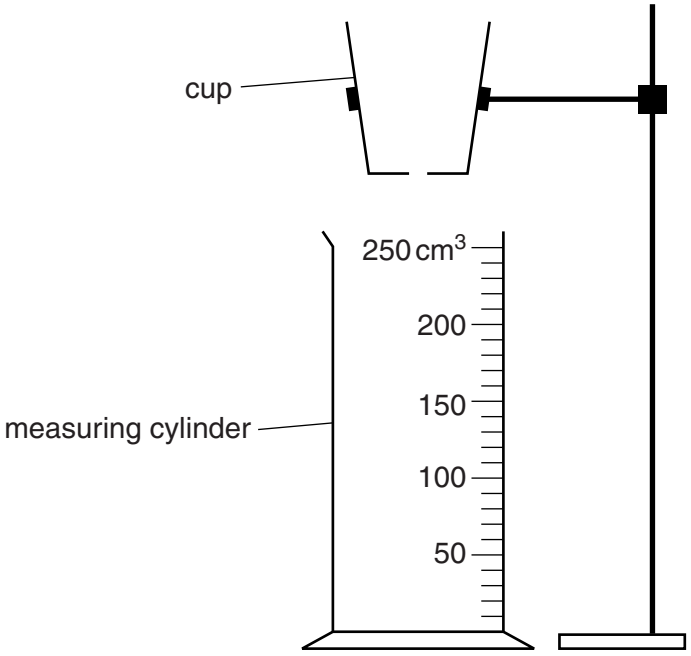


Fig. 2.3

She pours water into the cup until it is about two-thirds full. She measures the time t_1 taken for 50 cm^3 of water to fall into the measuring cylinder. The stopwatch reading is shown in Fig. 2.4.

Fig. 2.4

After setting the stopwatch to zero, she measures the time t_2 taken for the next 50 cm^3 of water to fall into the measuring cylinder. The stopwatch reading is shown in Fig. 2.5.

Fig. 2.5

(i) Calculate the average rate of flow of water R_1 for the first 50 cm^3, using the equation $R_1 = \frac{k}{t_1}$, where $k = 50\,cm^3$.

R_1 = ...

(ii) Calculate the average rate of flow of water R_2 for the next 50 cm^3, using the equation $R_2 = \frac{k}{t_2}$, where $k = 50\,cm^3$.

R_2 = ...
[2]

(e) A student suggests that the experiment described in part **(b)** would be improved by having a steady flow of cold water added to the hot water.

Suggest one possible disadvantage of using the method described in part **(d)** to produce such a flow of water.

.....

.....
[1]

(f) The experiment described in part **(b)** could be repeated to check the results.

Suggest two conditions that should be kept constant in order to provide a reliable check.

1. .....

2. .....
[2]

[Total: 9]

4 The IGCSE class is investigating the scale of a thermometer.

(a) Record room temperature θ_R as shown on the thermometer in Fig. 2.1.

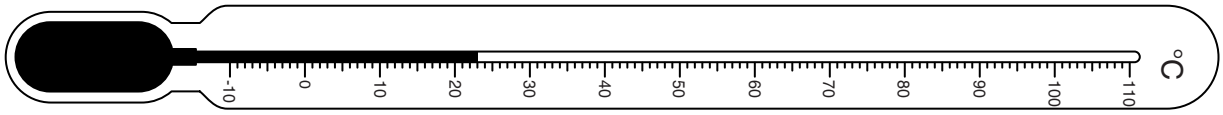


Fig. 2.1

θ_R = ...[1]

A student pours hot water into a beaker. She measures the temperature θ of the water in the beaker every 30 s. The readings are shown in Table 2.1.

Table 2.1

t/		*d*/
0	80	
30	74	
60	69	
90	65	
120	63	
150	61	
180	60	

(b) (i) Using Fig. 2.2, measure, and record in the table, the distance *d* from the end of the thermometer to the position of the liquid in the thermometer at the first temperature reading in the table.

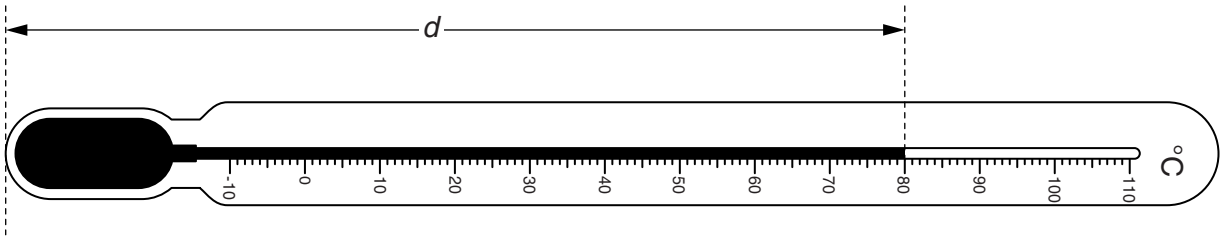


Fig. 2.2

(ii) Repeat the measurement in **(b)(i)** for all the other temperature readings. [2]

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

(c) The student plotted a graph of θ against d. A sketch of the graph obtained is shown in Fig. 2.3.

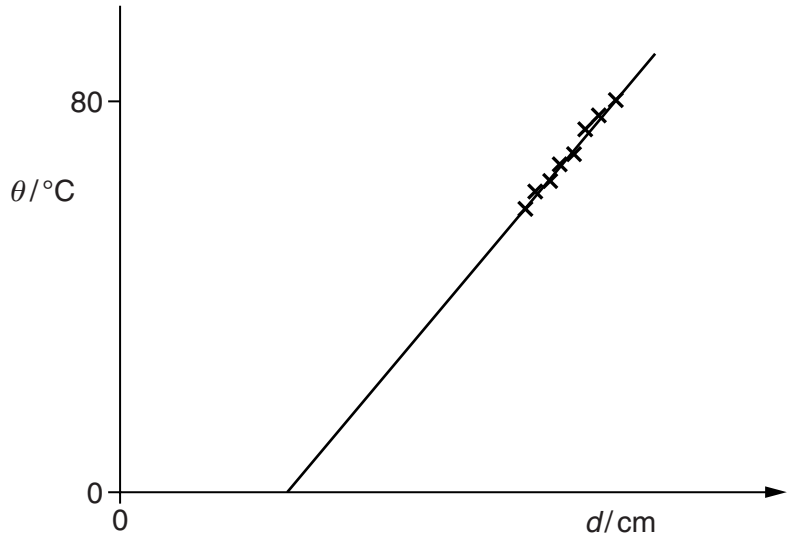


Fig. 2.3

(i) Explain how the graph line shows that θ is not directly proportional to d.

.....

.....[1]

(ii) Suggest why, when $\theta = 0\,°C$, the value of d is not zero.

.....

.....

.....
[1]

(d) Determine, as accurately as possible, the distance x between the 1 °C marks on the thermometer shown in Fig. 2.2. Show your working.

x = ...[3]

[Total: 9]

5 The IGCSE class is investigating the cooling of water.

(a) A student places a thermometer in a beaker of cold water.

Using Fig. 2.1, record the temperature θ_C of the cold water supplied to the student.

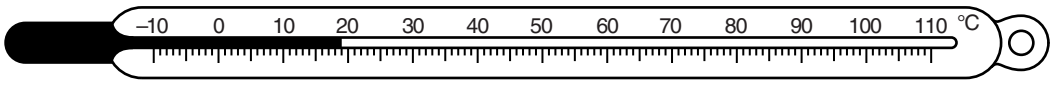


Fig. 2.1

θ_C = ...[1]

(b) The student pours 200 cm^3 of hot water into a beaker. She measures the temperature of the water at 30 s intervals. The readings are shown in Table 2.1.

Table 2.1

t/	θ/
0	80
30	75
60	72
90	69
120	67
150	66

Complete the column headings in the table. [1]

(c) The student empties the beaker and pours another 200 cm^3 of the hot water into the beaker. She measures the temperature θ_H of the water in the beaker.

θ_H = ...78 °C.....

She then empties the cold water from the measuring cylinder shown in Fig. 2.2 into the beaker of hot water. She measures the temperature θ_A of the water in the beaker.

θ_A = ...74 °C.....

Using Fig. 2.2, record the volume V_A of cold water.

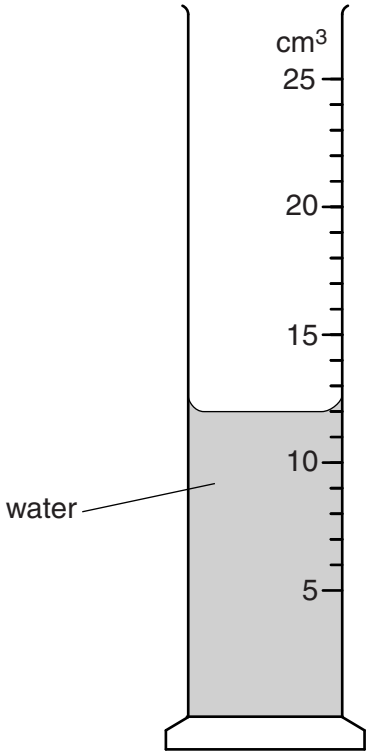


Fig. 2.2

V_A = ...[1]

(d) Estimate the volume V of cold water that, added to the hot water, would give the same temperature drop as allowing the hot water to cool for 150 s.

Use the evidence from the table and the readings in parts **(b)** and **(c)**. Explain briefly how you arrived at your answer.

.....

.....

.....

V = ...[2]

(e) This laboratory investigation could be used as a small-scale model for a process in a factory. The laboratory investigation would be repeated many times.

Suggest two conditions that should be kept constant in order to provide reliable results.

1. .....

2. .....
[2]

[Total: 7]