



Cambridge International AS & A Level

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PHYSICS

9702/31

Paper 3 Advanced Practical Skills 1

May/June 2025

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 [].

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

- 1** In this experiment, you will investigate the oscillation of masses on springs.

You have been provided with masses and springs.

Set up the apparatus as shown in Fig. 1.1.

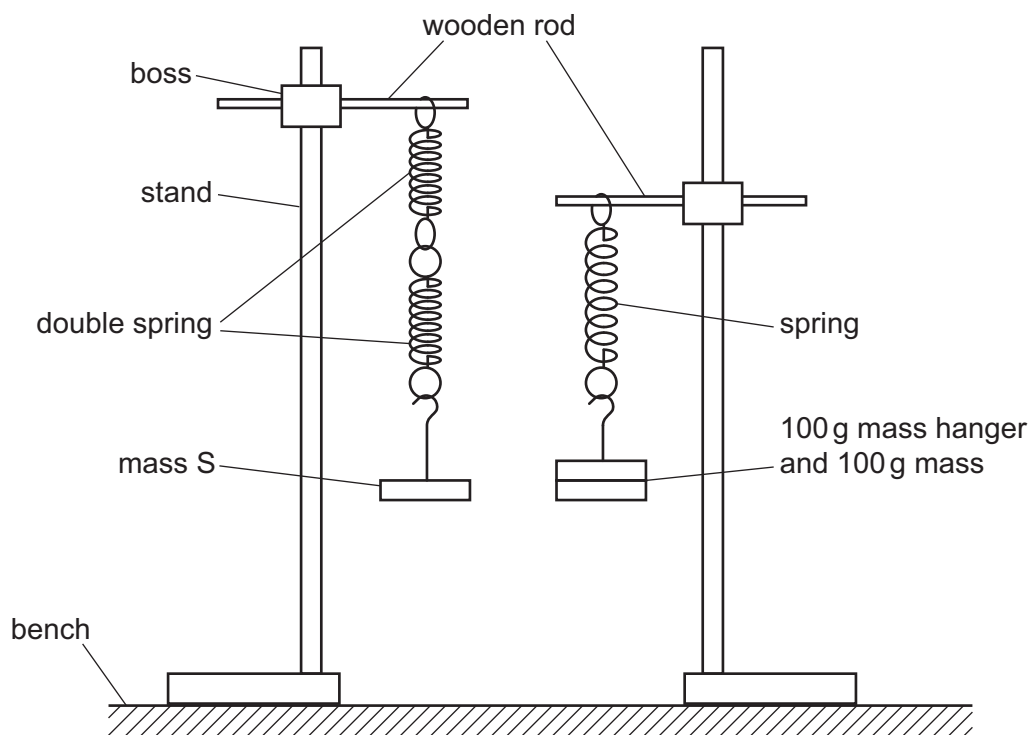


Fig. 1.1

- (a)**
- Ensure the bottoms of both masses are at the same level.
 - Pull both masses down through a short distance and release them at the same time.
 - Watch the oscillations of the masses. The masses initially oscillate in phase, then out of phase and then back in phase.
 - The number of oscillations of mass S from release until the masses are back in phase for the first time is n_0 .

Determine and record n_0 .

$$n_0 = \dots\dots\dots [2]$$





(b) (i) • Add a mass of 30 g to mass S. The added mass is M .

- Record M .

$M = \dots\dots\dots$

- Repeat (a). The number of oscillations of mass S from release until the masses are back in phase for the first time is n .

- Determine and record n .

$n = \dots\dots\dots$ [1]

(ii) Calculate N , where

$$N = n_0 - n.$$

$N = \dots\dots\dots$ [1]





- (c) Vary M by changing the number of 10g masses added to mass S and determine n . Do **not** use $M = 0$.

Repeat until you have five sets of values of M and n .

Record your results in a table. Include values of N . Also include values of N^3 to three significant figures.

[8]

- (d) (i) Plot a graph of N^3 on the y -axis against M on the x -axis.

[3]

- (ii) Draw the straight line of best fit.

[1]

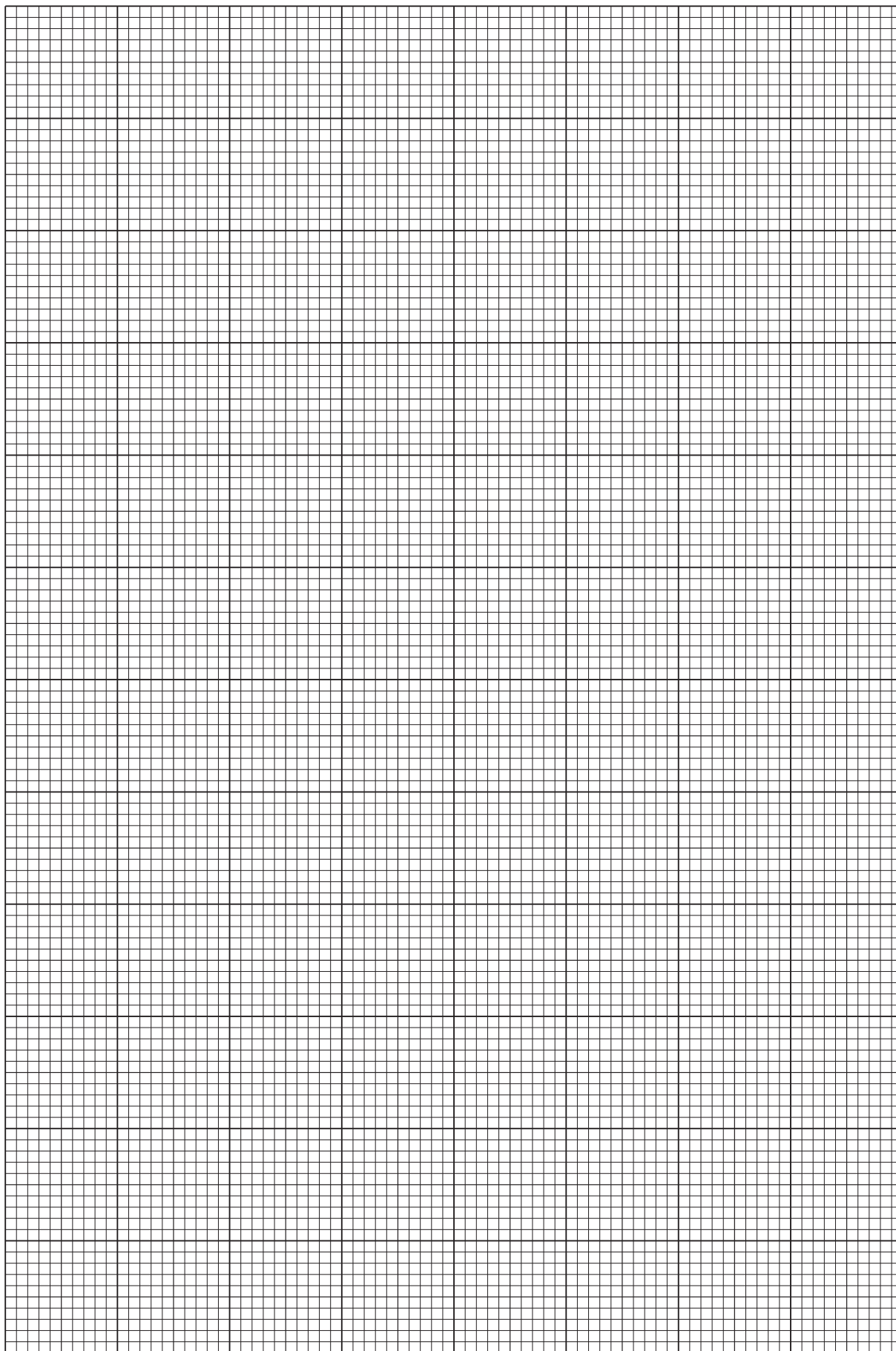
- (iii) Determine the gradient and y -intercept of this line.

gradient = ...

y -intercept = ...

[2]







(e) It is suggested that the quantities N and M are related by the equation

$$N^3 = PM + Q$$

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 behaviour of paper on water.

You have been provided with two sheets of tracing paper.

- (a)
- On one of the sheets of tracing paper, draw two identical rectangles as shown in Fig. 2.1 where $c = 4.0 \text{ cm}$ and $d = 6.0 \text{ cm}$. The orientation of the rectangles must be as shown in Fig. 2.1.
 - Add labels A and B to the rectangles, as shown in Fig. 2.1.

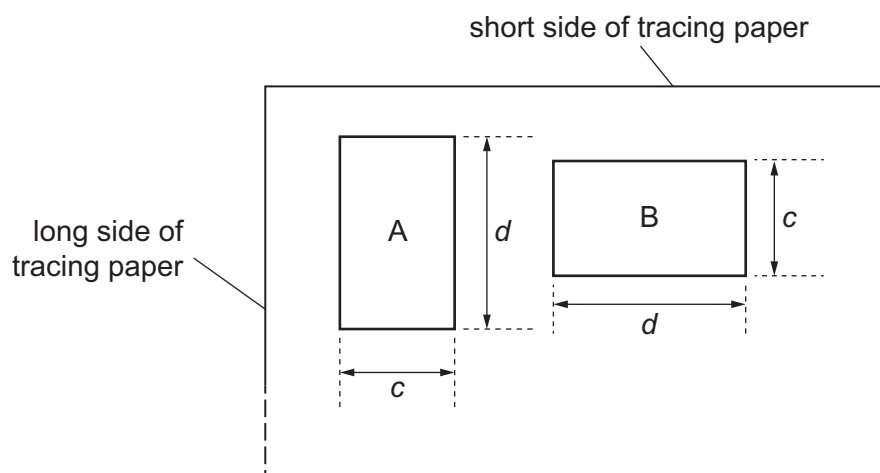


Fig. 2.1

- Use the scissors to cut out the rectangles.
- Take measurements to determine the average value of d .

$d = \dots\dots\dots \text{ cm [1]}$





- (b) (i) • When A is placed flat on the surface of the water in one of the bowls, the shape will curl up as shown in Fig. 2.2. Two edges of the paper will curl and then meet.

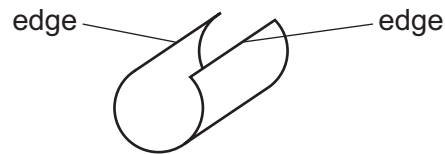


Fig. 2.2

The time between placing A on the water and the two edges meeting is T_A .

- Place A flat on the water.
- Determine T_A .

$$T_A = \dots\dots\dots$$

- Remove A from the water and place it in the empty bowl.

[2]

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

$$\text{percentage uncertainty} = \dots\dots\dots \% [1]$$

- (c) (i) • Repeat the procedure in (b)(i) for B. The time between placing B on the water and the two edges meeting is T_B .

$$T_B = \dots\dots\dots$$

- Remove B from the water.
- Compare your values of T_A and T_B . Record the longer time.

$$\text{longer time} = \dots\dots\dots [1]$$





(ii) The quantity W is given by

$$W = \frac{\text{longer time}}{\text{shorter time}}$$

Calculate W .

$$W = \dots\dots\dots [1]$$

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

.....

.....

..... [1]

(d) Repeat (a), (b)(i), (c)(i) and (c)(ii) using new rectangles with $c = 4.0$ cm and $d = 9.0$ cm.

$$d = \dots\dots\dots \text{ cm}$$

$$T_A = \dots\dots\dots$$

$$T_B = \dots\dots\dots$$

$$\text{longer time} = \dots\dots\dots$$

$$W = \dots\dots\dots [3]$$





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

$$W^2 = kd$$

where k is a constant.

Using your data, calculate **two** values of k .

first value of k = ...

second value of k = ...

[1]

- (f) 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 (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.

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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.

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[4]

[Total: 20]





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Cambridge International AS & A Level

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PHYSICS

9702/32

Paper 3 Advanced Practical Skills 2

May/June 2025

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 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.

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1 In this experiment, you will investigate a light-dependent resistor (LDR).

(a) • Connect the circuit shown in Fig. 1.1.

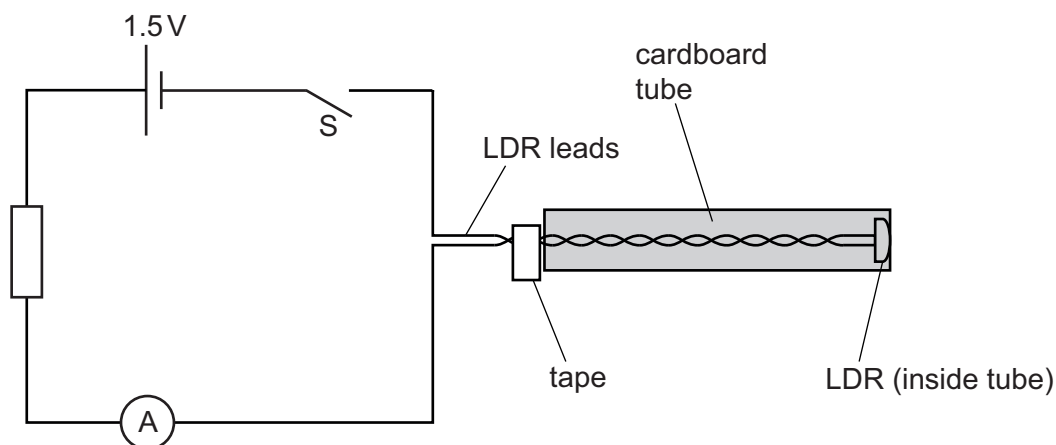


Fig. 1.1

- Ensure that the switch S is open.
- Slide the LDR leads into the tube until the front of the LDR is just level with the open end of the tube, as shown in Fig. 1.1.
- With the LDR in this position, attach a piece of adhesive tape to the leads as a marker at the other end of the tube, as shown in Fig. 1.1.
- Slide the tube until the LDR is approximately half-way along it, as shown in Fig. 1.2.

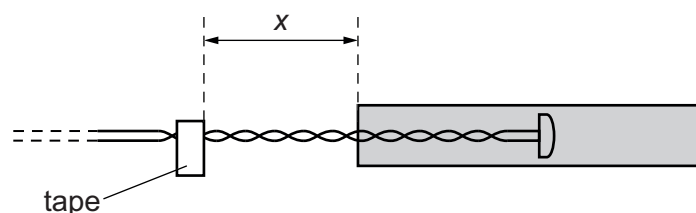


Fig. 1.2





- The distance between the tape and the tube is x .

Measure and record x .

$x =$

- Close S and record the ammeter reading I .

$I =$

- Open S.

[2]





- (b) Change x by moving the LDR to a new position inside the tube, with x in the range 4 cm to 18 cm. Record x and I .

Repeat until you have six sets of values of x and I .

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

[10]

- (c) (i) Plot a graph of $\sqrt{I}$ on the y -axis against x on the x -axis.

[3]

- (ii) Draw the straight line of best fit.

[1]

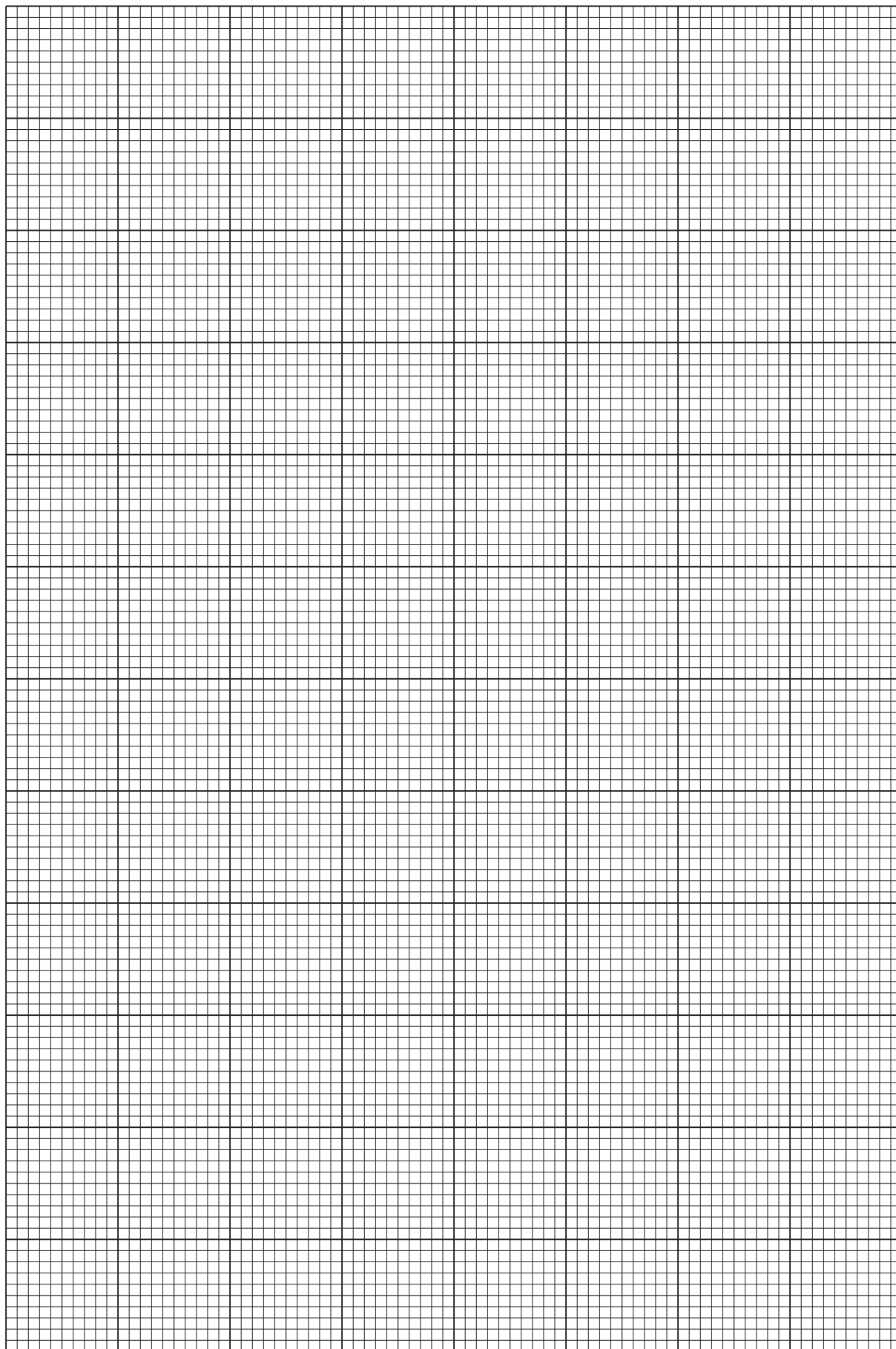
- (iii) Determine the gradient and y -intercept of this line.

gradient = ...

y -intercept = ...

[2]







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

$$\sqrt{I} = ax + b$$

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 elastic properties of rubber cord.

- (a) (i) You are provided with a wire with a clip and two slotted masses attached, as shown in Fig. 2.1.

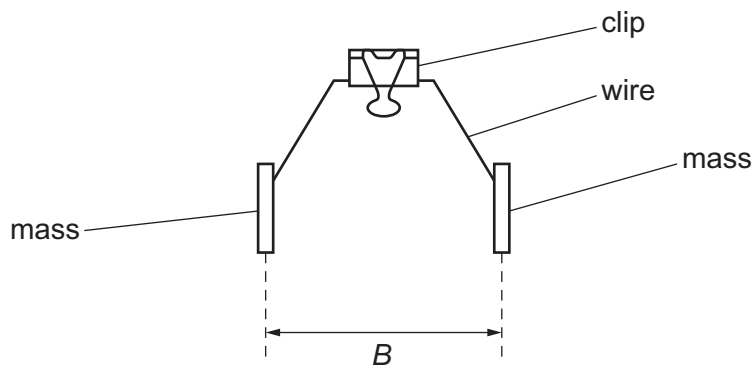


Fig. 2.1

The distance between the centres of the two slotted masses is B , as shown in Fig. 2.1.

Measure and record B .

$B = \dots\dots\dots$ [1]

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

percentage uncertainty = $\dots\dots\dots\%$ [1]





- (b) (i) • You are provided with two lengths of rubber cord. Select the **longer** cord.
- The diameter of the cord is d .

Measure and record d .

$d = \dots\dots\dots$ [1]

- (ii) • Suspend the clip, wire and masses using the **longer** cord secured in the two clips, as shown in Fig. 2.2.

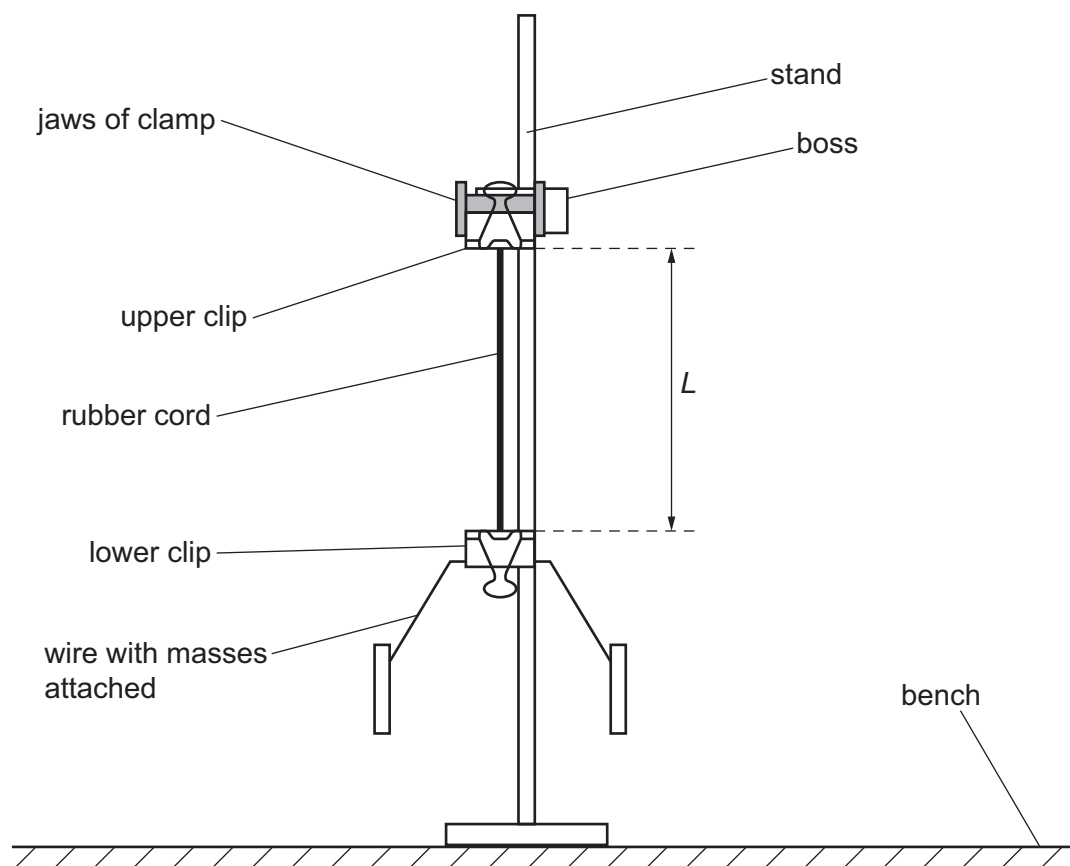


Fig. 2.2 (not to scale)

- The length of cord between the two clips is L , as shown in Fig. 2.2.

Measure and record L .

$L = \dots\dots\dots$ [1]





- (iii) • Keeping the cord vertical, rotate the lower clip through approximately 180° and release the clip. The clip will rotate with a small number of oscillations.
- Take measurements to determine the period T of these oscillations.

$T = \dots\dots\dots$ s [2]

(c) Using the **shorter** length of rubber cord, repeat (b).

$d = \dots\dots\dots$

$L = \dots\dots\dots$

$T = \dots\dots\dots$ s
[3]





- (d) It is suggested that the relationship between T , B , L and d is

$$T^2 = \frac{B^2 L}{k d^4}$$

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.

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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.

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[4]

[Total: 20]





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PHYSICS**9702/33**

Paper 3 Advanced Practical Skills 1

May/June 2025**2 hours**

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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)** • Set up the circuit shown in Fig. 1.1.

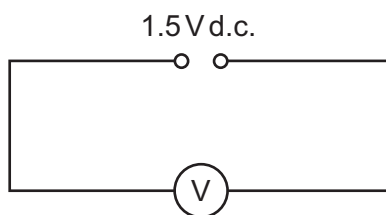


Fig. 1.1

- Record the voltmeter reading E .

$E =$ [1]



(b) You have been provided with a metre rule with a wire attached. You have also been provided with two identical resistors placed in component holders, each labelled R.

- Set up the circuit shown in Fig. 1.2.

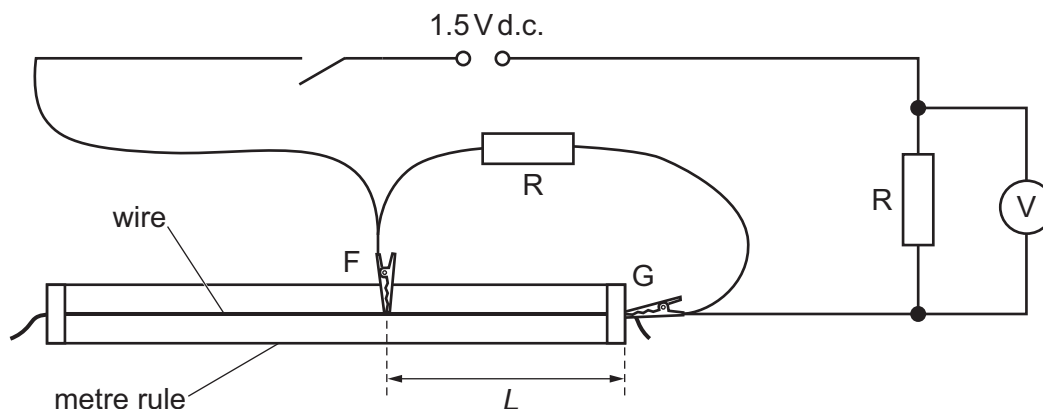


Fig. 1.2

- F and G are crocodile clips.

The distance between F and G is L . Attach F and G to the wire so that L is approximately 30 cm.

- Close the switch.
- Record the value of L and the voltmeter reading V .

$L =$

$V =$

- Open the switch.

[1]





- (c) • Write down the value of E from (a).

$E =$

- **Increase** L by changing the position of F on the wire. Record L and V and repeat until you have six sets of values of L and V . Include your values from (b).

Record your results in a table. Include values of $\frac{E - V}{L}$ in your table.

[9]

- (d) (i) Plot a graph of $\frac{E - V}{L}$ on the y-axis against V on the x-axis.

[3]

- (ii) Draw the straight line of best fit.

[1]

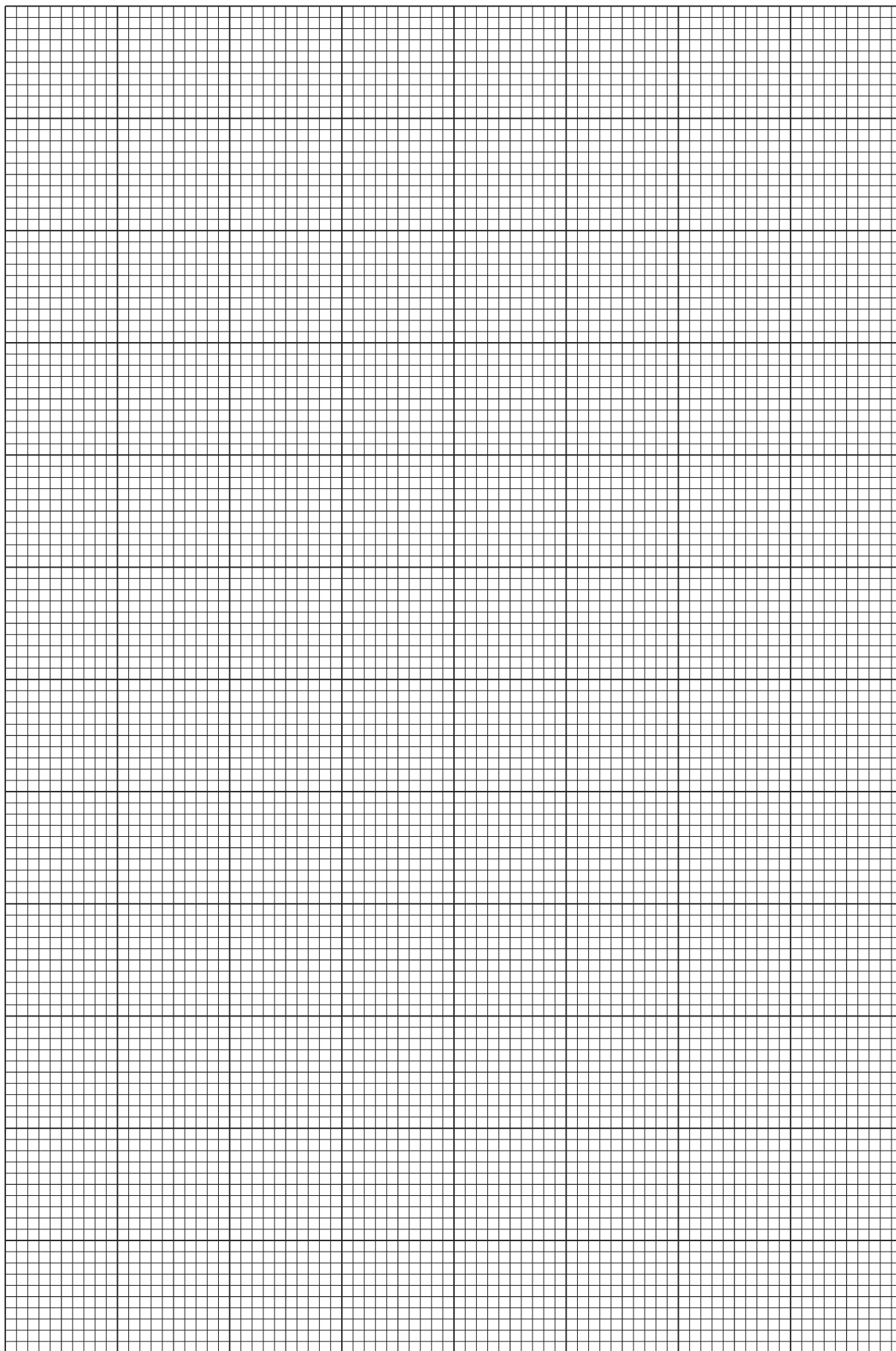
- (iii) Determine the gradient and y-intercept of this line.

gradient = ...

y-intercept = ...

[2]







(e) It is suggested that the quantities V and L are related by the equation

$$\frac{E - V}{L} = PV - Q$$

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) The resistance of R is R .

Theory suggests that:

- P and Q are both inversely proportional to R
- the graph cuts the x -axis at a value of $V = \frac{E}{2}$ for all values of R .

A student repeats the experiment using two identical resistors, each with a lower value of R than in the original experiment.

For the student's 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 chain of paper clips.

You have been provided with two spheres of modelling clay.

- (a) (i) The diameter of the **smaller** sphere is d , as shown in Fig. 2.1.

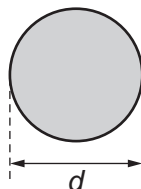


Fig. 2.1

Measure and record d .

$d =$ [1]

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

percentage uncertainty = ...% [1]





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

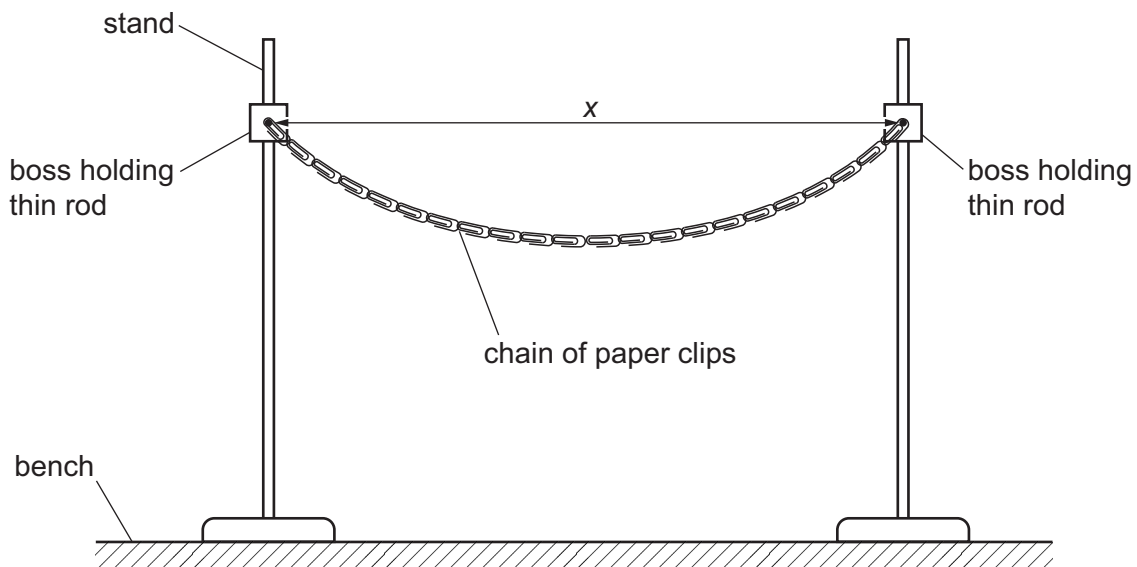


Fig. 2.2

- Ensure that the rods are the same height above the bench.
- Slide the paper clips at the ends of the chain onto the rods.
- The distance between the centres of the rods is x .
Position the stands so that x is approximately 70 cm.
- Measure and record x .

$x = \dots\dots\dots$ cm [1]



- (ii) • Use the hook to attach the **smaller** sphere of modelling clay to the chain of paper clips as shown in Fig. 2.3.

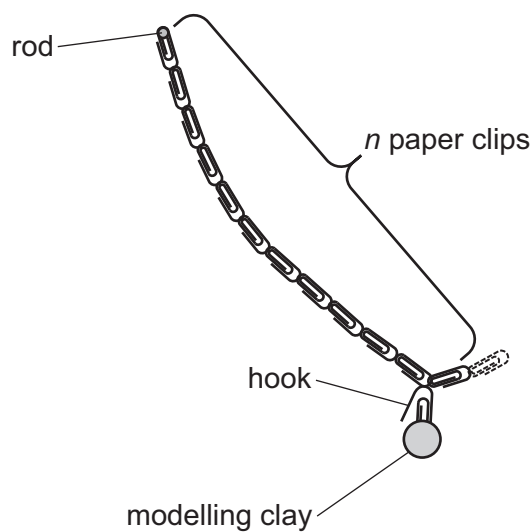


Fig. 2.3

- The number of paper clips between the hook and the end of the chain is n , as shown in Fig. 2.3.

Place the hook so that n is 11.

- Calculate N , where

$$N = \sqrt[3]{n^2}.$$

Give your answer to three significant figures.

$$N = \dots\dots\dots [1]$$

- (c) • Pull the sphere towards you through a short distance. When the sphere is released, it will oscillate.
- Take measurements to determine the period T of these oscillations.

$$T = \dots\dots\dots [2]$$





- (d) • Roll the two spheres into one larger sphere.
- Measure and record the diameter d of the larger sphere.

$d =$

- Repeat **(b)** and **(c)** with a value x of approximately 80 cm and with the hook placed so that n is 7.

$x =$ cm

$N =$

$T =$ [3]





- (e) It is suggested that the relationship between T , d , N and x is

$$T^2 = \frac{kdN}{x^2}$$

where k is a constant.

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

first value of k = ...

second value of k = ... [1]

- (ii) 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 15%.

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.

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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.

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[Total: 20]

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Cambridge International AS & A Level

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PHYSICS

9702/34

Paper 3 Advanced Practical Skills 2

May/June 2025

2 hours

You must answer on the question paper.

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INSTRUCTIONS

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

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

(a) (i) • Assemble the apparatus as shown in Fig. 1.1.

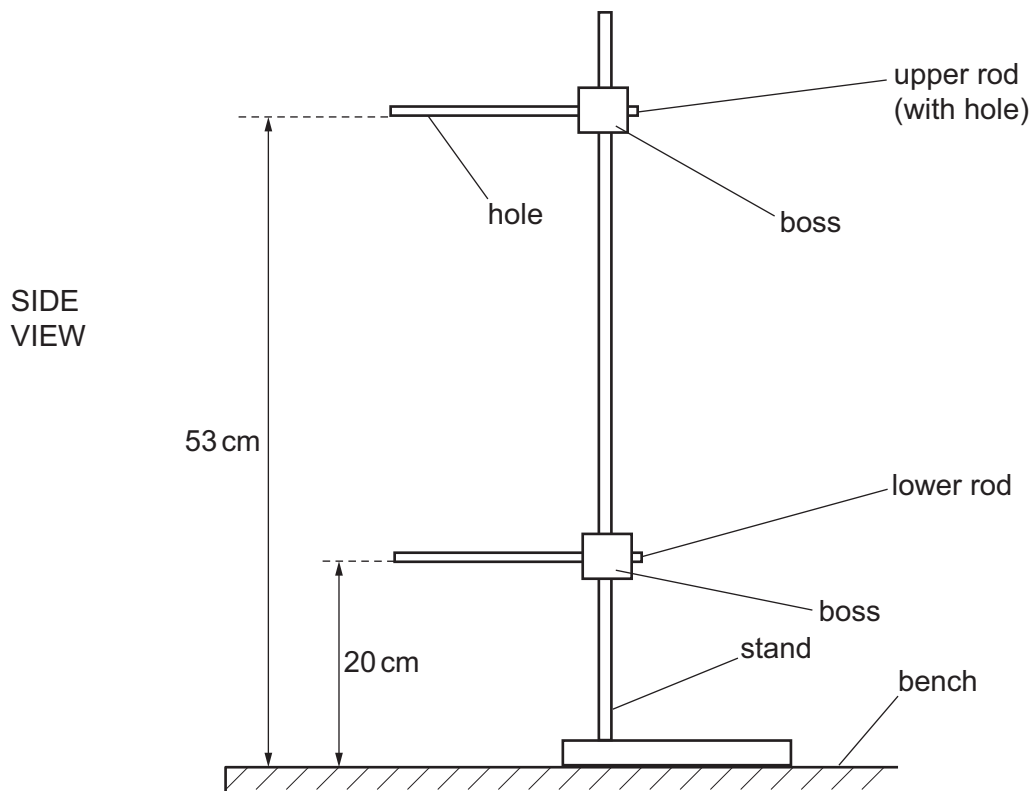


Fig. 1.1

- Rotate the upper rod in the boss so that the hole is vertical.



- Thread the string of the pendulum up through the hole in the upper rod and pull it through until the pendulum bob is approximately 2 cm above the bench. Use the clip to fasten the string to the stand to prevent the string from slipping down through the hole, as shown in Fig. 1.2.

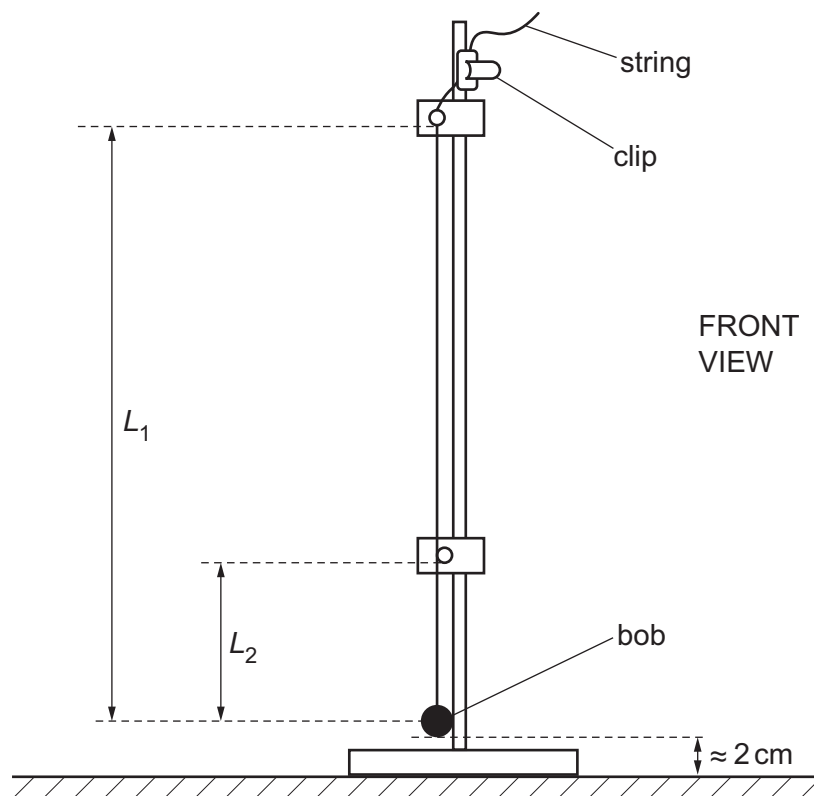


Fig. 1.2

- Turn the lower rod horizontally so that the string is just touching the rod. **Leave both rods in these positions for the whole experiment.**
- The distance of the centre of the bob below the upper rod is L_1 .
The distance of the centre of the bob below the lower rod is L_2 .

Measure and record L_1 and L_2 .

$L_1 = \dots\dots\dots$

$L_2 = \dots\dots\dots$

[1]

- (ii)
- Push the bob so that the string moves a short distance away from the lower rod and then release it. The bob will oscillate.
 - Take measurements to find the period T of the oscillations.

$T = \dots\dots\dots$ [2]





- (b) Move the string through the hole and refasten it to change L_1 . Measure and record L_1 , L_2 and T .

Repeat until you have six sets of values of L_1 , L_2 and T .

Record your results in a table. Include values of $(\sqrt{L_1} + \sqrt{L_2})$ to three significant figures in your table.

[8]

- (c) (i) Plot a graph of T on the y -axis against $(\sqrt{L_1} + \sqrt{L_2})$ on the x -axis.

[3]

- (ii) Draw the straight line of best fit.

[1]

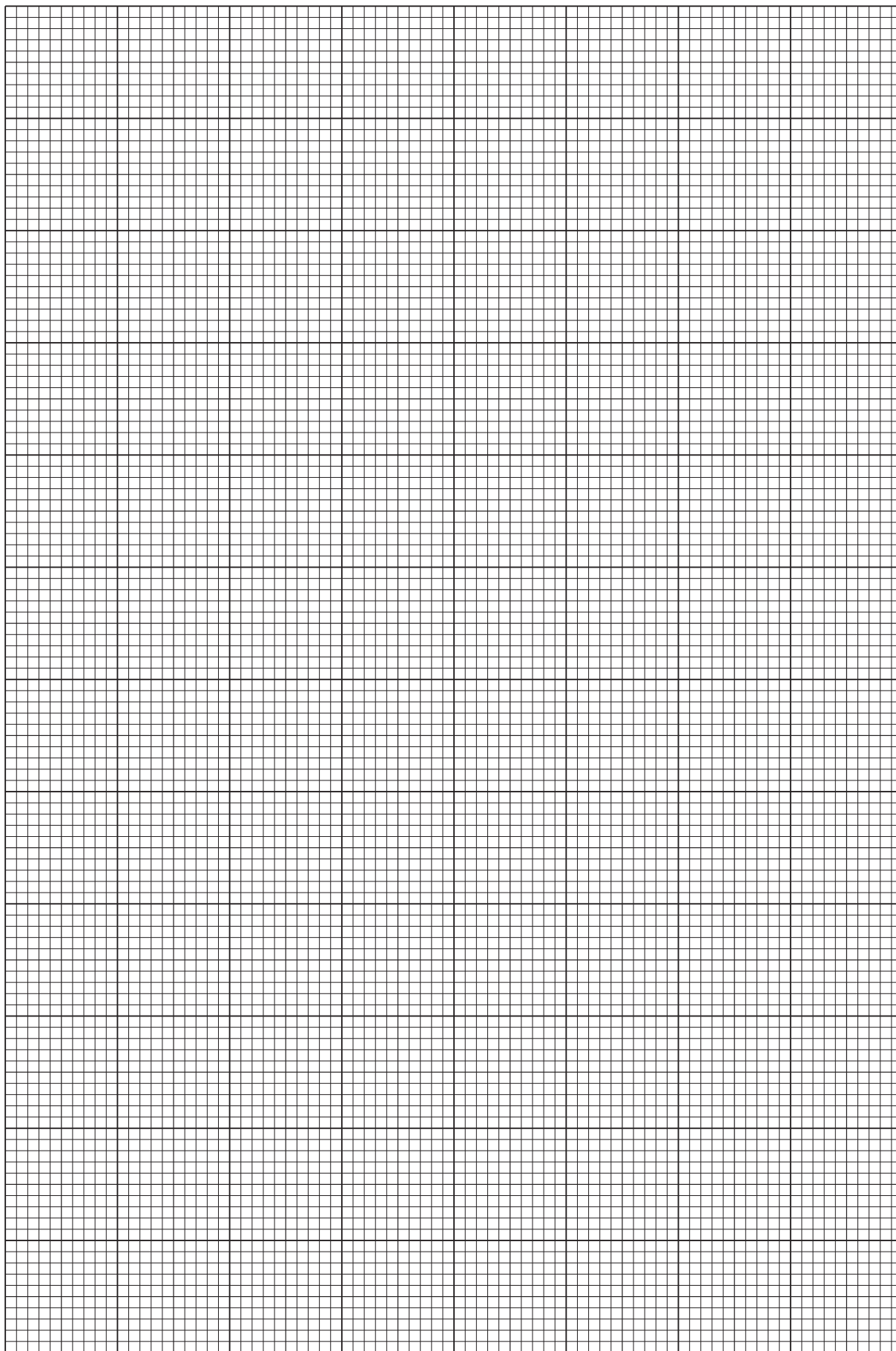
- (iii) Determine the gradient and y -intercept of this line.

gradient = ...

y -intercept = ...

[2]







- (d) It is suggested that the quantities T , L_1 and L_2 are related by the equation

$$T = a(\sqrt{L_1} + \sqrt{L_2}) + b$$

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]

- (e) Theory suggests that a is related to the acceleration of free fall g by

$$g = \left(\frac{\pi}{a}\right)^2.$$

Using your value for a , calculate a value for g .
Give an appropriate unit.

$g =$ [1]

[Total: 20]



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

2 In this experiment, you will investigate the motion of steel balls falling through water in a tube.

(a) (i) You have been provided with a wide tube attached to a wooden strip.

Measure and record the **internal** diameter D of the wide tube.

$D = \dots\dots\dots$ [2]

(ii) • Assemble the apparatus as shown in Fig. 2.1.

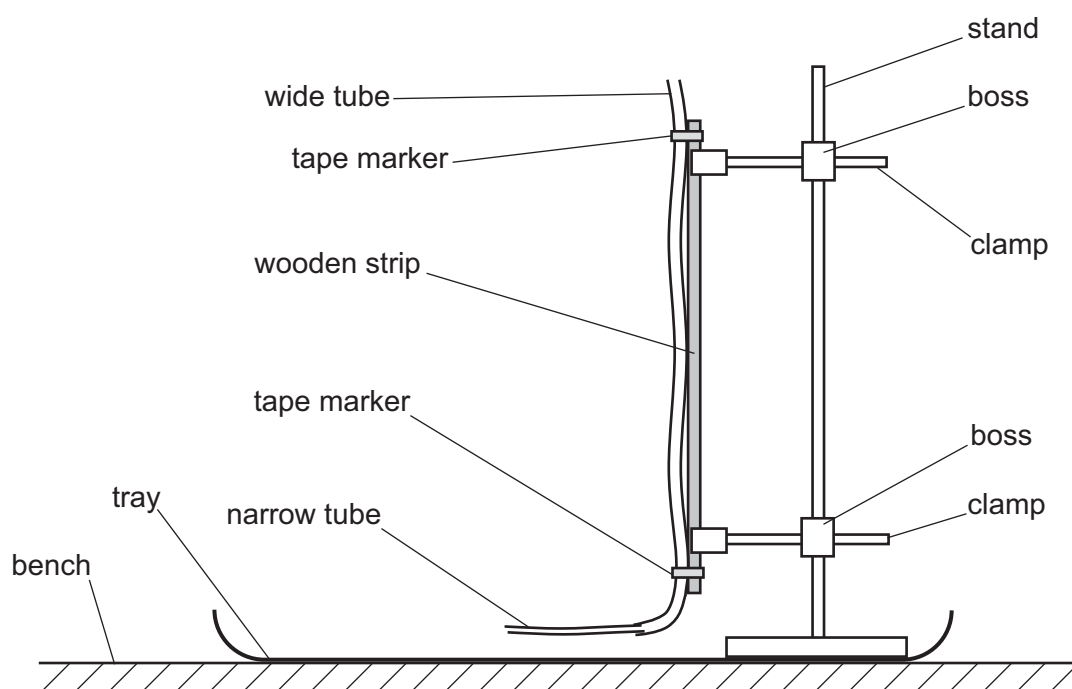


Fig. 2.1



You have been provided with four steel balls of two different diameters.

- Measure and record the diameter d of one of the **larger** balls.

$d =$

- Fill the syringe with water from the beaker.
- Push the nozzle of the syringe securely into the narrow tube. Slowly push the syringe plunger until the wide tube is filled to the top with water. Leave the syringe attached to the narrow tube.
- Drop one of the **larger** balls into the wide tube and watch it fall down past the two tape markers.
- Use the magnet to retrieve the ball from the tube.

[1]

- (b) (i) • Drop one of the **larger** balls into the wide tube.
- Take measurements to determine the time t for the ball to fall from the upper tape marker to the lower tape marker.

$t =$ [2]

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

percentage uncertainty = ...% [1]





- (c) • Measure and record the diameter d of one of the **smaller** balls.

$d =$

- Using one of the **smaller** balls, repeat (b)(i).

$t =$

[3]

- (d) It is suggested that the relationship between t , D and d is

$$\frac{1}{t} = k(D^2 - d^2)$$

where k is a constant.

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

first value of $k =$

second value of $k =$

[1]

- (ii) 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 10%.

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

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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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4

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[4]

[Total: 20]

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PHYSICS

9702/35

Paper 3 Advanced Practical Skills 1

May/June 2025

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 **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 the oscillations of a magnet.

You have been provided with a small magnet attached to a string. You have also been provided with a bar magnet, a plotting compass and a sheet of paper.

- (a) • Draw a straight line of approximate length 20 cm on the sheet of paper.
- Mark point X at the centre of this line as shown in Fig. 1.1.

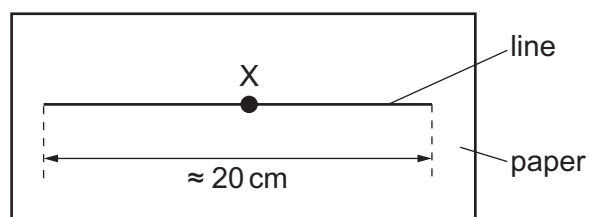


Fig. 1.1

- Rotate the paper so that the straight line on the paper is aligned with the N–S direction shown by the plotting compass, as shown in Fig. 1.2.
- Keep the magnets away from the plotting compass while you are doing this.**

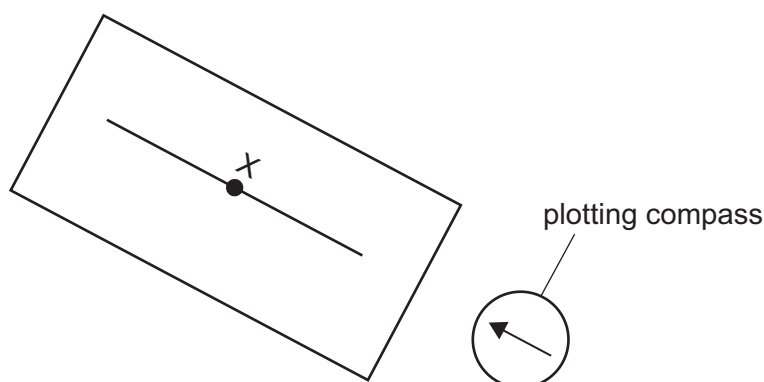


Fig. 1.2

- Fix the paper to the bench in this position using adhesive putty.
- The paper should stay in this position throughout the experiment.**





- Set up the apparatus as shown in Fig. 1.3.

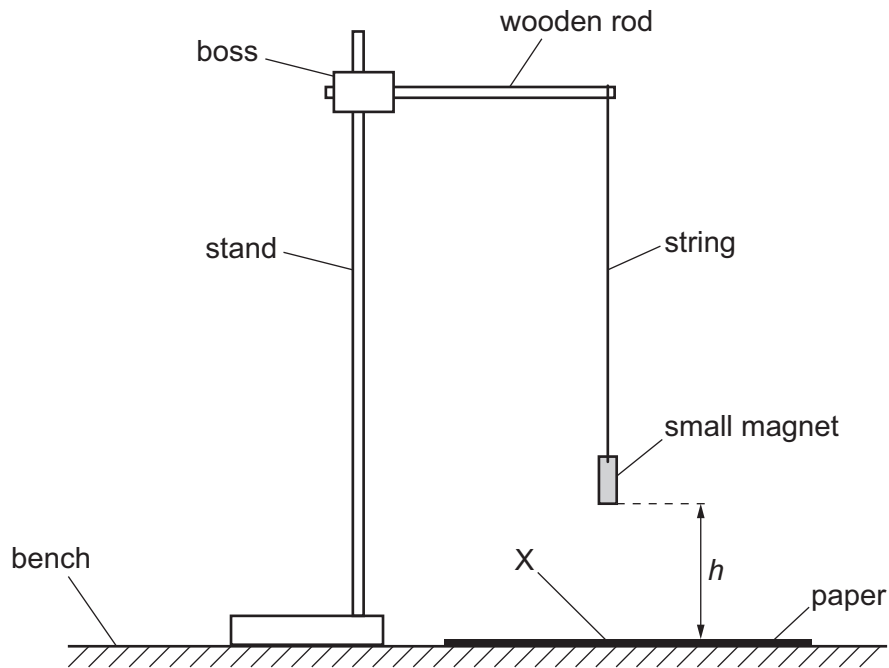


Fig. 1.3

- Adjust the position of the stand until the small magnet is directly over point X on the paper.
- The distance between the bottom of the small magnet and the paper is h .

Adjust the height of the boss until h is 3.0 cm.

- Displace the small magnet through a short distance **in the direction of the line on the paper**.
- Release the small magnet. The small magnet will oscillate.
- The period of the oscillations of the small magnet is T_0 .

Take measurements to determine T_0 .

$$T_0 = \dots\dots\dots [2]$$



- (b) • Place the bar magnet on the sheet of paper at the position shown in Fig. 1.4.

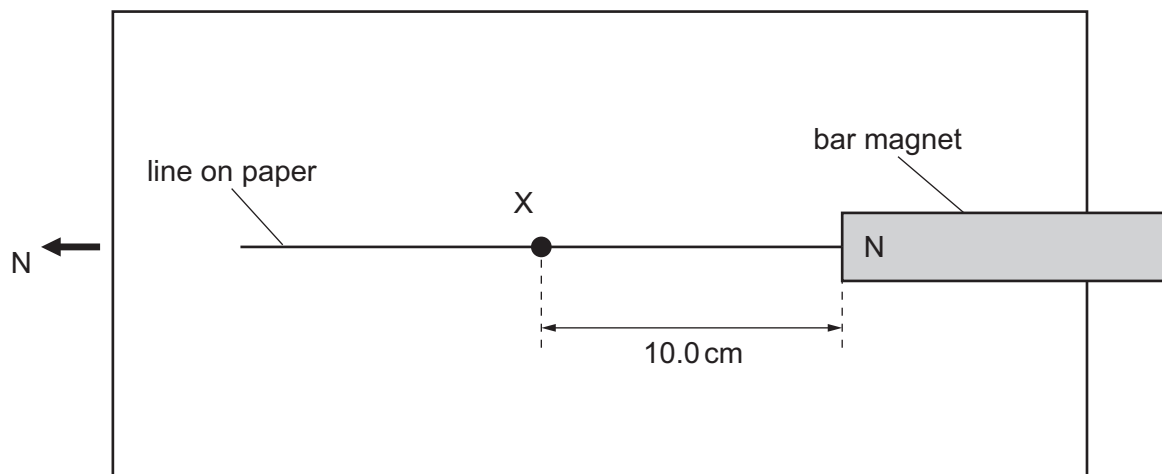


Fig. 1.4

- Draw around the bar magnet. **Do not move it from this position.**
- Displace the small magnet through a short distance in the direction of the line on the paper. Release the small magnet. The small magnet will oscillate.
- The period of the oscillations of the small magnet is T .

Record h and determine T .

$h = \dots\dots\dots$

$T = \dots\dots\dots$

[1]



(c) Write down your value of T_0 from (a).

$T_0 =$

Change the height of the boss such that h is in the range $3.0 \text{ cm} \leq h \leq 9.0 \text{ cm}$.

For each value of h , determine T .

Repeat until you have six sets of values of h and T . Include your values from (b).

Record your results in a table. Include values of $\frac{T}{T_0}$ in your table.

(d) (i) Plot a graph of $\frac{T}{T_0}$ on the y-axis against h on the x-axis.

[9]

(ii) Draw the straight line of best fit.

[3]

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

[1]

gradient = ...

y-intercept = ...

[2]







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

$$\frac{T}{T_0} = Ph + Q$$

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]



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

- 2** In this experiment, you will investigate the behaviour of suspended cardboard sheets.

You have been provided with two cardboard sheets labelled A and B.

- (a) • The thickness of sheet A is t . Use the micrometer to measure t .
- Record t .

$t = \dots\dots\dots$ mm [1]

- (b) (i) • Use the nail to make holes in two corners of sheet A as shown in Fig. 2.1.

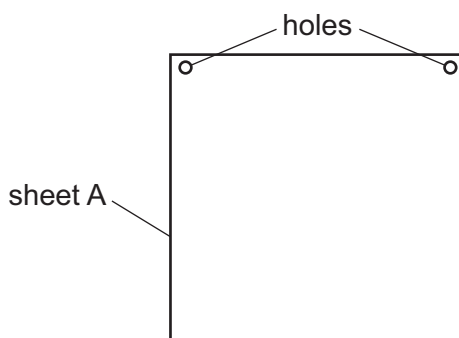


Fig. 2.1

- Ensure that the sheet is able to swing freely on the nail when the nail is placed in either hole.
- Set up the apparatus as shown in Fig. 2.2.

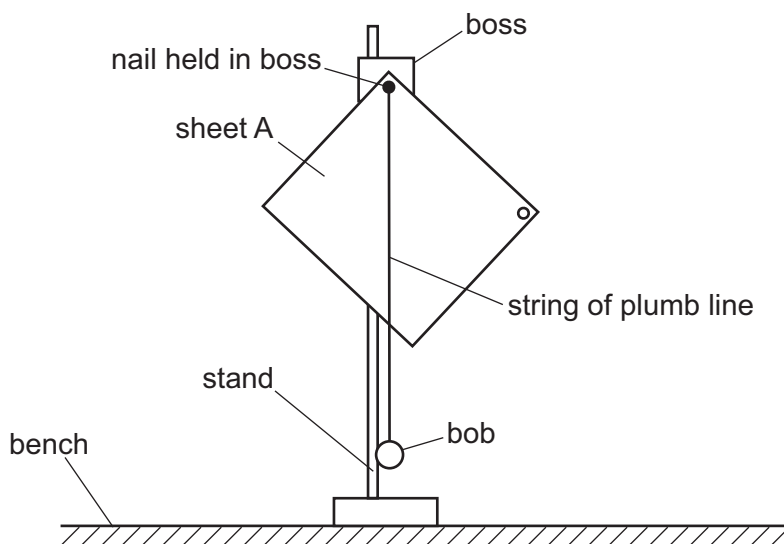


Fig. 2.2

- Place the nail through one of the holes in A and place the string loop of the plumb line over the nail.



- Draw a line on A along the length of the string of the plumb line.
- Place the nail through the other hole in A and draw a line on A along the length of the string of the plumb line.
- The two lines will cross at a point called the centre of gravity. Label this point P as shown in Fig. 2.3.

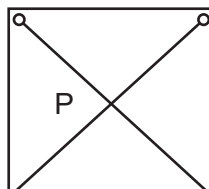


Fig. 2.3

- Use adhesive putty to attach the two 10g masses to A at the edge of the sheet as shown in Fig. 2.4.

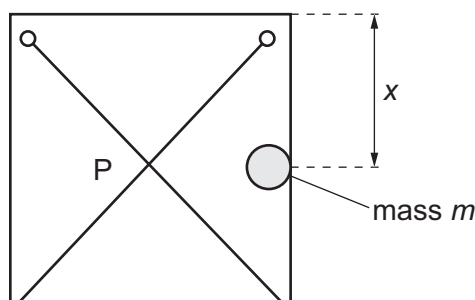


Fig. 2.4

- The distance between the top edge of the sheet and the centre of the masses is x , as shown in Fig. 2.4.

The total mass attached to the sheet is m .

Adjust the position of the masses until x is approximately 10 cm.

- Record m and x .

$m = \dots\dots\dots$ g

$x = \dots\dots\dots$ cm
[1]





- (ii) • Repeat the same process to determine the new centre of gravity of A. Label this point Q.
- The distance between P and Q is y , as shown in Fig. 2.5.

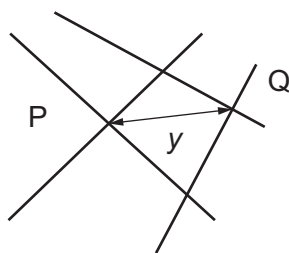


Fig. 2.5

Measure and record y .

$y = \dots\dots\dots$ cm [2]

- (iii) Estimate the percentage uncertainty in your value of y . Show your working.

percentage uncertainty = $\dots\dots\dots$ % [1]

- (iv) Calculate $\frac{y^2}{m^2}$.

$\frac{y^2}{m^2} = \dots\dots\dots$ cm²g⁻² [1]

- (v) Justify the number of significant figures that you have given for your value of $\frac{y^2}{m^2}$.

.....

.....

..... [1]





(c) Using sheet B, repeat (a), (b)(i), (b)(ii) and (b)(iv) with a value of m of 10 g and a value of x of approximately 5 cm.

$t =$ mm

$m =$ g

$x =$ cm

$y =$ cm

$\frac{y^2}{m^2} =$ cm^2g^{-2}
[3]





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

$$\frac{y^2}{m^2} = \frac{k}{xt}$$

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 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.

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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.

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[4]

[Total: 20]





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PHYSICS

9702/37

Paper 3 Advanced Practical Skills 1

May/June 2025

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 [].

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This document has **12** pages.



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

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

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

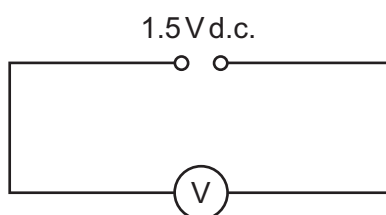


Fig. 1.1

- Record the voltmeter reading E .

$E =$ [1]





(b) You have been provided with a metre rule with a wire attached. You have also been provided with two identical resistors placed in component holders, each labelled R.

- Set up the circuit shown in Fig. 1.2.

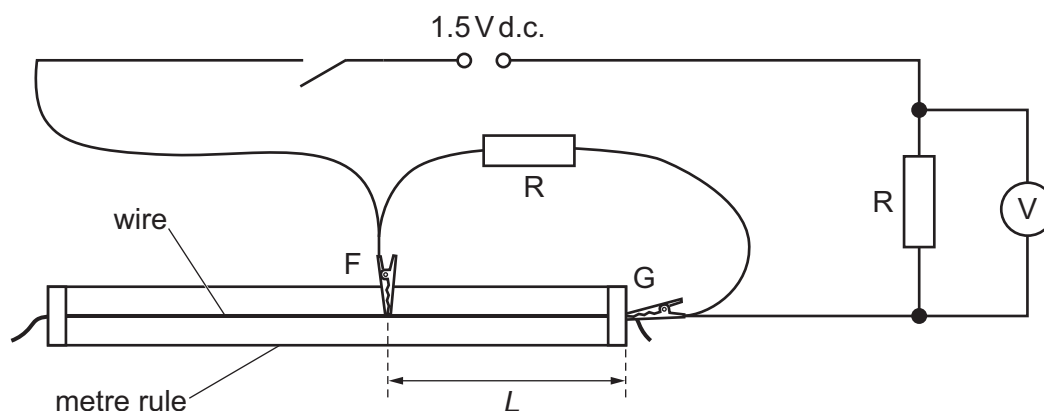


Fig. 1.2

- F and G are crocodile clips.

The distance between F and G is L . Attach F and G to the wire so that L is approximately 30 cm.

- Close the switch.
- Record the value of L and the voltmeter reading V .

$L =$

$V =$

- Open the switch.

[1]





- (c) • Write down the value of E from (a).

$E =$

- **Increase** L by changing the position of F on the wire. Record L and V and repeat until you have six sets of values of L and V . Include your values from (b).

Record your results in a table. Include values of $\frac{E - V}{L}$ in your table.

[9]

- (d) (i) Plot a graph of $\frac{E - V}{L}$ on the y-axis against V on the x-axis.

[3]

- (ii) Draw the straight line of best fit.

[1]

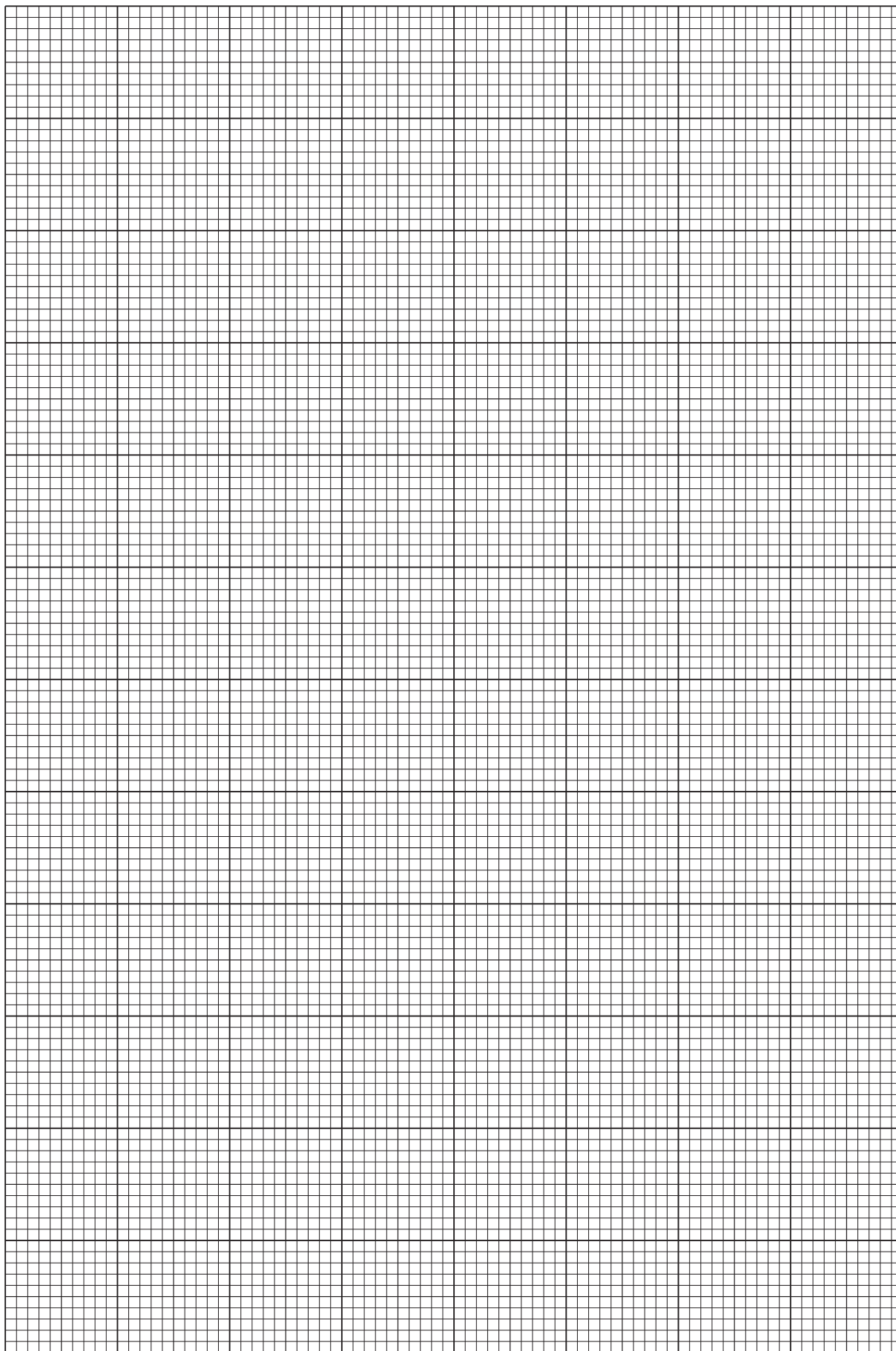
- (iii) Determine the gradient and y-intercept of this line.

gradient = ...

y-intercept = ...

[2]







- (e) It is suggested that the quantities V and L are related by the equation

$$\frac{E - V}{L} = PV - Q$$

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) The resistance of R is R .

Theory suggests that:

- P and Q are both inversely proportional to R
- the graph cuts the x -axis at a value of $V = \frac{E}{2}$ for all values of R .

A student repeats the experiment using two identical resistors, each with a lower value of R than in the original experiment.

For the student's 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 chain of paper clips.

You have been provided with two spheres of modelling clay.

- (a) (i) The diameter of the **smaller** sphere is d , as shown in Fig. 2.1.

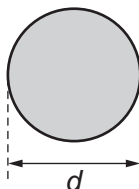


Fig. 2.1

Measure and record d .

$d =$ [1]

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

percentage uncertainty = ...% [1]





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

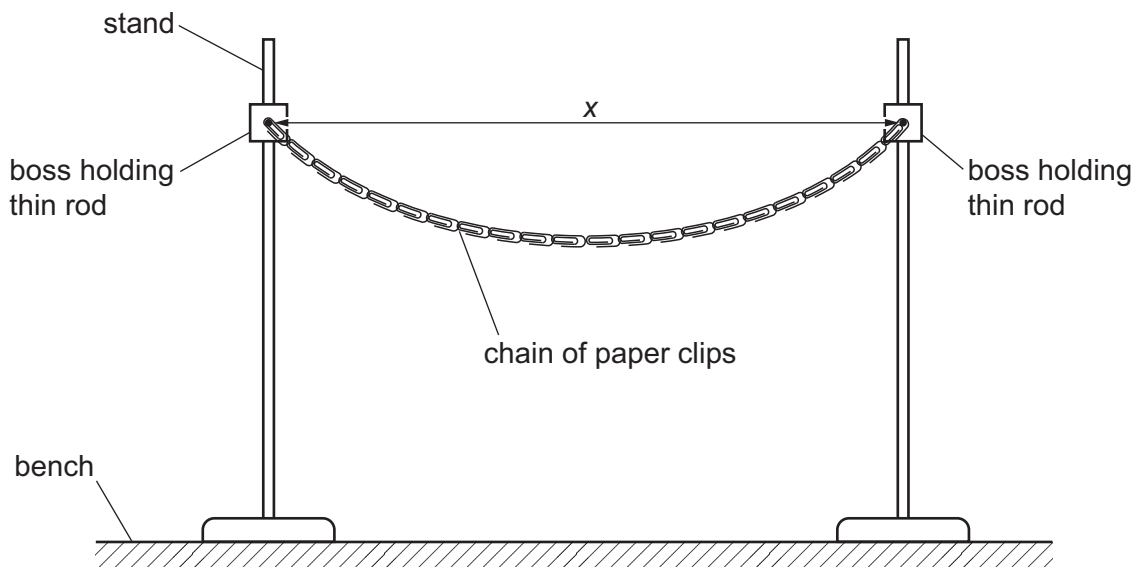


Fig. 2.2

- Ensure that the rods are the same height above the bench.
- Slide the paper clips at the ends of the chain onto the rods.
- The distance between the centres of the rods is x .
Position the stands so that x is approximately 70 cm.
- Measure and record x .

$x = \dots\dots\dots$ cm [1]



- (ii) • Use the hook to attach the **smaller** sphere of modelling clay to the chain of paper clips as shown in Fig. 2.3.

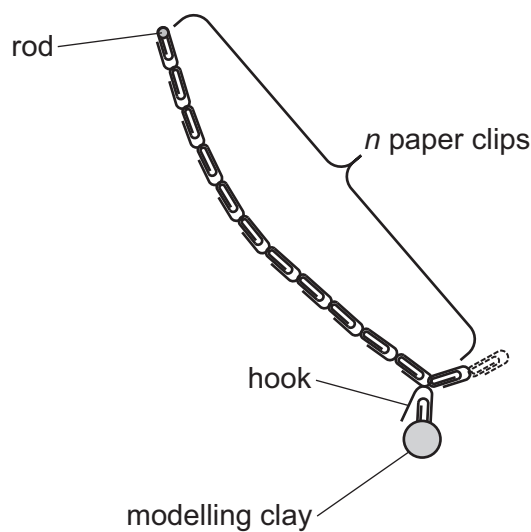


Fig. 2.3

- The number of paper clips between the hook and the end of the chain is n , as shown in Fig. 2.3.

Place the hook so that n is 11.

- Calculate N , where

$$N = \sqrt[3]{n^2}.$$

Give your answer to three significant figures.

$$N = \dots\dots\dots [1]$$

- (c) • Pull the sphere towards you through a short distance. When the sphere is released, it will oscillate.
- Take measurements to determine the period T of these oscillations.

$$T = \dots\dots\dots [2]$$





- (d) • Roll the two spheres into one larger sphere.
- Measure and record the diameter d of the larger sphere.

$d =$

- Repeat **(b)** and **(c)** with a value x of approximately 80 cm and with the hook placed so that n is 7.

$x =$ cm

$N =$

$T =$ [3]





- (e) It is suggested that the relationship between T , d , N and x is

$$T^2 = \frac{kdN}{x^2}$$

where k is a constant.

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

first value of k = ...

second value of k = ...

[1]

- (ii) 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 15%.

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.

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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.

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[4]

[Total: 20]

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PHYSICS

9702/38

Paper 3 Advanced Practical Skills 2

May/June 2025

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 [].

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



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

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

(a) (i) • Assemble the apparatus as shown in Fig. 1.1.

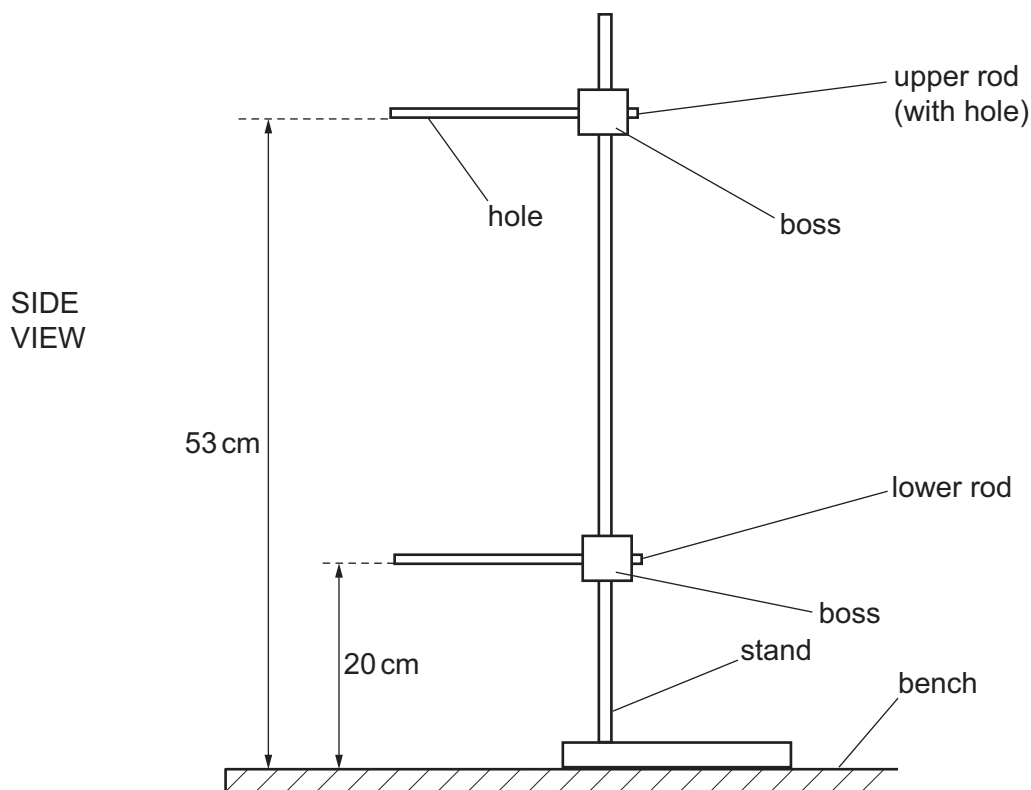


Fig. 1.1

- Rotate the upper rod in the boss so that the hole is vertical.



- Thread the string of the pendulum up through the hole in the upper rod and pull it through until the pendulum bob is approximately 2 cm above the bench. Use the clip to fasten the string to the stand to prevent the string from slipping down through the hole, as shown in Fig. 1.2.

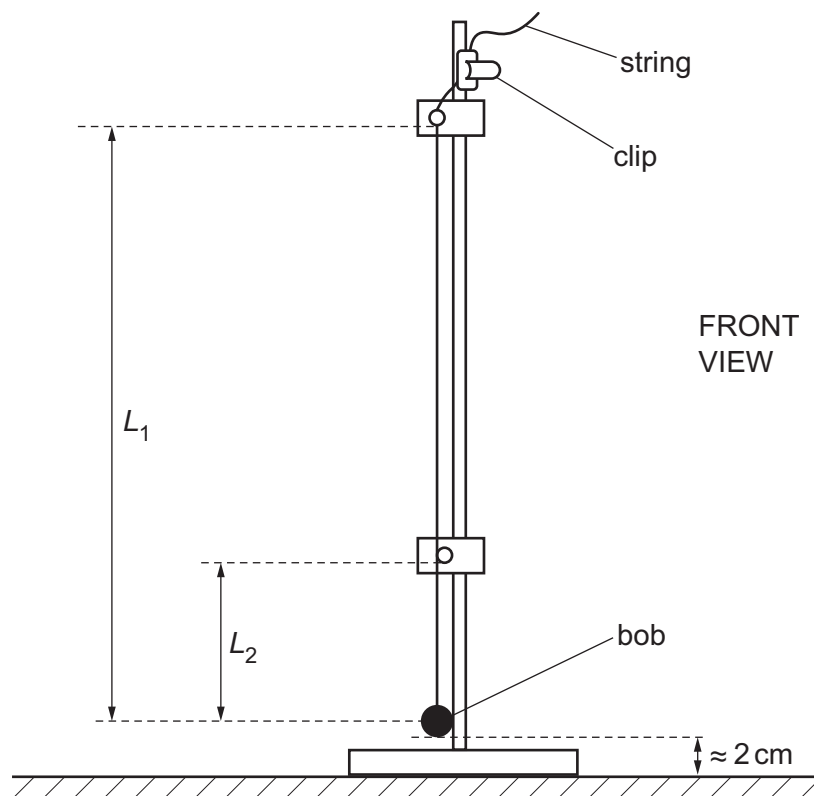


Fig. 1.2

- Turn the lower rod horizontally so that the string is just touching the rod. **Leave both rods in these positions for the whole experiment.**
- The distance of the centre of the bob below the upper rod is L_1 . The distance of the centre of the bob below the lower rod is L_2 .

Measure and record L_1 and L_2 .

$L_1 = \dots\dots\dots$

$L_2 = \dots\dots\dots$

[1]

- (ii)
- Push the bob so that the string moves a short distance away from the lower rod and then release it. The bob will oscillate.
 - Take measurements to find the period T of the oscillations.

$T = \dots\dots\dots$ [2]





- (b) Move the string through the hole and refasten it to change L_1 . Measure and record L_1 , L_2 and T .

Repeat until you have six sets of values of L_1 , L_2 and T .

Record your results in a table. Include values of $(\sqrt{L_1} + \sqrt{L_2})$ to three significant figures in your table.

[8]

- (c) (i) Plot a graph of T on the y -axis against $(\sqrt{L_1} + \sqrt{L_2})$ on the x -axis.

[3]

- (ii) Draw the straight line of best fit.

[1]

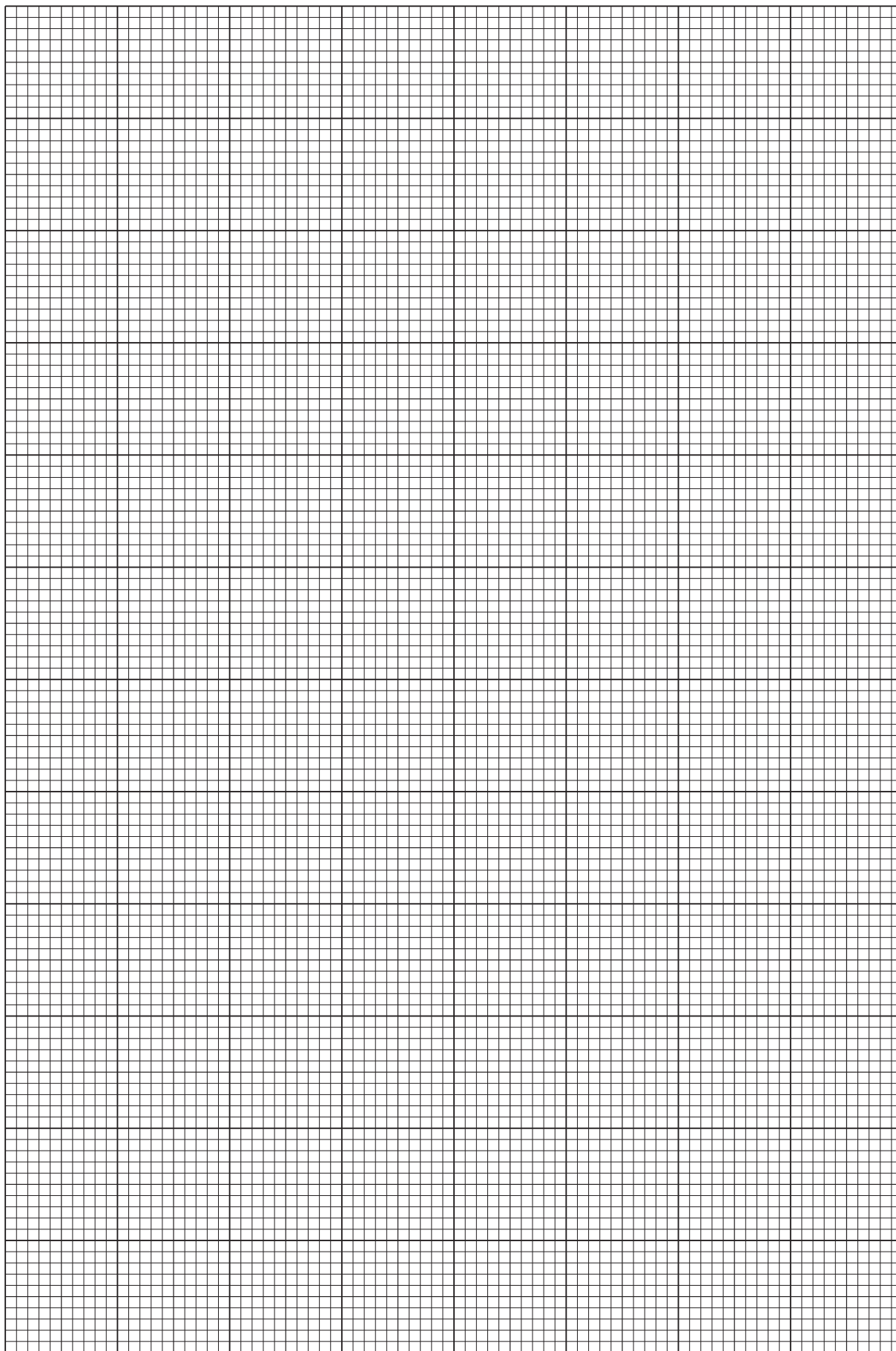
- (iii) Determine the gradient and y -intercept of this line.

gradient = ...

y -intercept = ...

[2]







- (d) It is suggested that the quantities T , L_1 and L_2 are related by the equation

$$T = a(\sqrt{L_1} + \sqrt{L_2}) + b$$

where a and b are constants.

Using your answers in (c)(iii), determine the values of a and b .
Give appropriate units.

$$a = \dots\dots\dots$$

$$b = \dots\dots\dots$$

[2]

- (e) Theory suggests that a is related to the acceleration of free fall g by

$$g = \left(\frac{\pi}{a}\right)^2.$$

Using your value for a , calculate a value for g .
Give an appropriate unit.

$$g = \dots\dots\dots [1]$$

[Total: 20]



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7

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

2 In this experiment, you will investigate the motion of steel balls falling through water in a tube.

(a) (i) You have been provided with a wide tube attached to a wooden strip.

Measure and record the **internal** diameter D of the wide tube.

$D = \dots\dots\dots$ [2]

(ii) • Assemble the apparatus as shown in Fig. 2.1.

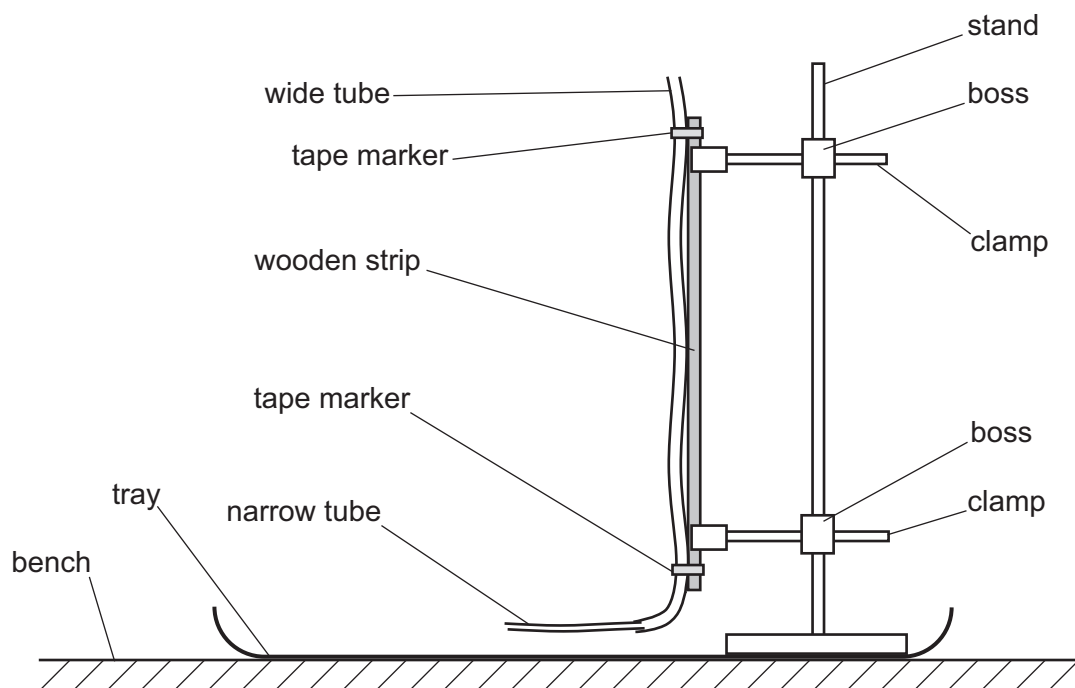


Fig. 2.1



You have been provided with four steel balls of two different diameters.

- Measure and record the diameter d of one of the **larger** balls.

$d =$

- Fill the syringe with water from the beaker.
- Push the nozzle of the syringe securely into the narrow tube. Slowly push the syringe plunger until the wide tube is filled to the top with water. Leave the syringe attached to the narrow tube.
- Drop one of the **larger** balls into the wide tube and watch it fall down past the two tape markers.
- Use the magnet to retrieve the ball from the tube.

[1]

- (b) (i) • Drop one of the **larger** balls into the wide tube.
- Take measurements to determine the time t for the ball to fall from the upper tape marker to the lower tape marker.

$t =$ [2]

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

percentage uncertainty = ...% [1]





- (c) • Measure and record the diameter d of one of the **smaller** balls.

$d =$

- Using one of the **smaller** balls, repeat (b)(i).

$t =$

[3]

- (d) It is suggested that the relationship between t , D and d is

$$\frac{1}{t} = k(D^2 - d^2)$$

where k is a constant.

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

first value of $k =$

second value of $k =$

[1]

- (ii) 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 10%.

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

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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

.....

[4]

[Total: 20]

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