Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

PHYSICS **9702/33**

Paper 3 Advanced Practical Skills 1 **May/June 2021**

2 hours

You must answer on the question paper.

You will need: The materials and apparatus listed in the confidential instructions

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.
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- Do **not** write on any bar codes.
- You will be allowed to work with the apparatus for a maximum of 1 hour for each question.
- You should record all your observations in the spaces provided in the question paper as soon as these observations are made.
- You may use a calculator.
- You should show all your working and use appropriate units.

INFORMATION

- The total mark for this paper is 40.
- The number of marks for each question or part question is shown in brackets [ ].

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1	
2	
Total	

This document has **12** pages. Any blank pages are indicated.

[Turn over

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

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

(a) You have been provided with two identical wooden strips labelled A and B.

Measure and record the length *L* of the wire between the nails on strip A, as shown in Fig. 1.1.

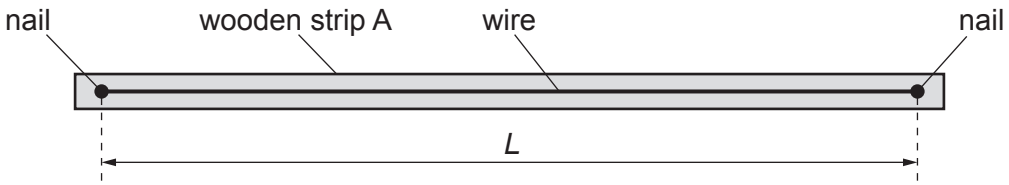


Fig. 1.1

L = ... [1]

(b) ● Set up the circuit shown in Fig. 1.2.

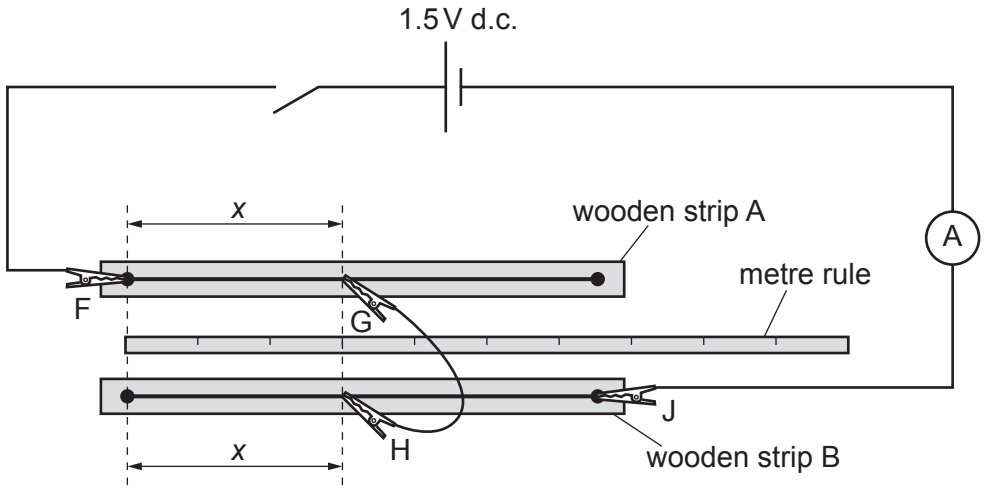


Fig. 1.2

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

  Attach G to the wire on wooden strip A so that the distance *x* between the nail on strip A and G is approximately 30 cm, as shown in Fig. 1.2.

- Attach H to the wire on wooden strip B so that it is the same distance *x* from the nail on strip B.

- Close the switch.

- Record *x* and the ammeter reading *I*.

  x = ...

  I = ...

- Open the switch.

[1]

(c) Vary x and repeat **(b)** until you have six sets of readings of x and I. Include your values from **(b)**.

Record your results in a table. Include values of $\frac{1}{I}$ in your table.

[9]

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

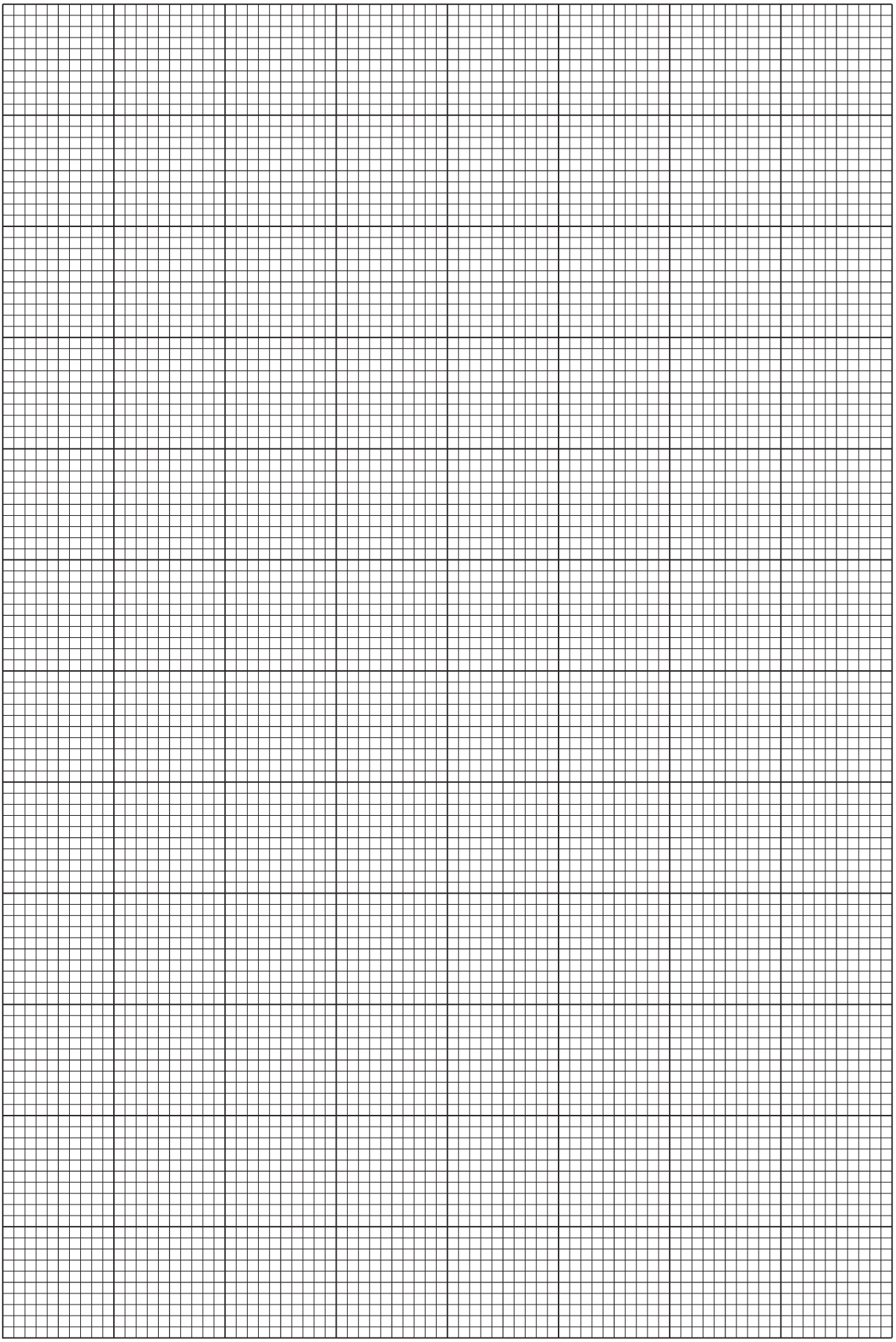
(ii) Draw the straight line of best fit. [1]

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

gradient = ...

y-intercept = ...

[2]



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

$$\frac{1}{I} = Px + Q$$

where P and Q are constants.

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

P = ...

Q = ...
[2]

(f) Theory suggests that

$$\frac{P}{Q} = \frac{\left(\frac{\rho_A}{\rho_B} - 1\right)}{L}$$

where ρ_A is the resistivity of the wire on strip A and ρ_B is the resistivity of the wire on strip B.

Calculate $\frac{\rho_A}{\rho_B}$.

$\frac{\rho_A}{\rho_B}$ = ... [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 loaded wooden strip.

(a) You have been provided with a rectangular wooden strip with a hole in its centre.

- Use some of the adhesive putty to attach the two 100 g masses as near as possible to one end of the strip, as shown in Fig. 2.1 and Fig. 2.2.

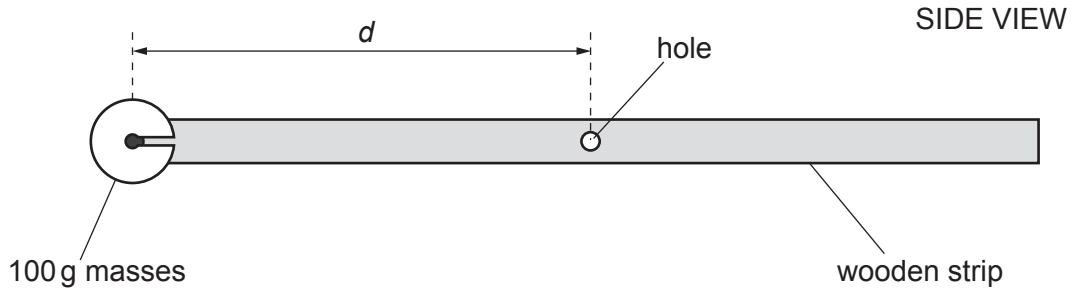


Fig. 2.1

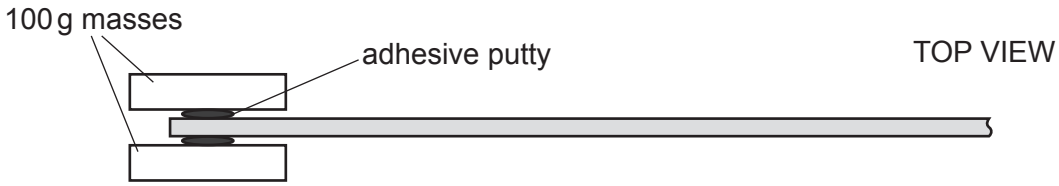


Fig. 2.2

- The distance between the centre of the masses and the hole is *d*, as shown in Fig. 2.1.

  Measure and record *d*.

d = ... [1]

(b) Estimate the percentage uncertainty in your value of *d*. Show your working.

percentage uncertainty = ... [1]

(c) (i) ● Attach the two 50 g masses to the other end of the strip so that the distance between the centres of these masses and the hole is also equal to *d*.

● Set up the apparatus as shown in Fig. 2.3.

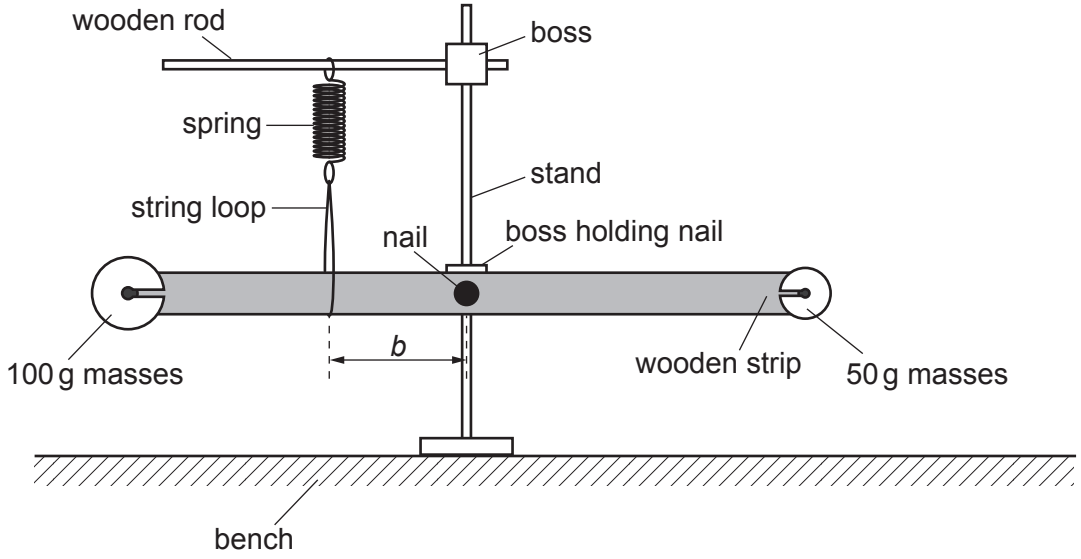


Fig. 2.3 (not to scale)

● The distance between the string loop and the nail in the centre of the strip is *b*. Adjust the position of the string loop and spring until *b* is approximately 10 cm.

● Adjust the heights of the bosses until the strip is horizontal and the spring and string loop are vertical.

● Measure and record *b*.

b = ... [1]

(ii) Calculate α where

$$\alpha = \frac{b}{d}.$$

α = ... [1]

(iii) Justify the number of significant figures that you have given for your value of α.

.....

.....

..... [1]

(d)
- Move the end of the strip with the 100 g masses down through a short distance.
- Release the end of the strip. The strip will oscillate up and down.
- Take measurements to determine the period T of these oscillations.

T = ... [2]

(e)
- Change the value of b to approximately 20 cm.
- Adjust the heights of the bosses until the strip is horizontal and the spring and string loop are vertical.
- Measure and record b.

b = ...

- Repeat **(c)(ii)** and **(d)**.

α = ...

T = ...
[2]

(f) It is suggested that the relationship between T and α is

$$T = \frac{C}{\alpha}$$

where C is a constant.

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

first value of C = ...

second value of C = ...
[1]

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

.....

.....

.....

..... [1]

(g) Theory suggests that

$$C = 2\pi\sqrt{\frac{3m}{k}}$$

where m is 0.100 kg and k is the spring constant of the spring.

Use your second value of C to determine a value for k. Give an appropriate unit.

k = ... [1]

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

1. .....

.....

2. .....

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3. .....

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4. .....

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[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. .....

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4. .....

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[4]

[Total: 20]

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Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

PHYSICS **9702/34**

Paper 3 Advanced Practical Skills 2 **May/June 2021**

2 hours

You must answer on the question paper.

You will need: The materials and apparatus listed in the confidential instructions

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
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- Do **not** write on any bar codes.
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- You may use a calculator.
- You should show all your working and use appropriate units.

INFORMATION

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Total	

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

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

(a) (i) ● Assemble the apparatus as shown in Fig. 1.1 with each nail held securely in a boss and at the same height above the bench. Position the stands so that the distance between the nails is approximately 60 cm.

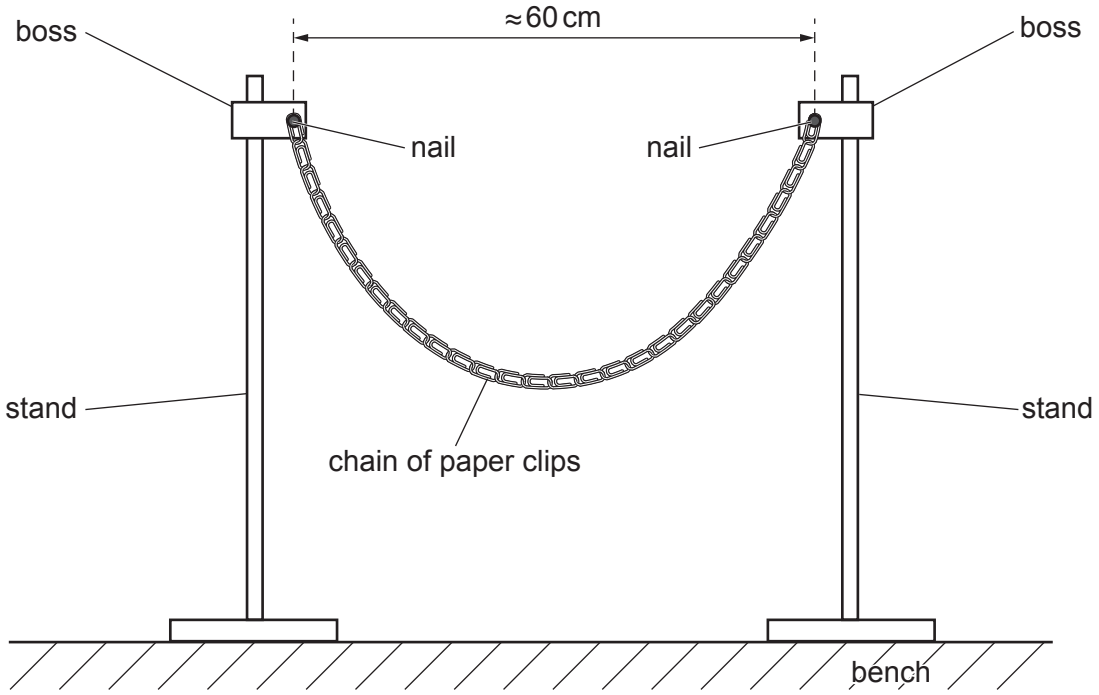


Fig. 1.1

● Rest one of the metre rules on the nails, as shown in Fig. 1.2.

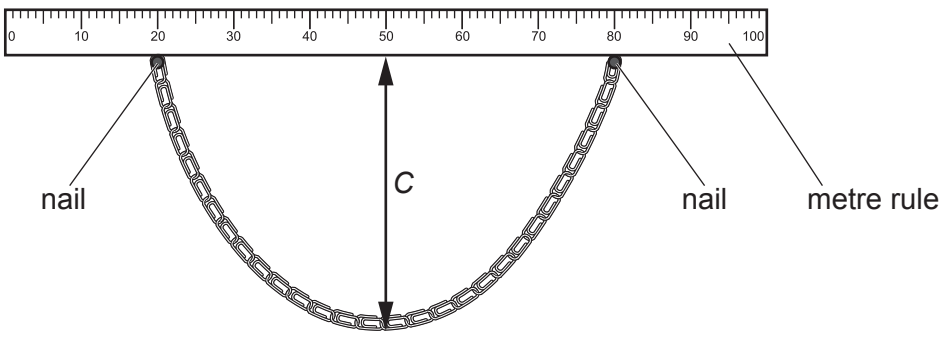


Fig. 1.2

● The vertical distance between the horizontal metre rule and the lowest part of the chain is *C*.

Using the other metre rule, measure and record *C*.

C = ... cm [1]

(ii) ● Push the bottom of the chain a short distance away from you. Release it so that it swings towards and away from you.

● Take measurements to determine the period T of these oscillations.

T = ... [2]

(b) Repeat **(a)** with different distances between the stands until you have six sets of values of C and T.
All values of C must be greater than 15 cm.

Record your results in a table. Include values of $\frac{1}{T}$ and $\frac{1}{\sqrt{C}}$ in your table.

[9]

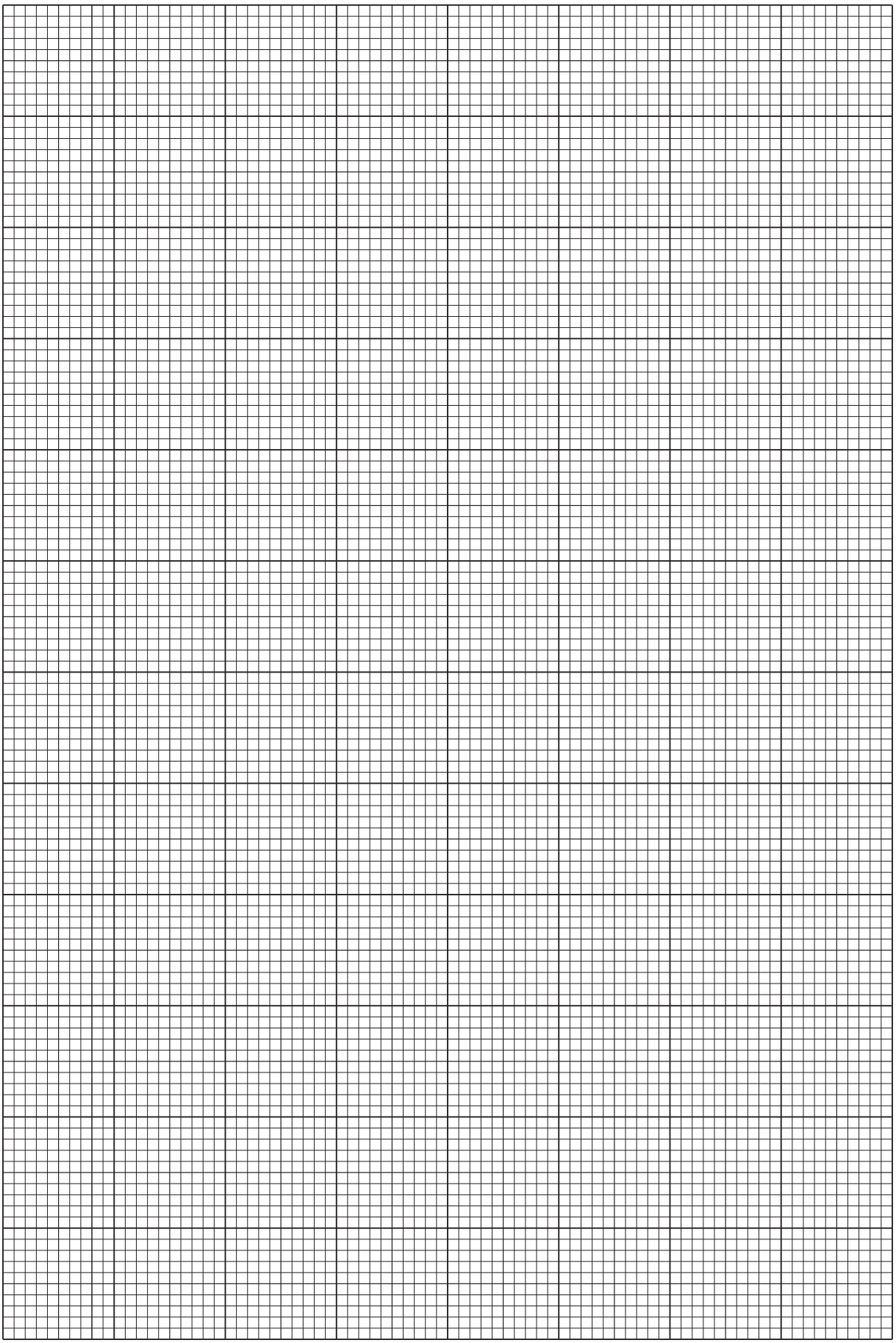
(c) **(i)** Plot a graph of $\frac{1}{T}$ on the y-axis against $\frac{1}{\sqrt{C}}$ on the x-axis. [3]

(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 T and C are related by the equation

$$\frac{1}{T} = \frac{a}{\sqrt{C}} + b$$

where a and b are constants.

Use your answers in **(c)(iii)** to determine the values of a and b.
Give appropriate units.

a = ...

b = ...
[2]

[Total: 20]

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

2 In this experiment, you will investigate the deformation of a foam ring.

(a) (i) ● Assemble the apparatus as shown in Fig. 2.1.
The wooden rod should pivot freely on the nail.

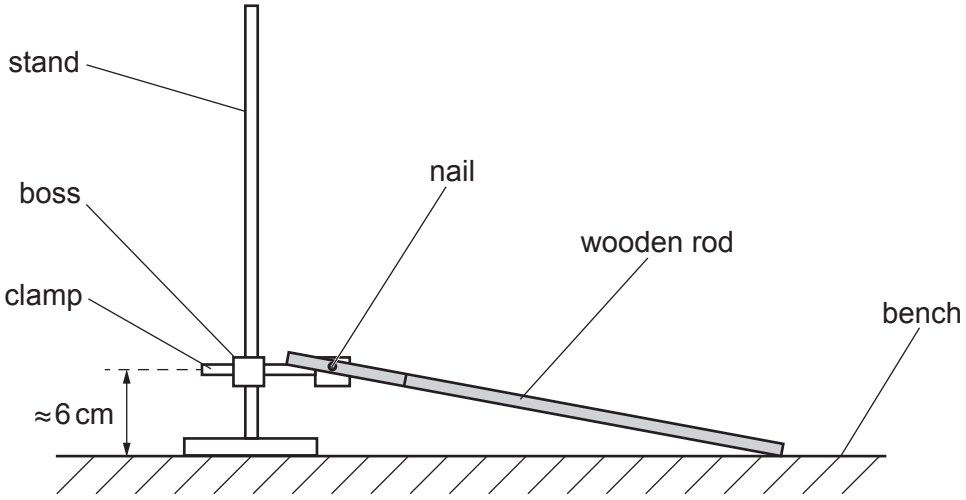


Fig. 2.1

- Take the **larger** of the two foam rings.
- Using the metre rule, measure and record the inner diameter D_1 and the outer diameter D_2, as shown in Fig. 2.2.

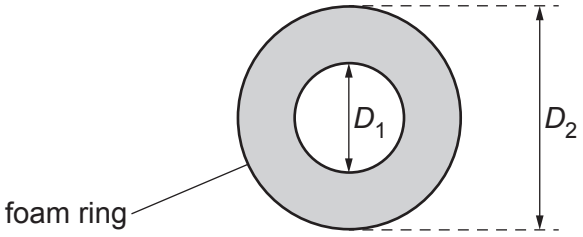


Fig. 2.2

D_1 = ... mm

D_2 = ... mm
[2]

(ii) Estimate the percentage uncertainty in your value of D_2. Show your working.

percentage uncertainty = ... [1]

(b) ● Position the ring under the line on the rod and centrally on the wooden block, as shown in Fig. 2.3.

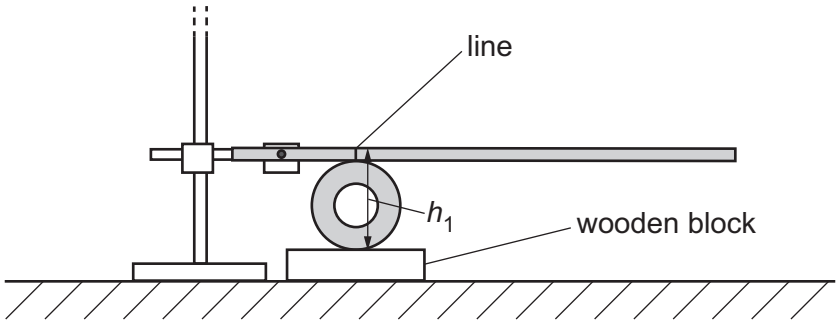


Fig. 2.3

- Adjust the height of the boss so that the rod is horizontal.
- The vertical distance, next to the ring, of the top of the rod above the block is h_1, as shown in Fig. 2.3.

  Using the calipers, measure and record h_1.

  h_1 = ... mm

- Place the slotted mass at the end of the rod, as shown in Fig. 2.4.

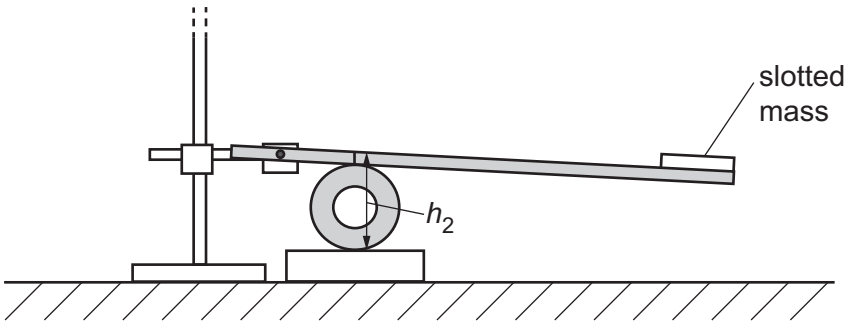


Fig. 2.4

- The vertical distance, next to the ring, of the top of the rod above the block is now h_2, as shown in Fig. 2.4.

  Measure and record h_2.

  h_2 = ... mm

- Calculate y where $y = h_1 - h_2$.

  y = ... mm
  [2]

(c) (i) The distance between the nail and the line is A and the distance between the nail and the centre of the slotted mass is B, as shown in Fig. 2.5.

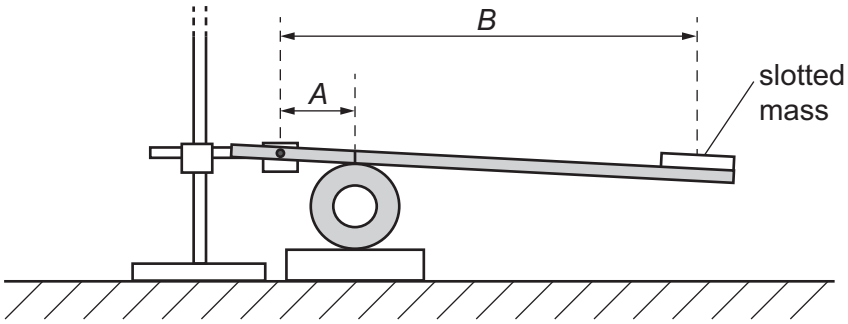


Fig. 2.5

Measure and record A and B.

A = ... cm

B = ... cm
[1]

(ii) Calculate the additional force F on the ring using

$$F = \frac{mgB}{A}$$

where $g = 9.81\,\text{N kg}^{-1}$ and $m = 0.100\,\text{kg}$.

F = ... N [1]

(iii) Justify the number of significant figures you have given for your value of F.

.....

.....

..... [1]

(d) ● Take the **smaller** of the two foam rings.

● Using the metre rule, measure and record the inner diameter D_1 and the outer diameter D_2.

D_1 = ... mm

D_2 = ... mm

● Repeat **(b)** using the smaller ring.

h_1 = ... mm

h_2 = ... mm

y = ... mm
[2]

(e) It is suggested that the relationship between D_1, D_2, F and y is

$$\frac{(D_2^2 - D_1^2)}{D_2^3} = \frac{kF}{y}$$

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. .....

.....

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. .....

.....

[4]

[Total: 20]

Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

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PHYSICS **9702/35**

Paper 3 Advanced Practical Skills 1 **May/June 2021**

2 hours

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Total	

This document has **12** pages.

[Turn over

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

1 In this experiment, you will investigate the motion of a pendulum bob.

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

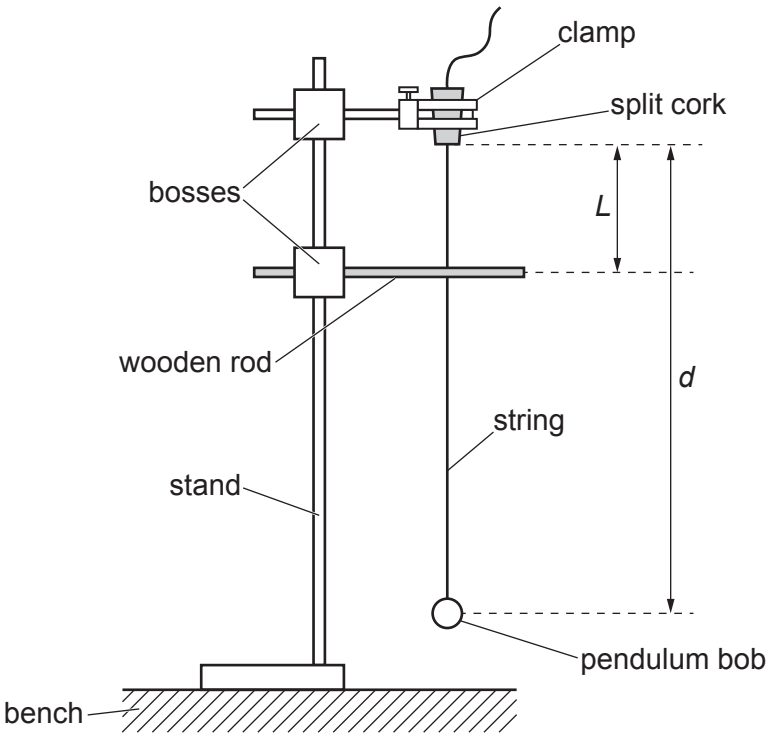


Fig. 1.1

● The distance between the bottom of the cork and the centre of the bob is *d*.

The distance between the bottom of the cork and the centre of the wooden rod is *L*.

Adjust the height of the rod until the value of *L* is approximately 10 cm. Ensure the rod is horizontal and the string is just touching the rod.

● Measure and record *L*.

L = ... [1]

(b) ● Adjust the string in the cork until the value of d is approximately 30 cm.

● Measure and record d.

d = ...

● Pull the bob towards you through a short distance at right angles to the rod.

● Release the bob. The bob will oscillate.

● Determine the period T of these oscillations.

T = ... s
[1]

(c) ● Write down your value of L from **(a)**.

L = ...

● Keeping L **constant**, repeat **(b)** with different values of d until you have five sets of values of d and T.

Record your results in a table. Include values of $\frac{T}{\sqrt{d}}$ and $\sqrt{\frac{(d-L)}{d}}$ in your table.

[10]

(d) **(i)** Plot a graph of $\frac{T}{\sqrt{d}}$ on the y-axis against $\sqrt{\frac{(d-L)}{d}}$ on the x-axis. [3]

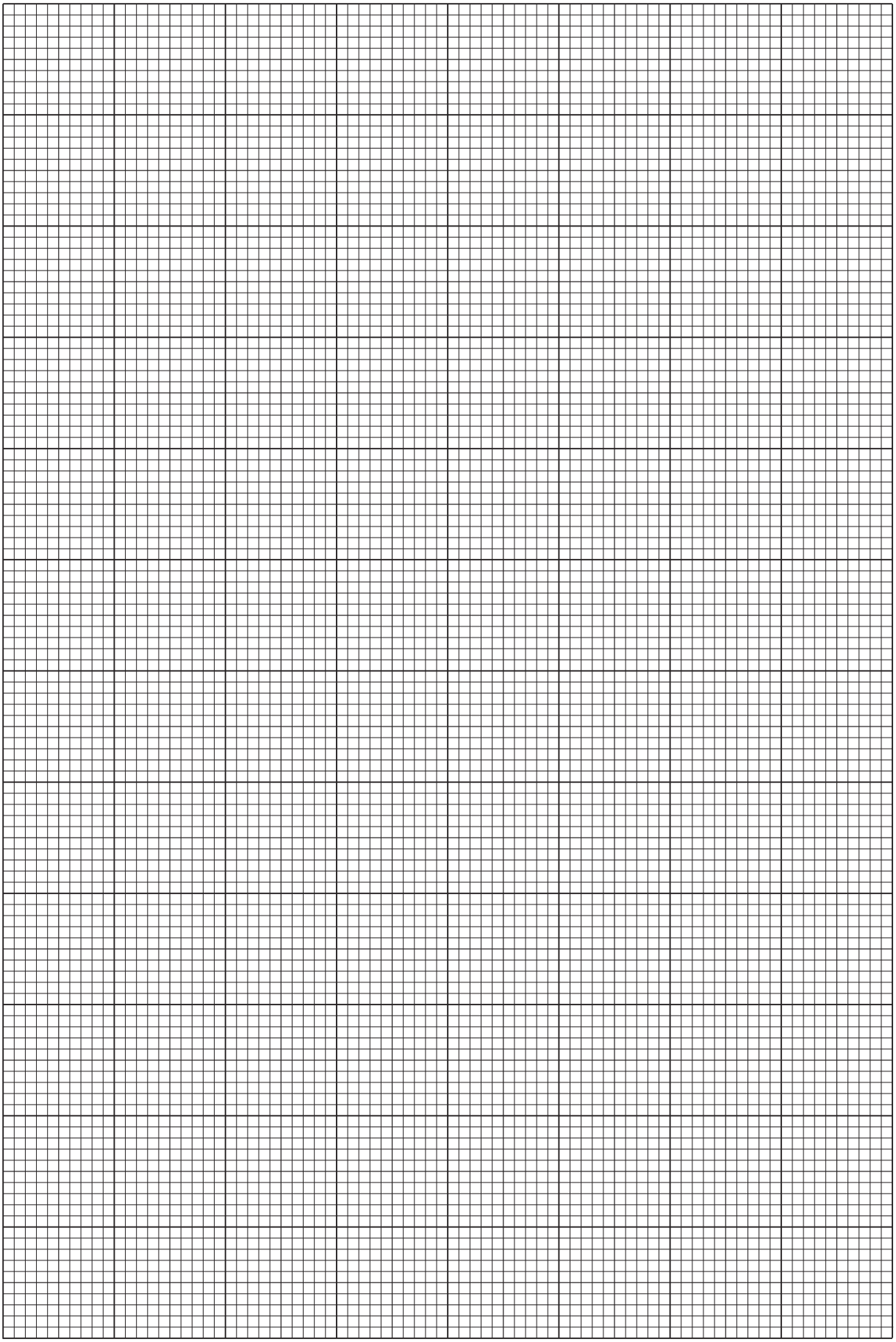
(ii) Draw the straight line of best fit. [1]

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

gradient = ...

y-intercept = ...

[2]



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

$$\frac{T}{\sqrt{d}} = P\sqrt{\frac{(d-L)}{d}} + Q$$

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]

[Total: 20]

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

2 In this experiment, you will investigate the equilibrium of a wooden strip.

(a) You have been provided with a wooden strip. There are three holes in the strip and string is attached to two of the holes.

- Press the modelling clay onto the end of the strip as shown in Fig. 2.1.

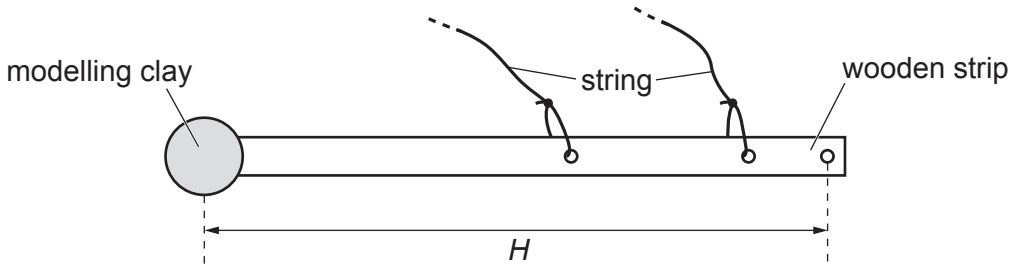


Fig. 2.1

- The distance between the centre of the modelling clay and the centre of the hole at the other end of the strip is *H*.

  Using the ruler, take measurements to determine *H*.

H = ... cm [1]

(b) (i) ● Set up the apparatus as shown in Fig. 2.2.

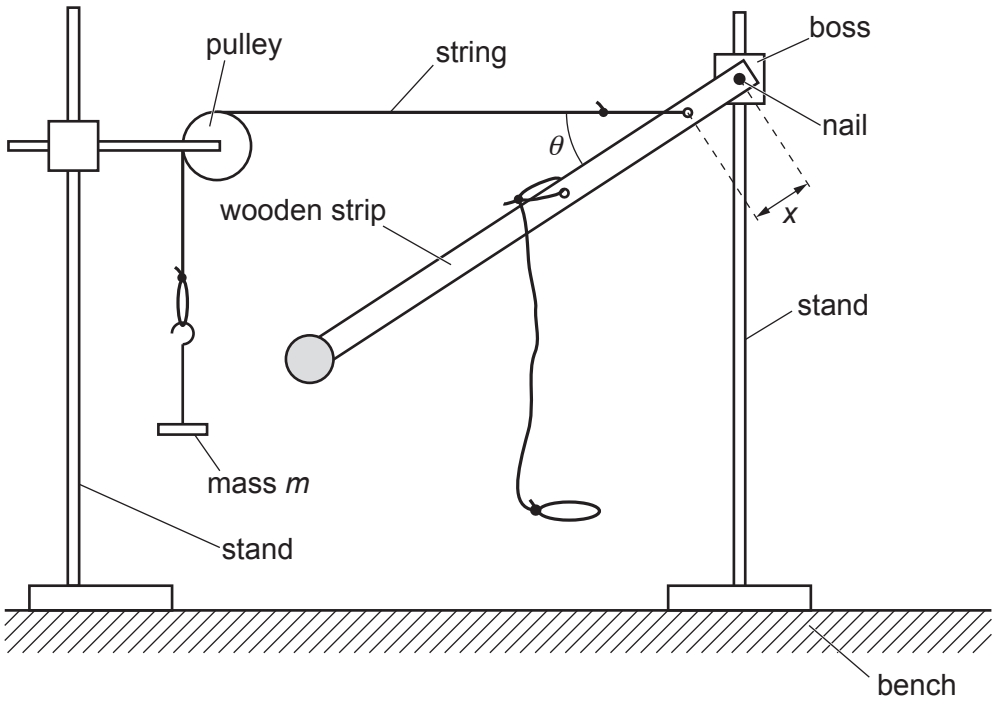


Fig. 2.2 (not to scale)

- Hang a mass m of 100 g from the string.
- Adjust the heights of the boss and pulley until the string between the strip and the pulley is horizontal.
- The distance between the nail and the hole through which the string is attached is x.

  The angle between the strip and the horizontal string is θ.

  Measure and record x and θ.

x = ... cm

θ = ... °

[2]

(ii) Estimate the percentage uncertainty in your value of θ. Show your working.

percentage uncertainty = ... [1]

(iii) Calculate $x \tan \theta$.

$x \tan \theta =$ ..... cm [1]

(iv) Justify the number of significant figures that you have given for your value of $x \tan \theta$.

.....

.....

..... [1]

(c) ● Remove the mass and the string from the pulley.

● Set up the apparatus as shown in Fig. 2.3 using the other string.

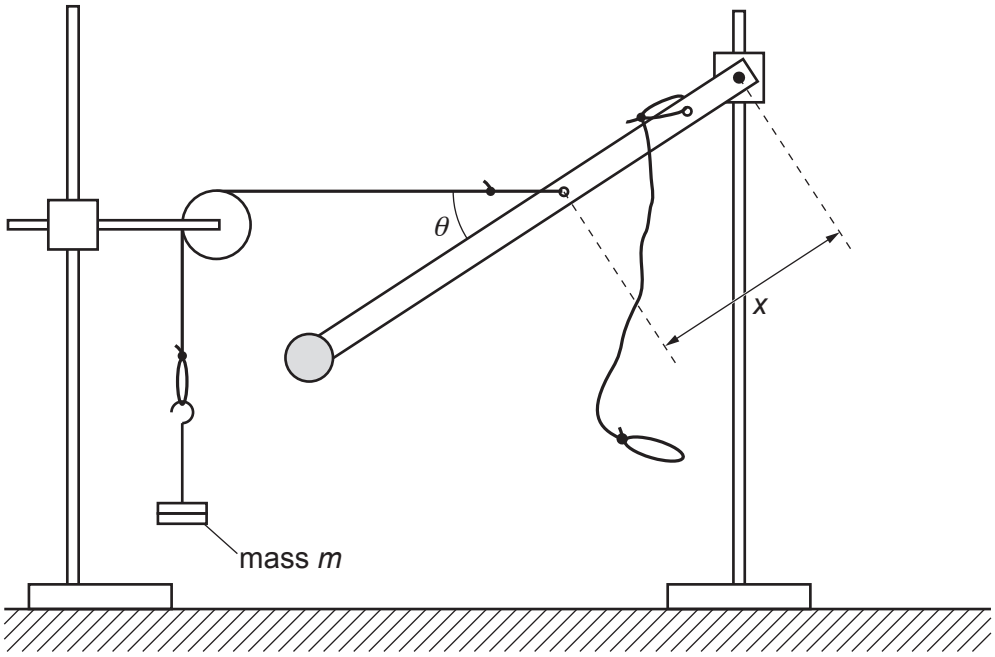


Fig. 2.3 (not to scale)

● Hang a mass m of 200 g from the string.

● Adjust the heights of the boss and pulley until the string between the strip and the pulley is horizontal.

● The distance between the nail and the hole through which the string is attached is x.

The angle between the strip and the horizontal string is θ.

Measure and record x and θ.

x = ... cm

θ = ... °

● Calculate $x \tan \theta$.

$x \tan \theta$ = ... cm

[3]

(d) It is suggested that the relationship between x, θ and m is

$$x \tan\theta = \frac{k}{m}$$

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

$$k = \frac{5HM}{6}$$

where M is the mass of the wooden strip.

Use your second value of k to calculate a value for M.
Give an appropriate unit.

M = ... [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. .....

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2. .....

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3. .....

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4. .....

.....

[4]

[Total: 20]