Cambridge International AS & A Level

Cambridge Assessment International Education
Cambridge International Advanced Subsidiary and Advanced Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

PHYSICS **9702/33**

Paper 3 Advanced Practical Skills 1 **May/June 2019**

2 hours

Candidates answer on the Question Paper.

Additional Materials: As listed in the Confidential Instructions.

READ THESE INSTRUCTIONS FIRST

Write your centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
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DO **NOT** WRITE IN ANY BARCODES.

Answer **both** questions.
You will be allowed to work with the apparatus for a maximum of one hour for each question.
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You are reminded of the need for good English and clear presentation in your answers.

Electronic calculators may be used.
You may lose marks if you do not show your working or if you do not use appropriate units.

Additional answer paper and graph paper should be used only if it becomes necessary to do so.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

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1	
2	
Total	

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Cambridge Assessment International Education

[Turn over

You may not need to use all of the materials provided.

1 In this experiment, you will investigate the oscillations of a metre rule.

(a) • Set up the apparatus as shown in Fig. 1.1.

• Attach the beaker to the block of wood using modelling clay.

• The distance between the centre of each 150 g mass and the nearest end of the rule is x.

Adjust the apparatus so that the value of x is approximately 20 cm and the rule is balanced on the beaker, as shown in Fig. 1.1.

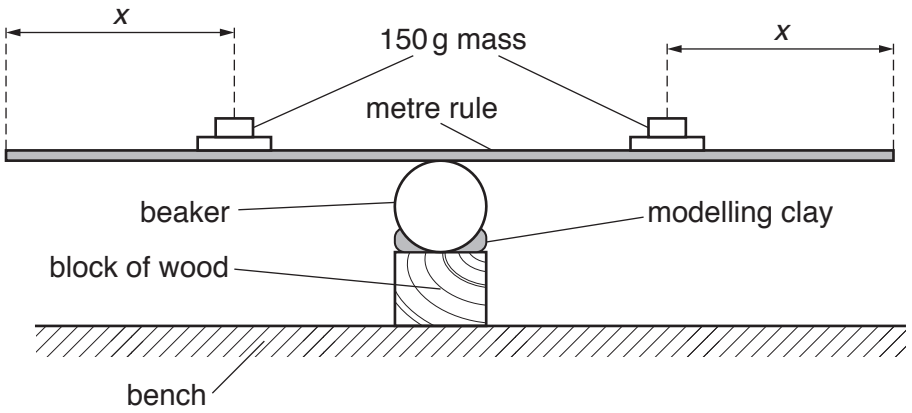


Fig. 1.1

• Record x.

x = ... [1]

(b) • Pull one end of the rule down through a short distance.

• Release the end of the rule so that it oscillates.

• Determine the period T of these oscillations.

T = ... [2]

(c) **Reduce** x by changing the positions of the 150 g masses on the rule.
Measure and record x and T. Repeat until you have five sets of values.

Record your results in a table.

[7]

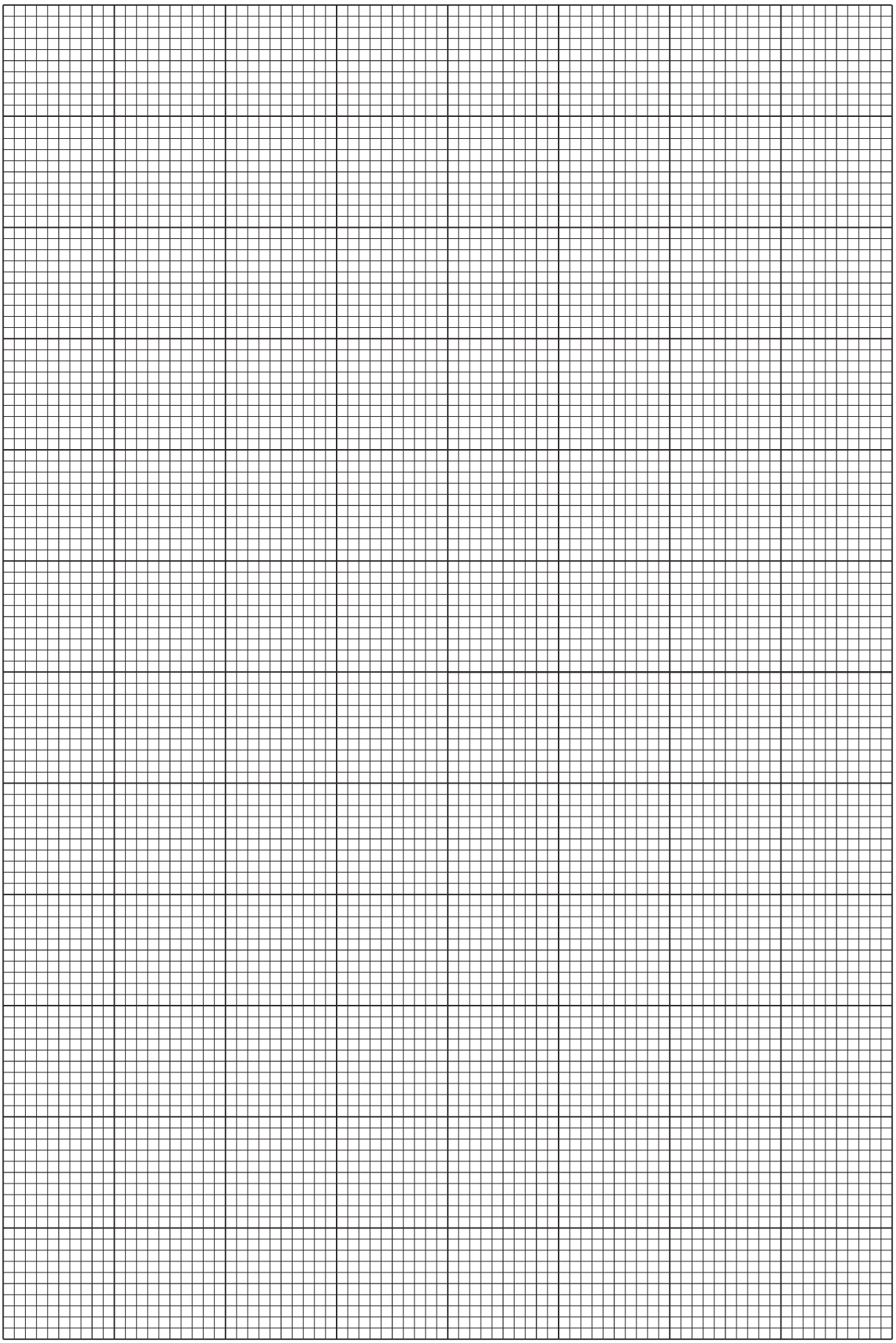
(d) **(i)** Plot a graph of T on the y-axis against x on the x-axis. [3]

(ii) Draw the straight line of best fit. [1]

(iii) Determine the gradient and y-intercept of this line.

gradient = ...

y-intercept = ...
[2]



(e) It is suggested that the quantities T and x are related by the equation

$$T = Px + Q$$

where P and Q are constants.

Using your answers in **(d)(iii)**, determine the values of P and Q.
Give appropriate units.

P = ...

Q = ...
[2]

(f) For one particular value of x, the value of T is the same as when there are no masses on the rule.

- Remove the masses from the rule.
- Balance the rule on the beaker and repeat **(b)**.

T = ...

- Use your value of T and answers in **(e)** to calculate this value of x.
  Give your answer to three significant figures.

x = ... [2]

[Total: 20]

You may not need to use all of the materials provided.

2 In this experiment, you will investigate the path of a bouncing ball.

(a) (i) • Set up the apparatus as shown in Fig. 2.1.

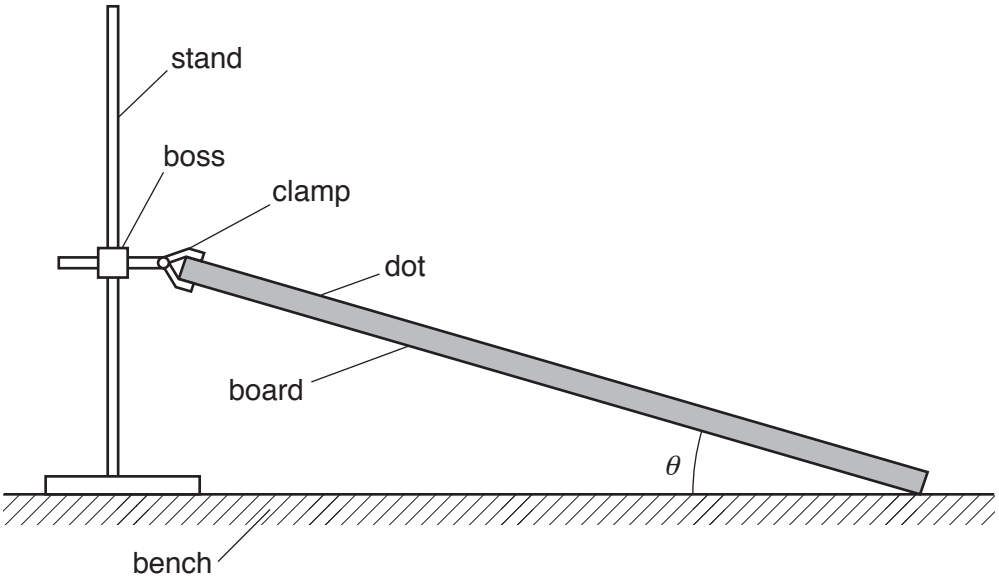


Fig. 2.1

- Support the board using the clamp.
- The dot on the board should be facing upwards and be close to the top end of the board.

The angle θ between the board and the bench should be approximately 25°.

Measure and record θ.

θ = ...° [1]

(ii) Calculate $(\sin 2\theta)(\cos 2\theta)$.

$(\sin 2\theta)(\cos 2\theta)$ = ... [1]

(iii) Justify the number of significant figures that you have given for your value of $(\sin 2\theta)(\cos 2\theta)$.

.....

.....

..... [1]

(b) • Use the G-clamp to support the card vertically, as shown in Fig. 2.2.

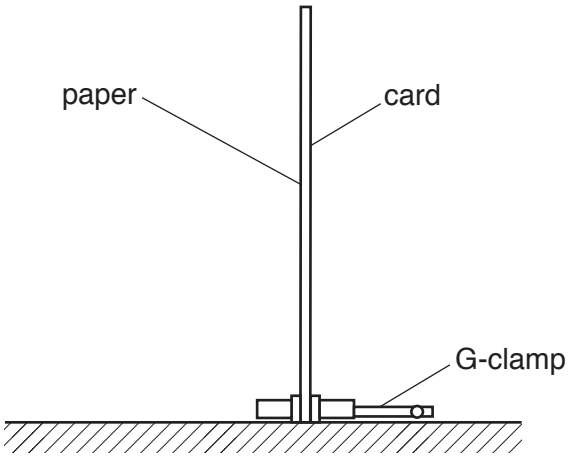


Fig. 2.2

• Position the card at the lower edge of the board, as shown in Fig. 2.3.

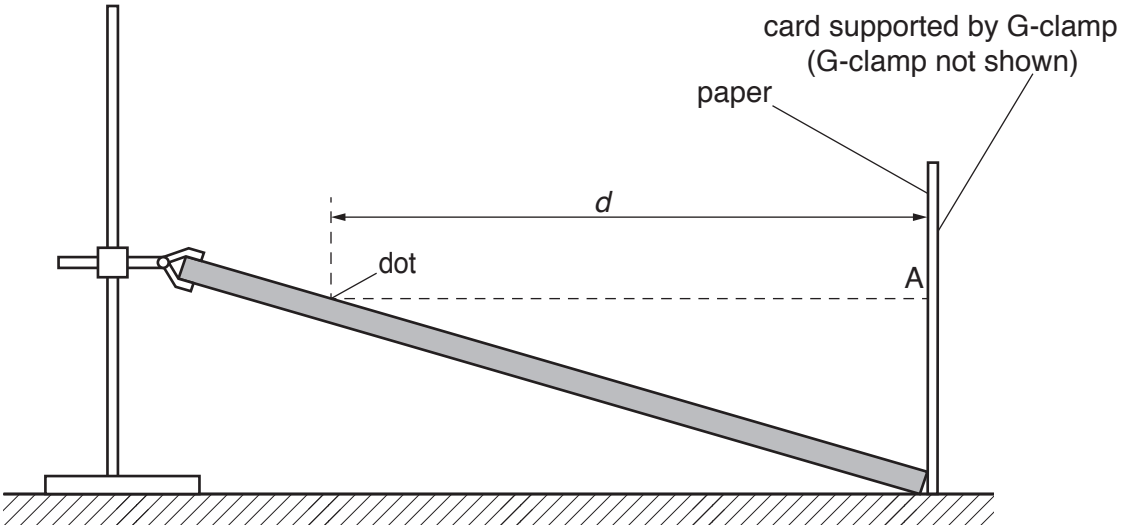


Fig. 2.3

• Draw a horizontal line on the paper at the same height above the bench as the dot. Label this line A.

• The horizontal distance between the line A and the dot is *d*.

Measure and record *d*.

d = ... [2]

(c) (i)

- Hold the ball vertically above the dot on the board, as shown in Fig. 2.4.
- Release the ball so that it bounces from the board and strikes the card.
- Continue releasing the ball from different heights until the ball strikes the line A.
- The height of the ball above the dot is *h*.

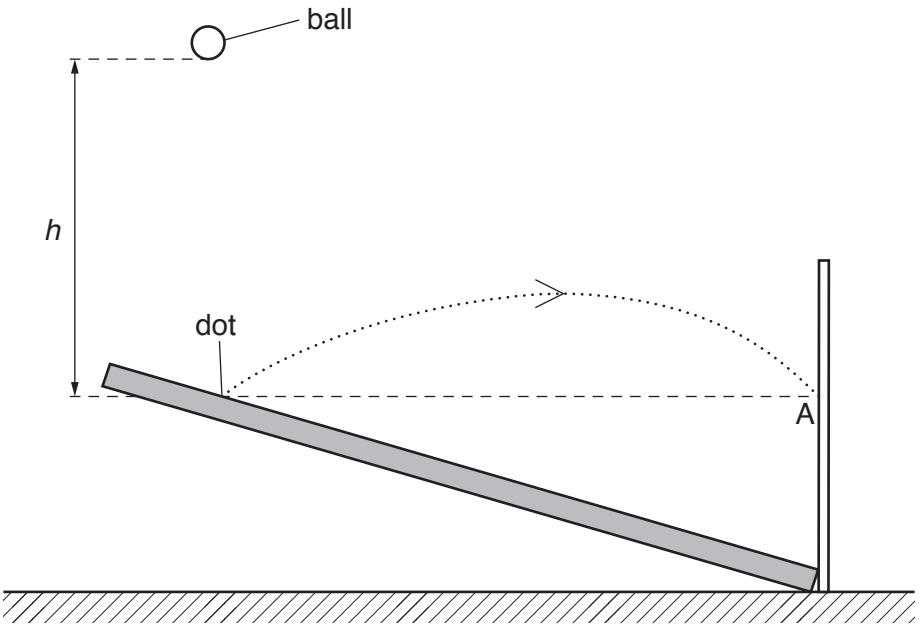


Fig. 2.4

Measure and record *h*.

h = ... [1]

(ii) Estimate the percentage uncertainty in your value of *h*.

percentage uncertainty = ... [1]

(d) • Adjust the apparatus so that θ is approximately 15°.

Measure and record θ and repeat **(a)(ii)**.

θ = ... °

$(\sin 2\theta)(\cos 2\theta)$ = ...

• Repeat **(b)**, labelling your second line B.

d = ...

• Repeat **(c)(i)** using line B.

h = ...
[3]

(e) It is suggested that the relationship between h, d and θ is

$$h = \frac{kd}{(\sin 2\theta)(\cos 2\theta)}$$

where k is a constant.

(i) Using your data, calculate two values of k.

first value of k = ...

second value of k = ...
[1]

(ii) Explain whether your results support the suggested relationship.

.....

.....

.....

..... [1]

(f) **(i)** Describe four sources of uncertainty or limitations of the procedure for this experiment.

1. .....

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2. .....

.....

3. .....

.....

4. .....

.....

[4]

(ii) Describe four improvements that could be made to this experiment. You may suggest the use of other apparatus or different procedures.

1. .....

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2. .....

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3. .....

.....

4. .....

.....

[4]

[Total: 20]

Cambridge International AS & A Level

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CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

8885476375

PHYSICS **9702/34**

Paper 3 Advanced Practical Skills 2 **May/June 2019**

2 hours

Candidates answer on the Question Paper.

Additional Materials: As listed in the Confidential Instructions.

READ THESE INSTRUCTIONS FIRST

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You may not need to use all of the materials provided.

1 In this experiment, you will investigate the equilibrium position of a cardboard triangle.

(a) • Assemble the apparatus as shown in Fig. 1.1, with the nail passing through the hole marked A and the wire hook passing through one of the remaining holes.

• Ensure that the nail is held securely in the clamp and that the cardboard triangle can swing freely on the nail.

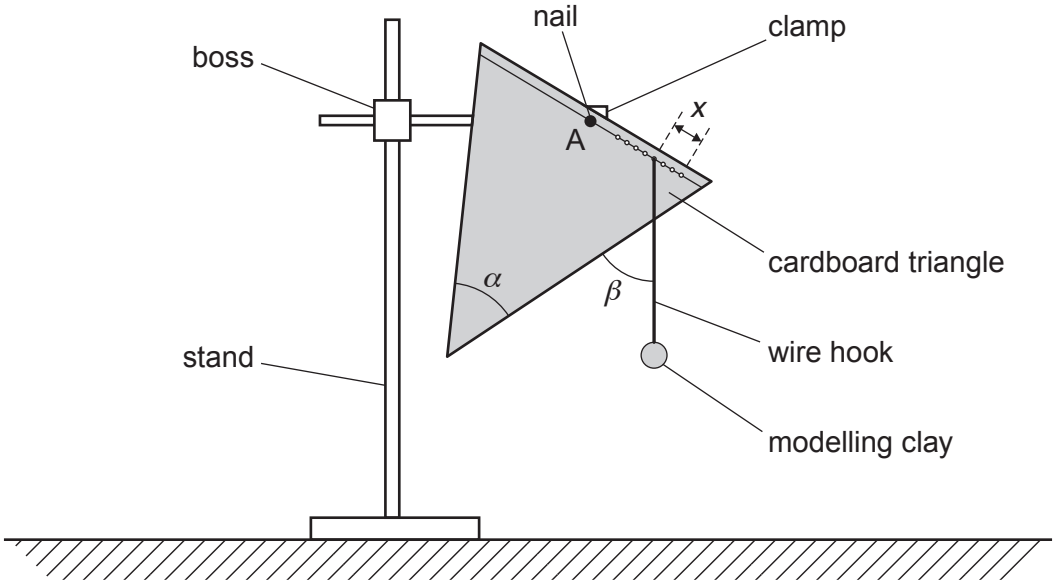


Fig. 1.1 (not to scale)

• The angle of the lower corner of the card is α, as shown in Fig. 1.1.

• Measure and record α.

α = ... °

• Calculate the value of $\frac{\alpha}{2}$.

$\frac{\alpha}{2}$ = ... °

[1]

(b) • The angle between the wire hook and the edge of the card is β, as shown in Fig. 1.1.

Measure and record β.

β = ... °

• The distance between the hole with the wire hook in it and the hole furthest from A is x, as shown in Fig. 1.1.

Measure and record x.

x = ... cm
[1]

(c) Move the wire hook to another hole and repeat **(b)** until you have six sets of values of β and x.

Record your results in a table.
Include values of $\tan\left(\beta - \frac{\alpha}{2}\right)$ in your table.

[10]

(d) **(i)** Plot a graph of $\tan\left(\beta - \frac{\alpha}{2}\right)$ on the y-axis against x on the x-axis. [3]

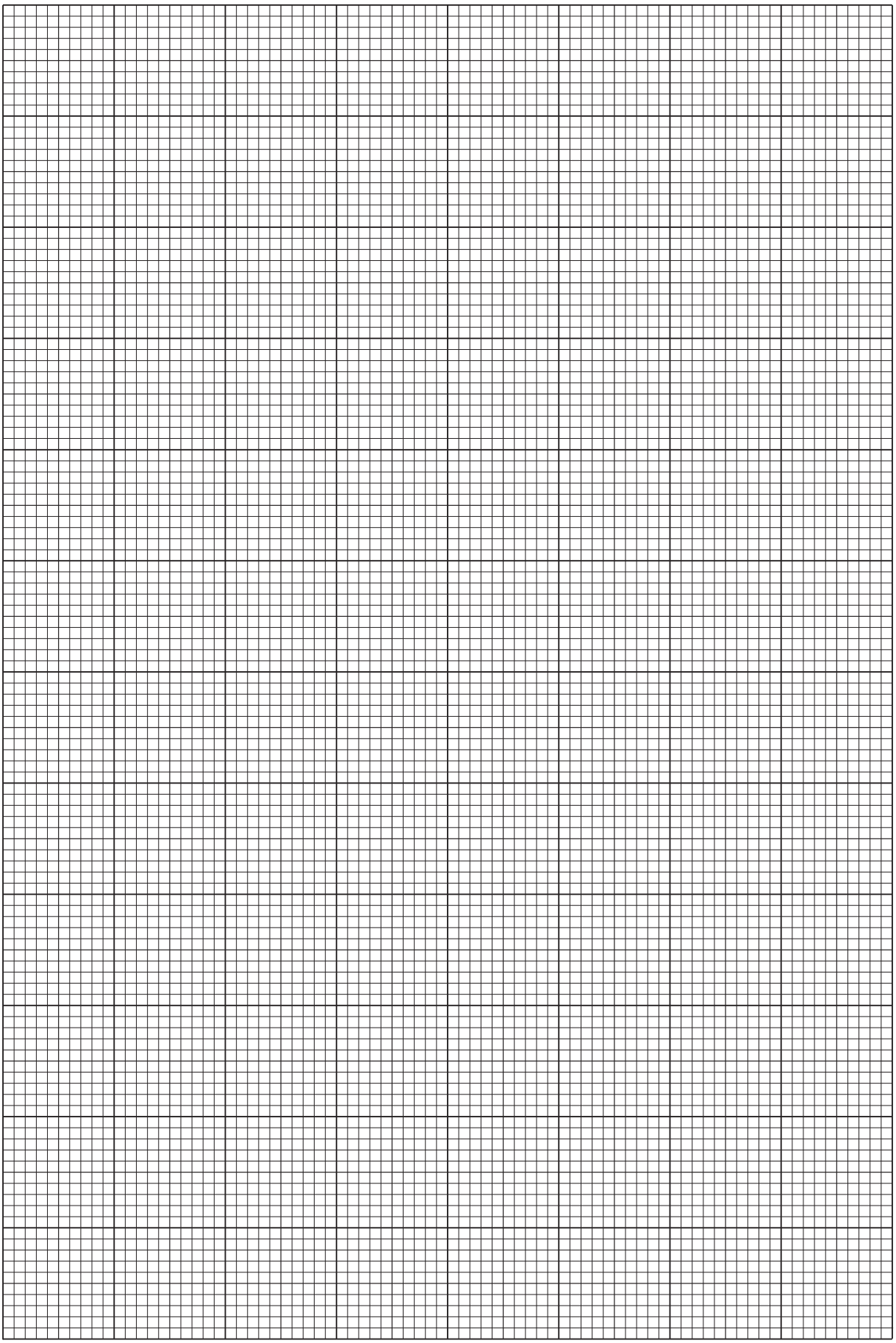
(ii) Draw the straight line of best fit. [1]

(iii) Determine the gradient and y-intercept of this line.

gradient = ...

y-intercept = ...
[2]

5



(e) It is suggested that the quantities β, α and x are related by the equation

$$\tan\left(\beta - \frac{\alpha}{2}\right) = Px + Q$$

where P and Q are constants.

Use your answers in **(d)(iii)** to determine the values of P and Q.
Give appropriate units.

P = ...

Q = ...
[2]

[Total: 20]

You may not need to use all of the materials provided.

2 In this experiment, you will investigate the forces on an irregularly shaped object.

(a) • Position the wooden strip on the prism so that it is balanced. Make a small mark on the side of the strip where it rests on the prism, as shown in Fig. 2.1.

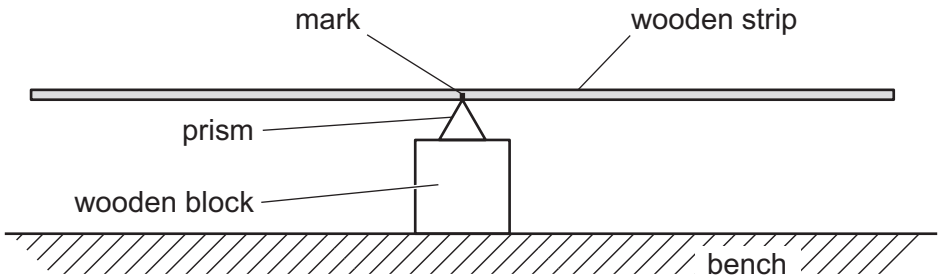


Fig. 2.1

- Place the beaker under the wooden strip.
- Hang the **larger** rock inside the beaker at a distance of 30.0 cm from the mark, then balance the strip by placing the mass on the other side of the mark, as shown in Fig. 2.2.

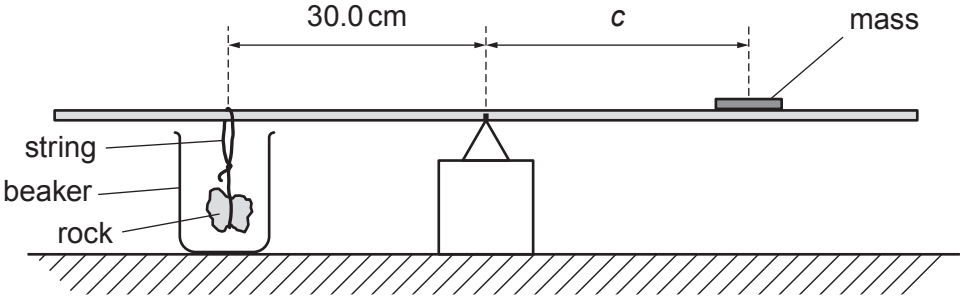


Fig. 2.2

- The distance between the centre of the mass and the mark is *c*.

  Measure and record *c*.

c = ... [2]

(b) • Pour water into the beaker until the rock is completely immersed.

• Balance the strip by moving the position of the mass, as shown in Fig. 2.3.

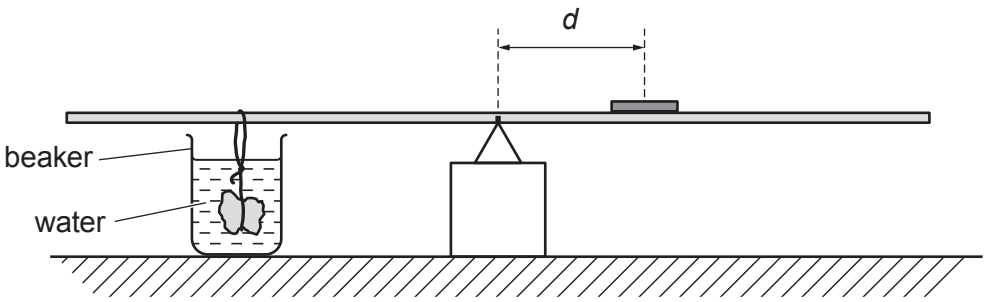


Fig. 2.3

• Ensure that the rock is completely immersed and is not touching the bottom of the beaker.

• The distance between the centre of the mass and the mark is *d*.

Measure and record *d*.

d = ... [1]

(c) Estimate the percentage uncertainty in your value of *d*.

percentage uncertainty = ... [1]

(d)
- Carefully remove the rock from the water.
- Pour the water from the beaker into the jug.
- Replace the rock with the **smaller** rock, ensuring that it is 30.0 cm from the mark.
- Balance the strip by placing the mass on the other side of the mark, as shown in Fig. 2.2.
- Measure and record c.

c = ...

- Repeat **(b)**.

d = ...
[3]

(e) It is suggested that the relationship between c and d is

$$k(c - d) = c$$

where k is a constant.

(i) Using your data, calculate two values of k.

first value of k = ...

second value of k = ...
[1]

(ii) Justify the number of significant figures that you have given for your values of k.

.....

.....

..... [1]

(iii) Explain whether your results in **(e)(i)** support the suggested relationship.

.....

.....

..... [1]

(f) The value of k is related to the densities of water and of the rock by

$$k = \frac{\text{density of the rock}}{\text{density of water}} .$$

The density of water is $1000\,\text{kg}\,\text{m}^{-3}$. Calculate the density of the larger rock.

density of the larger rock = ... [2]

(g) (i) Describe four sources of uncertainty or limitations of the procedure for this experiment.

1. .....

.....

2. .....

.....

3. .....

.....

4. .....

.....

[4]

(ii) Describe four improvements that could be made to this experiment. You may suggest the use of other apparatus or different procedures.

1. .....

.....

2. .....

.....

3. .....

.....

4. .....

.....

[4]

[Total: 20]

Cambridge International AS & A Level

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PHYSICS **9702/35**

Paper 3 Advanced Practical Skills 1 **May/June 2019**

2 hours

Candidates answer on the Question Paper.

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You may not need to use all of the materials provided.

1 In this experiment, you will investigate an electrical circuit.

(a) (i) You have been provided with two metre rules. One is labelled P and the other is labelled Q.

- Set up the circuit shown in Fig. 1.1.

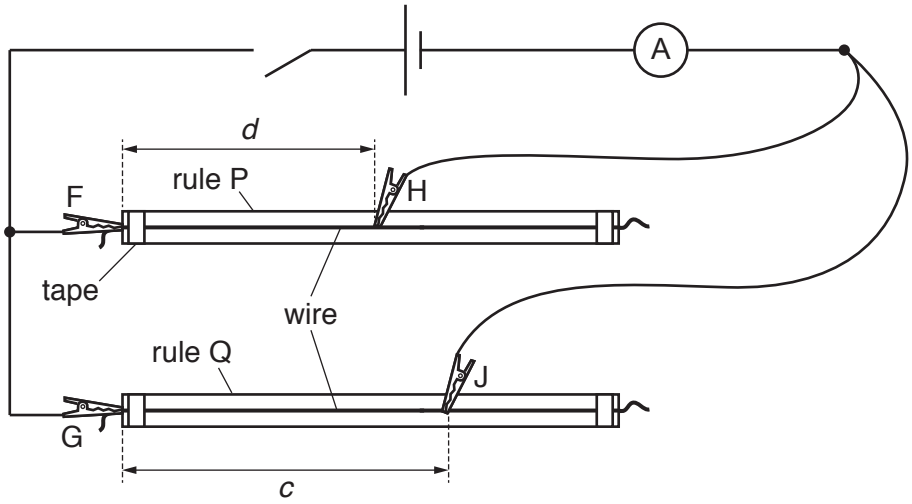


Fig. 1.1

- F, G, H and J are crocodile clips.

  Place H approximately half-way along the wire on rule P.

- The distance between F and H is *d*, as shown in Fig. 1.1.

  Record *d*.

d = ...

- Place J on the wire on rule Q so that the distance between G and J is approximately 60 cm. The distance between G and J is *c*, as shown in Fig. 1.1.

- Record *c*.

c = ...

- Calculate *n*, where $n = \frac{c - d}{d}$.

n = ...
[1]

(ii) • Close the switch.

• Record the ammeter reading I.

I = ...

• Open the switch.

[1]

(b) **Keeping *d* constant**, vary *c* until you have six sets of readings of *c* and I. Do **not** use values of *c* less than *d*.

Record your results in a table. Include values of *n* and $\frac{(n+2)}{(n+1)}$ in your table.

[9]

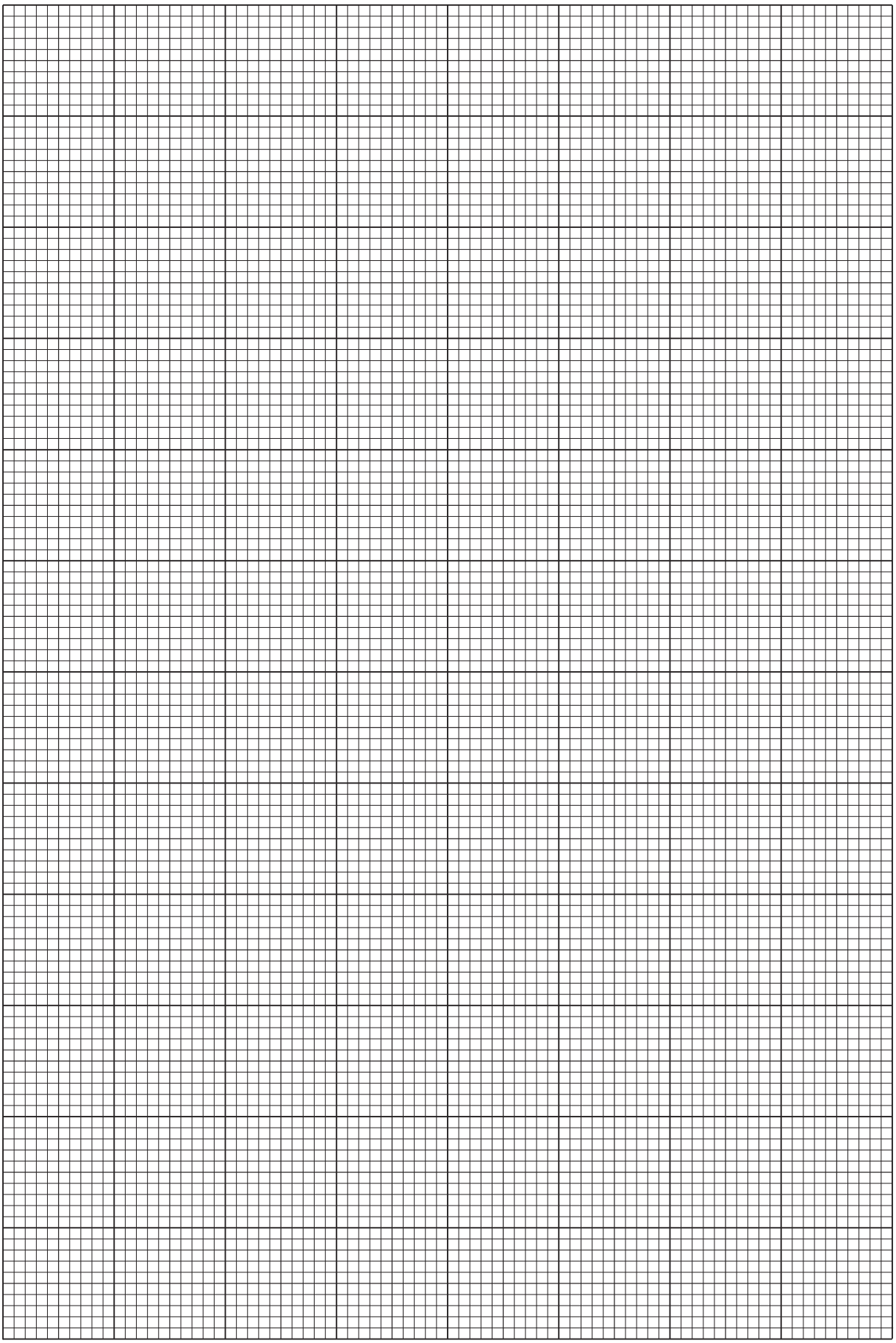
(c) **(i)** Plot a graph of I on the *y*-axis against $\frac{(n+2)}{(n+1)}$ on the *x*-axis. [3]

(ii) Draw the straight line of best fit. [1]

(iii) Determine the gradient and *y*-intercept of this line.

gradient = ...

y-intercept = ...
[2]



(d) It is suggested that the quantities I and n are related by the equation

$$I = S\frac{(n+2)}{(n+1)} + T$$

where S and T are constants.

Using your answers in **(c)(iii)**, determine values for S and T.
Give appropriate units.

S = ...

T = ...
[2]

(e) Theory suggests that S is inversely proportional to d and that T is independent of d.
The experiment is repeated using the same equipment but a larger value of d.

For this experiment, draw a second line on the graph to show the expected results.
Label this line W. [1]

[Total: 20]

You may not need to use all of the materials provided.

2 In this experiment, you will investigate the oscillations of a pendulum.

(a) • Set up the apparatus as shown in Fig. 2.1.

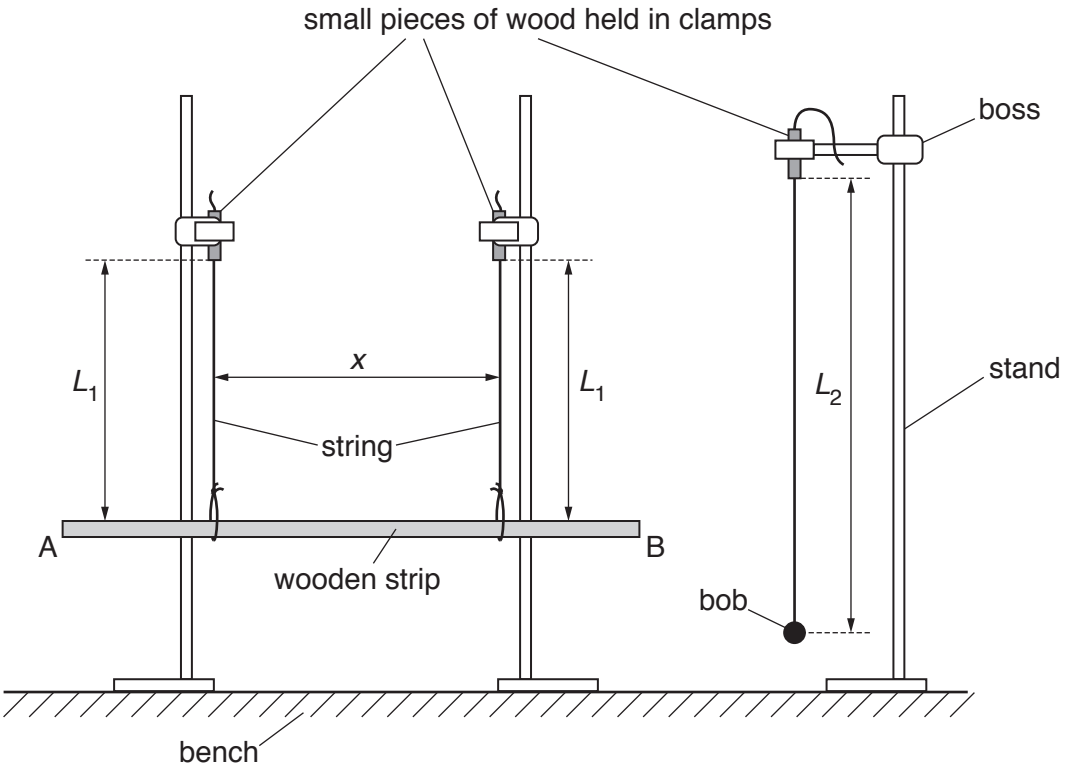


Fig. 2.1

• The distance between the strings supporting the wooden strip is x.

The distances between the top of the strip and the bottom of the small pieces of wood should be equal. These distances are both L_1.

The distance between the centre of the bob and the bottom of the small pieces of wood is L_2.

Adjust the position of the strings so that $x \approx 25\,\text{cm}$, $L_1 \approx 25\,\text{cm}$ and $L_2 \approx 45\,\text{cm}$.

• The strings should be vertical, the strip should be parallel to the bench and the strip should be supported centrally by the strings.

Measure and record x and L_1.

$x =$ ..... cm

$L_1 =$ ..... cm

[2]

(b) (i)

- Pull the bob and end B of the strip towards you through a short distance.
- Release the bob and the strip together so that they oscillate.
- Adjust L_2 until the periods of the oscillations of the bob and of the strip are the same.
- Measure and record L_2.

L_2 = ... cm [1]

(ii) Estimate the percentage uncertainty in your value of L_2.

percentage uncertainty = ... [1]

(iii) Calculate $\frac{L_1}{L_2}$.

$\frac{L_1}{L_2}$ = ... [1]

(iv) Justify the number of significant figures that you have given for your value of $\frac{L_1}{L_2}$.

.....

.....

..... [1]

(c) • Change x to approximately 30 cm and L_1 to approximately 20 cm.

• The strings should be vertical, the strip should be parallel to the bench and the strip should be supported centrally by the strings.

Measure and record x and L_1.

x = ... cm

L_1 = ... cm

• Repeat **(b)(i)** and **(b)(iii)**.

L_2 = ... cm

$\frac{L_1}{L_2}$ = ...
[3]

(d) It is suggested that the relationship between L_1, L_2 and x is

$$\frac{L_1}{L_2} = kx^2$$

where k is a constant.

(i) Using your data, calculate two values of k.

first value of k = ...

second value of k = ...
[1]

(ii) Explain whether your results support the suggested relationship.

.....

.....

.....

..... [1]

(e) Theory suggests that

$$k = \frac{3}{l^2}$$

where l is the length of the strip.

Using your second value of k, calculate l.
Give an appropriate unit.

l = ... [1]

(f) **(i)** Describe four sources of uncertainty or limitations of the procedure for this experiment.

1. .....

.....

2. .....

.....

3. .....

.....

4. .....

.....

[4]

(ii) Describe four improvements that could be made to this experiment. You may suggest the use of other apparatus or different procedures.

1. .....

.....

2. .....

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3. .....

.....

4. .....

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[4]

[Total: 20]

12

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