Cambridge Assessment
International Education

Cambridge IGCSE™

CANDIDATE NAME		
CENTRE NUMBER		CANDIDATE NUMBER

CO-ORDINATED SCIENCES **0654/62**

Paper 6 Alternative to Practical **February/March 2022**

1 hour 30 minutes

You must answer on the question paper.

No additional materials are needed.

INSTRUCTIONS
- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

INFORMATION
- The total mark for this paper is 60.
- The number of marks for each question or part question is shown in brackets [ ].

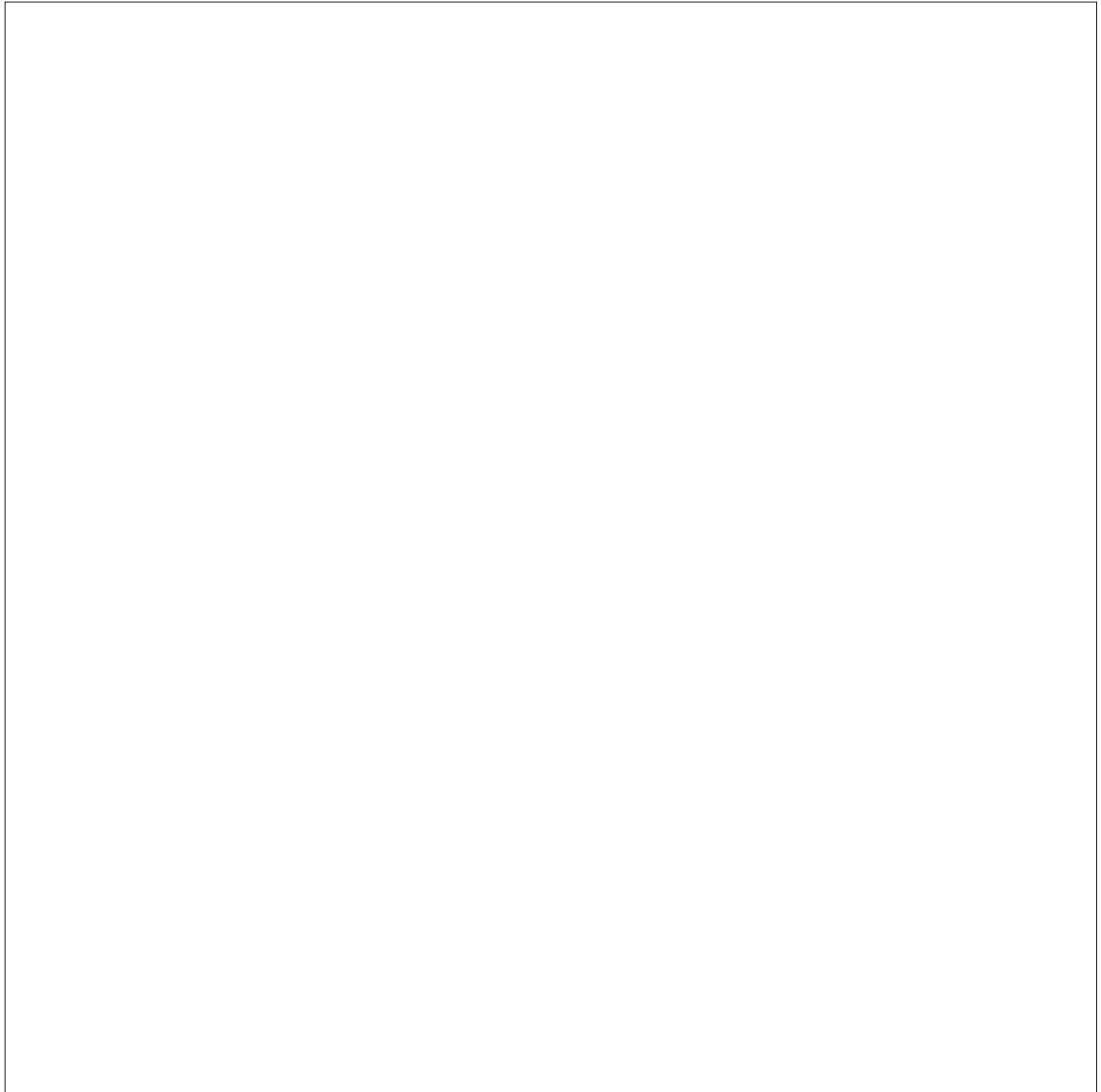This document has **24** pages. Any blank pages are indicated.

[Turn over

1 Fig. 1.1 shows a flower with some of the petals removed.

Fig. 1.1

3

(a) (i) In the box, make a large, detailed, pencil drawing of the flower.

Include the internal parts of the flower.

[3]

(ii) On your drawing, add a line labelled **C** to identify a carpel. [1]

(b) (i) **On Fig. 1.1**, draw a line to join points **A** and **B**. This shows the width of one petal.

Record this width, **AB**, in millimetres to the nearest millimetre.

width **AB** of petal on Fig. 1.1 = ... mm [1]

(ii) Draw a line to show the same width **AB** of the petal on your drawing.

Record this width in millimetres to the nearest millimetre.

width of petal on your drawing = ... mm [1]

   (iii) Use your measurements in **(b)(i)** and **(b)(ii)** to calculate the magnification *M* of your drawing.

Use the equation shown.

$$M = \frac{\text{width of petal on your drawing}}{\text{width } \mathbf{AB} \text{ of petal on Fig. 1.1}}$$

M = ... [1]

(c) A student tests the carpel for the presence of starch.

State the reagent used to test for the presence of starch.

Give the observation for a positive result.

reagent ....

observation ....

....
[2]

[Total: 9]

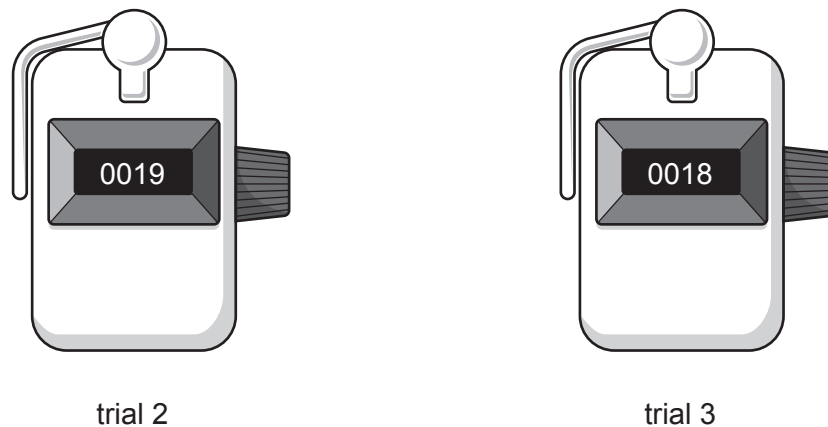**2** A student investigates the effect of exercise on pulse rate.

Procedure

The student:

- measures the number of pulses (beats) in 15 seconds
- records this number in Table 2.1 as trial 1.

The student repeats this procedure two more times for trials 2 and 3.

(a) (i) Read and record in Table 2.1 the counter readings in Fig. 2.1 for trials 2 and 3.

| 0019 | 0018 |

trial 2   trial 3

Fig. 2.1

Table 2.1

trial	number of pulses (beats) in 15 seconds	pulse rate / beats per minute
1	16	
2		
3		

[1]

(ii) Complete Table 2.1 by calculating the pulse rate for each trial.

Use the equation shown.

pulse rate = number of pulses (beats) in 15 second $\times$ 4

[1]

(iii) Calculate the student's average pulse rate.

average pulse rate = ... beats per minute [1]

(iv) State how the student finds their pulse.

....

.... [1]

(b) Two students compare their fitness. They record their pulse rate before exercise (resting pulse rate).

Both students have a resting pulse rate of 75 beats per minute.

After running for 5 minutes, they record their pulse rate every minute for 4 minutes.

Their results are shown in Table 2.2.

Table 2.2

time after exercise /minutes	pulse rate for student **A** /beats per minute	pulse rate for student **B** /beats per minute
0	140	142
1	126	131
2	111	119
3	96	108
4	82	97

7

(i) The data for student **A** has been plotted on the grid for you.

Label the axes, including units.
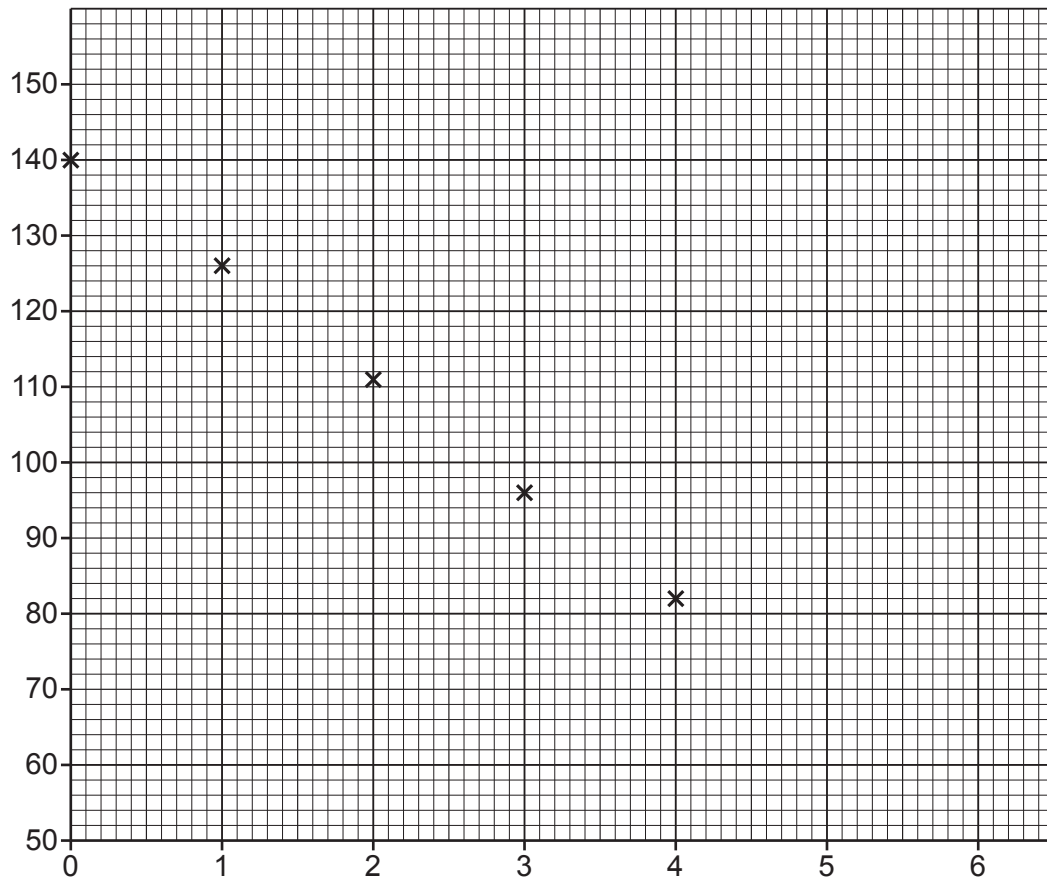
[1]

(ii) Draw and label the best-fit line for student **A**. [1]

(iii) Using the same axes, plot the data from Table 2.2 for student **B**. [1]

(iv) Draw and label the best-fit line for student **B**. [1]

(v) The student with the greater fitness is the one whose heart rate returns to the resting pulse rate in the shorter time.

On your graphs, extend each line of best fit until it reaches the resting pulse rate of 75 beats per minute.

Record the time it takes for the resting pulse rate to reach 75 beats per minute for each student.

student **A** ....

student **B** ....

[2]

(vi) Suggest which student has the greater fitness.

Explain your answer.

student ....

explanation ....

....

[1]

[Total: 11]

3 A student tests some water samples with soap solution.

Water is called **soft water** if it forms a good lather (foam) with only a small volume of soap solution.

Rainwater is soft water.

Water is called **hard water** if it needs a lot of soap to make a lather.

(a) Procedure

The student:

Step **1** places $10\,cm^3$ of rainwater into a boiling tube (large test-tube)

Step **2** adds $1\,cm^3$ of soap solution to the rainwater in the boiling tube

Step **3** puts a stopper in the boiling tube and shakes the soap solution and rainwater mixture vigorously

Step **4** repeats steps **2** and **3**, if no lather is made, until there is a lather in the boiling tube

Step **5** records in a tally chart the number of $1\,cm^3$ lots of soap solution added.

The student repeats the procedure with boiled rainwater, hard water, boiled hard water, sea water and boiled sea water instead of rainwater.

(i) Suggest a piece of apparatus suitable for measuring $1\,cm^3$ of soap solution and adding it to the water sample.

.... [1]

(ii) Fig. 3.1 shows the tally chart of the student's results.

rainwater	|
boiled rainwater	|
hard water	||||| ||||| ||||| ||
boiled hard water	|
sea water	||||| ||||| ||||| ||||| |||
boiled sea water	||||| |||||
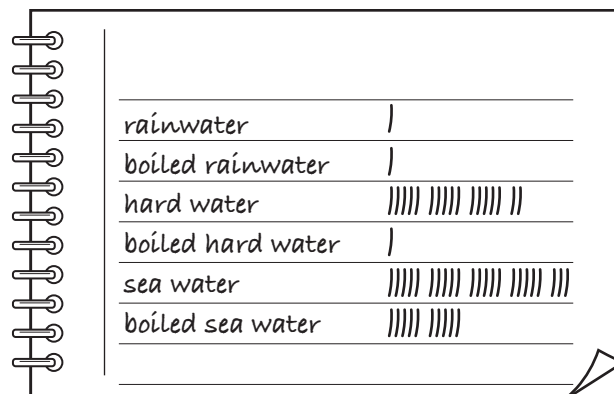
Fig. 3.1

Record in Table 3.1 the volume of soap solution added to each water sample.

Boiled sea water has been done for you.

Table 3.1

water sample	volume of soap solution added / cm^3
rainwater	
boiled rainwater	
hard water	
boiled hard water	
sea water	
boiled sea water	10

[2]

(iii) The more soap solution needed to make a lather, the harder the water.

Place the water samples in a list in order of hardness, starting with the hardest.

hardest

↓

softest [2]

(iv) Suggest what the student can do to have more confidence in the volume of soap solution needed to make a lather.

....

.... [1]

(b) There are two types of water hardness.

Temporary hardness is removed by boiling.

Permanent hardness is **not** removed by boiling.

(i) Look at Table 3.1.

Circle the correct answer to show what happens to the volume of soap solution needed to make a lather when the hard water is boiled.

decreases   **stays the same**   **increases**

Explain your answer.

....

....
[1]

(ii) Look at Table 3.1.

Circle the correct answer to show what happens to the volume of soap solution needed to make a lather when the sea water is boiled.

decreases   **stays the same**   **increases**

Explain your answer.

....

....

....
[2]

(c) (i) The reason water is hard is because it contains dissolved substances.

The student tests the sea water to find out which dissolved substances it contains.

The student also tests water with known dissolved substances.

The student's results are shown in Table 3.2.

Table 3.2

test	magnesium chloride solution	calcium sulfate solution	sodium hydrogencarbonate solution	potassium sulfate solution	sea water
dilute nitric acid and aqueous barium nitrate	colourless solution	white ppt.	bubbles and colourless solution	white ppt.	bubbles and white ppt.
dilute nitric acid and aqueous silver nitrate	white ppt.	colourless solution	bubbles and colourless solution	colourless solution	bubbles and colourless solution
dilute nitric acid	colourless solution	colourless solution	bubbles and colourless solution	colourless solution	bubbles and colourless solution
flame test	no colour	brick red	yellow	lilac	brick red

State which **two** substances from Table 3.2 are in the sea water.

Explain your answers using the results in Table 3.2.

substance 1 ....

explanation ....

....

substance 2 ....

explanation ....

....
[3]

(ii) The gas given off when acid is added to sodium hydrogencarbonate is carbon dioxide.

Describe the test for carbon dioxide and give the observation for a positive result.

test ....

observation ....
[1]

[Total: 13]

13

BLANK PAGE

4 Hard water contains many dissolved solids.

Plan an experiment to find out how hardness is affected by the **mass** of solid dissolved in water.

You are provided with six water samples, numbered 1 to 6.

The order of hardness of the water samples 1 to 6 is shown.

most hard	1
	2
	3
	4
	5
least hard	6

You must not use any chemicals or any soap.

You may use any common laboratory apparatus.

Include in your plan:

- the apparatus needed
- a brief description of the method, explaining any safety precautions
- the measurements you will make including how to make them as accurate as possible
- the variables you will control
- how you will process your results to draw a conclusion.

You may include a labelled diagram if you wish.

You may include a results table if you wish. You are **not** required to include any results.

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

.... [7]

5 A student determines the mass *m* of a load **L** by a balancing method.

(a) Procedure

The student:

- fixes a load to a metre rule with the centre of the load over the 10.0 cm mark
- places a pivot directly under the 50.0 cm mark on the rule
- places a 100 g mass on the rule
- adjusts the position of the 100 g mass until the rule balances.
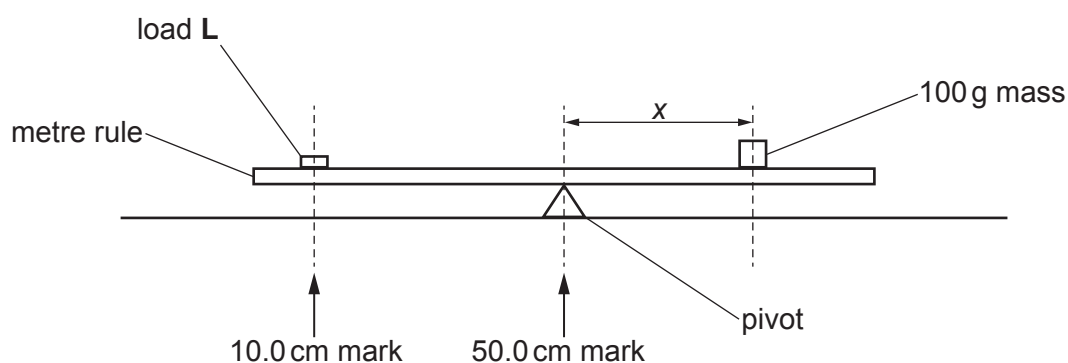
Fig. 5.1 shows the arrangement at balance.

Fig. 5.1

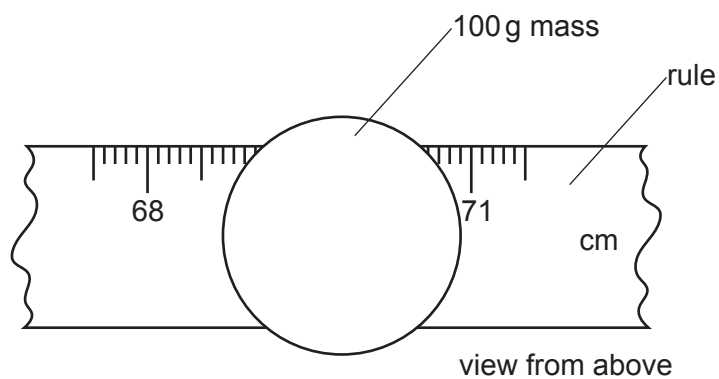Fig. 5.2 shows the position of the 100 g mass on the rule at balance.

Fig. 5.2

(i) Record the position *P* of the left-hand edge of the 100 g mass at balance.

Give your answer to the nearest 0.1 cm.

P = ... cm [1]

(ii) Record the position *Q* of the right-hand edge of the 100 g mass at balance.

Give your answer to the nearest 0.1 cm.

Q = ... cm [1]

(iii) Calculate the position *R* on the rule at the centre of the 100 g mass.

Use the equation shown.

$$R = \frac{(P + Q)}{2}$$

R = ... cm [1]

(iv) Calculate the distance *x* from the 50.0 cm mark to the centre of the 100 g mass.

Use the equation shown.

$$x = R - 50$$

x = ... cm [1]

(b) (i) State how the student avoids a line-of-sight (parallax) error when reading the values of *P* and *Q*.

....

.... [1]

(ii) It is difficult to balance the rule exactly.

Describe how the student makes the rule balance.

....

.... [1]

(c) The student repeats the procedure in **(a)** for a mass of 80 g.

The student's result is shown.

position on the rule at the centre of the 80 g mass = 75.2 cm

Calculate the distance *y* from the 50.0 cm mark to the centre of the 80 g mass at balance.

y = ... cm [1]

(d) A value for the mass m of load **L** is found using the equation shown.

$$m = 0.25\,(4x + 5y)$$

Use your value of x from **(a)(iv)** and your value of y from **(c)** to determine the mass m of the load.

Give your answer to **two** significant figures.

$m =$ .... g [2]

(e) Look at your values for x and y.

Suggest why the student does **not** choose a mass of 5 g to try to balance the rule.

....

.... [1]

[Total: 10]

19

BLANK PAGE

[Turn over

6 A student investigates the cooling of water in a beaker.

(a) Procedure

The student:

- pours 200 cm^3 of hot water into the beaker
- lowers a thermometer into the beaker until its bulb is just covered by the hot water, as shown in Fig. 6.1
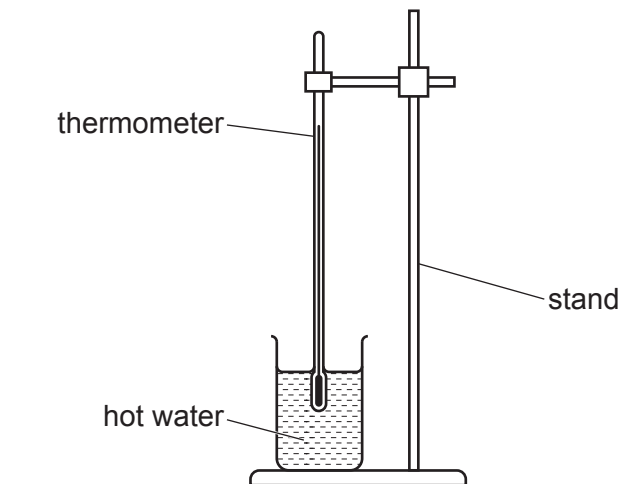
Fig. 6.1

- waits for 20 seconds
- starts a stop-clock and reads the thermometer.

The reading on the thermometer at time = 0 is shown in Fig. 6.2.
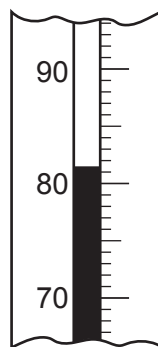
Fig. 6.2

(i) Record the reading at time = 0 in the second column of Table 6.1.

Table 6.1

	thermometer bulb near the water surface	thermometer bulb near the bottom of the beaker
time / …..	temperature / …..	temperature / …..
0		84.5
60	79.5	81.5
	78.0	79.0
	76.5	
	74.0	74.0
	72.5	72.0

[1]

(ii) The student records, in Table 6.1, the reading of the thermometer every 60 seconds.

Some of the student's results are shown in Table 6.1.

Complete the table headings by adding the missing units. [1]

(iii) Complete the time column. [1]

(b) Procedure

The student:

- removes the thermometer from the beaker and empties the beaker
- repeats the procedure in **(a)**, but this time, lowers the thermometer into the beaker until its bulb is just above the bottom of the beaker, as shown in Fig. 6.3.
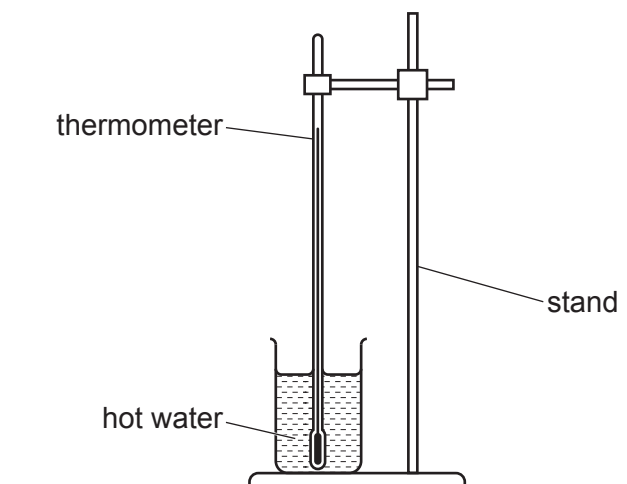
Fig. 6.3

(i) The student misses out one of the thermometer readings in Table 6.1.

Use the data in Table 6.1 to suggest a value for the missing temperature.

missing temperature = ... [1]

(ii) Use Table 6.1 to calculate the total decrease in temperature in 300 seconds for each position of the thermometer bulb.

temperature decrease for the bulb near the surface of the water = ...

temperature decrease for the bulb near the bottom of the water = ...

[1]

(iii) State where the rate of cooling is greater.

Justify your answer with reference to the student's results.

bulb position ....

justification ....

....

[2]

(c) Use the results to suggest how a thermometer can be used to measure accurately the temperature of a liquid.

....

.... [1]

(d) A student repeats the experiment to check the results.

Suggest **one** variable that is kept constant.

.... [1]

(e) State **one** modification that the student can make to the **apparatus** to reduce the rate of cooling of the water.

....

.... [1]

[Total: 10]

24

BLANK PAGE