Cambridge International AS & A Level

Cambridge International Examinations
Cambridge International Advanced Subsidiary and Advanced Level

CANDIDATE NAME

CENTRE NUMBER | | | | | |

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5926418372

PHYSICS **9702/33**

Paper 3 Advanced Practical Skills 1 **October/November 2017**

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.
Do not use staples, paper clips, glue or correction fluid.
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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You may not need to use all of the materials provided.

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

(a) You have been provided with a 10 g mass hanger and several 10 g slotted masses.

Set up the apparatus as shown in Fig. 1.1.

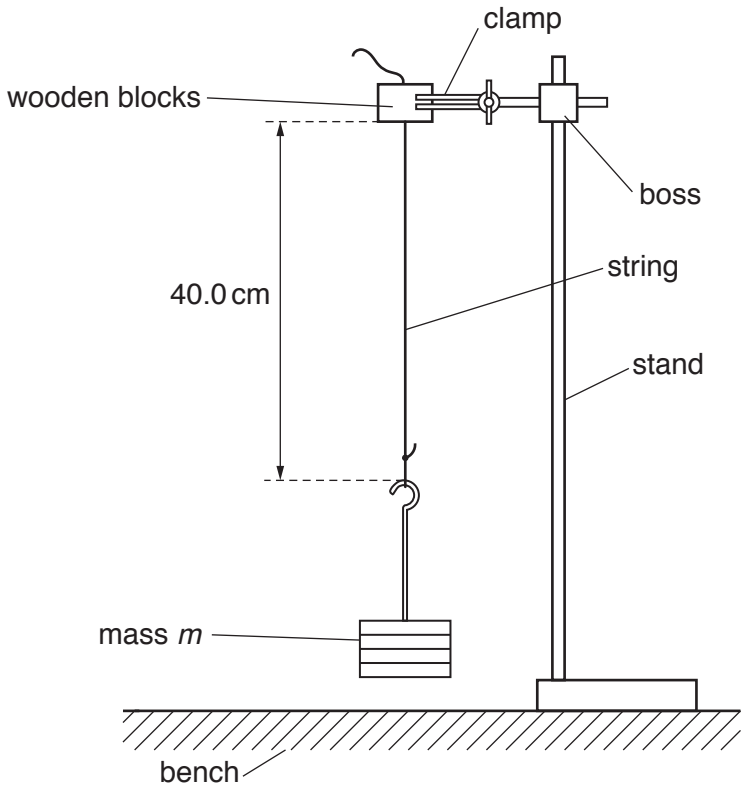


Fig. 1.1

Adjust the string so that the distance between the bottom of the wooden blocks and the top of the mass hanger is 40.0 cm.

The combined mass *m* of the mass hanger and slotted masses must be 70 g.

(b) (i) Twist the mass through **ten** complete turns as shown in Fig. 1.2.

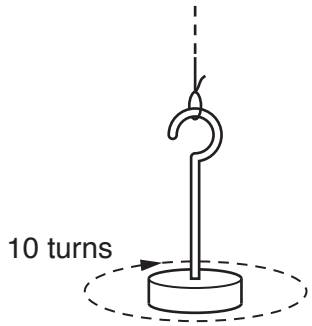


Fig. 1.2

(ii) When the mass is released, it will rotate one way and then rotate the other way. This motion will continue until the mass comes to rest. At this point, the mass will continue to swing slightly with very little rotation.

Release the mass. Measure and record the time *a* taken for the mass to come to rest.

a = ...[1]

(iii) Change the distance between the bottom of the wooden blocks and the top of the mass hanger to 20.0 cm.

(iv) Repeat **(b)(i)**.

Release the mass. Measure and record the time *b* taken for the mass to come to rest.

b = ...[1]

(v) Change the distance between the bottom of the wooden blocks and the top of the mass hanger to 40.0 cm.

(c) Change m and repeat **(b)** until you have six sets of values of m, a and b. You may include your results from **(b)**.

Record your results in a table. Include values of $\frac{a^2}{b}$ in your table.

[10]

(d) **(i)** Plot a graph of $\frac{a^2}{b}$ on the y-axis against m on the x-axis. [3]

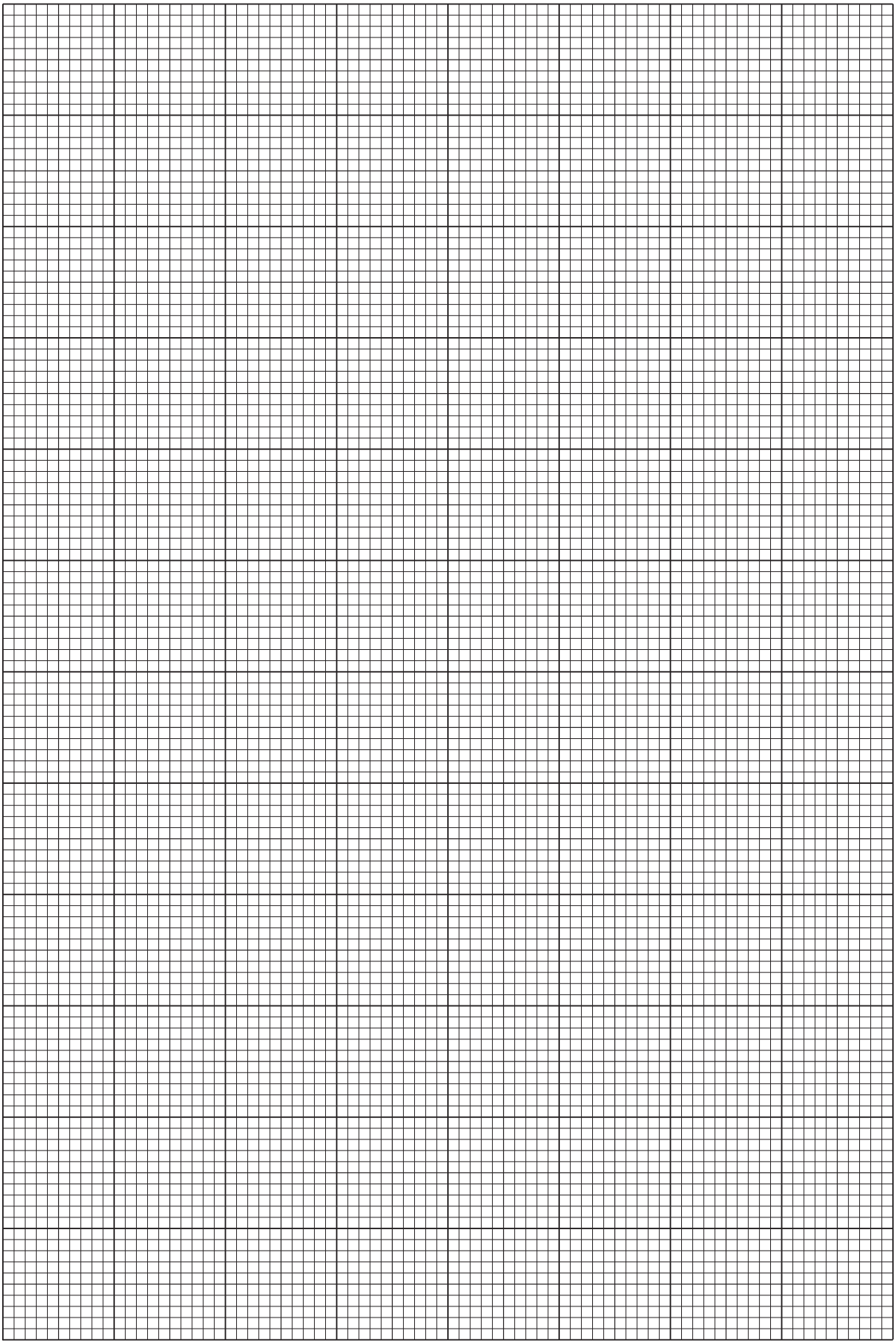
(ii) Draw the straight line of best fit. [1]

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

gradient = ...

y-intercept = ...

[2]



(e) It is suggested that the quantities a, b and m are related by the equation

$$\frac{a^2}{b} = Pm + Q$$

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 equilibrium of a metre rule supported by springs.

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

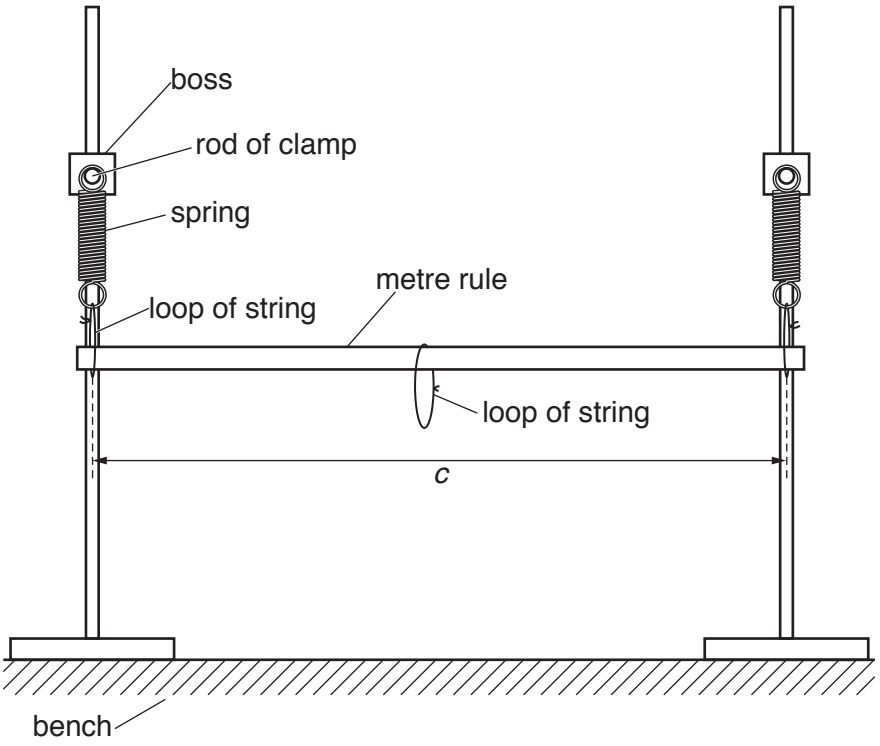


Fig. 2.1

Adjust the position of the bosses until the metre rule is parallel to the bench.

The loops of string supporting the rule should be vertical and as close to the ends of the rule as possible.

The distance between these loops is *c*.

(ii) Measure and record *c*.

c = ... cm [1]

(b) Suspend a mass *m* of 0.100 kg from the loop of string as shown in Fig. 2.2.

The distance between the string loop below boss A and the string loop supporting the mass is *x*.
Move the mass so that *x* is approximately 80 cm.

Adjust the height of boss B until the rule is parallel to the bench as shown in Fig. 2.2.

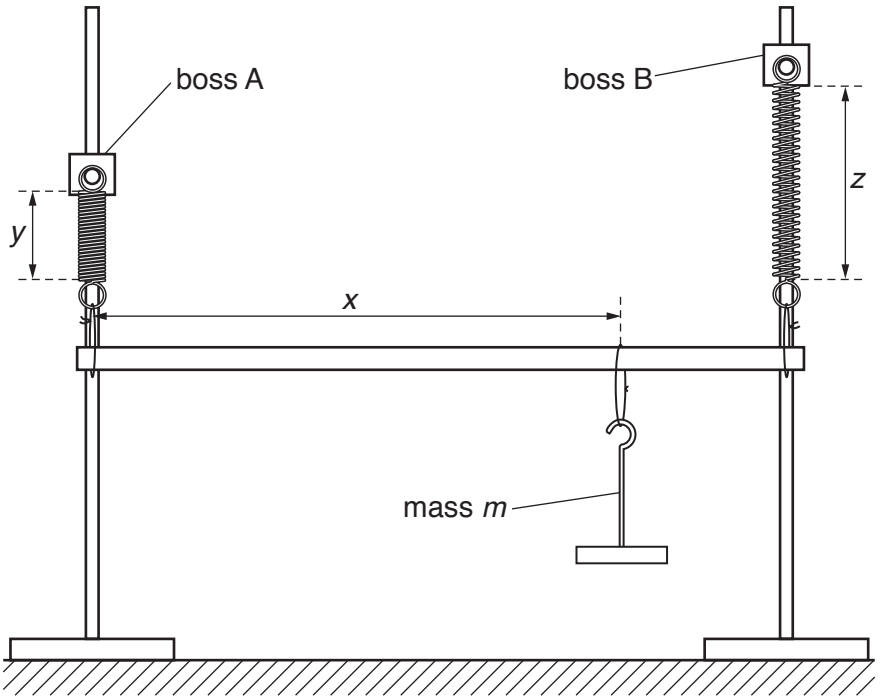


Fig. 2.2

The lengths of the coiled sections of the springs are *y* and *z* as shown in Fig. 2.2.

(c) **(i)** Record m.

m = ... kg

(ii) Measure and record x.

x = ... cm [1]

(iii) Measure and record y.

y = ... cm

(iv) Measure and record z.

z = ... cm [1]

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

percentage uncertainty = ...[1]

(e) **(i)** Calculate $\left(x - \frac{c}{2}\right)$.

$\left(x - \frac{c}{2}\right)$ = ... cm [1]

(ii) Calculate $\frac{(z-y)}{m}$. Give an appropriate unit.

$\frac{(z-y)}{m}$ = ...[1]

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

.....

.....

.....[1]

(g) (i) Change m to 0.200 kg. Adjust the position of the mass and the height of boss B until the value of y is the **same** as in **(c)(iii) and** the metre rule is parallel to the bench.

(ii) Repeat **(c)(i)**, **(c)(ii)**, **(c)(iv)** and **(e)**.

m = ... kg

x = ... cm

z = ... cm

$\left(x - \frac{c}{2}\right)$ = ... cm

$\frac{(z-y)}{m}$ = ...

[3]

(h) It is suggested that the relationship between x, c, z, y and m is

$$\left(x - \frac{c}{2}\right) = \frac{k(z-y)}{m}$$

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]

(i) **(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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4. .....

..... [4]

[Total: 20]

Cambridge International AS & A Level

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CANDIDATE NAME

CENTRE NUMBER | | | | | |

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4967887368

PHYSICS **9702/34**

Paper 3 Advanced Practical Skills 2 **October/November 2017**

2 hours

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

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

(a) Assemble the apparatus as shown in Fig. 1.1 with the total mass *m* of the mass hanger and mass equal to 150 g.

The distance between the bottom of the split cork and the bottom of the mass hanger should be 64 cm. It may be necessary for the mass to hang over the edge of the bench.

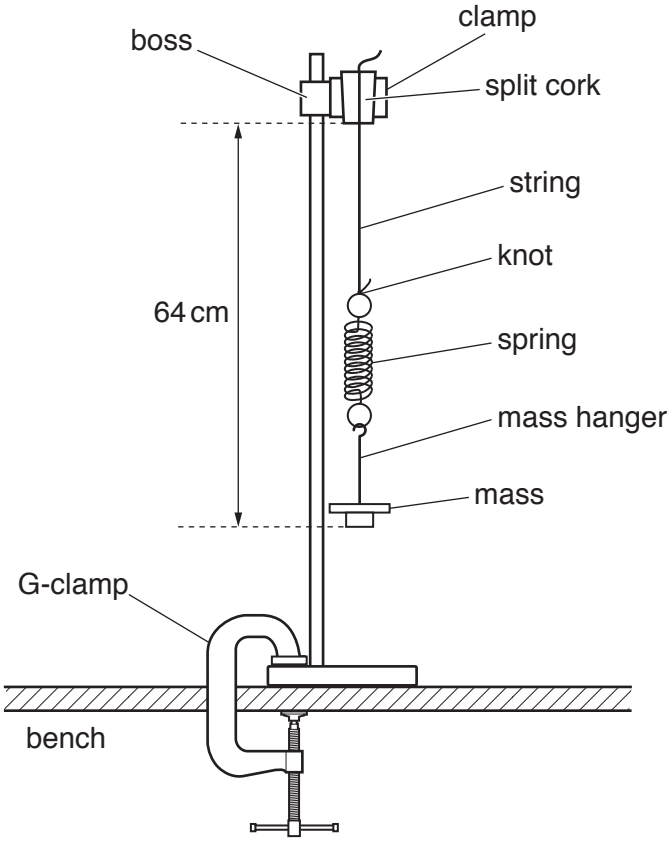


Fig. 1.1

(b) (i) Move the mass a short distance to one side and then carefully release it so that it swings with as little bouncing as possible, as shown in Fig. 1.2.

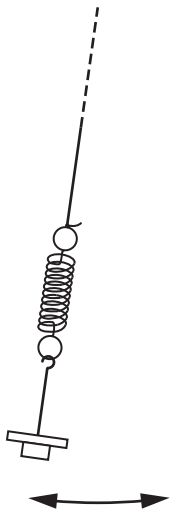


Fig. 1.2

(ii) Take measurements to determine the period T of the pendulum.

T = ... [2]

(c) Change m and repeat **(b)** until you have six sets of values of m and T. **Do not adjust the string in the split cork**.
Record your results in a table. Include values of T^2 in your table.

[10]

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

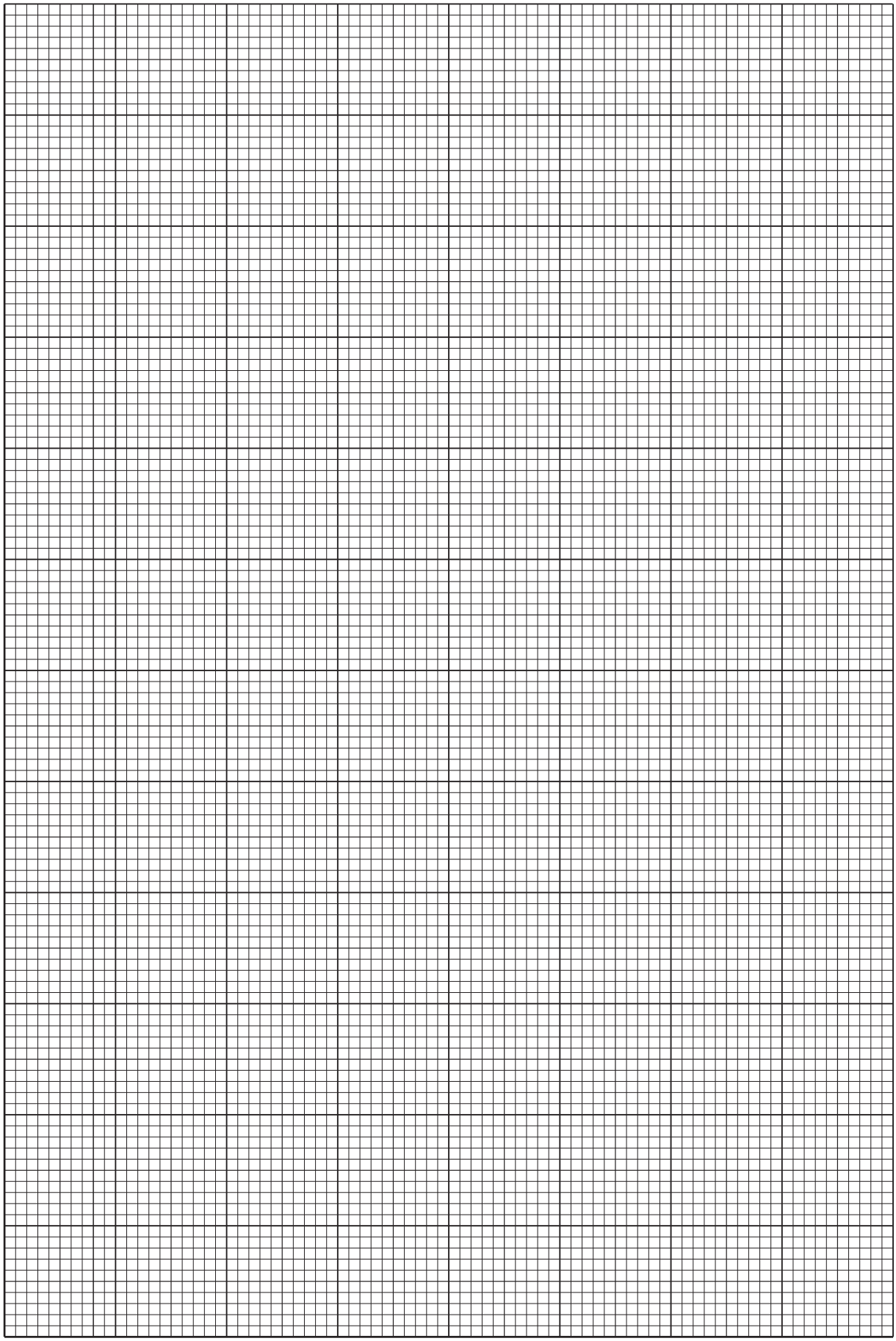
(ii) Draw the straight line of best fit. [1]

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

gradient = ...

y-intercept = ...

[2]



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

$$T^2 = am + b$$

where a and b are constants.

Use your answers from **(d)(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 an optical system.

(a) (i) Use a small piece of Plasticine to fix the torch horizontally on one of the wooden blocks.

(ii) Put the remaining Plasticine inside the transparent container and push the lens into it so that the lens is held vertically and parallel to two opposite sides of the container.

(b) (i) Position the apparatus as shown in Fig. 2.1, with the front of the torch approximately 32 cm from the lens.

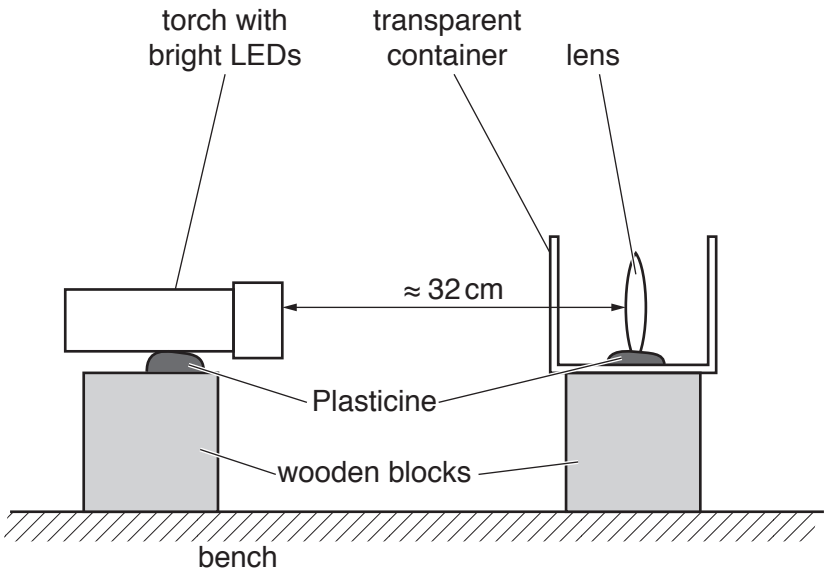


Fig. 2.1 (not to scale)

(ii) Switch on the torch.

(iii) Measure the distance u from the front of the torch to the centre of the lens, as shown in Fig. 2.2.

u = ... [1]

(iv) Place the white screen as shown in Fig. 2.2. Keeping the screen vertical, move it until it shows a sharp image of the LEDs in the torch.

(v) Measure the distance v from the centre of the lens to the screen, as shown in Fig. 2.2.

v = ... [1]

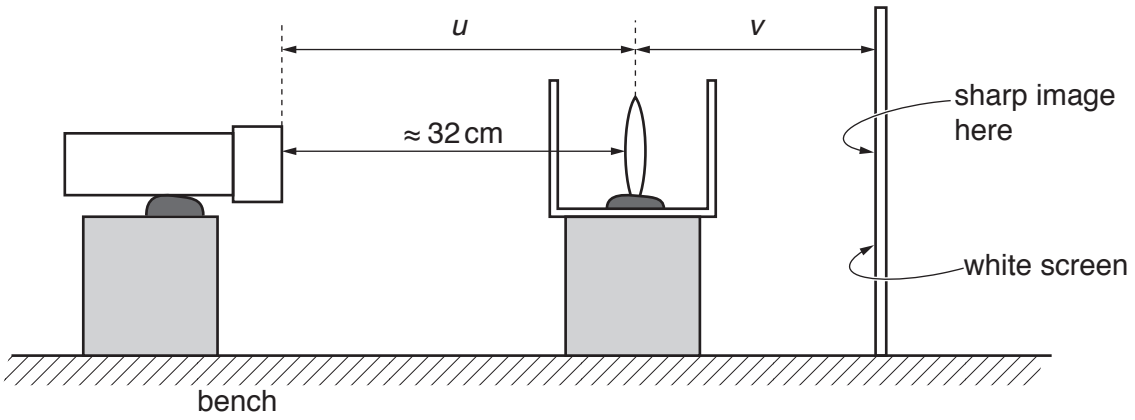


Fig. 2.2 (not to scale)

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

percentage uncertainty = ... [1]

(d) Calculate the value of f using the expression $f = \frac{uv}{(u + v)}$.

f = ... [1]

(e) **(i)** Without moving the container and the torch, pour water into the container to submerge the lens.

(ii) Reposition the screen so that it shows a sharp image of the LEDs.

(iii) Measure the new distance v_w from the lens to the screen.

v_w = ... [2]

(iv) Calculate f_w using $f_w = \frac{uv_w}{(u + v_w)}$.

f_w = ...

(v) Switch off the torch.

(f) Justify the number of significant figures you have given for your value of f_w.

.....

.....

.....[1]

(g) **(i)** Pour the water from the container back into the beaker, making sure that the lens remains fixed in the container.

(ii) Repeat **(b)**, **(d)** and **(e)** but with the front of the torch approximately 22 cm from the lens.

u = ...

v = ...

f = ...

v_w = ...

f_w = ...
[3]

(h) It is suggested that the relationship between f_w and f is

$$f_w = kf$$

where k is a constant.

(i) Using your data from **(d)** and **(e)(iv)** and your data from **(g)**, calculate two values of k.

first value of k = ...

second value of k = ...

[1]

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

.....

.....

.....

.....[1]

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

1. .....

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2. .....

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3. .....

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4. .....

.....

[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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3. .....

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[4]

[Total: 20]

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CANDIDATE NAME

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1447792141

PHYSICS **9702/35**

Paper 3 Advanced Practical Skills 1 **October/November 2017**

2 hours

Candidates answer on the Question Paper.

Additional Materials: As listed in the Confidential Instructions.

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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) Set up the circuit shown in Fig. 1.1.

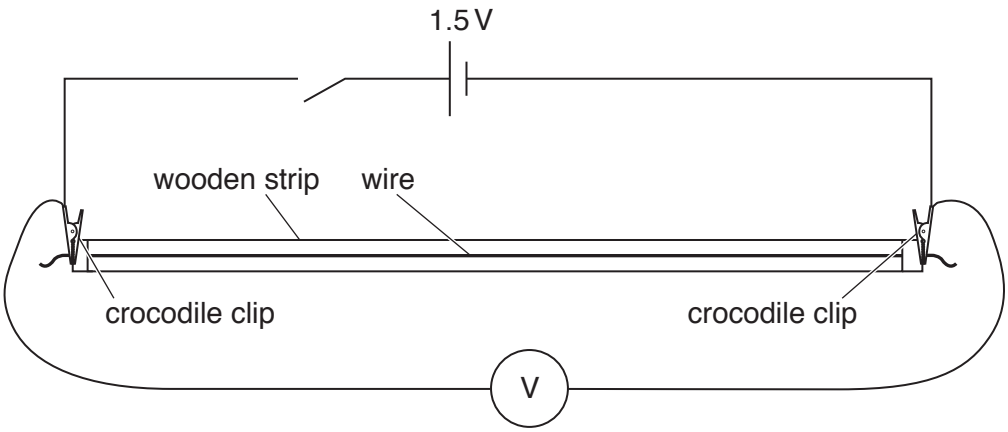


Fig. 1.1

(ii) Close the switch.

(iii) Record the voltmeter reading V.

V = ...[1]

(iv) Open the switch.

(v) Calculate $\frac{V}{2}$.

$\frac{V}{2}$ = ...

(b) (i) Set up the circuit shown in Fig. 1.2, using a resistor of resistance R equal to 10 Ω.

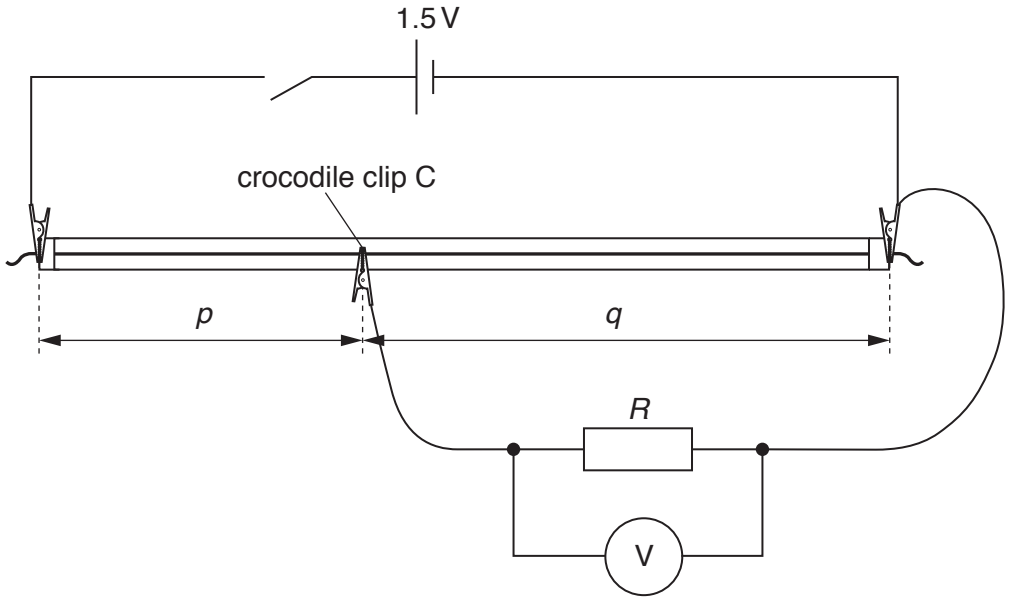


Fig. 1.2

(ii) Close the switch.

(iii) Move crocodile clip C along the wire until the voltmeter reading is equal to your value for $\frac{V}{2}$ in **(a)(v)**.

(iv) Measure and record the distances p and q as shown in Fig. 1.2.

p = ...

q = ... [1]

(v) Open the switch.

(c) Using one resistor at a time, vary R and repeat **(b)(ii)**, **(b)(iii)**, **(b)(iv)** and **(b)(v)** until you have six sets of readings of p, q and R. You may include your results from **(b)**.

Record your results in a table. Include values of $\frac{q}{R}$ and $\frac{q}{p}$ in your table.

[10]

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

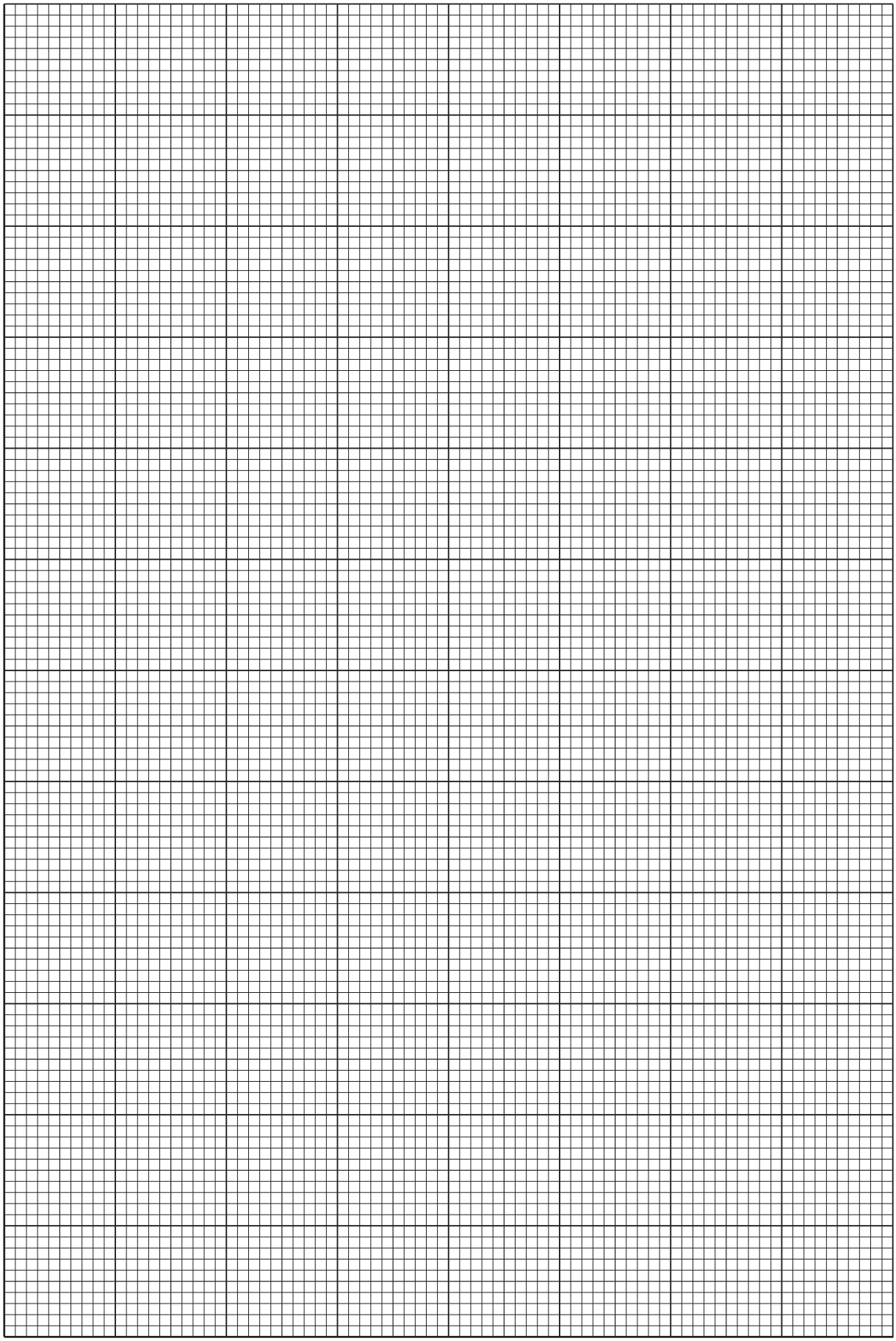
(ii) Draw the straight line of best fit. [1]

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

gradient = ...

y-intercept = ...

[2]



(e) It is suggested that the quantities p, q and R are related by the equation

$$\frac{q}{p} = \frac{aq}{R} + b$$

where a and b are constants.

Using your answers in **(d)(iii)**, determine values for 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 motion of a Y-shaped pendulum.

(a) You have been provided with two loops of string.

Stretch one of the loops as shown in Fig. 2.1.

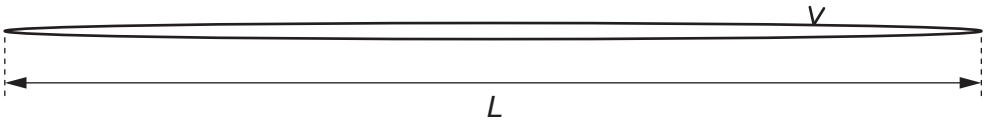


Fig. 2.1

Measure and record the length *L* as shown in Fig. 2.1.

L = ...[1]

(b) **(i)** Set up the apparatus as shown in Fig. 2.2. Move the stands so that the distance between the centres of the rods of the clamps is 25.0 cm.

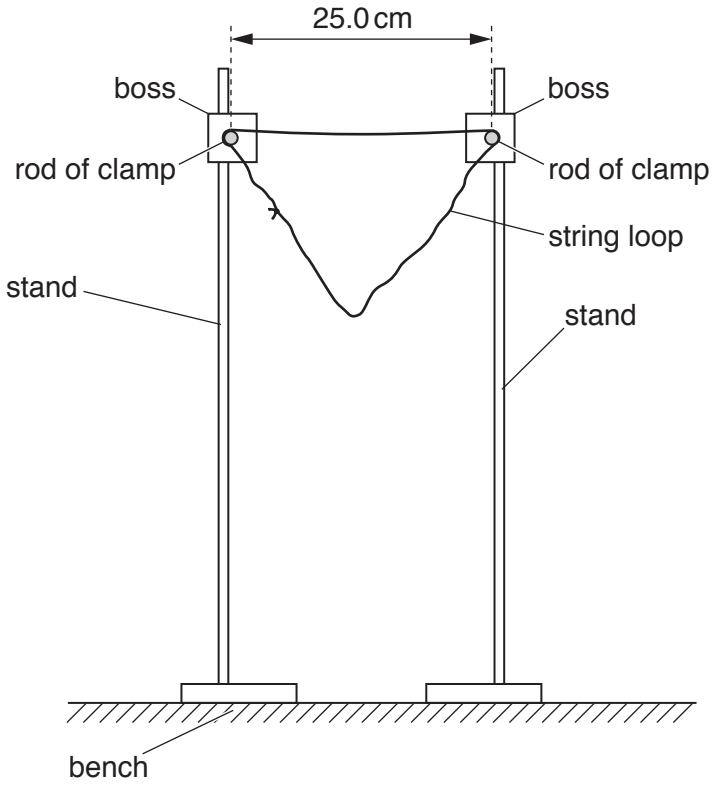


Fig. 2.2

(ii) Pull down on the bottom of the loop until it is fully stretched as shown in Fig. 2.3.

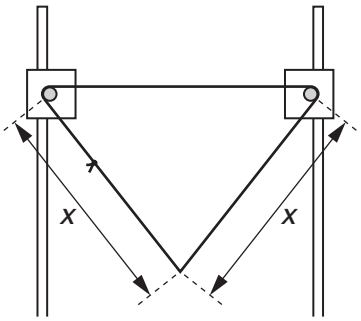


Fig. 2.3

The distance between the bottom of the loop and the centre of a rod is x.

Measure and record x.

x = ... [2]

(iii) Estimate the percentage uncertainty in your value of x.

percentage uncertainty = ... [1]

(iv) Calculate G where

$$G = \sqrt{L(2x - L)} \ .$$

G = ... [1]

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

.....

.....

..... [1]

(c) (i) You have been provided with two pendulum bobs tied to strings.

Tie the string attached to one of the bobs to the string loop so that the distance between the knot and the centre of the bob is equal to x, as shown in Fig. 2.4.

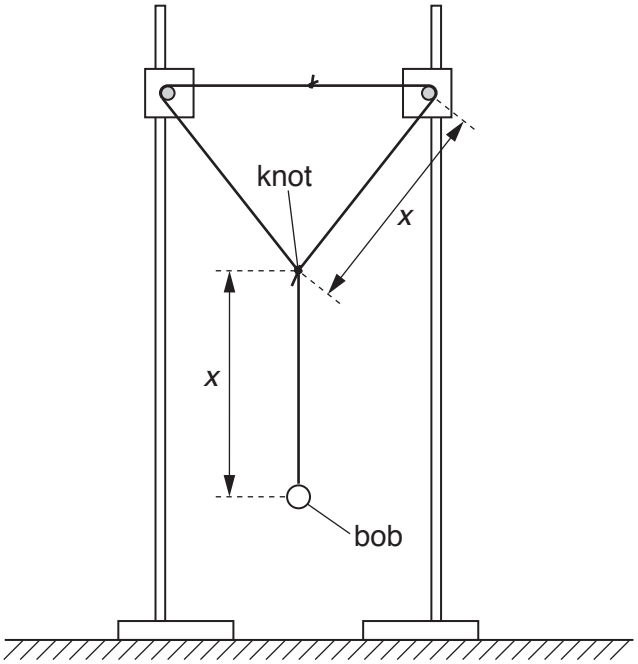


Fig. 2.4

(ii) Pull the bob a short distance towards you. Release the bob. The bob will oscillate.

Determine the period T of these oscillations.

T = ...[1]

(d) Move one of the stands until the distance between the centres of the rods of the clamps is 30.0 cm.

Using the second loop and bob, repeat **(a)**, **(b)(ii)**, **(b)(iv)** and **(c)**.

L = ...

x = ...

G = ...

T = ...

[3]

(e) It is suggested that the relationship between T, G and x is

$$T^2 = k(G + x)$$

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. .....

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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]

[Total: 20]

Cambridge International AS & A Level

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Cambridge International Advanced Subsidiary and Advanced Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

3133103509

PHYSICS **9702/36**

Paper 3 Advanced Practical Skills 2 **October/November 2017**

2 hours

Candidates answer on the Question Paper.

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

(a) Measure and record the length L of the wire shape, as shown in Fig. 1.1.

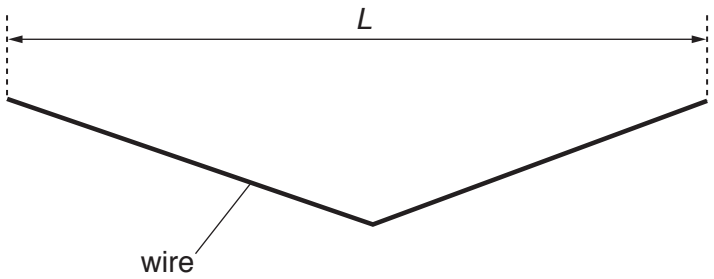


Fig. 1.1

L = ... cm

(b) (i) Assemble the apparatus as shown in Fig. 1.2.
The rods of the clamps should be **parallel to each other and at the same height above the bench**. The wire shape should be placed centrally on the rods.

Adjust the apparatus so that the distance between the centres of the rods is approximately 22 cm.

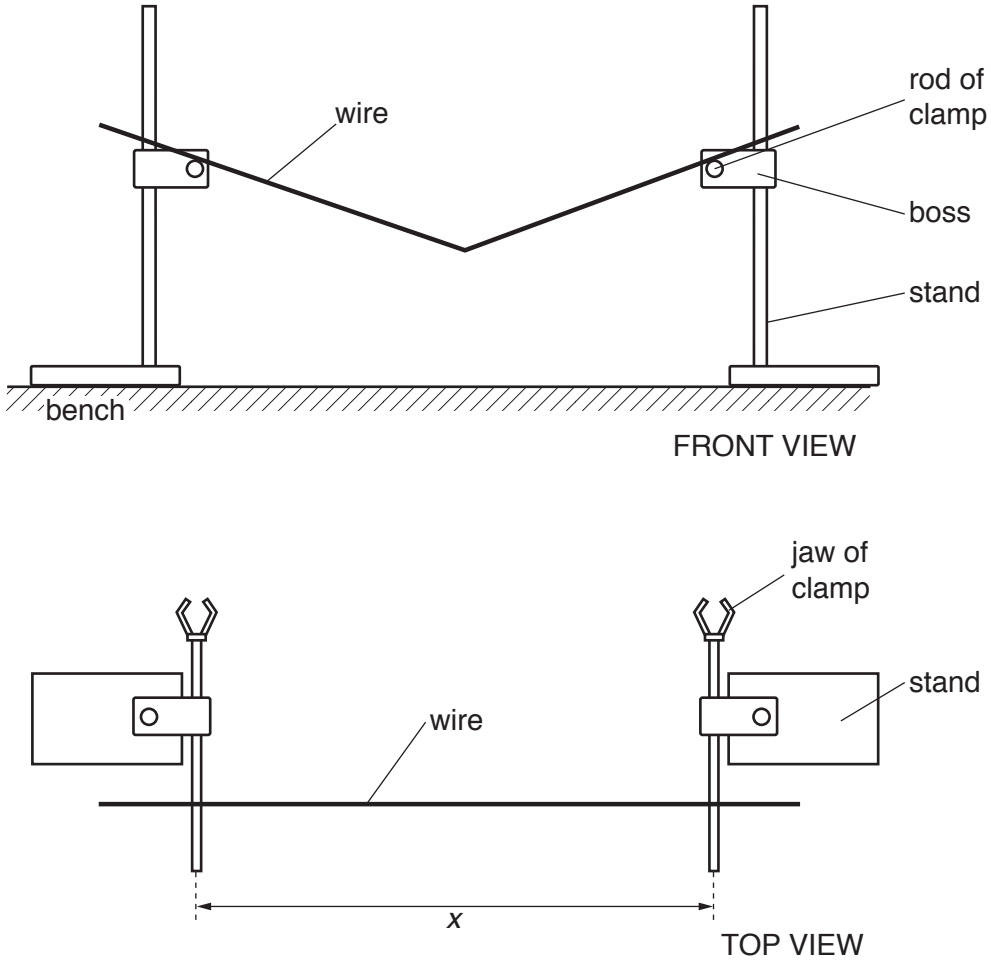


Fig. 1.2

(ii) The distance between the centres of the rods is x. Measure and record x.

x = ... cm

(c) **(i)** Push the centre of the wire a small distance away from you.
Release it so that it oscillates.

(ii) Take measurements to determine the period T of the oscillations.

T = ... [2]

(d) For values of x less than $\frac{L}{2}$, the wire shape inverts as shown in Fig. 1.3.

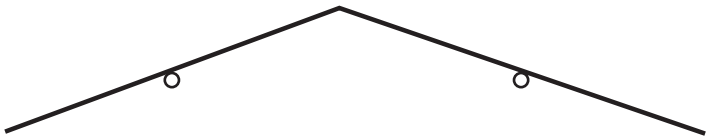


Fig. 1.3

Calculate $\frac{L}{2}$.

$\frac{L}{2}$ = ... cm

(e) Vary x in the range $\frac{L}{2} < x < 24\,\text{cm}$. Repeat **(b)(ii)** and **(c)** until you have six sets of values of x and T.

Record your results in a table. Include your values from **(b)(ii)** and **(c)**. Also include values of $\left(x - \frac{L}{2}\right)$ and $\frac{1}{T^2}$ in your table.

[10]

(f) **(i)** Plot a graph of $\frac{1}{T^2}$ on the y-axis against $\left(x - \frac{L}{2}\right)$ on the x-axis. [3]

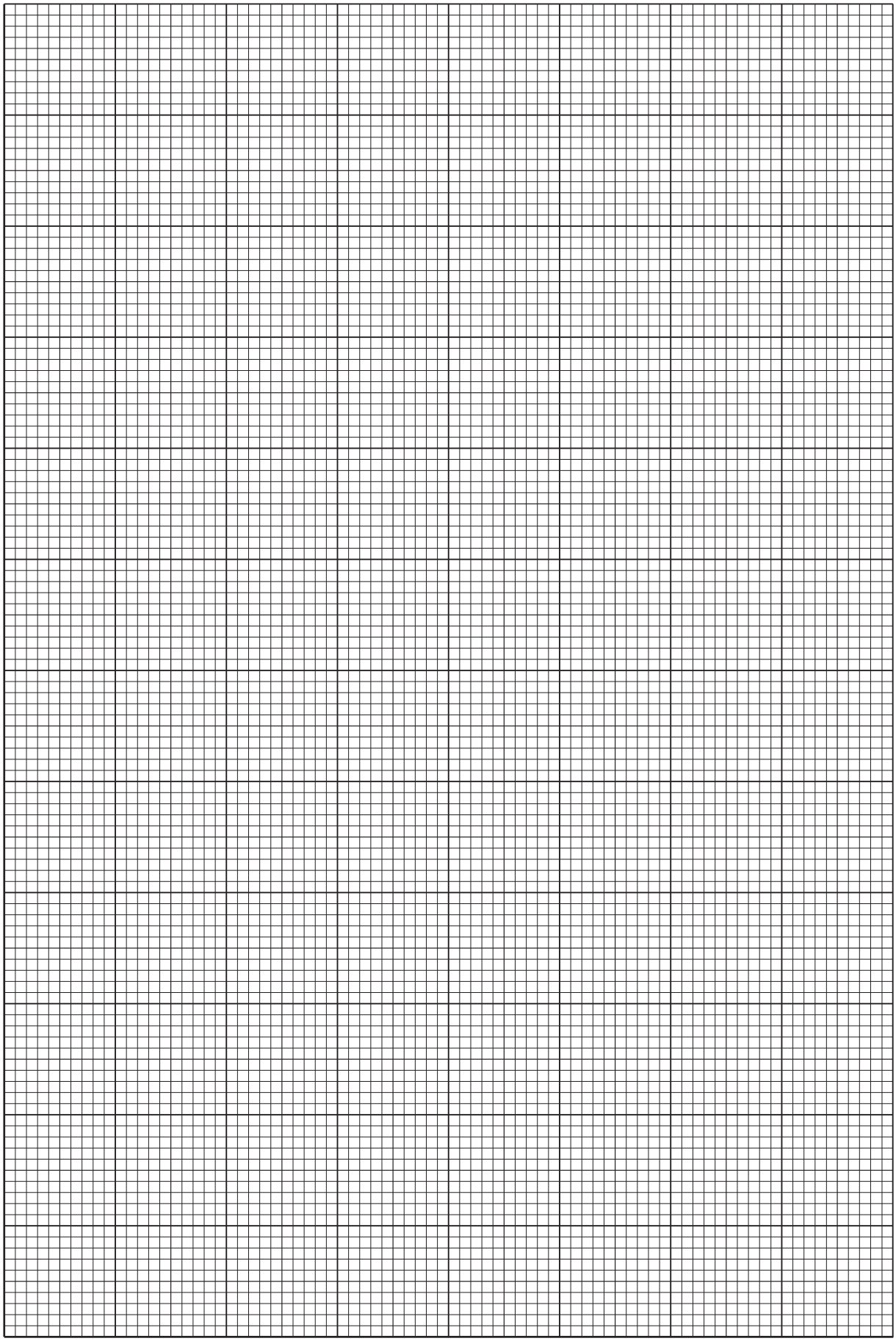
(ii) Draw the straight line of best fit. [1]

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

gradient = ...

y-intercept = ...

[2]



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

$$\frac{1}{T^2} = a\left(x - \frac{L}{2}\right) + b$$

where a and b are constants.

Using your answers in **(f)(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 how the deflection of a wooden strip depends on the distribution of the load on the strip.

(a) (i) Lay the wooden strip flat on the bench.
Place the ten slotted masses along the strip, as shown in Fig. 2.1.

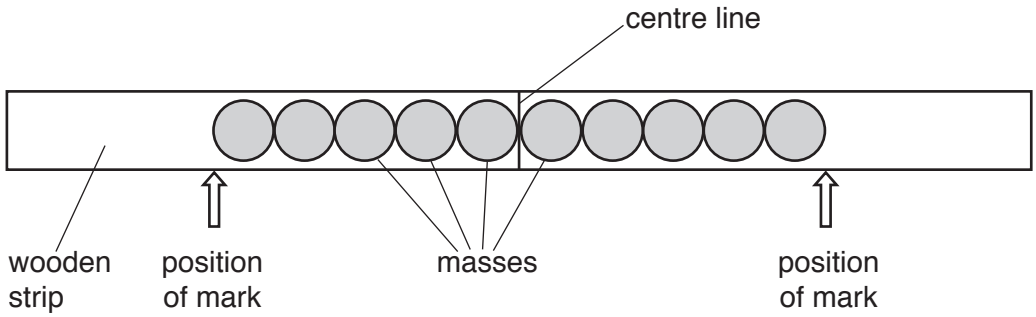


Fig. 2.1

(ii) Using the pen, make a small mark on the edge of the strip at each end of the row of masses, as shown in Fig. 2.1.

(iii) Remove the masses.

(iv) Measure and record the distance *D* between the marks, as shown in Fig. 2.2.

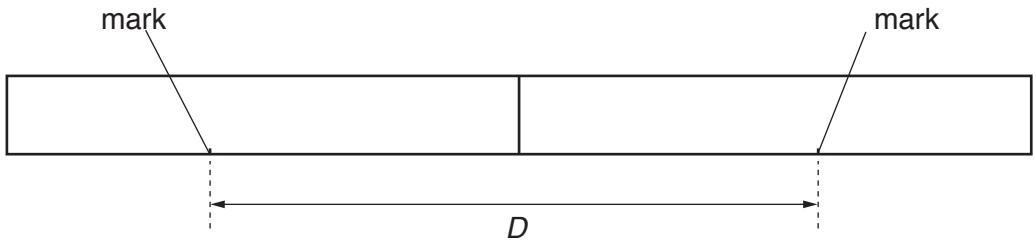


Fig. 2.2

D = ... [1]

(b) (i) Place the strip on the two wooden blocks with the inner edges of the blocks at the marks, as shown in Fig. 2.3.

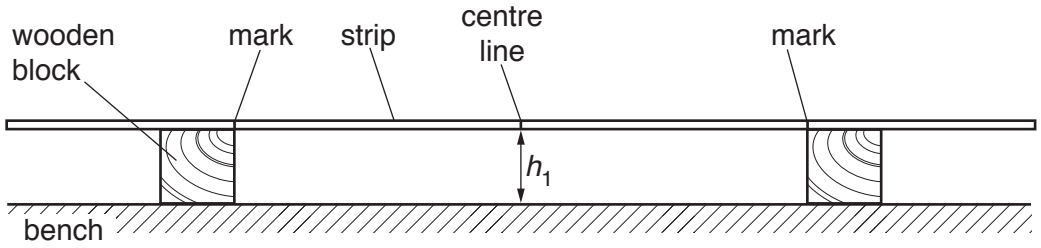


Fig. 2.3

(ii) Measure and record the height h_1 of the **bottom** of the strip at the centre line, as shown in Fig. 2.3.

h_1 = ... [1]

(c) Estimate the percentage uncertainty in your value of h_1.

percentage uncertainty = ... [1]

(d) (i) Replace the masses on the strip and ensure the blocks are still positioned at the marks. Measure and record the height h_2 of the bottom of the strip at the centre line, as shown in Fig. 2.4.

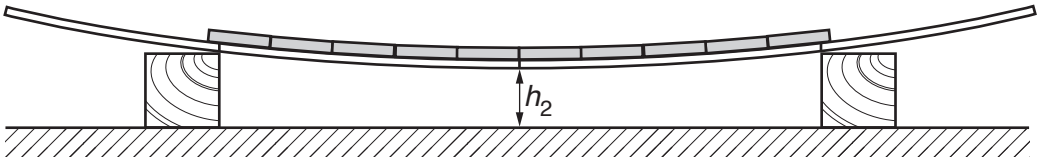


Fig. 2.4

h_2 = ...

(ii) Calculate d, where $d = h_1 - h_2$.

d = ... [1]

(e) (i) Remove the masses from the strip.

(ii) Ensure the blocks are still positioned at the marks. Measure and record the height h_3 of the bottom of the strip at the centre line.

h_3 = ...

(iii) Place all the masses at the centre line, as shown in Fig. 2.5.

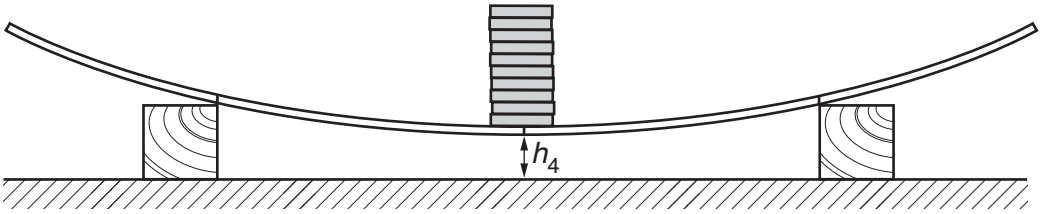


Fig. 2.5

(iv) Ensure the blocks are still positioned at the marks, then measure and record the height h_4 of the bottom of the strip at the centre line.

h_4 = ...

(v) Calculate p, where $p = h_3 - h_4$.

p = ...

(f) **(i)** Remove the masses.

(ii) Measure the thickness t and the width w of the strip, as shown in Fig. 2.6.

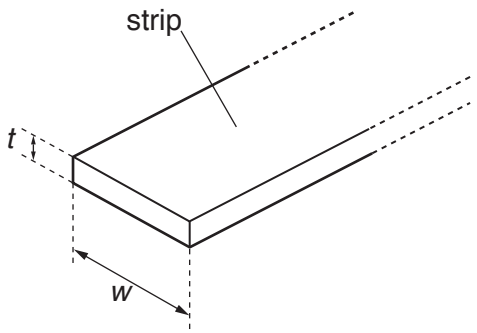


Fig. 2.6

t = ...

w = ...
[1]

(iii) Calculate the Young modulus E for the material of the strip using

$$E = \frac{FD^3}{4pwt^3}$$

where F = 10.0 N.

E = ... [1]

(g) Repeat **(a)**, **(b)**, **(d)** and **(e)** using **eight** masses.

D = ...

h_1 = ...

h_2 = ...

d = ...

h_3 = ...

h_4 = ...

p = ...
[3]

(h) It is suggested that the relationship between d and p is

$$d = kp$$

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 you have given for your values of k.

.....

.....

.....[1]

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

.....

.....

.....

.....[1]

(i) **(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]