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 2023**

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.
- Do **not** use an erasable pen or correction fluid.
- 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 [ ].

For Examiner's Use	
1	
2	
Total	

This document has **12** pages.

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

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

You have been provided with a cylinder and a pendulum.

(a) ● Use adhesive putty to attach the string to the cylinder as shown in Fig. 1.1.

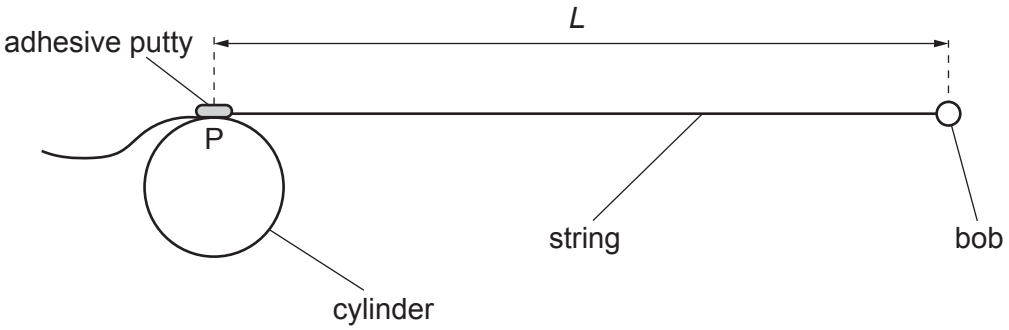


Fig. 1.1

● P is the point at which the string is attached to the cylinder.

The distance between P and the centre of the bob is *L*.

Adjust the adhesive putty and string so that *L* is approximately 45 cm.

● Measure and record *L*.

L = ... [1]

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

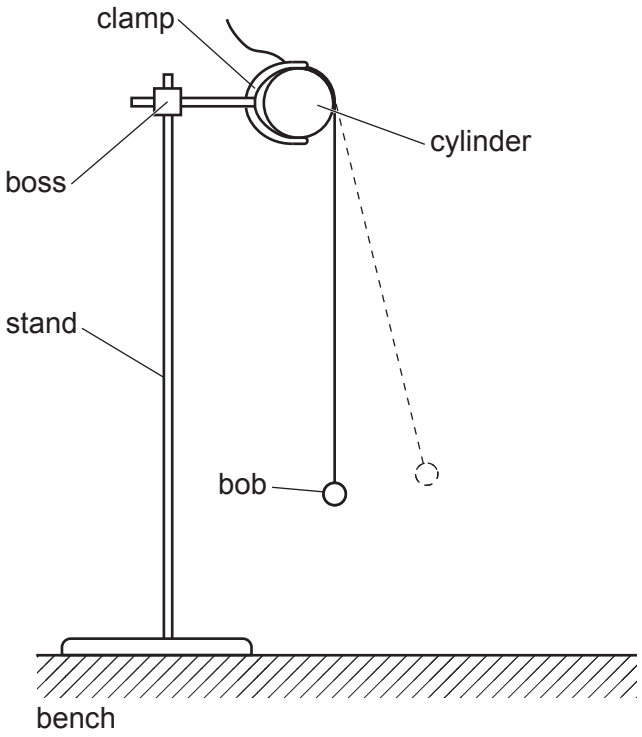


Fig. 1.2

- Move the bob a short distance **away** from the stand, as shown in Fig. 1.2.
- Release the bob. The bob will oscillate.
- Determine the period T of the oscillations of the bob.

T = ... [2]

(c) Change L by attaching a different point on the string to the cylinder and determine T. Repeat until you have six sets of values of L and T.

Record your results in a table. Include values of T^3 and L^2 in your table.

[9]

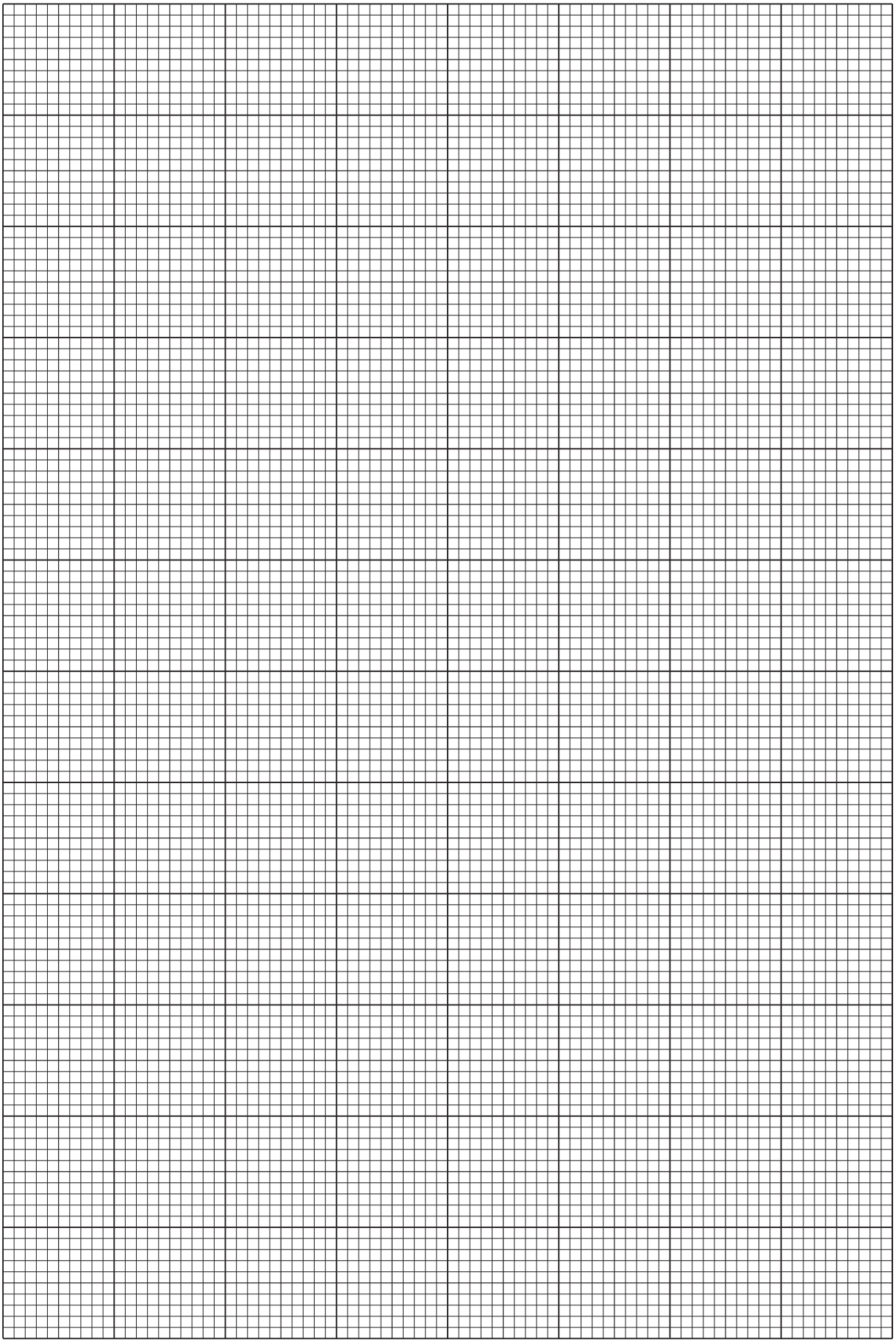
(d) **(i)** Plot a graph of T^3 on the y-axis against L^2 on the x-axis. [3]

(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 L are related by the equation

$$T^3 = EL^2 + F$$

where E and F are constants.

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

E = ...

F = ...
[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 card.

You have been provided with a card.

(a) The card has one edge of length h and another edge of length x, as shown in Fig. 2.1.

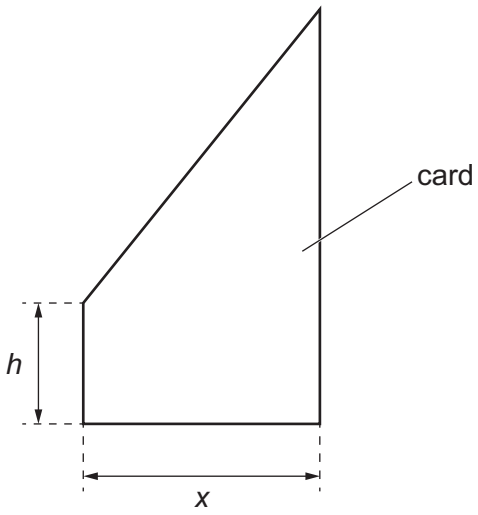


Fig. 2.1

(i) Measure and record h and x.

h = ... cm

x = ... cm
[1]

(ii) Calculate the area A of the card, where

$$A = hx + \frac{5x^2}{8}.$$

A = ...cm^2 [1]

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

.....

.....

..... [1]

(b) (i) ● Use the nail to make a hole close to one corner of the card, as shown in Fig. 2.2.

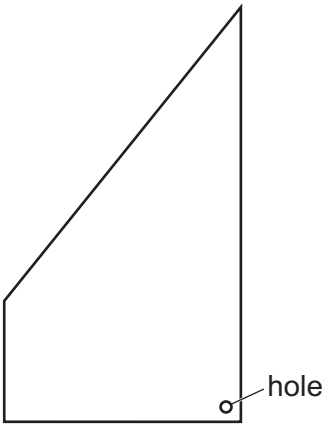


Fig. 2.2

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

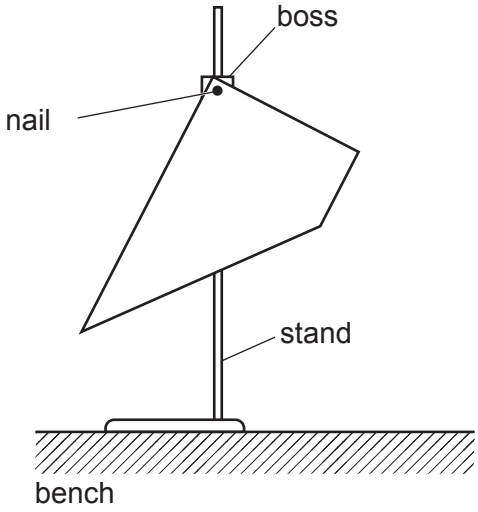


Fig. 2.3

● Push the nail through the hole in the card.

● Fix the nail in the boss.

● Ensure that the card swings freely from the nail.

● Use the set square and the ruler to draw a vertical line on the card below the nail.

● Repeat using **two** more holes close to two other corners of the card.

- Fig. 2.4 shows an example of the card with three lines drawn on it.

  The three lines cross at distances *c* and *d* from the two edges of the card shown in Fig. 2.4.

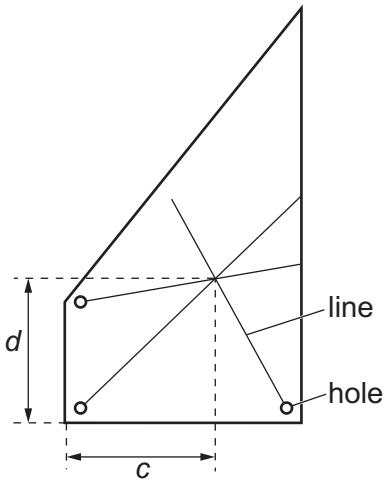


Fig. 2.4

Measure and record *c* and *d*.

c = ... cm

d = ... cm
[2]

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

percentage uncertainty = ... % [1]

(c) (i) ● Cut the card as shown in Fig. 2.5 so that x is approximately 9 cm.

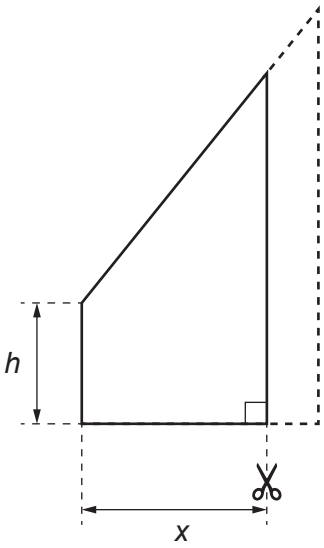


Fig. 2.5

● Measure and record x.

x = ... cm [1]

(ii) Repeat **(a)(ii)** and **(b)(i)**.

A = ... cm^2

c = ... cm

d = ... cm
[3]

(d) It is suggested that the relationship between c, A, h and x is

$$cA = \frac{hx^2}{2} + kx^3$$

where k is a constant.

Using your data, calculate two values of k.

first value of k = ...

second value of k = ...
[1]

(e) It is suggested that the percentage uncertainty in the values of k is 5%.

Using this uncertainty, explain whether your results support the relationship in **(d)**.

.....

.....

.....

..... [1]

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

For any uncertainties in measurement that you describe, you should state the quantity being measured and a reason for the uncertainty.

1 .....

.....

2 .....

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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 .....

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4 .....

.....

[4]

[Total: 20]

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 2023**

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.
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- You may use a calculator.
- You should show all your working and use appropriate units.

INFORMATION

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For Examiner's Use	
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 the oscillations of a pendulum.

(a) • Assemble the apparatus as shown in Fig. 1.1 with the nail held securely in the cork. Check that the wooden rod can swing freely.

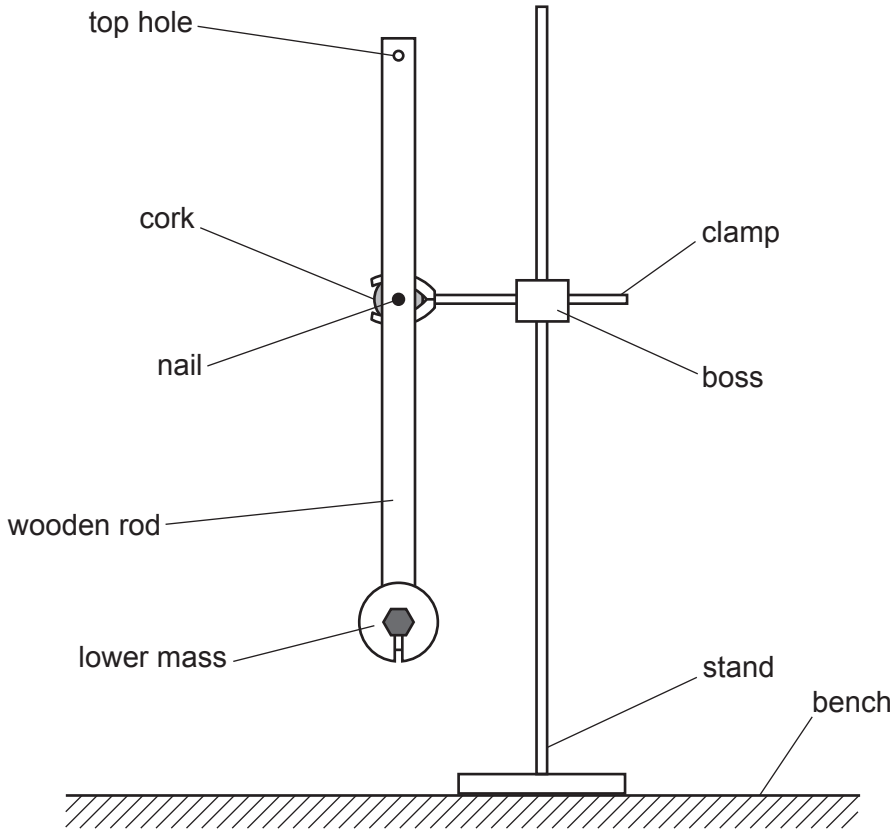


Fig. 1.1

- You have been provided with one 50 g and four 10 g slotted masses. Use the bolt and nut to attach some of the 10 g slotted masses to the top hole.
- Record the total mass M of the slotted masses that are attached to the top hole.

M = ...

- Push the bottom of the wooden rod a small distance to one side.
- Release the wooden rod so that it oscillates.
- Take measurements to determine the period T of the oscillations.

T = ...
[3]

(b) Change M and determine T. Repeat until you have six sets of values of M and T. Do **not** change the lower mass.

Record your results in a table. Include values of M^2 and T^2 in your table.

[9]

(c) **(i)** Plot a graph of T^2 on the y-axis against M^2 on the x-axis. [3]

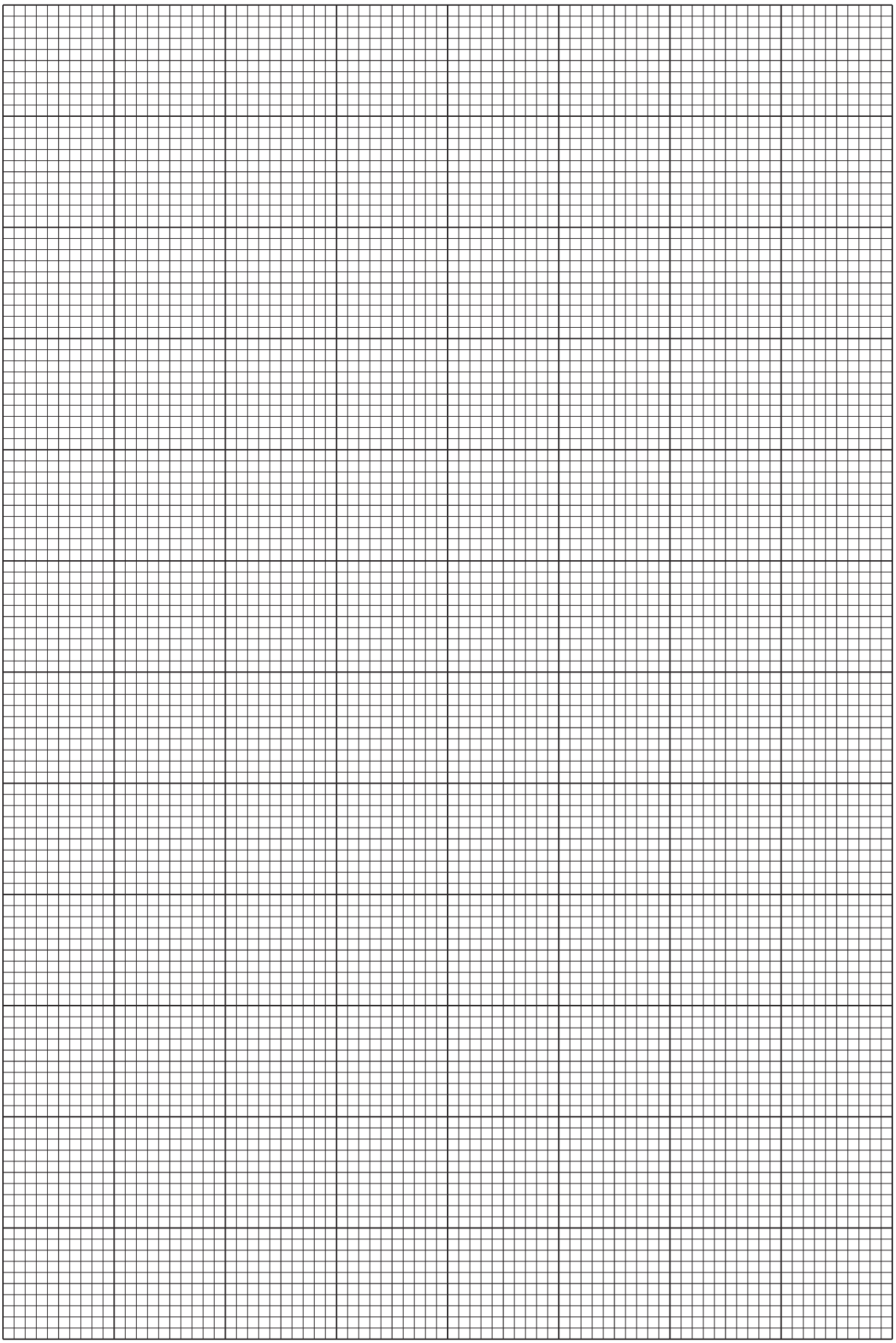
(ii) Draw the straight line of best fit. [1]

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

gradient = ...

y-intercept = ...

[2]



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

$$T^2 = aM^2 + b$$

where a and b are constants.

Using your answers in **(c)(iii)**, 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 thermal expansion of plastic.

(a) You have been provided with two plastic pipes. Each pipe has a string loop attached at each end, as shown in Fig. 2.1.

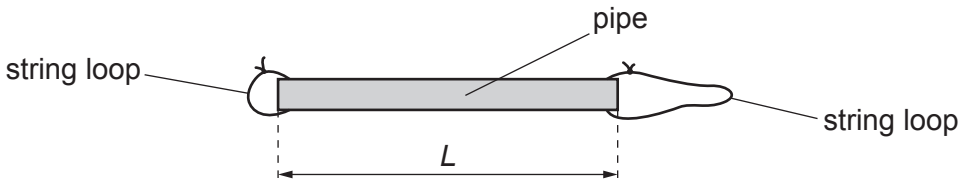


Fig. 2.1

- Measure and record the length L of the **longer** pipe, as shown in Fig. 2.1.

L = ...

- Place the thermometer on the bench. Record the room temperature T_0.

T_0 = ...
[2]

(b) **(i)** You have been provided with a wooden rod supported by a pin.

- Using the longer pipe, assemble the apparatus as shown in Fig. 2.2.

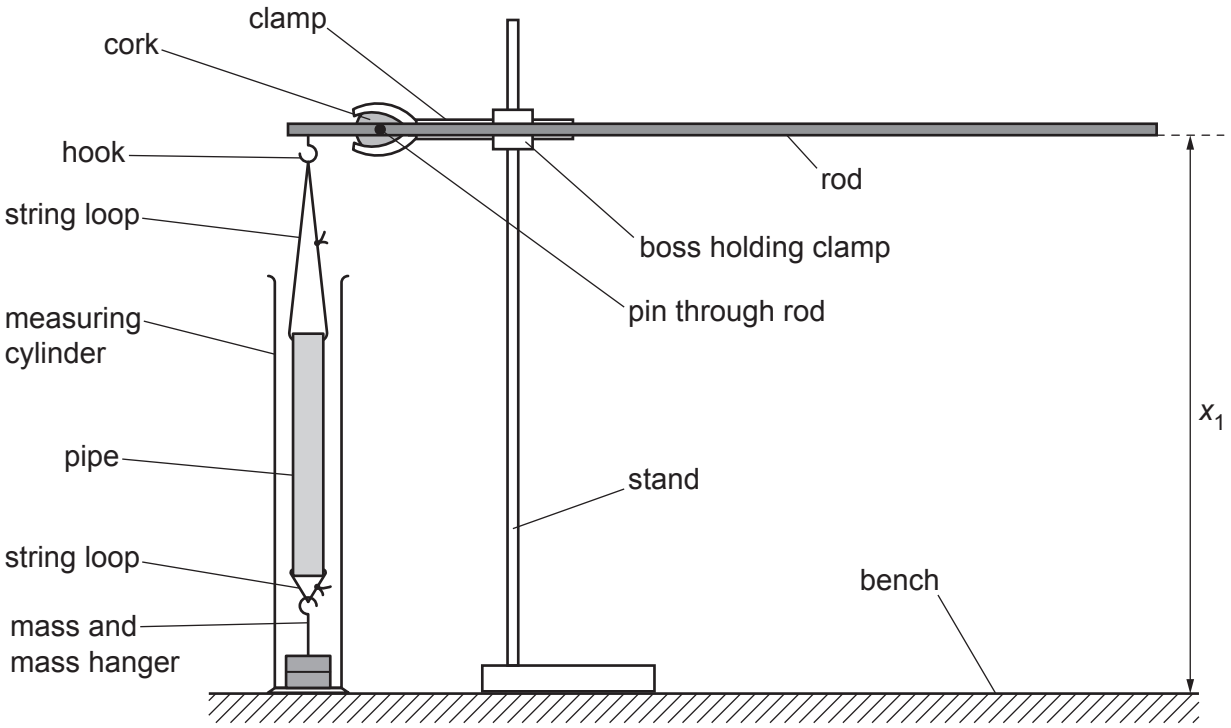


Fig. 2.2

- Adjust the apparatus so that the rod is parallel to the bench and the mass hanger rests on the bottom of the measuring cylinder.
- Measure and record the height x_1 of the end of the rod above the bench, as shown in Fig. 2.2.

x_1 = ... [1]

(ii)
- Slowly pour boiling water into the measuring cylinder until it covers the pipe.
- Place the thermometer in the water. Record the temperature T.

T = ...

- Remove the thermometer from the water.
- The expansion of the pipe causes the end of the rod to move down. Measure the new height x_2 of the end of the rod above the bench.

x_2 = ...

- Carefully remove the pipe and mass hanger (the masses will be very hot) and pour the hot water into the sink.

[2]

(iii) Calculate $(x_1 - x_2)$.

$(x_1 - x_2)$ = ... [1]

(iv) Estimate the percentage uncertainty in your value of $(x_1 - x_2)$. Show your working.

percentage uncertainty = ... % [1]

(c) • Measure and record the length L of the **shorter** pipe.

L = ...

• Repeat **(b)(i)**, **(b)(ii)** and **(b)(iii)** using the shorter pipe.

x_1 = ...

T = ...

x_2 = ...

$(x_1 - x_2)$ = ...
[2]

(d) It is suggested that the relationship between x_1, x_2, L, T and T_0 is

$$k(x_1 - x_2) = L(T - T_0)$$

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]

(e) It is suggested that the percentage uncertainty in the values of k is 20%.

Using this uncertainty, explain whether your results support the relationship in **(d)**.

.....

.....

.....

..... [1]

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

For any uncertainties in measurement that you describe, you should state the quantity being measured and a reason for the uncertainty.

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]

Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

PHYSICS **9702/35**

Paper 3 Advanced Practical Skills 1 **May/June 2023**

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.
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- You may use a calculator.
- You should show all your working and use appropriate units.

INFORMATION

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For Examiner's Use	
1	
2	
Total	

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

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

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

You have been provided with a metre rule with a wire attached.

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

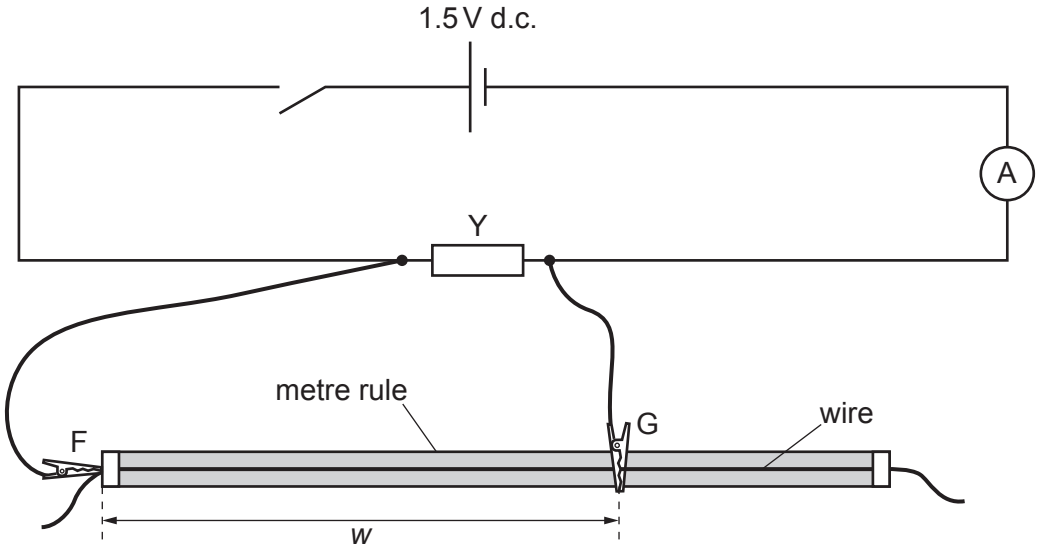


Fig. 1.1

- F and G are crocodile clips.

  The distance between F and G is *w*. Attach G to the wire so that *w* is approximately 70 cm.

- Close the switch.

- Record the value of *w* and the ammeter reading I_1.

w = ...

I_1 = ...

- Open the switch.

[1]

(b) ● Keep F and G in the **same** positions so that the value of *w* remains the **same**.

● Change some of the connecting leads to set up the circuit shown in Fig. 1.2.

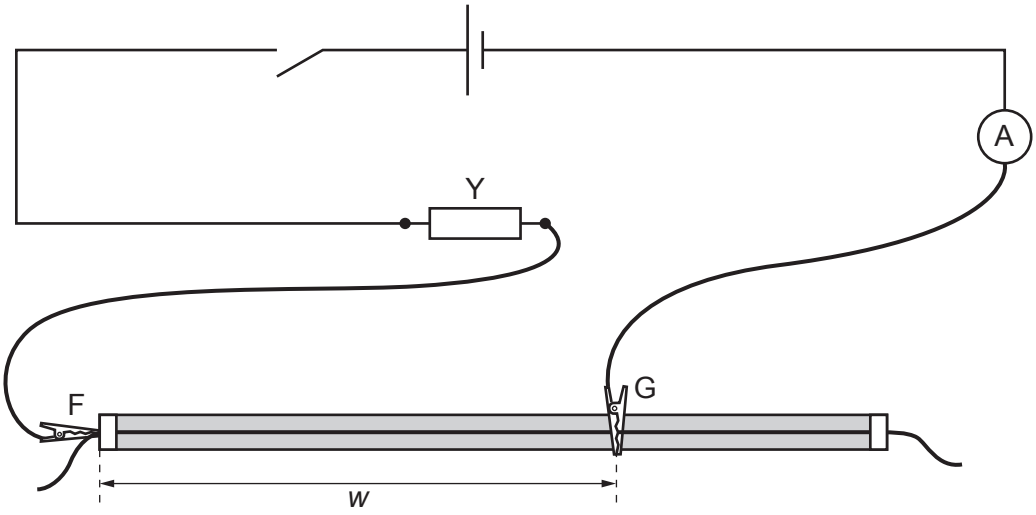


Fig. 1.2

● Close the switch.

● Record the ammeter reading I_2.

I_2 = ...

● Open the switch.

● Calculate $I_1 I_2$.

$I_1 I_2$ = ...
[1]

(c) Using values of w greater than 55 cm, change w by placing G at different positions on the wire and record I_1 and I_2.

Repeat until you have six sets of readings of w, I_1 and I_2. Include your values from **(a)** and **(b)**.

Record your results in a table. Include values of $I_1 I_2$ and $\frac{1}{w}$ in your table.

[10]

(d) (i) Plot a graph of $I_1 I_2$ on the y-axis against $\frac{1}{w}$ on the x-axis. [3]

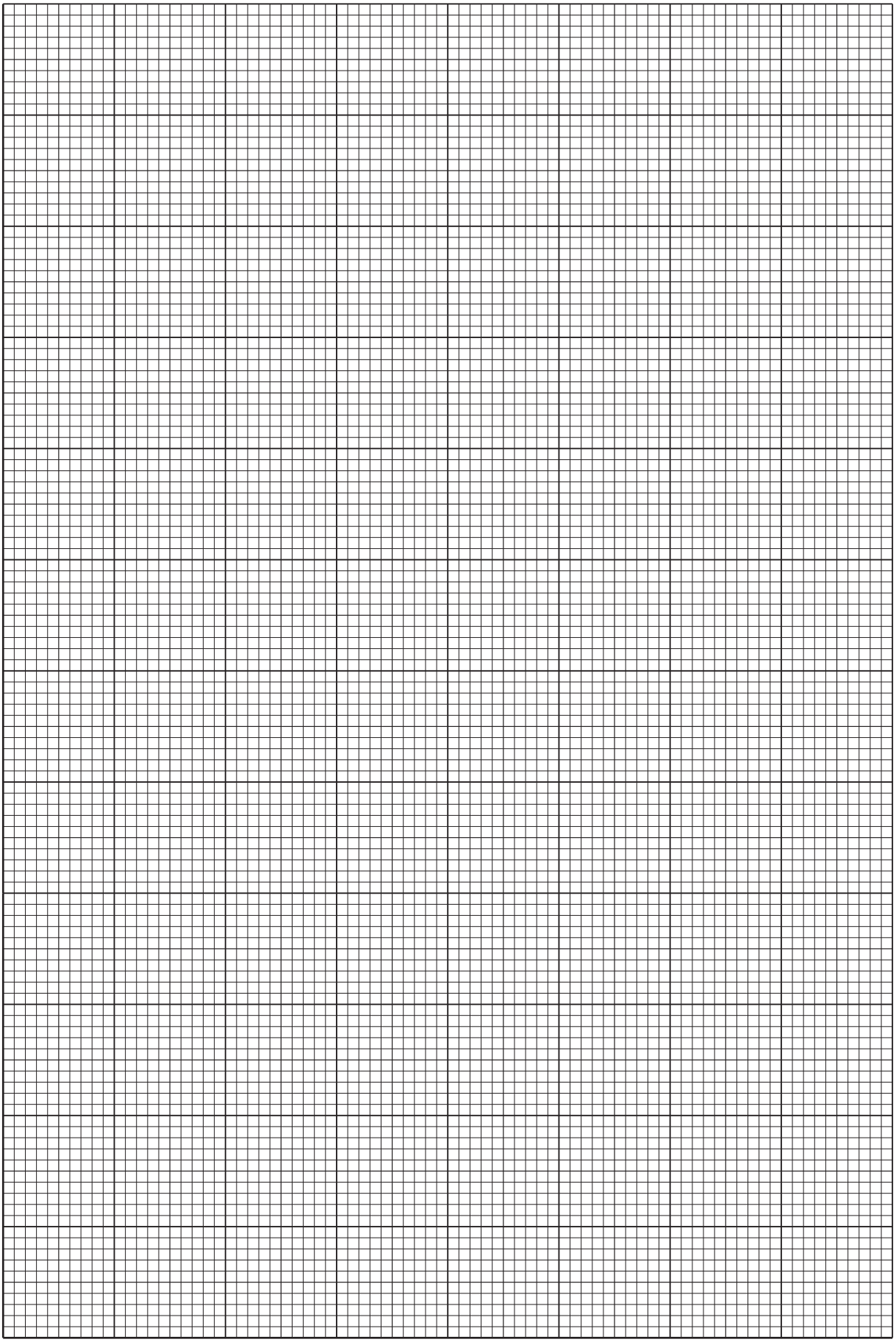
(ii) Draw the straight line of best fit. [1]

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

gradient = ...

y-intercept = ...

[2]



(e) It is suggested that the quantities I_1, I_2 and w are related by the equation

$$I_1 I_2 = \frac{P}{w} + Q$$

where P and Q are constants.

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

P = ...

Q = ...
[2]

[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.

You have been provided with two cylinders A and B.

(a) (i) The diameter of cylinder A is *D*, as shown in Fig. 2.1.

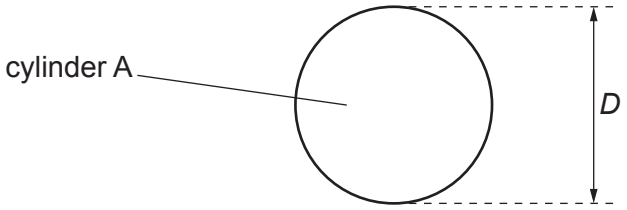


Fig. 2.1

Measure and record *D*.

D = ... [1]

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

percentage uncertainty = ... % [1]

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

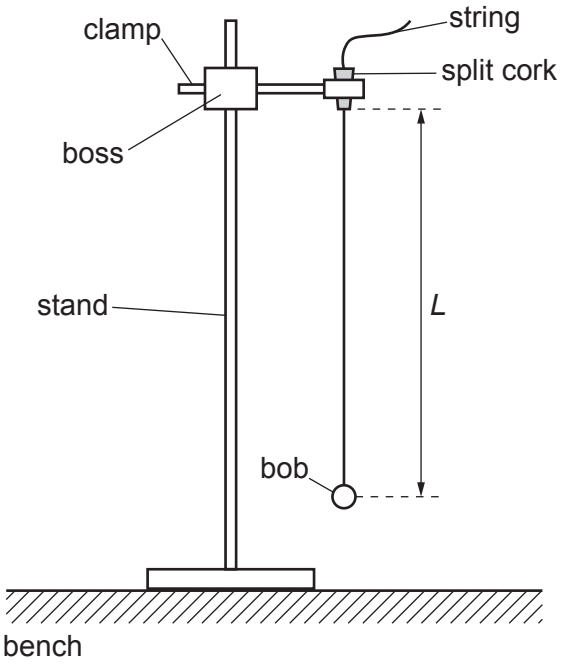


Fig. 2.2

● The distance between the bottom of the split cork and the centre of the bob is L.

Adjust the position of the string in the split cork until the value of L is approximately 50 cm.

● Measure and record L.

L = ...

● Move the bob through a short distance.

● Release the bob. The bob will oscillate.

● Determine the period T_1 of the oscillations of the bob.

T_1 = ...
[2]

(c) (i) ● Use adhesive putty to attach the string to cylinder A as shown in Fig. 2.3.

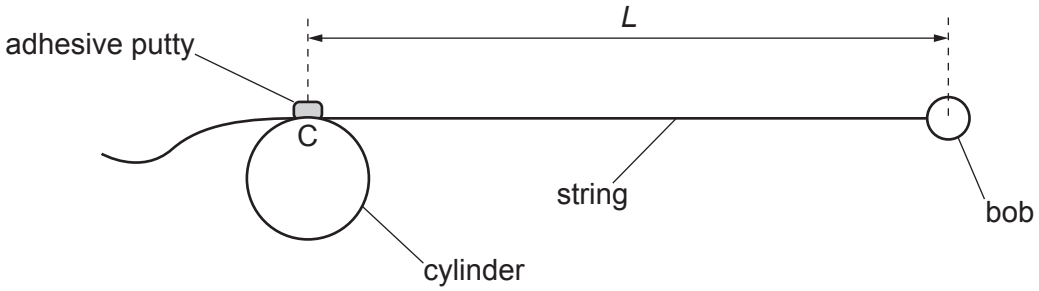


Fig. 2.3

● C is the point at which the string is attached to the cylinder.

Adjust the position of the adhesive putty until the distance between C and the centre of the bob is equal to your value of *L* from **(b)**.

● Set up the apparatus as shown in Fig. 2.4.

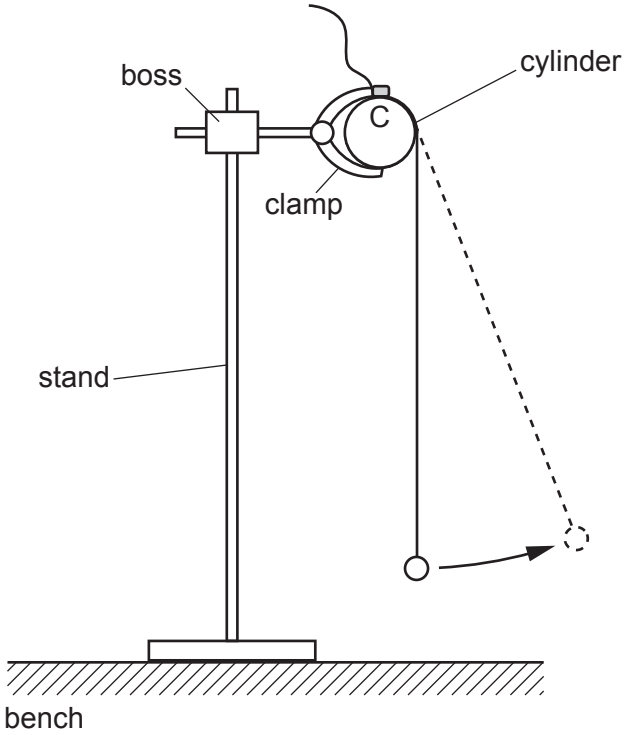


Fig. 2.4

- Move the bob a short distance **away** from the stand, as shown in Fig. 2.4.
- Release the bob. The bob will oscillate.
- Determine the period T_2 of the oscillations of the bob.

T_2 = ... [1]

(ii) Calculate $(T_1 - T_2)$.

$(T_1 - T_2)$ = ... [1]

(d) Using cylinder B and a value of L of approximately 40 cm, repeat **(a)(i)**, **(b)** and **(c)**.

D = ...

L = ...

T_1 = ...

T_2 = ...

$(T_1 - T_2)$ = ...
[3]

(e) It is suggested that the relationship between T_1, T_2, D and L is

$$(T_1 - T_2) = \frac{kD}{L}$$

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]

(f) It is suggested that the percentage uncertainty in the values of k is 10%.

Using this uncertainty, explain whether your results support the relationship in **(e)**.

.....

.....

.....

..... [1]

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

For any uncertainties in measurement that you describe, you should state the quantity being measured and a reason for the uncertainty.

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]