

CANDIDATE
NAME

--

CENTRE
NUMBER

--	--	--	--	--

CANDIDATE
NUMBER

--	--	--	--

PHYSICS

Paper 3 Advanced Practical Skills 1

9702/31

May/June 2015

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 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.

You are expected to record all your observations as soon as these observations are made, and to plan the presentation of the records so that it is not necessary to make a fair copy of them.

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.

For Examiner's Use	
1	
2	
Total	

This document consists of **12** printed pages.

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

- 1** In this experiment, you will investigate how the current in a circuit varies as the resistance of the circuit is changed.

- (a) (i)** You have been provided with a length of bare wire and two crocodile clips which have small screws on them. Connect the wire between the crocodile clips using the screws as shown in Fig. 1.1.

The length w of wire between the screws should be approximately 50 cm. The screws should be tightened using the screwdriver.

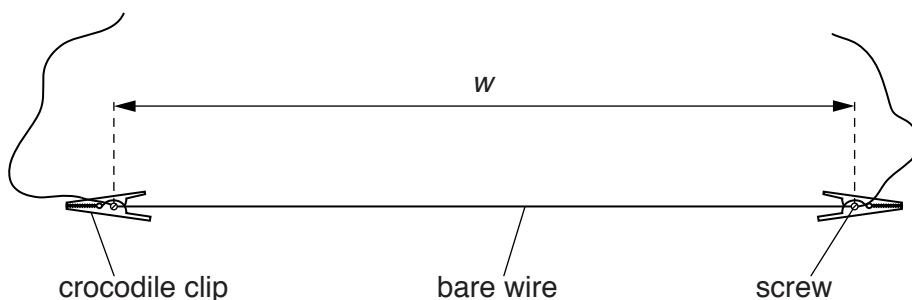


Fig. 1.1

- (ii)** Measure and record w .

$w = \dots\dots\dots$ [1]



- (b) (i)** Set up the circuit as shown in Fig. 1.2.

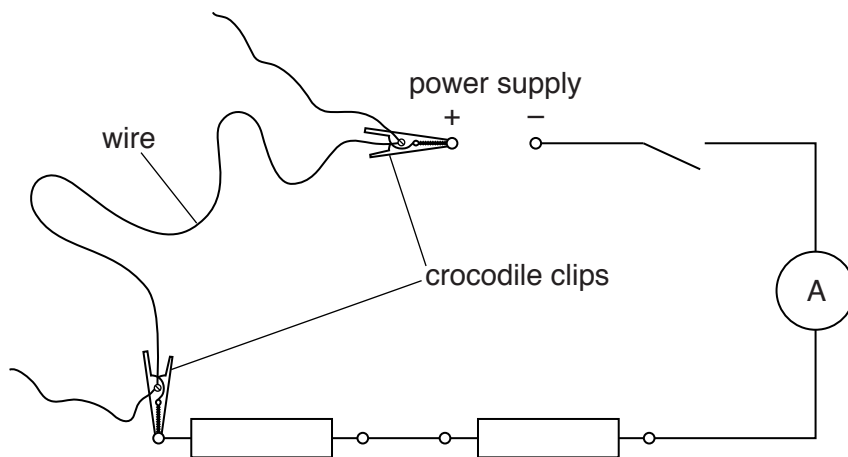


Fig. 1.2

- (ii)** Close the switch.

- (iii)** Record the ammeter reading I_A .

$I_A = \dots\dots\dots$

(iv) Open the switch.

(c) (i) Move the crocodile clip to set up the circuit as shown in Fig. 1.3.

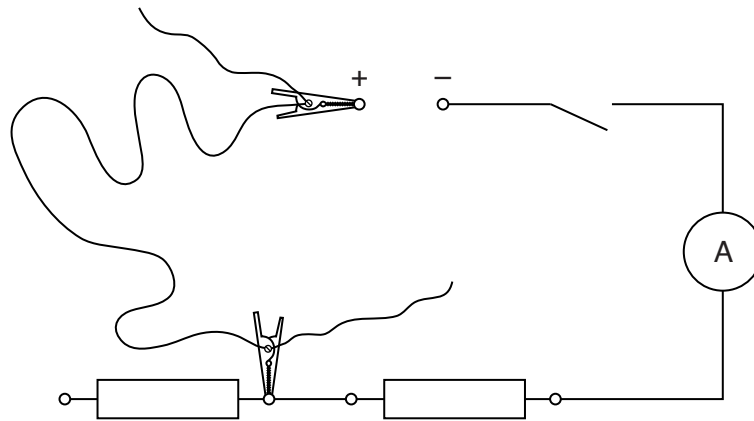


Fig. 1.3

(ii) Close the switch.

(iii) Record the ammeter reading I_B .

$I_B = \dots\dots\dots [1]$

(iv) Open the switch.

(d) Change w and repeat **(a)(ii)**, **(b)** and **(c)** until you have six sets of values of w , I_A and I_B .

Include values of $\frac{(I_A + I_B)}{I_A I_B}$ in your table.

--

[10]

(e) (i) Plot a graph of $\frac{(I_A + I_B)}{I_A I_B}$ on the y -axis against w on the x -axis.

[3]

(ii) Draw the straight line of best fit.

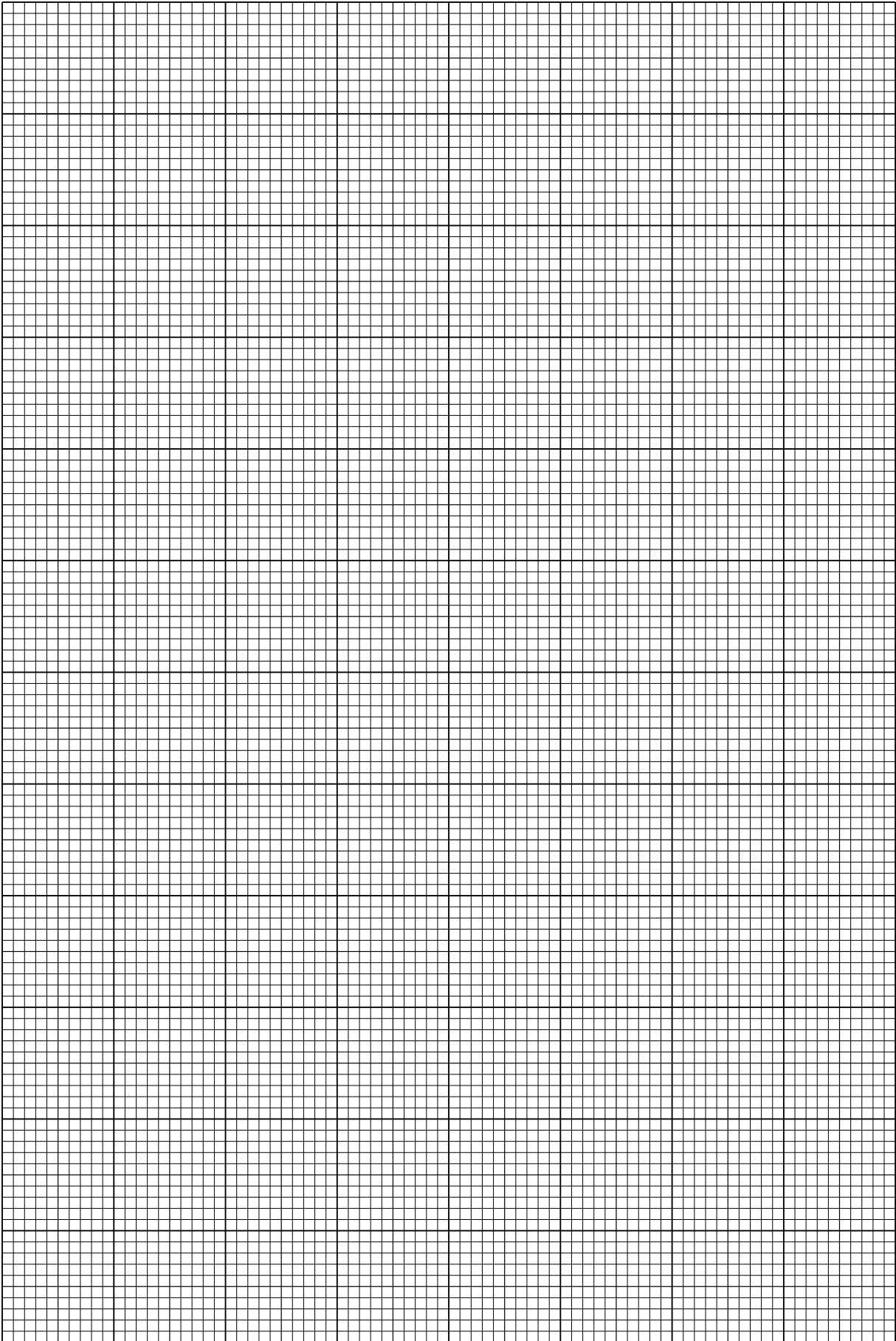
[1]

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

gradient = ...

y -intercept = ...

[2]



- (f) The quantities I_A , I_B and w are related by the equation

$$\frac{(I_A + I_B)}{I_A I_B} = Mw + N$$

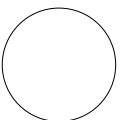
where M and N are constants.

Using your answers in (e)(iii), determine values for M and N .
Give appropriate units.

$M =$

$N =$

[2]



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

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

(a) (i) Measure and record the length L of the **longer** wooden strip as shown in Fig. 2.1.

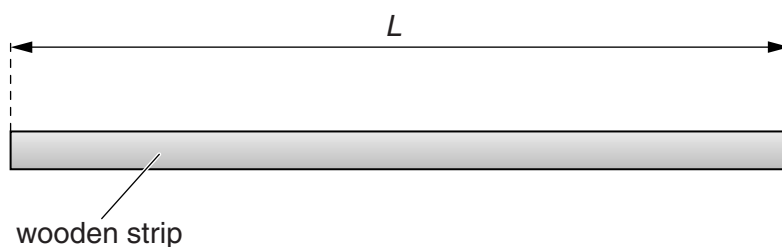


Fig. 2.1

$L =$ [1]

(ii) Measure and record the mass m , in grams, of the **longer** wooden strip.

$m =$ g [1]

(iii) Calculate the mass per unit length p of the wood, where

$$p = \frac{m}{L}.$$

$p =$

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

.....

.....

..... [1]

- (b) (i) Measure and record the mass M , in grams, of the slotted mass.

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

- (ii) Use the Blu-Tack to attach the slotted mass to the top of the **longer** wooden strip as shown in Fig. 2.2.

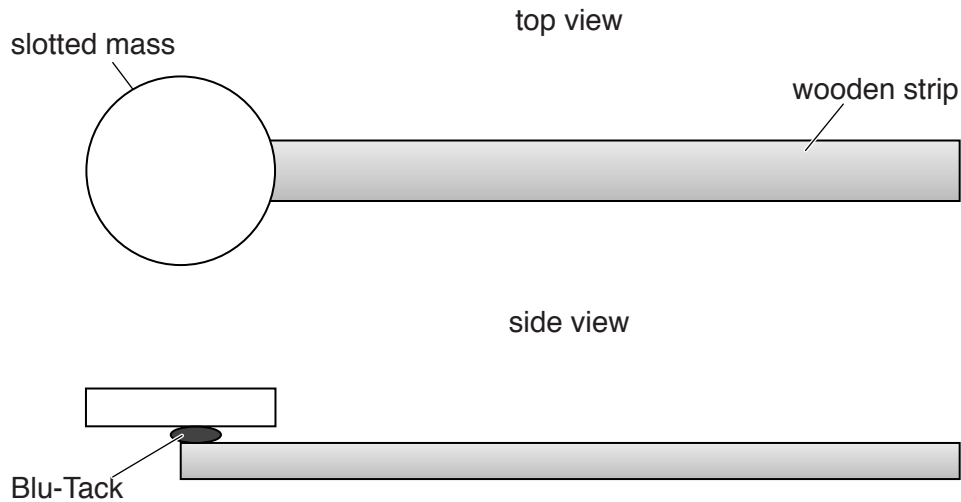


Fig. 2.2

The centre of the slotted mass should be positioned at the end of the wooden strip.

- (iii) Calculate C , where

$$C = \frac{L^2}{2(M + Lp)}.$$

$C = \dots\dots\dots$ [1]

- (c) (i) Balance the wooden strip on the pivot as shown in Fig. 2.3.

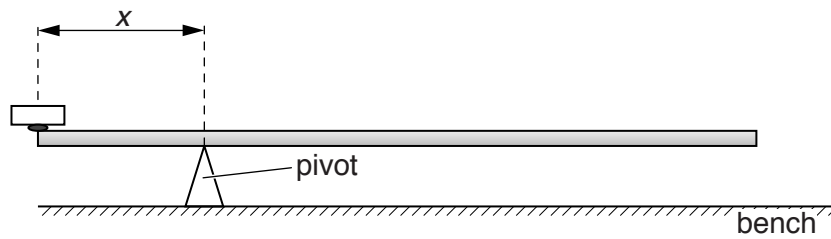


Fig. 2.3

- (ii) Measure and record the distance x from the pivot to the end of the wooden strip as shown in Fig. 2.3. **Do not mark the wooden strip.**

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

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

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

(d) Repeat (a)(i), (b)(ii), (b)(iii), (c)(i) and (c)(ii) for the **shorter** wooden strip.

$L =$

$C =$

$x =$

[3]

- (e) It is suggested that the relationship between x and C is

$$x = kC$$

where k is a constant.

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

first value of $k = \dots\dots\dots$

second value of $k = \dots\dots\dots$

[1]

- (ii) Explain whether your results in (e)(i) support the suggested relationship.

.....

.....

.....

..... [1]

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

1.

.....

2.

.....

3.

.....

4.

.....

[4]



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

1.

.....

2.

.....

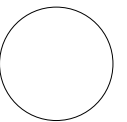
3.

.....

4.

.....

[4]



Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced online in the Cambridge International Examinations Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download at www.cie.org.uk after the live examination series.

Cambridge International Examinations is part of the Cambridge Assessment Group. Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.

CANDIDATE
NAME

--

CENTRE
NUMBER

--	--	--	--	--

CANDIDATE
NUMBER

--	--	--	--



PHYSICS

Paper 3 Advanced Practical Skills 2

9702/32

May/June 2015

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.

You are expected to record all your observations as soon as these observations are made, and to plan the presentation of the records so that it is not necessary to make a fair copy of them.

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.

For Examiner's Use

1	
2	
Total	

This document consists of **12** printed pages.

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

1 In this experiment, you will investigate the forces acting on a wooden strip in equilibrium.

(a) The apparatus has been assembled for you as shown in Fig. 1.1.

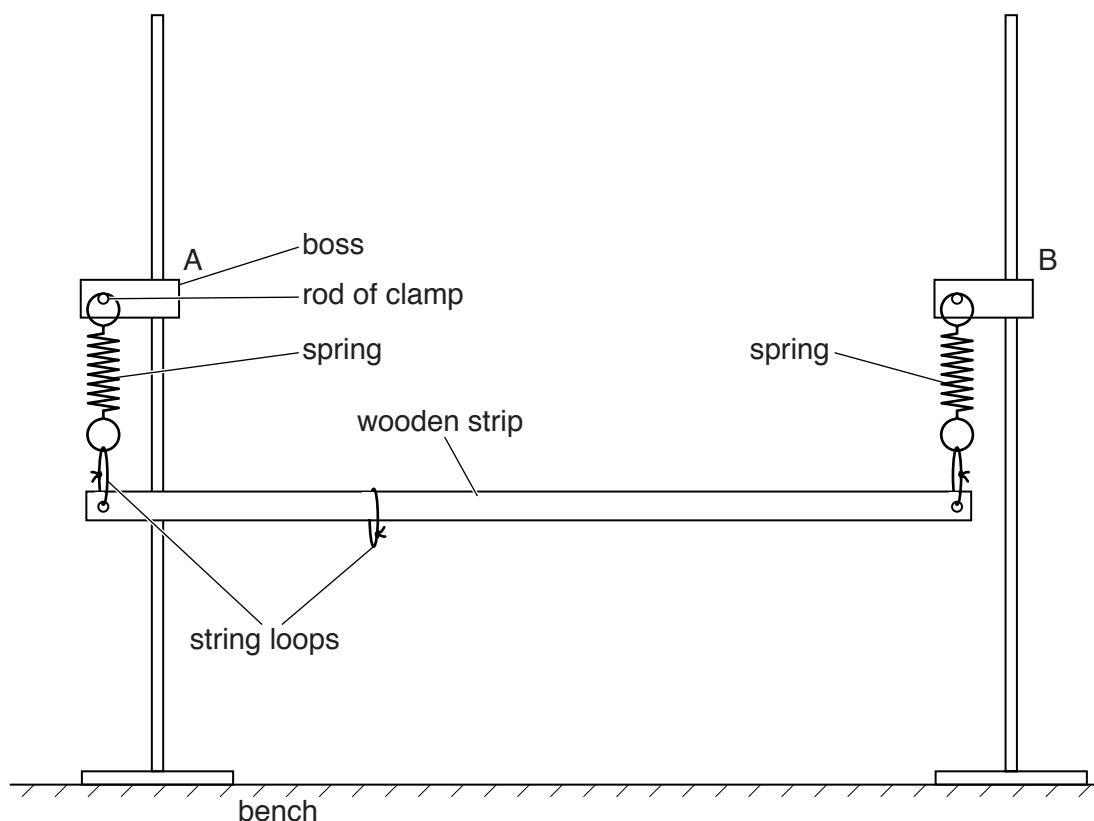


Fig. 1.1

- (i)** Adjust the positions of the stands so that the springs are vertical.
- (ii)** If necessary, adjust the height of the boss A so that the wooden strip is parallel to the bench.

- (b) (i) Increase the height of boss A by approximately 10 cm.
Leave boss B at the same height throughout the experiment.
- (ii) Hang the mass M from the string loop as shown in Fig. 1.2.

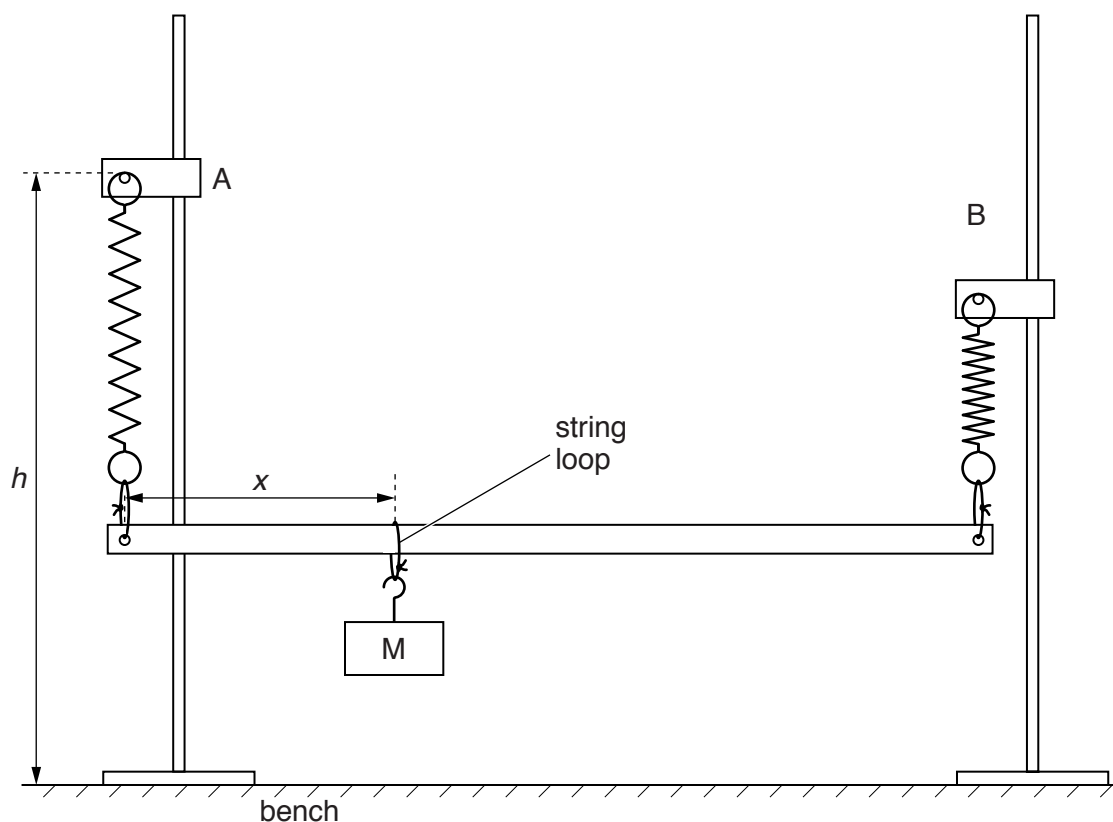


Fig. 1.2

- (c) (i) Adjust the position of the string loop until the wooden strip is parallel to the bench again.
- (ii) Measure and record the distance h from the bench to the top of the spring at A, as shown in Fig. 1.2.

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

- (iii) Measure and record the distance x from the string loop below A to the string loop supporting M , as shown in Fig. 1.2.

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

- (d) Lower boss A and repeat (c) until you have six sets of values of h and x .

Include values of $\frac{1}{h}$ and $\frac{x}{h}$ in your table.

The position of boss B should remain the same throughout the experiment.

--

[10]

- (e) (i) Plot a graph of $\frac{1}{h}$ on the y -axis against $\frac{x}{h}$ on the x -axis.

[3]

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

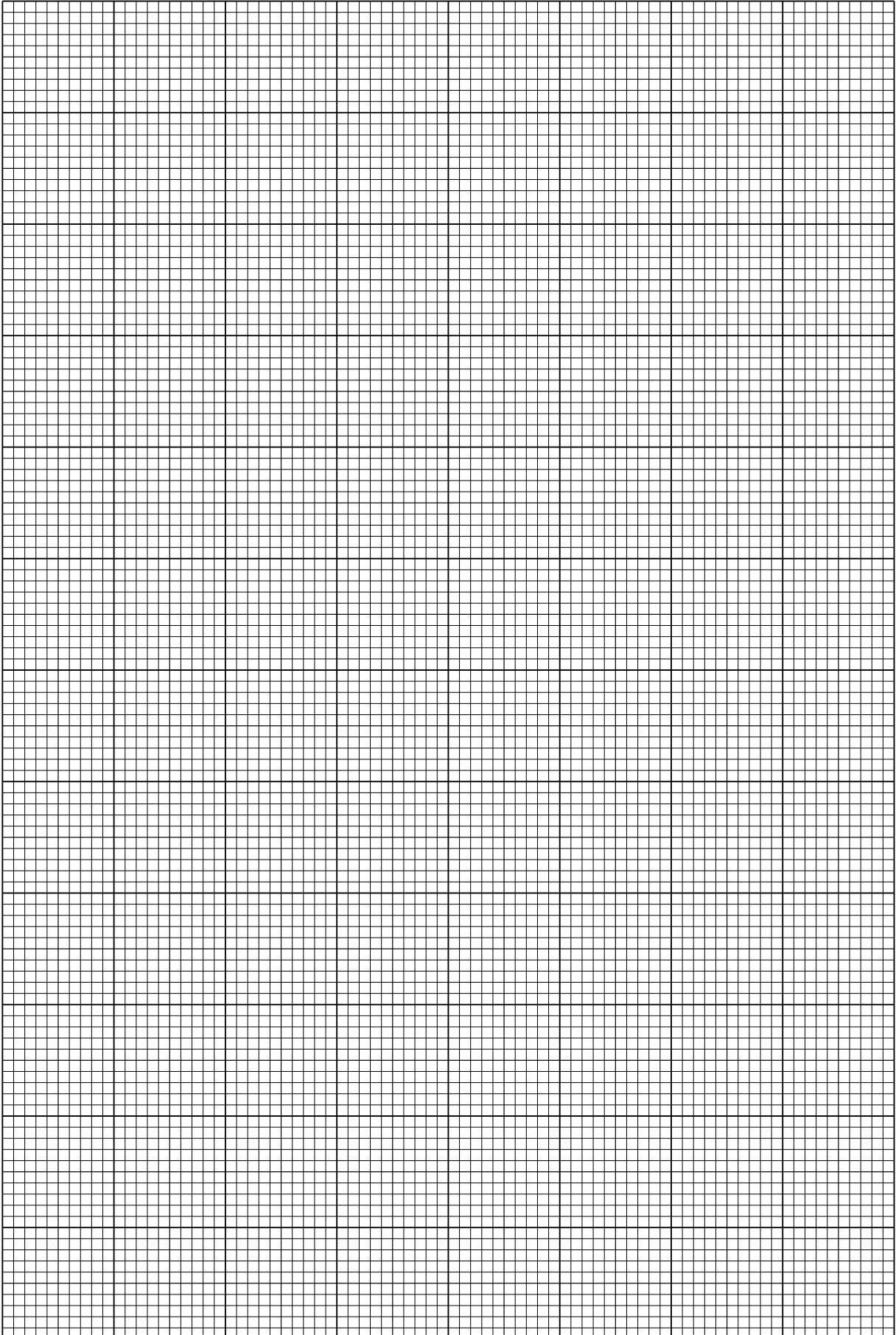
[1]

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

gradient = ...

y -intercept = ...

[2]



- (f) The quantities h and x are related by the equation

$$\frac{1}{h} = \frac{ax}{h} + b$$

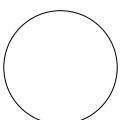
where a and b are constants.

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

$a =$

$b =$

[2]



Please turn over for Question 2.

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

- 2** In this experiment, you will investigate the force from the surface of water acting on a wire loop.

(a) You are provided with two circular wire loops, each with a hook.
Take the smaller loop.

(i) Make sure that the loop lies flat on the bench, and that the loop is horizontal if suspended by its hook.

(ii) Take measurements to find the diameter D of the loop, as shown in Fig. 2.1.

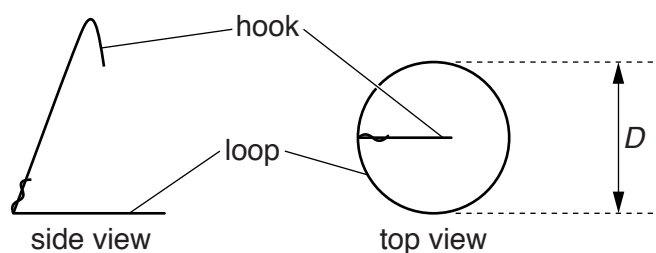


Fig. 2.1 (not to scale)

$D =$ cm [2]

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

percentage uncertainty = ... [1]

--

(iv) Calculate the circumference C of the loop using the expression $C = \pi D$.

$C =$ [1]

--

(b) Justify the number of significant figures you have given for your value of C .

.....

.....

..... [1]

--

- (c) You are also provided with a stand holding a spring with a pointer.

Hold a ruler vertically behind the pointer, as shown in Fig. 2.2.

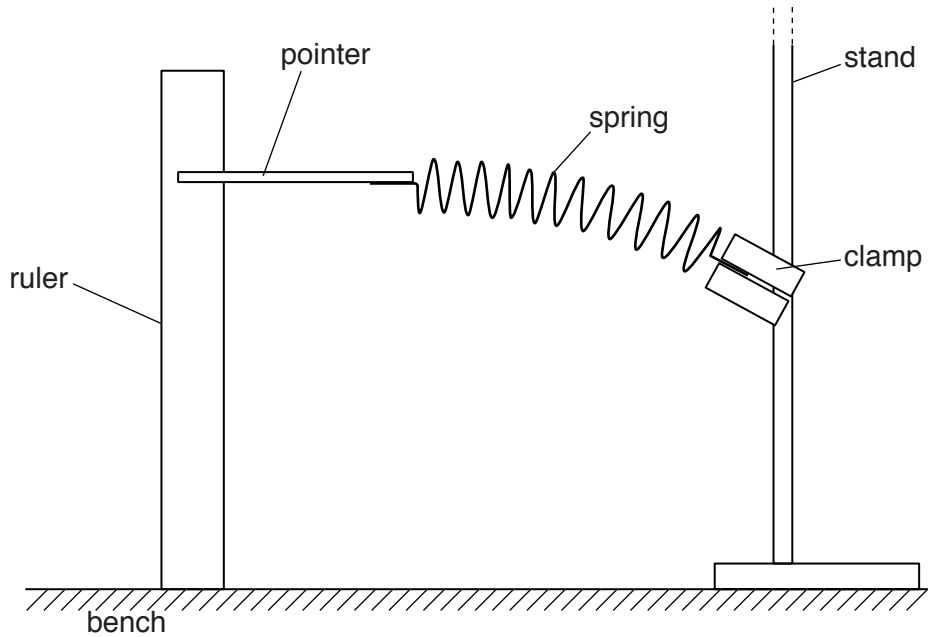


Fig. 2.2

- (d) (i) Place the hook of the wire loop onto the end coil of the spring, as shown in Fig. 2.3.

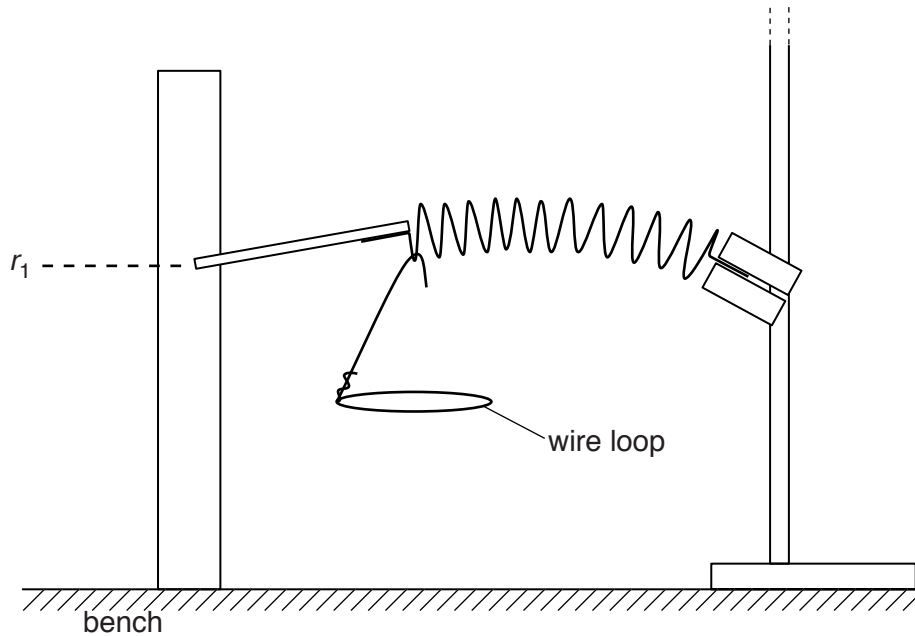


Fig. 2.3

- (ii) Record the pointer reading r_1 .

$r_1 =$ [1]

- (iii) Position the beaker of water underneath the wire loop and then lift the beaker up until the water is in contact with the loop, as shown in Fig. 2.4.

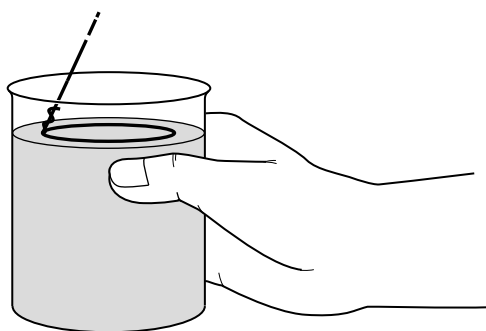


Fig. 2.4

- (iv) **Slowly** lower the beaker. The water surface will pull the loop down until it breaks away from the water surface.
- (v) Repeat steps (iii) and (iv), this time recording the pointer reading r_2 just before the loop breaks away.

$r_2 =$ [1]

- (vi) Remove the wire loop from the spring.

- (e) Using the other wire loop, repeat (a)(i), (a)(ii), (a)(iv), (c) and (d).

$D =$

$C =$

$r_1 =$

$r_2 =$

[3]

- (f) It is suggested that the relationship between r_1 , r_2 and C is

$$r_1 - r_2 = kC$$

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]

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

1.

.....

2.

.....

3.

.....

4.

.....

[4]



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

1.

.....

2.

.....

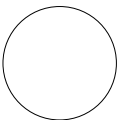
3.

.....

4.

.....

[4]



Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced online in the Cambridge International Examinations Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download at www.cie.org.uk after the live examination series.

Cambridge International Examinations is part of the Cambridge Assessment Group. Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.

CANDIDATE
NAME

--

CENTRE
NUMBER

--	--	--	--	--

CANDIDATE
NUMBER

--	--	--	--

PHYSICS

9702/33

Paper 3 Advanced Practical Skills 1

May/June 2015

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.

You are expected to record all your observations as soon as these observations are made, and to plan the presentation of the records so that it is not necessary to make a fair copy of them.

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.

For Examiner's Use	
1	
2	
Total	

This document consists of **13** printed pages and **3** blank pages.

BLANK PAGE

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

- 1** In this experiment, you will investigate how the position of a suspended card varies with the distribution of masses attached to it.

(a) (i) Use the nail to make two holes in the card as shown in Fig. 1.1 and Fig. 1.2.



Fig. 1.1

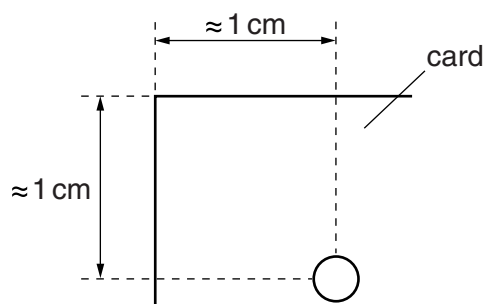


Fig. 1.2

The holes should be approximately 1 cm from the edges of the card as shown in Fig. 1.2.

Each hole should be big enough for the card to swing freely when the nail is inserted in the hole.

(ii) Record the mass C of the card shown on the base of the stand.

$C = \dots\dots\dots \text{ g}$

- (b) (i) Set up the apparatus as shown in Fig. 1.3. Suspend the card from the nail through one of the holes. Hang the plumb-line from the nail. Mark the card at a point along the plumb-line as shown in Fig. 1.3.

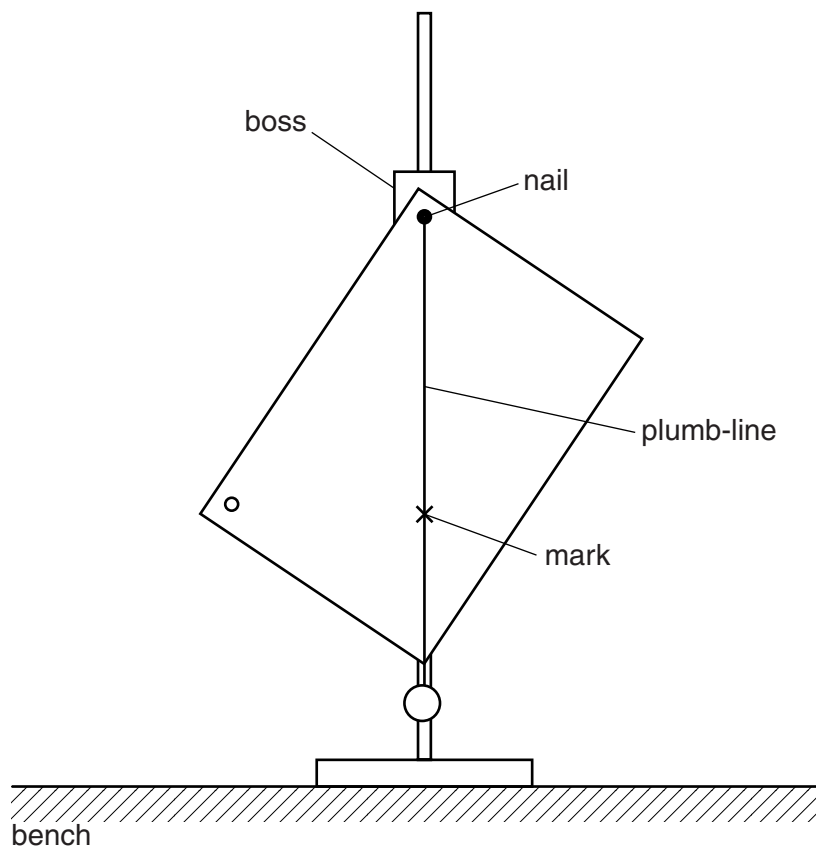


Fig. 1.3

- (ii) Remove the card. Draw a line on the card through the hole and the mark. This line should go just over half the length of the card as shown in Fig. 1.4.
- (iii) Repeat (b)(i) and (b)(ii) using the other hole in the card.
- (iv) Measure and record the distance y as shown in Fig. 1.4.

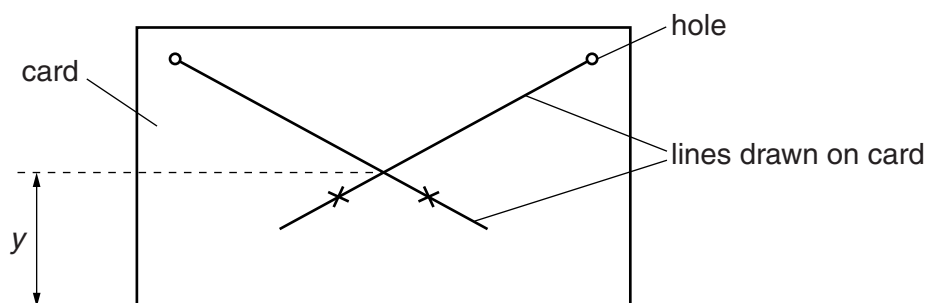


Fig. 1.4

$y = \dots\dots\dots$ [1]



- (c) (i) Using some Blu-Tack, attach one of the 10g slotted masses to the card. The position of the slotted mass should be half-way along the edge of the card and touching the edge as shown in Fig. 1.5.

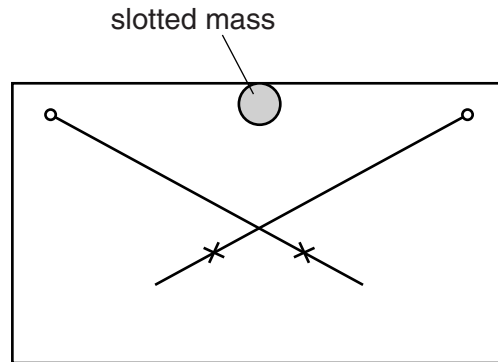


Fig. 1.5

- (ii) Repeat (b) using the card with the mass attached.

$y = \dots\dots\dots$ [1]



- (d) The mass attached to the card is m . Increase m by fixing another 10 g slotted mass on top of, or behind, the first mass.

Record m and repeat (b) until you have six sets of readings of m and y . Include your results from (b) and (c).

Include values of $y(C + m)$ in your table.

--

[10]

- (e) (i) Plot a graph of $y(C + m)$ on the y -axis against m on the x -axis.

[3]

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

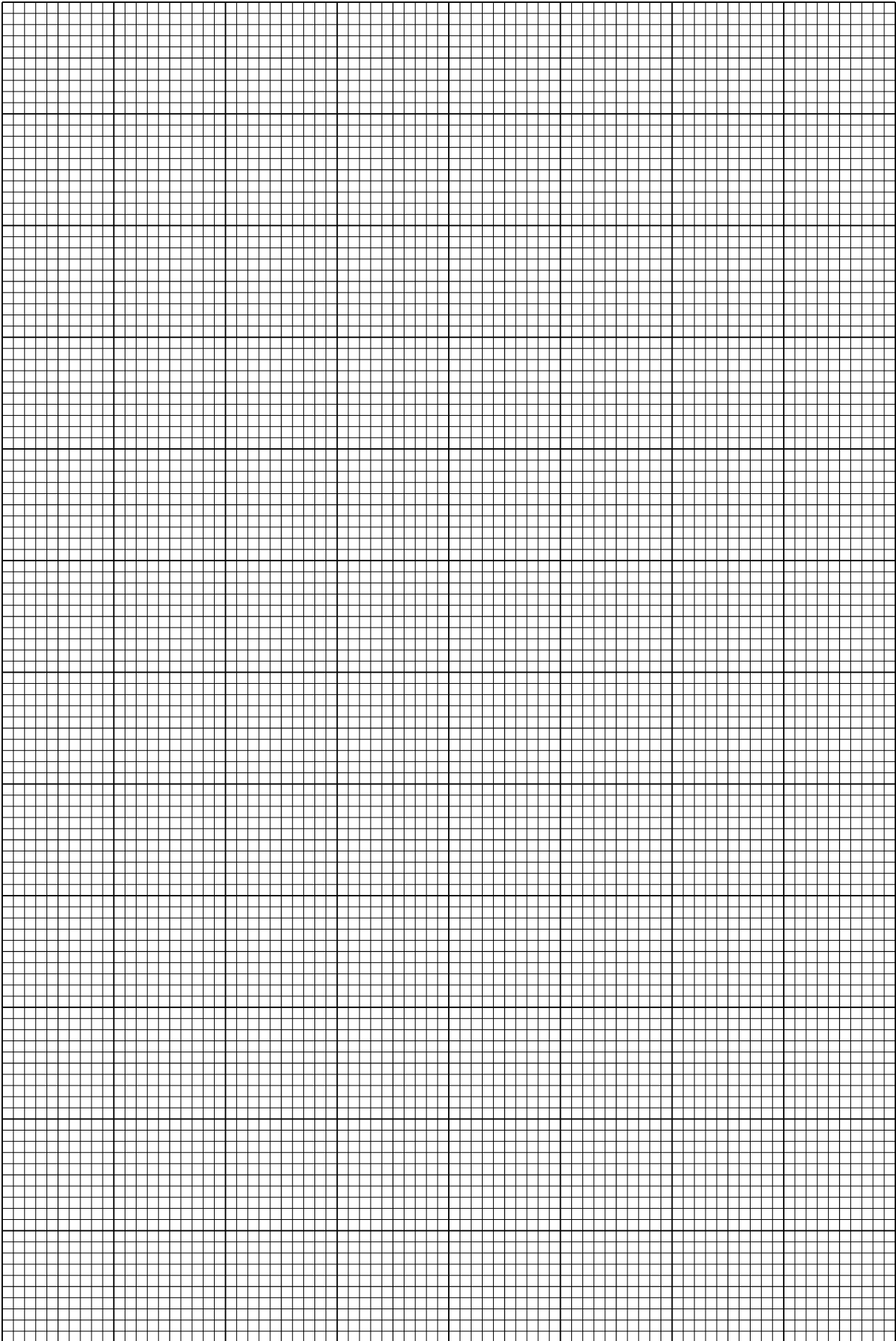
[1]

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

gradient = ...

y -intercept = ...

[2]



- (f) It is suggested that the quantities y , C and m are related by the equation

$$y(C + m) = Am + \frac{AB}{2}$$

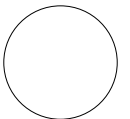
where A and B are constants.

Use your answers in (e)(iii) to determine the values of A and B .
Give appropriate units.

$A =$

$B =$

[2]



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

2 In this experiment, you will investigate the motion of a small container in water.

- (a)** You have been provided with three glass marbles and a small container with a separate lid.

The dimensions of the glass marbles and the small container are shown in Fig. 2.1.

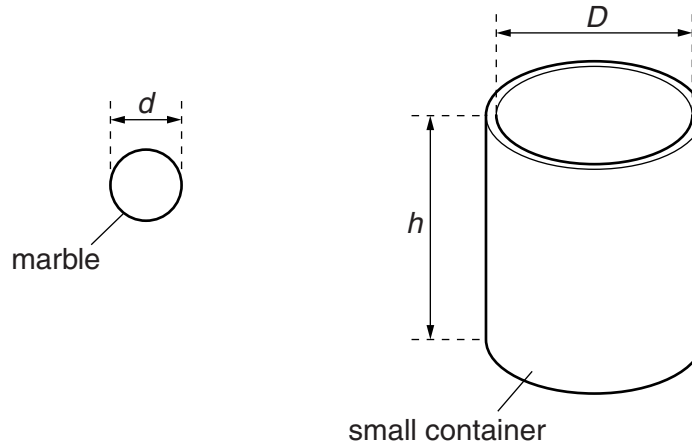


Fig. 2.1

- (i)** Measure and record the diameter d of the marble and the inner diameter D of the small container.

$d =$

$D =$ [1]

☐

- (ii)** Measure and record the height h of the small container.

$h =$ [1]

☐

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

percentage uncertainty = ...[1]

- (b) (i) Place the small container in the tray. Fill the small container with water from the beaker.
- (ii) Place **two** glass marbles in the small container. Wait until the water has stopped overflowing. Place the lid on the small container.
- (iii) The fraction x of glass in the small container is given by

$$x = \frac{2nd^3}{3D^2h}$$

where n is the number of marbles in the small container.

Calculate x .

$x =$ [1]

- (c) Justify the number of significant figures that you have given for your value of x .

.....

.....

.....[1]

- (d) (i) Place the small container in the cylinder as shown in Fig. 2.2.

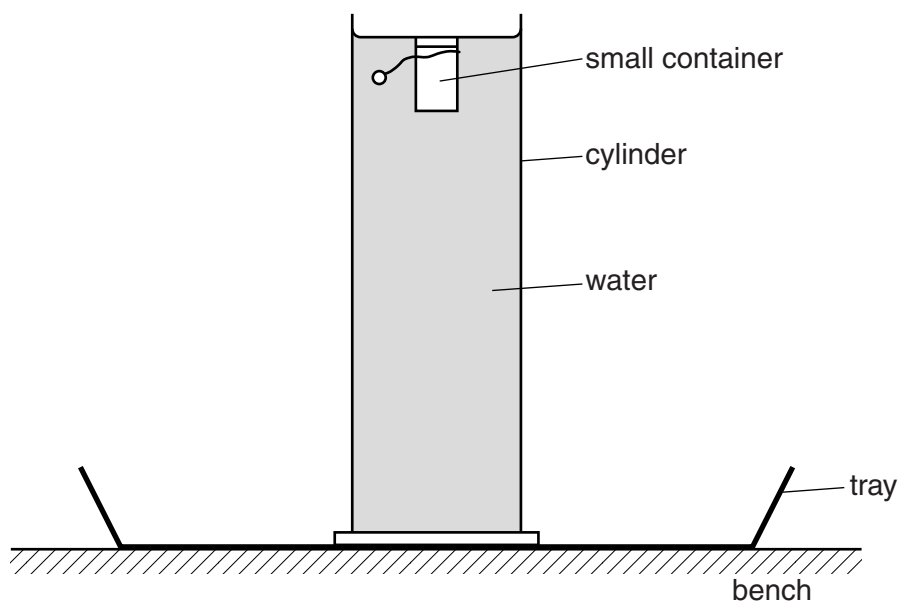


Fig. 2.2

- (ii) Release the small container and measure the time t taken for the small container to fall to the bottom of the cylinder.

$t = \dots\dots\dots$ [2]

(e) Repeat (b) and (d) using **three** marbles.

$x =$

$t =$

[3]

- (f) It is suggested that the relationship between t and x is

$$t^2 = \frac{k}{x}$$

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]

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

1.

.....

2.

.....

3.

.....

4.

.....

[4]



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

1.

.....

2.

.....

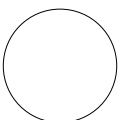
3.

.....

4.

.....

[4]



BLANK PAGE

Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced online in the Cambridge International Examinations Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download at www.cie.org.uk after the live examination series.

Cambridge International Examinations is part of the Cambridge Assessment Group. Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.

CANDIDATE
NAME

--

CENTRE
NUMBER

--	--	--	--	--

CANDIDATE
NUMBER

--	--	--	--

PHYSICS

9702/34

Paper 3 Advanced Practical Skills 2

May/June 2015

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.

You are expected to record all your observations as soon as these observations are made, and to plan the presentation of the records so that it is not necessary to make a fair copy of them.

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.

For Examiner's Use

1	
2	
Total	

This document consists of **10** printed pages and **2** blank pages.

BLANK PAGE

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

1 In this experiment, you will investigate a metre rule rocking on a beaker.

- (a)** Assemble the apparatus as shown in Fig. 1.1 with the beaker horizontal. The centres of each of the two masses should be at the same distance r from the centre of the metre rule, where r is approximately 30 cm.

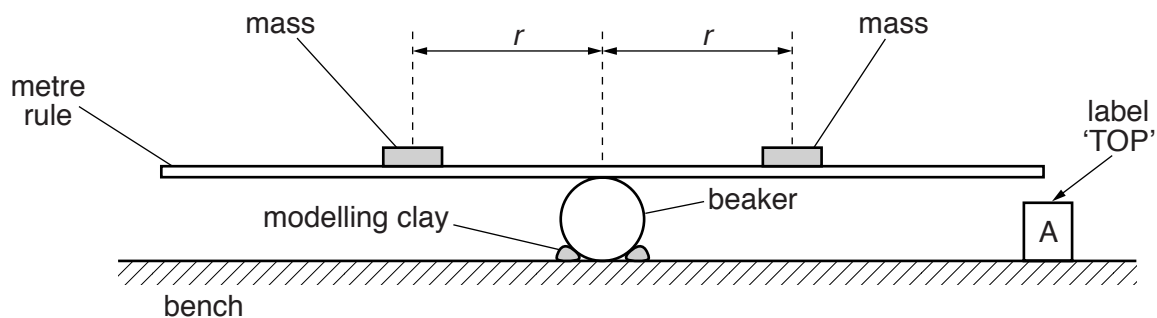


Fig. 1.1

- (b) (i)** Measure and record the distance r .

$r = \dots\dots\dots$ [1]

- (ii)** Adjust the position of the metre rule on the beaker so that the metre rule is balanced and approximately parallel to the bench.

- (c) (i)** Hold down the end of the metre rule on A, as shown in Fig. 1.2.

- (ii)** Release the metre rule and measure and record the time T for it to move up and then down again to its lowest position, as shown in Fig. 1.2.

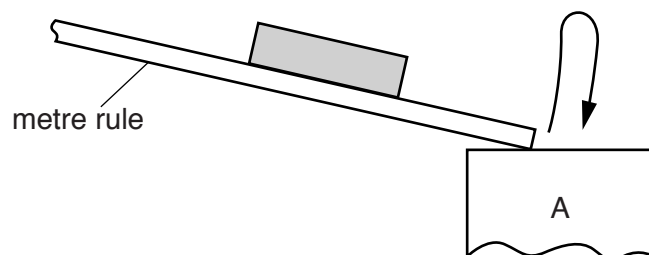


Fig. 1.2

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

- (d) Reposition the two masses at a different distance r from the centre of the metre rule and repeat (b) and (c) until you have six sets of values of r and T .

Use values of r less than or equal to 40 cm.
Include values of r^2 and T^3 in your table.

--

[9]

- (e) (i) Plot a graph of T^3 on the y -axis against r^2 on the x -axis.

[3]

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

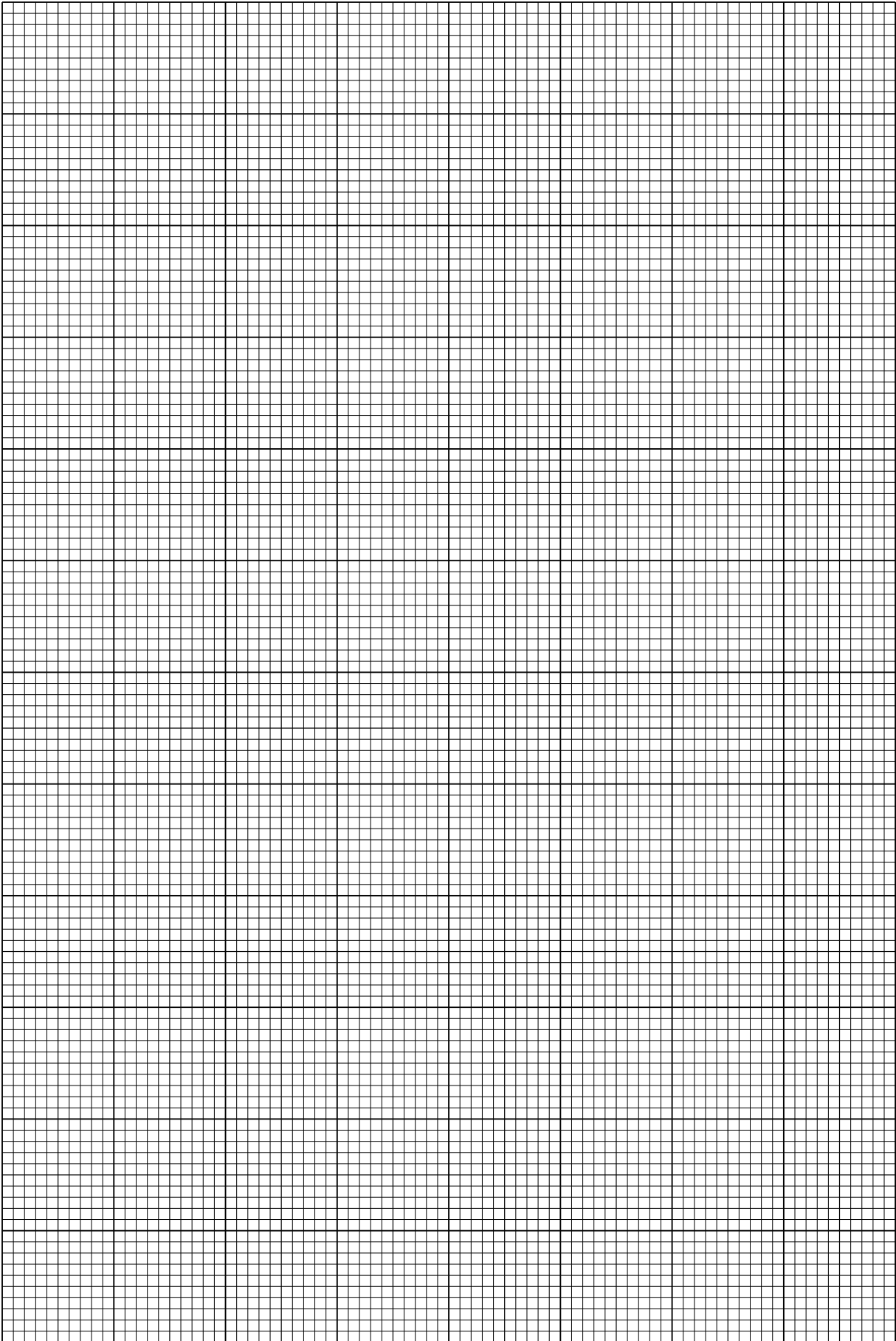
[1]

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

gradient = ...

y -intercept = ...

[2]



- (f) The quantities T and r are related by the equation

$$T^3 = ar^2 + b$$

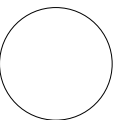
where a and b are constants.

Use your answers from (e)(iii) to determine the values of a and b .
Give appropriate units.

$a =$

$b =$

[2]



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

- 2** In this experiment, you will investigate how the optical properties of a lens depend on its shape.

(a) (i) Select one of the two glass lenses.

(ii) Take measurements to determine the thickness t , diameter D and edge height h of the lens, as shown in Fig. 2.1.

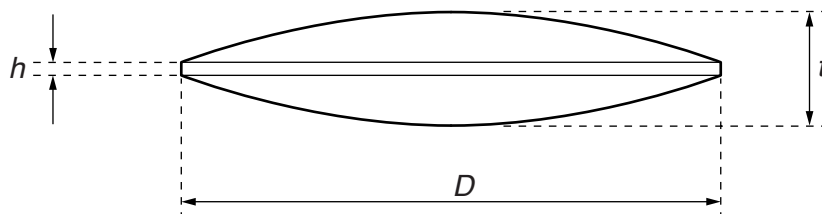


Fig. 2.1

$t =$ cm

$D =$ cm

$h =$ cm
[3]

(b) Calculate R , where

$$R = \frac{D^2 + (t - h)^2}{4(t - h)}.$$

$R =$ cm [2]

- (c) You are provided with a small card which names a bright object in your exam room. You are also provided with a white screen.

- (i) Use the lens to focus a sharp image of the bright object onto the screen, as shown in Fig. 2.2.

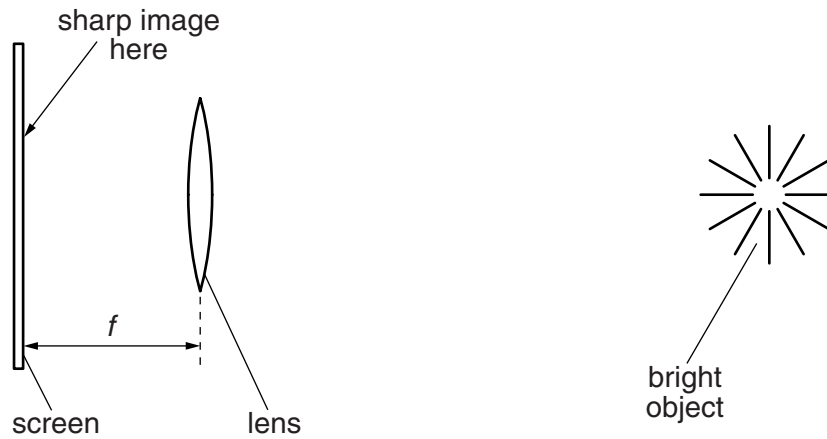


Fig. 2.2 (not to scale)

- (ii) Measure the distance f from the lens to the screen, as shown in Fig. 2.2.

$f =$ cm [1]

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

percentage uncertainty = ... [1]

(d) Using the second lens, repeat (a)(ii), (b), (c)(i) and (c)(ii).

$t = \dots\dots\dots$ cm

$D = \dots\dots\dots$ cm

☐

$h = \dots\dots\dots$ cm

$R = \dots\dots\dots$ cm

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

☐

Question 2 continues on page 10.

- (e) It is suggested that the relationship between R and f is

$$R = kf$$

where k is a constant.

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

first value of $k = \dots\dots\dots$

second value of $k = \dots\dots\dots$

[2]

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

.....

[1]

--

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

1.

.....

2.

.....

3.

.....

4.

.....

[4]



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

1.

.....

2.

.....

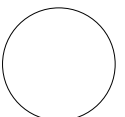
3.

.....

4.

.....

[4]



BLANK PAGE

Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced online in the Cambridge International Examinations Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download at www.cie.org.uk after the live examination series.

Cambridge International Examinations is part of the Cambridge Assessment Group. Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.

CANDIDATE
NAME

--

CENTRE
NUMBER

--	--	--	--	--

CANDIDATE
NUMBER

--	--	--	--

PHYSICS

9702/35

Paper 3 Advanced Practical Skills 1

May/June 2015

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.

You are expected to record all your observations as soon as these observations are made, and to plan the presentation of the records so that it is not necessary to make a fair copy of them.

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.

For Examiner's Use

1

2

Total

This document consists of **11** printed pages and **1** blank page.

BLANK PAGE

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

- 1** In this experiment, you will investigate how the voltage across components in a circuit varies as the resistance of the circuit is changed.

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

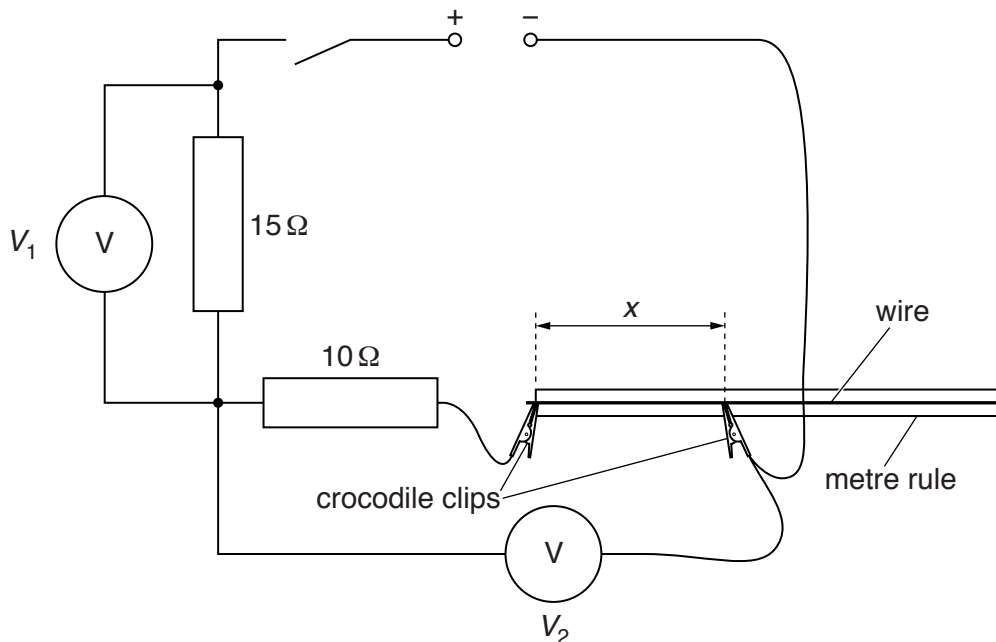


Fig. 1.1

Attach the crocodile clips to the wire so that the distance x is approximately 30 cm.

(ii) Measure and record x .

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

(b) (i) Close the switch.

(ii) Record the voltmeter readings V_1 and V_2 .

$V_1 = \dots\dots\dots$

$V_2 = \dots\dots\dots$ [1]

(iii) Open the switch.

- (c) Change x and repeat (a)(ii) and (b) until you have six sets of readings of x , V_1 and V_2 .

Include values of $\frac{V_2}{V_1}$ in your table.

[10]

- (d) (i) Plot a graph of $\frac{V_2}{V_1}$ on the y -axis against x on the x -axis.

[3]

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

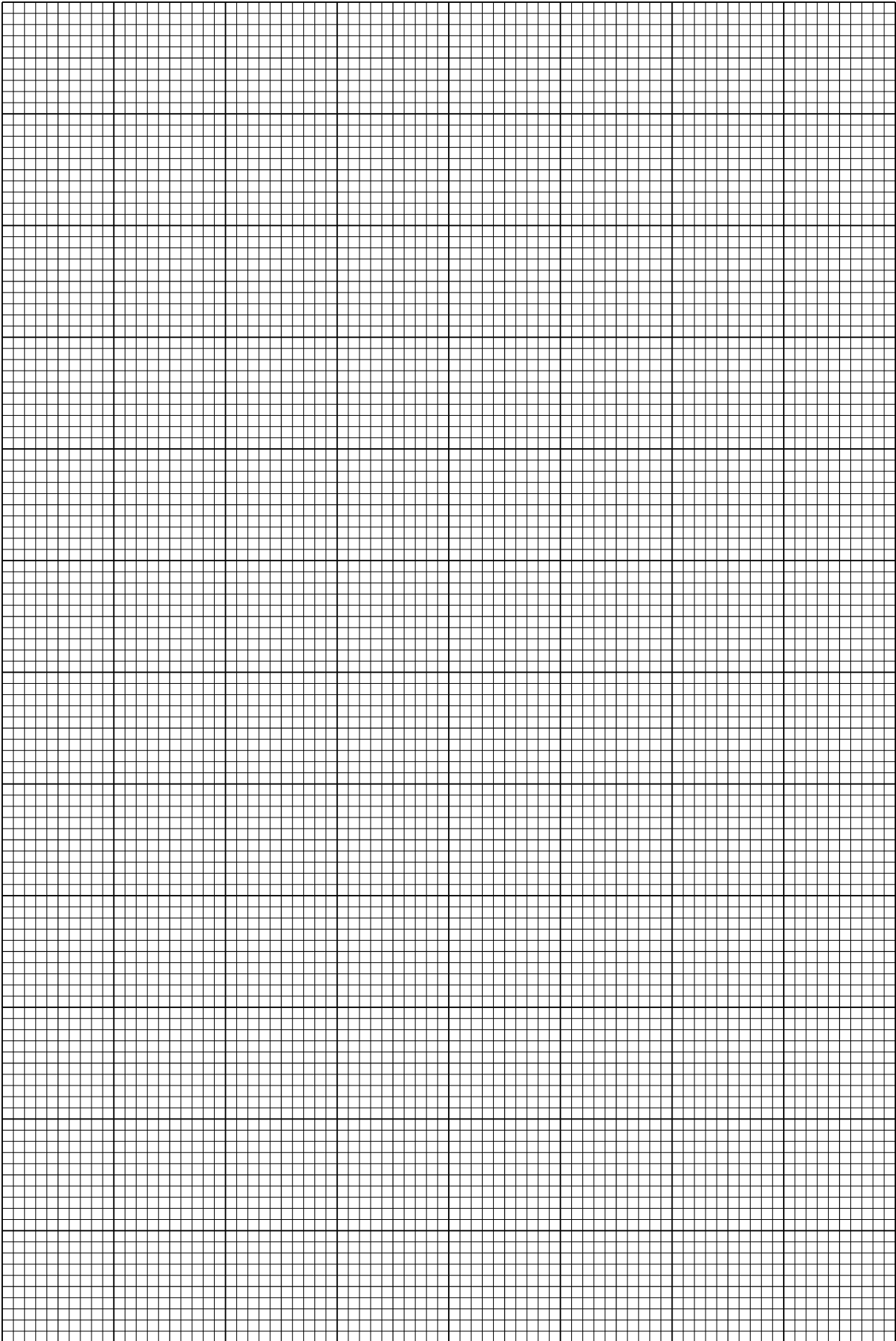
[1]

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

gradient = ...

y -intercept = ...

[2]



- (e) The quantities V_2 , V_1 and x are related by the equation

$$\frac{V_2}{V_1} = \frac{Ax}{P} + \frac{Q}{B}$$

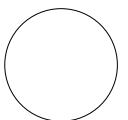
where $P = 15\ \Omega$, $Q = 10\ \Omega$ and A and B are constants.

Use your answers in (d)(iii) to determine values for A and B .
Give appropriate units.

$A =$

$B =$

[2]



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

2 In this experiment, you will investigate the motion of a metal bar.

- (a)** Use the loops on one piece of string to arrange the string on a wooden rod as shown in Fig. 2.1.
The loops of the string on the rod should be approximately 18 cm apart.
Repeat for the other rod and string.

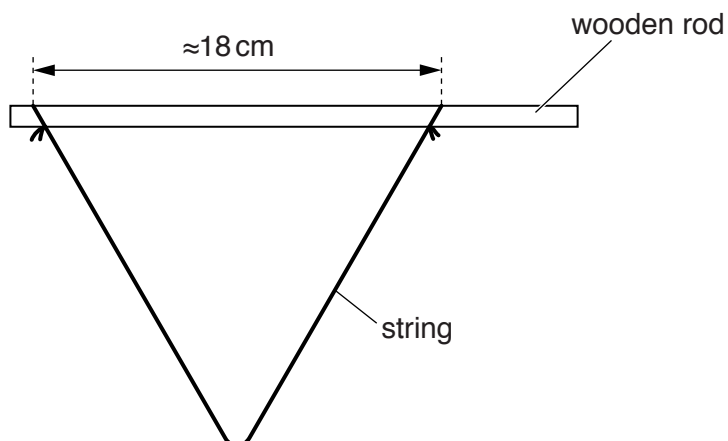


Fig. 2.1

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

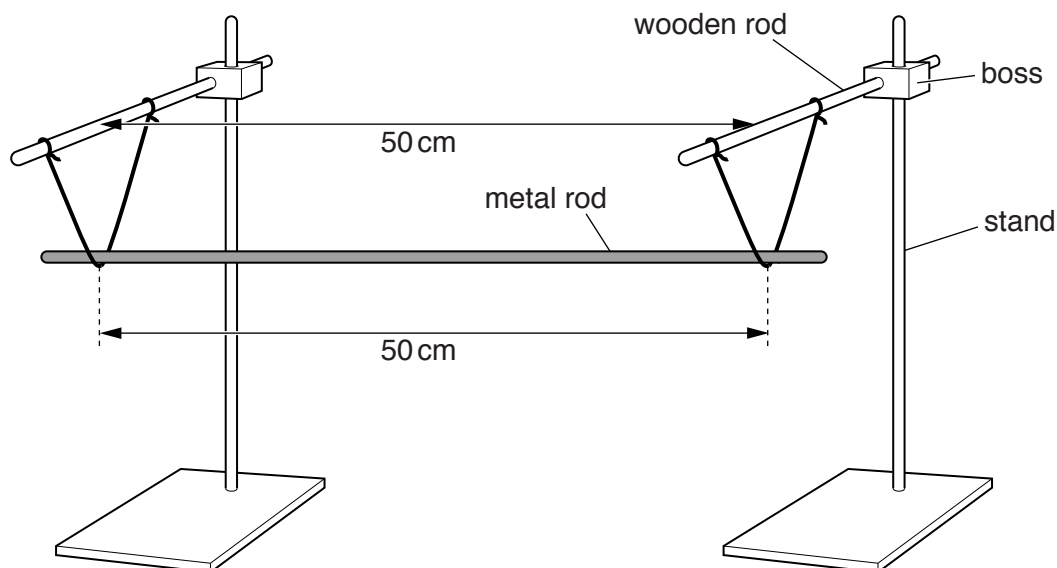


Fig. 2.2

The two wooden rods should be parallel, equal heights above the bench and 50 cm apart.

The two strings supporting the metal rod should be 50 cm apart.

- (c) (i) Measure and record the angle θ as shown in Fig. 2.3.

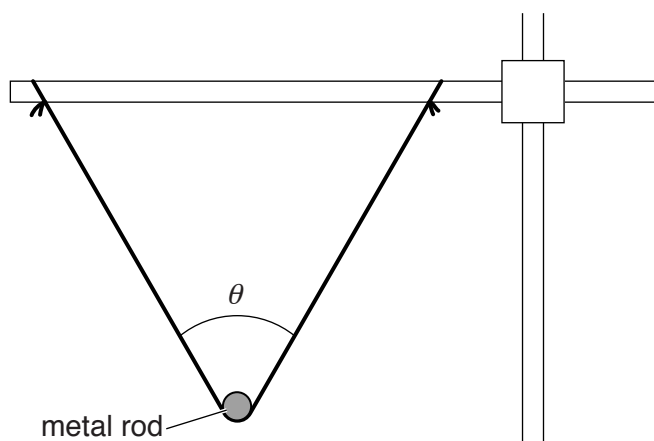


Fig. 2.3

$\theta = \dots\dots\dots$ [1]

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

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

- (iii) Calculate the value of $\cos\left(\frac{\theta}{2}\right)$.

$\cos\left(\frac{\theta}{2}\right) = \dots\dots\dots$ [1]

- (d) (i) Move the metal rod to the left.

Release the metal rod and watch the movement.

The metal rod will move to the right and then to the left again, completing a cycle as shown in Fig. 2.4.



Fig. 2.4

- (ii) The time taken for one complete cycle is T_1 .
By timing several of these complete cycles, determine an accurate value for T_1 .

$T_1 = \dots\dots\dots$ [2]

- (e) (i) Move the centre of the metal rod towards you through a small distance.
Release the metal rod and watch the movement.
The metal rod will move away from you and then back towards you completing a cycle as shown in Fig. 2.5.

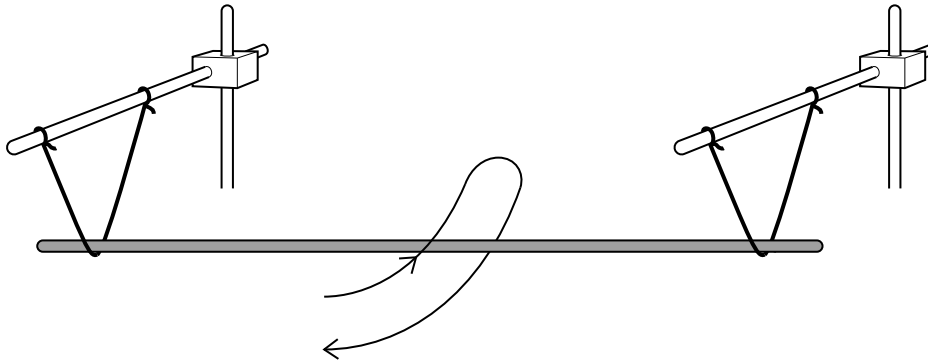


Fig. 2.5

- (ii) The time taken for one complete cycle is T_2 .
By timing several of these complete cycles, determine an accurate value for T_2 .

$T_2 = \dots\dots\dots$ [1]

--

- (f) (i) Reduce the distance between the loops of string on each wooden rod to approximately 9 cm as shown in Fig. 2.6.

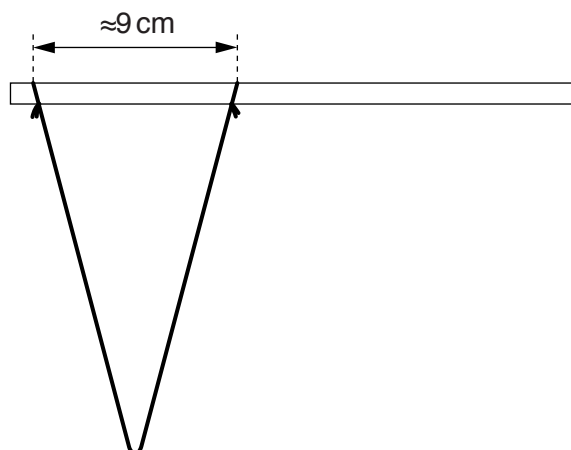


Fig. 2.6

- (ii) Repeat (b), (c)(i), (c)(iii), (d) and (e).

$$\theta = \dots\dots\dots$$



$$\cos\left(\frac{\theta}{2}\right) = \dots\dots\dots$$

$$T_1 = \dots\dots\dots$$

$$T_2 = \dots\dots\dots$$



[3]

- (g) It is suggested that the relationship between T_1 , T_2 and θ is

$$\frac{T_1}{T_2} = k \cos\left(\frac{\theta}{2}\right)$$

where k is a constant.

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

first value of k = ...

second value of k = ...

[1]

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

.....

.....

..... [1]

- (iii) Explain whether your results in (g)(i) support the suggested relationship.

.....

.....

.....

..... [1]

- (h) (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.

.....

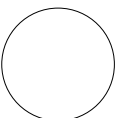
3.

.....

4.

.....

[4]



Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced online in the Cambridge International Examinations Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download at www.cie.org.uk after the live examination series.

Cambridge International Examinations is part of the Cambridge Assessment Group. Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.