Cambridge Assessment International Education

Cambridge O Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

2263417708

PHYSICS **5054/41**

Paper 4 Alternative to Practical **October/November 2021**

1 hour

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 30.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **16** pages. Any blank pages are indicated.

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1 A student investigates how the period of a pendulum depends upon its length.

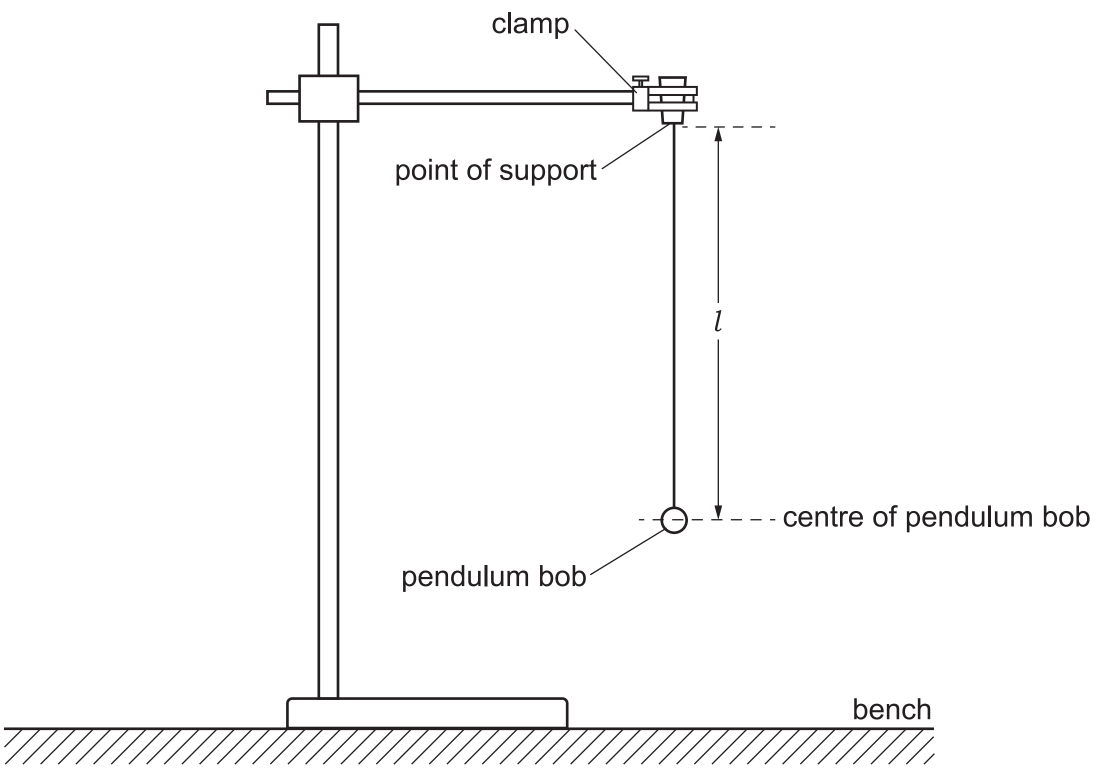

Fig. 1.1

The student:

- arranges the apparatus, as shown in Fig. 1.1
- clamps the string of the pendulum in position.

The length of the pendulum is the distance from the centre of the pendulum bob to the point of support.

(a) (i) Measure the distance l on Fig. 1.1 to the nearest millimetre. Record your result.

l = ... cm [1]

(ii) Fig. 1.1 is drawn to a scale of one-eighth of the full size.

Determine the actual length L of the pendulum from the point of support to the centre of the pendulum bob.

L = ... cm [1]

(b) The period T is the time taken for one complete oscillation of the pendulum.

One complete oscillation is one complete swing, e.g. from the middle to one side, through the middle to the other side and back to the middle.

(i) The student:

- adjusts the length of the thread until L is 15.0 cm
- gives the bob a small sideways displacement and releases it so that it oscillates
- records the time for 10 complete oscillations
- repeats this procedure two more times.

The following values of the time for 10 complete oscillations are recorded:

7.4 s　　　　7.8 s　　　　7.7 s

Calculate T_{10}, the average value of the time for 10 complete oscillations. Give your answer to 2 significant figures.

T_{10} = ... s [2]

(ii) The student repeats the procedure in **(b)(i)** for length L = 20.0 cm, 25.0 cm, 30.0 cm and 35.0 cm. The results are shown in Table 1.1.

Complete Table 1.1 using your answer from **(b)(i)**. You will need to calculate T and T^2.

Table 1.1

L /cm	T_{10} /s	T/s	T^2/s^2
15.0			
20.0	8.9	0.89	0.79
25.0	9.9	0.99	0.98
30.0	10.8	1.08	1.17
35.0	11.8	1.18	1.39

[1]

(iii) Explain why the student measures the time for 10 complete oscillations, rather than for 1 complete oscillation.

....

....

.... [1]

(iv) On the grid in Fig. 1.2, plot a graph of T^2 (y-axis) against L (x-axis). Start your axes from the origin (0,0). Draw the straight line of best fit. [4]

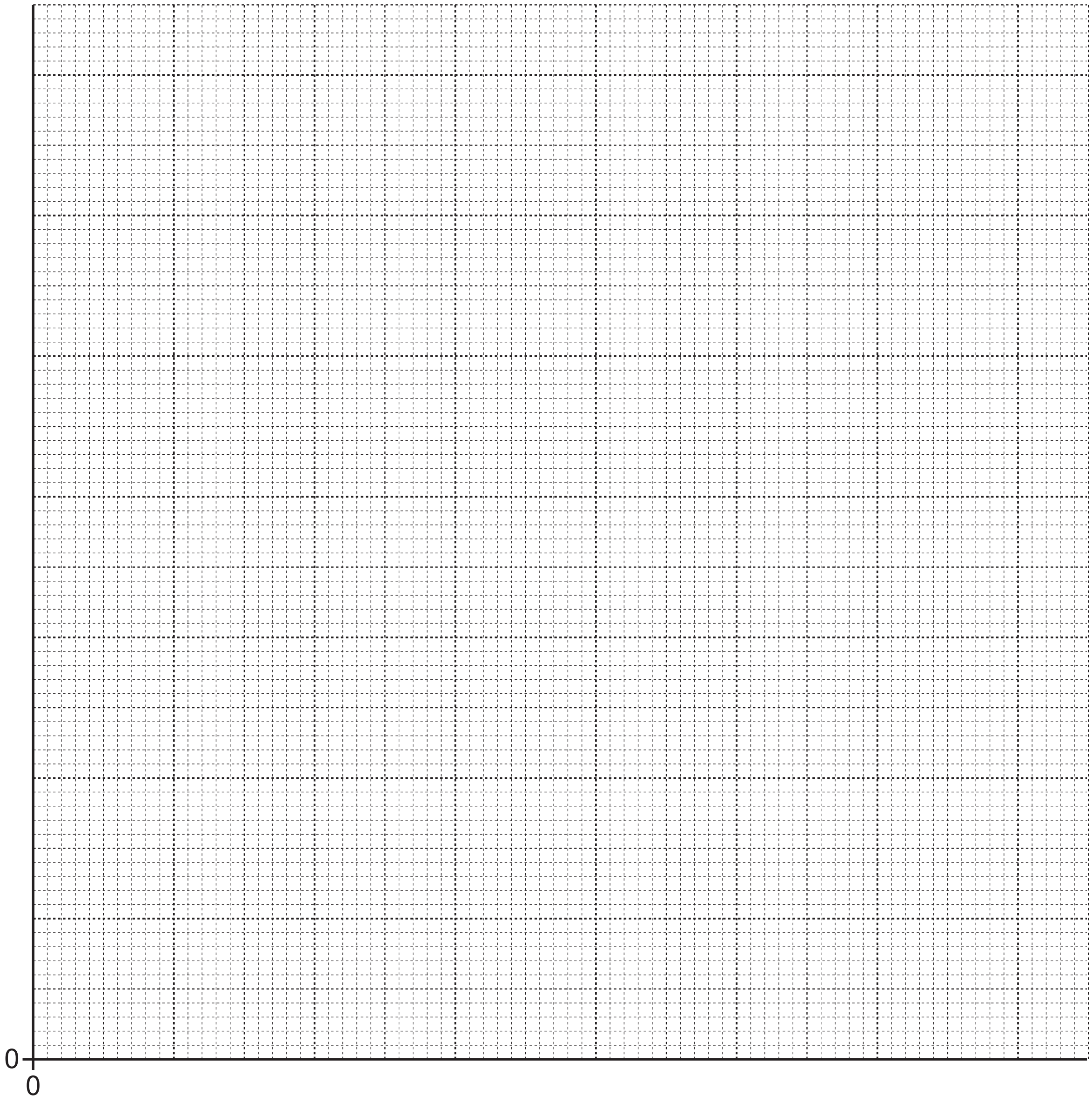

Fig. 1.2

(v) Determine the gradient *G* of your line.

Show your working and indicate on the graph the values you use.

G = ... [2]

(vi) Theory suggests that the gravitational field strength g is equal to:

$$g = \frac{0.39}{G}$$

Use this equation and your value of G in **(b)(v)** to calculate a value for g.

g = ... [1]

(vii) Compare the value of g you obtained in **(b)(vi)** with the accepted value of 10 N/kg.

State whether the two values agree with each other and justify your answer.

....

.... [1]

[Total: 14]

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2 A student carries out an investigation to find the specific heat capacity *c* of copper.

(a) The student places a small block of copper on a balance to find its mass *m*, as shown in Fig. 2.1.

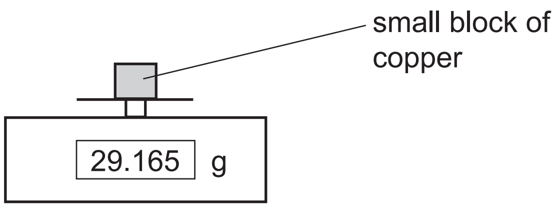

Fig. 2.1

Record the mass *m* of the block, correct to one decimal place.

m = ... g [1]

(b) The student measures a volume of water in a measuring cylinder, as shown in Fig. 2.2.

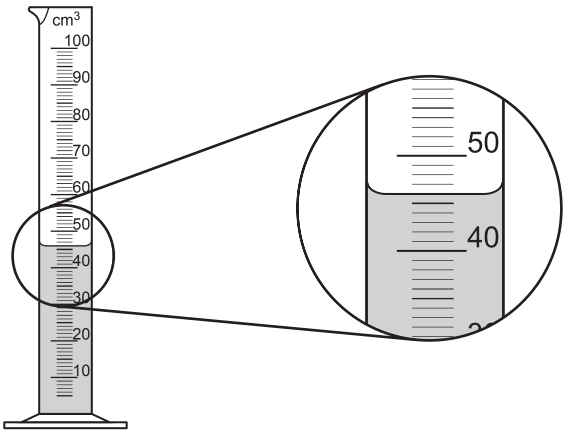

Fig. 2.2

Record the volume *V* of water shown in Fig. 2.2.

V = ... cm^3 [1]

(c) The student:

- pours the water from the measuring cylinder into a beaker
- records the initial temperature of the water as θ_1 = 23 °C
- places the copper block in boiling water for several minutes until the block is at a temperature of 100 °C
- lowers the copper block into the beaker of water and stirs the water until the reading on the thermometer stops rising
- records the final temperature of the water which is 27 °C.

The specific heat capacity *c* of copper can be found using the equation

$$c = \frac{V \times 4.2 \times (27 - \theta_1)}{m \times (100 - 27)}$$

Use your results in **(a)** and **(b)** and the value of θ_1 to calculate the value of *c*. Give the unit of your answer.

c = ... unit = ... [2]

(d) This method does not give an accurate value for *c*.

Suggest one reason for this.

....

.... [1]

[Total: 5]

3 A student investigates the resistance of a thermistor.

The student:

- places the thermistor in a beaker of cold water
- connects the thermistor into the circuit shown in Fig. 3.1.

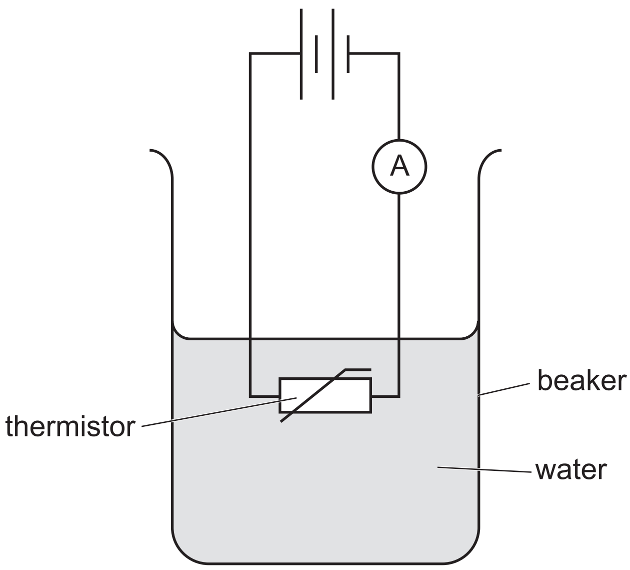

Fig. 3.1

(a) (i) On Fig. 3.1, draw a voltmeter connected to measure the voltage *V* across the thermistor. [1]

(ii) Fig. 3.2 shows the ammeter and voltmeter readings when the thermistor is in cold water.

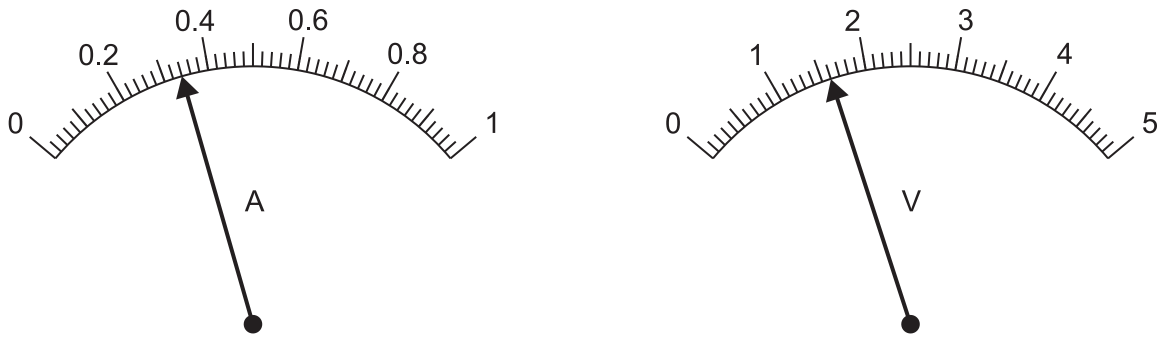

Fig. 3.2

Record the values of current *I* and voltage *V* when the thermistor is in cold water.

I = ... A

V = ... V [2]

(b) The student:

- adds some hot water to the beaker
- stirs the water
- repeats the reading of current and voltage.

(i) Explain why the student stirs the water.

....

....

.... [1]

(ii) The voltmeter reading does not change.

The new ammeter reading is shown in Fig. 3.3.

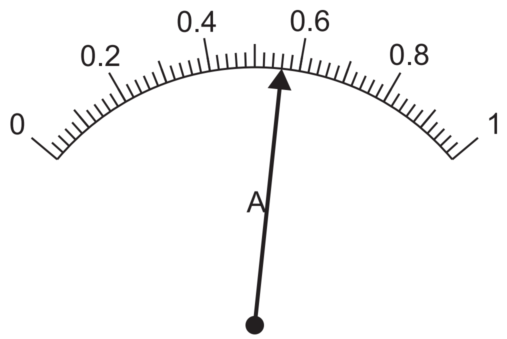

Fig. 3.3

Resistance *R* is given by the equation:

$$R = \frac{V}{I}$$

State how the resistance of the thermistor changes as the water becomes hotter.

Explain how the readings shown in Fig. 3.2 and Fig. 3.3 support your answer.

....

....

.... [2]

[Total: 6]

4 Fig. 4.1 shows a cardboard lamina with three small holes and a piece of string with a small mass attached at one end. The string and mass together are called a plumb line.

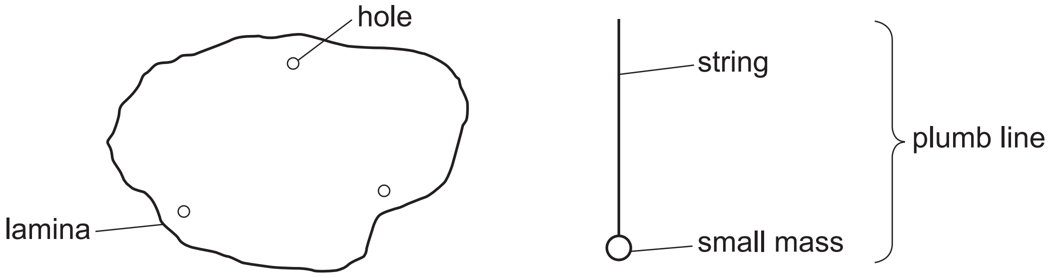

Fig. 4.1

(a) Describe an experiment that uses the apparatus shown in Fig. 4.1 to find the centre of mass of the lamina. A clamp, boss and stand and a long pin are also available for use.

Your answer **must** include a labelled diagram.

....

....

....

....

.... [4]

(b) Suggest how the position of the centre of mass found in **(a)** can be confirmed using a sharp pin only.

....

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.... [1]

[Total: 5]

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