2.2 Thermal properties and temperature

01. 0625_s20_qp_62 Q: 3

A student investigates some thermal properties of sand and water.

Fig. 3.1 shows the apparatus.

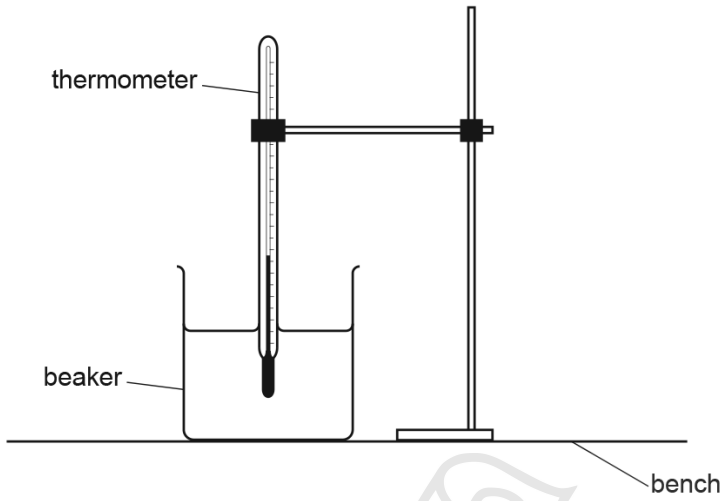


Fig. 3.1

(a) The thermometer in Fig. 3.2 shows the room temperature θ_S at the beginning of the experiment. Record θ_S.

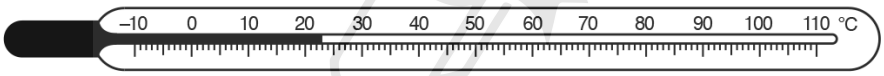


Fig. 3.2

θ_S = ... °C [1]

(b) The student is supplied with hot water at a temperature θ_H. She records the temperature of the hot water.

θ_H = 84 °C

She pours 100 cm^3 of hot water into a beaker that contains sand. Initially, the sand is at room temperature.

She measures the highest temperature θ_M of the mixture.

θ_M = 70 °C

(i) Calculate the rise in temperature θ_R of the sand using the equation $\theta_R = (\theta_M - \theta_S)$.

θ_R = ... °C [1]

(ii) Explain briefly what the student does after pouring the hot water into the sand and before taking the temperature, in order to obtain a reliable value for θ_M.

.....

..... [1]

(iii) Calculate the fall in temperature θ_F of the hot water using the equation $\theta_F = (\theta_H - \theta_M)$.

θ_F = ... °C

Calculate the ratio S using the equation $S = \frac{\theta_R}{\theta_F}$. Give your answer to a suitable number of significant figures for this experiment.

S = ... [1]

(c) The student pours 100 cm^3 of the hot water into a clean beaker that contains 100 cm^3 of water at room temperature. She records the highest temperature θ_M of the mixture.

θ_M = ... 49° C .....

Calculate the rise in temperature θ_R of the cold water using the equation $\theta_R = (\theta_M - \theta_S)$. Use the value of room temperature θ_S recorded in **(a)**.

θ_R = ...

Calculate the fall in temperature θ_F of the hot water using the equation $\theta_F = (\theta_H - \theta_M)$.

θ_F = ...

Calculate the ratio W using the equation $W = \frac{\theta_R}{\theta_F}$.

W = ... [2]

(d) The student studies the thermal properties of sand and water. She predicts that S should be equal to 6 × W.

State whether the results support the prediction. Justify your answer by reference to the readings.

statement .....

justification .....

.....

.....
[2]

(e) Suggest **two** temperatures that it would be sensible to keep constant when carrying out the experiments.

1. .....

2. .....

[2]

(f) The student measures the volume of the dry sand using a measuring cylinder before carrying out the experiment. Tick (✓) the boxes that show the precautions that she should take in order to obtain an accurate reading.

☐ Take the reading at the bottom of the meniscus.

☐ Tap the measuring cylinder to make sure the top of the sand is horizontal.

☐ View the scale of the measuring cylinder at right angles.

[1]

[Total: 11]

02. 0625_w18_qp_61 Q: 4

A student is investigating the relationship between the power produced by an electrical heater and the time taken to heat a beaker of water. The power of the heater is given by the equation $P = VI$, where V is the potential difference (p.d.) across the heater and I is the current in the heater.

Plan an experiment to investigate the relationship between the power produced by an electrical heater and the time taken to heat a beaker of water.

The following apparatus is available:

ammeter
voltmeter
0–12 V variable power supply
250 cm^3 beaker
heater
thermometer
stopwatch

The student can also use other apparatus and materials that are usually available in a school laboratory.

You should:

- complete the diagram in Fig. 4.1 to show the circuit that you would use
- explain briefly how you would carry out the investigation
- state the key variables that you would control
- draw a table with column headings, to show how you would display your readings (you are **not** required to enter any readings in the table)
- explain how you would use your results to reach a conclusion.

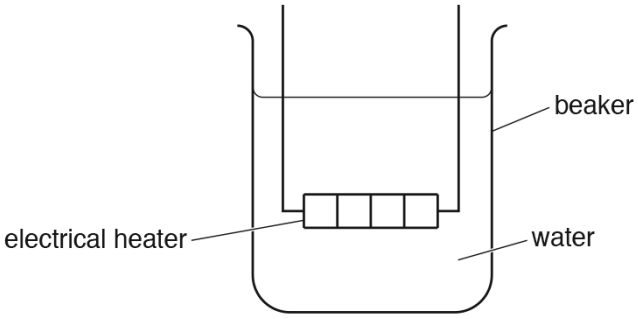


Fig. 4.1

.....

.....

.....

.....

.....

.....

.....

..... [7]

[Total: 7]

03. 0625_s13_qp_61 Q: 2

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.

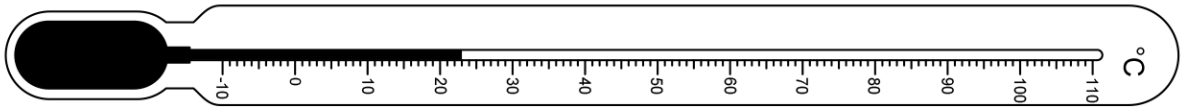


Fig. 2.1

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/	θ/	*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.

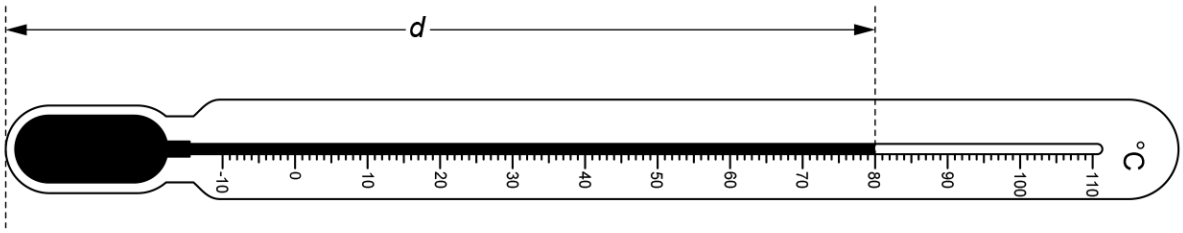


Fig. 2.2

(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.

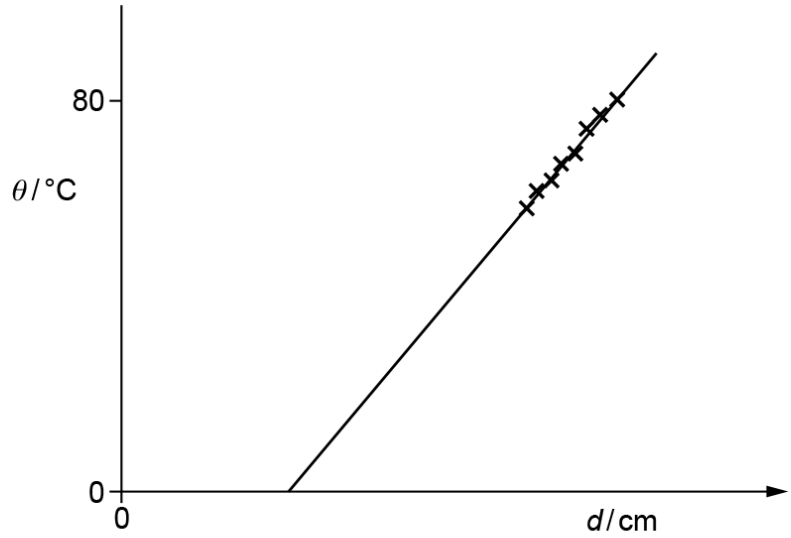


Fig. 2.3

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

.....

.....[1]

(ii) Suggest why, when θ = 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]

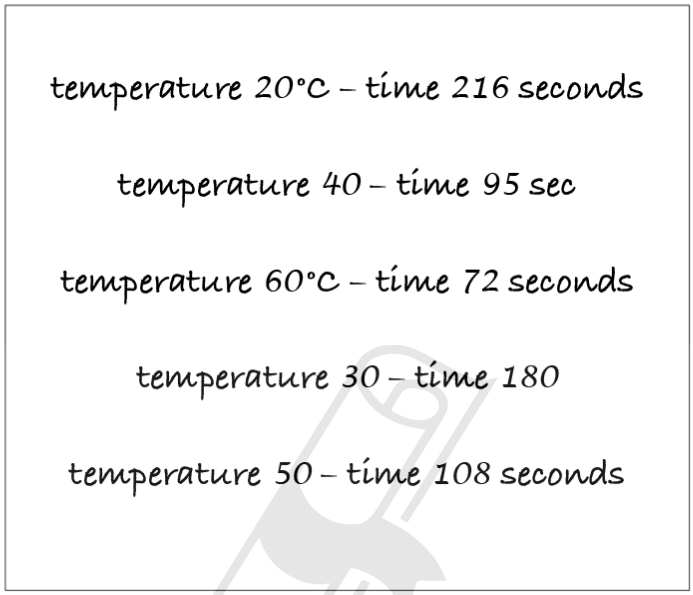
[Total: 9]

04. 0625_w13_qp_63 Q: 5

Two IGCSE students are investigating the melting of ice cubes in water.

They are dropping ice cubes into hot water at different temperatures and measuring the time taken for the cubes to melt.

This is a page from one student's notebook.



(a) In the space below, draw a suitable table. Enter the readings in such a way that it is easier to see a pattern from them.

[2]

(b) It appears that one of the readings does not fit the general pattern.

(i) At which temperature does this occur?

temperature ..... [1]

(ii) Suggest what the student might do next with the data to show more clearly that this reading does not fit the general pattern.

Explain how this would help to make it more clear.

suggestion .....

.....

explanation .....

.....

[2]

[Total: 5]

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(a)	23	1
(b)(i)	47	1
(b)(ii)	stir	1
(b)(iii)	14 and 3.36 or 3.4	1
(c)	26, 35 and 0.74(3)	1
	S and *W* with no units	1

(d)	statement to match results	1
	justification to match statement and including clear reference with appropriate number from the results	1
(e)	room temperature	1
	temperature of hot water	1
(f)	second and third boxes ticked	1

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02. 0625_w18_MS_61 Q: 4

	MP1 Workable, correct circuit diagram with power source and correct symbols for ammeter and voltmeter.	1
	Method to include:	
	MP2 Measuring V and I	1
	MP3 Repeating with at least two other values of V or power, and / or I	1
	MP4 Measuring time to raise water temperature by a specific amount or to a specific value	1
	MP5 Any **ONE** from: Same starting temperature Same finishing temperature Same temperature difference Same room temperature Same volume / mass / amount of water	1
	MP6 Table with clear columns for time, V and I, with appropriate units and P(or VI)	1
	MP7 Conclusion: Plot a graph of power against time.	1

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03. 0625_s13_MS_61 Q: 2

(a) $\theta_R = 23(°C)$ [1]

(b) table:
d values 11.9, 11.3, 10.8, 10.4, 10.2, 10.0, 9.9 [1]
all d values to nearest mm [1]
s, °C, cm or mm [1]

(c) **(i)** does not go through the origin [1]

(ii) d not measured from 0 °C mark (o.w.t.t.e.) [1]

(d) any l divided by any number of divisions [1]
l value between 89 and 119 [1]
x = 0.98 mm to 1.00 mm (with unit) [1]

[Total: 9]

04. 0625_w13_MS_63 Q: 5

(a) neat, clear table with column headings and correct units [1]
results arranged in order [1]

(b) **(i)** 40° [1]

(ii) plot a line graph [1]
reading will clearly not lie on line [1]
allow suggestion of appropriate mathematical treatment

[Total: 5]