

--

--	--	--	--	--

--	--	--	--

9702/31

May/June 2011

2 hours

Additional Materials: As listed in the Confidential Instructions.

READ THESE INSTRUCTIONS FIRST

DO **NOT** WRITE IN ANY BARCODES.

You may lose marks if you do not show your working or if you do not use appropriate units.

You are reminded of the need for good English and clear presentation in your answers.

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 **9** printed pages and **3** blank pages.

BLANK PAGE

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

For
Examiner's
Use

- 1** In this experiment you will investigate how the characteristics of a circuit vary with its resistance.

(a) Connect the circuit of Fig. 1.1.

You should expect to spend at least 15 minutes setting up your circuit.

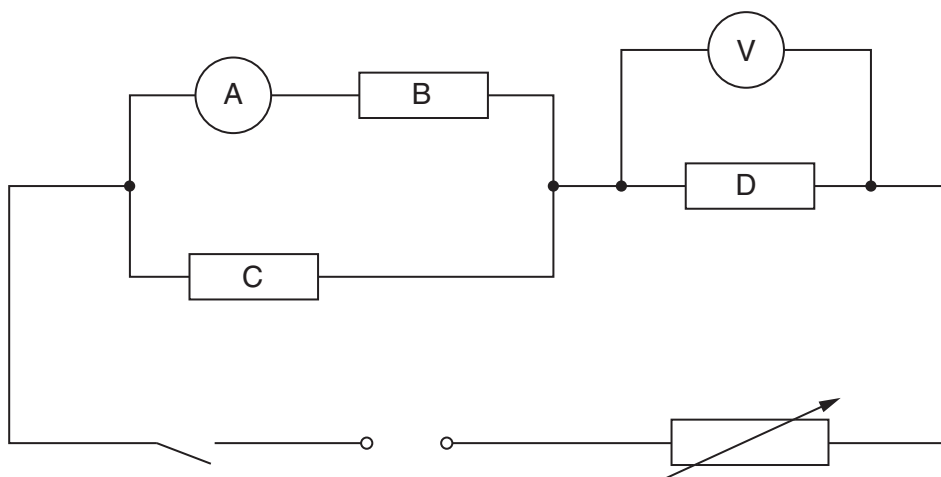


Fig. 1.1

- (b)** (i) Close the switch.
 (ii) Adjust the variable resistor until the current reading is at a maximum.
 (iii) Measure and record the ammeter reading I and the voltmeter reading V .

$I =$

$V =$

[2]

- (c) Adjust the variable resistor and repeat (b)(iii) until you have six sets of values of I and V . Include values of $\frac{1}{I}$ and $\frac{1}{V}$ in your table.

Open the switch when you have taken all your readings.

For
Examiner's
Use

☐

[10]

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

[3]

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

[1]

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

gradient = ...

y -intercept = ...

[2]

For
Examiner's
Use

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

$$\frac{1}{I} = \frac{3R}{V} + k$$

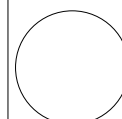
where R and k are constants.

Use your answer in (d)(iii) to determine the value of R .

Give appropriate units.

For
Examiner's
Use

$R =$ [2]



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

For
Examiner's
Use

- 2 In this experiment you will investigate how the motion of a metre rule balanced on a cylinder depends on the diameter of the cylinder.

(a) Measure and record the thickness t of the metre rule.

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

(b) (i) Measure and record the diameter d of cylinder A.

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

(ii) Calculate w , where $w = d - t$.

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

(c) (i) Use modelling clay to secure cylinder A to the bench and balance the metre rule on the cylinder, as shown in Fig. 2.1.

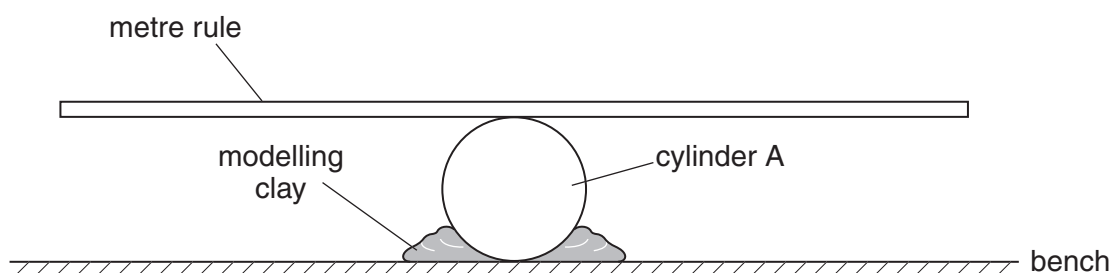


Fig. 2.1

- (ii) Move one end of the rule downwards.
 Release the rule and watch the movement.
 The end of the rule will move upwards and then downwards again, completing a swing as shown in Fig. 2.2.
 The time taken for each complete swing is T .

For
Examiner's
Use

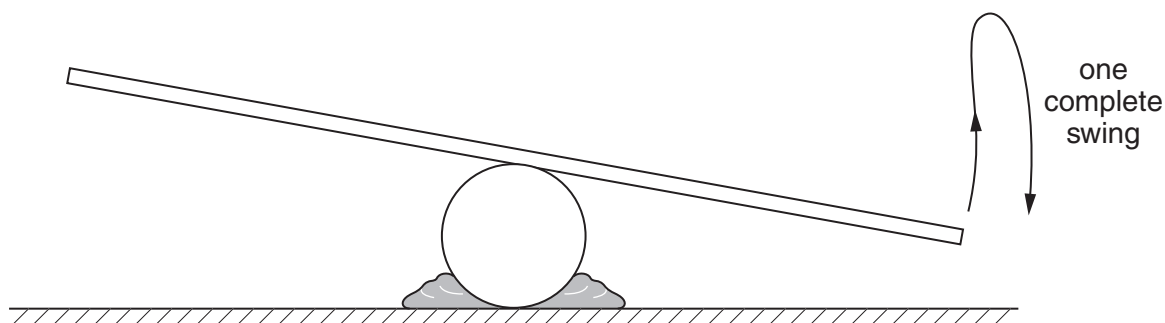


Fig. 2.2

By timing several of these complete swings, determine an accurate value for T .

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

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

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

(e) Repeat (b) and (c) for cylinder B.

For
Examiner's
Use

$d =$

$w =$

$T =$

[4]

(f) It is suggested that the quantities T and w are related by the equation

$$T^2 = \frac{k}{w}$$

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.

University of 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.



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education
Advanced Subsidiary Level and Advanced Level

CANDIDATE
NAME

--

CENTRE
NUMBER

--	--	--	--	--

CANDIDATE
NUMBER

--	--	--	--

PHYSICS

9702/32

Advanced Practical Skills 2

May/June 2011

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 a soft pencil for any diagrams, graphs or rough working.

Do not use staples, paper clips, highlighters, 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 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 submitted only if it becomes necessary to do so.

You are reminded of the need for good English and clear presentation in your answers.

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 **9** printed pages and **3** blank pages.



BLANK PAGE

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

For
Examiner's
Use

- 1** In this experiment, you will investigate how the equilibrium position of a pivoted wooden strip changes when a horizontal force is applied.
- (a)** Thread the string over the pulley and suspend the mass hanger from the end loop of the string, as shown in Fig. 1.1.

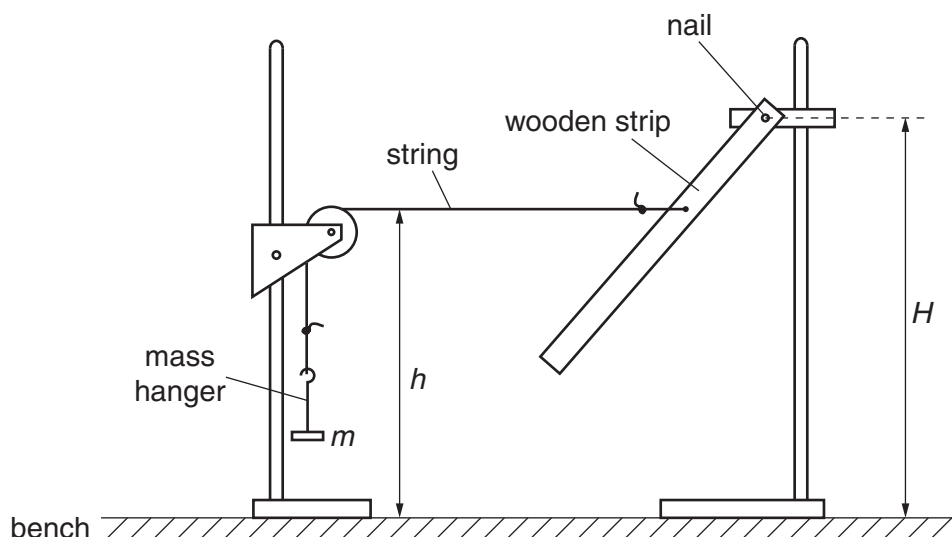


Fig. 1.1

- (b)** Measure and record the height H of the nail above the bench.

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

- (c)** Record the mass m that is suspended from the string.

$m = \dots\dots\dots$

- (d) (i)** Adjust the height of the pulley until the string is parallel to the bench. Measure and record the height h of the string above the bench.

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

- (ii)** Calculate the value of $(H-h)$.

$(H-h) = \dots\dots\dots$ cm

- (e) By adding masses to the hanger, change the total suspended mass m . Repeat (c) and (d) until you have six sets of values for m and h .

In your table of results include columns for the values of m^2 and $\frac{1}{(H-h)^2}$.

For
Examiner's
Use

[10]

- (f) (i) Plot a graph of $\frac{1}{(H-h)^2}$ on the y -axis against m^2 on the x -axis.

[3]

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

[1]

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

gradient = ...

y -intercept = ...

[2]

For
Examiner's
Use

- (g) It is suggested that the quantities h , H and m are related by the equation

$$\frac{1}{(H-h)^2} = abm^2 + b$$

where a and b are constants.

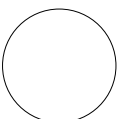
Using your answers from **(f)(iii)**, determine the values of a and b .
Give appropriate units.

For
Examiner's
Use

$a =$

$b =$

[2]



BLANK PAGE

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 deflection of a metre rule when two loads are placed on it.

For
Examiner's
Use

- (a) (i)** Position a metre rule on the two supports as shown in Fig. 2.1, with the supports 15.0 cm from each end of the rule.

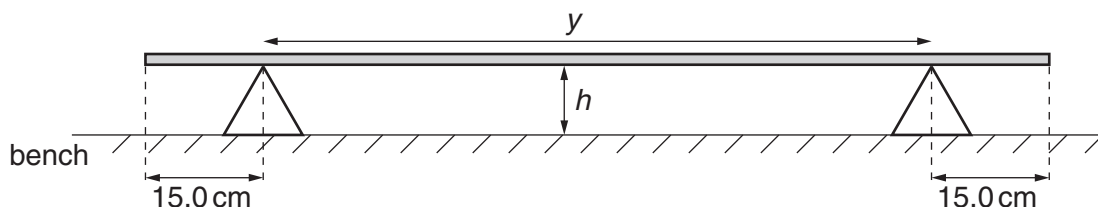


Fig. 2.1

- (ii)** Determine the distance y between the two supports.

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

- (iii)** Measure the height h of the bottom edge of the mid-point of the rule above the bench.

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

- (b) (i)** Position the two 500 g masses on top of the rule, with a mass 5.0 cm from each end of the rule, as shown in Fig. 2.2.

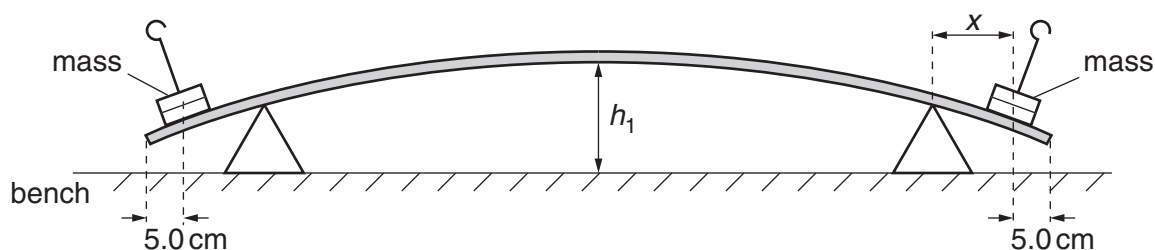


Fig. 2.2

- (ii)** Determine the distance x of a mass from its nearest support.

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

- (iii)** Measure the height h_1 of the bottom edge of the mid-point of the rule above the bench.

$h_1 = \dots\dots\dots$ [1]

- (c) (i) Calculate the deflection d of the mid-point of the rule, where $d = h_1 - h$.

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

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

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

- (d) (i) Remove the two 500 g masses and reposition the two supports 25.0 cm from each end of the rule.

- (ii) Repeat (a)(ii) and (a)(iii).

$y = \dots\dots\dots$

$h = \dots\dots\dots$

- (e) (i) Position the two 500 g masses on top of the rule, with a mass 15.0 cm from each end of the rule.

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

$x = \dots\dots\dots$

$h_1 = \dots\dots\dots$

$d = \dots\dots\dots$ [4]

Question 2 continues on the next page.

For
Examiner's
Use

☐
☐
☐
☐
☐
☐

- (f) (i) It is suggested that the quantities d and y are related by the equation

$$d = ky^2$$

where k is a constant.

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]

For
Examiner's
Use

☐
☐

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

For
Examiner's
Use

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.

.....

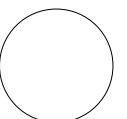
3.

.....

4.

.....

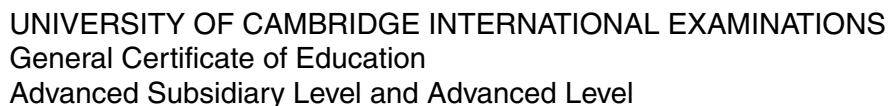
[4]



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.

University of 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.



--

--	--	--	--	--

--	--	--	--

9702/33

May/June 2011

2 hours

Additional Materials: As listed in the Confidential Instructions.

READ THESE INSTRUCTIONS FIRST

DO **NOT** WRITE IN ANY BARCODES.

You may lose marks if you do not show your working or if you do not use appropriate units.

You are reminded of the need for good English and clear presentation in your answers.

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.

For
Examiner's
Use

- 1** In this experiment you will investigate how the motion of a paper strip depends on its width.

- (a) (i)** Measure and record the width x of the thin paper strip, as shown in Fig. 1.1.

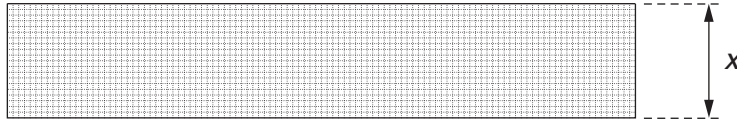


Fig. 1.1

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

- (ii)** Connect the clips to the strip, as shown in Fig. 1.2.

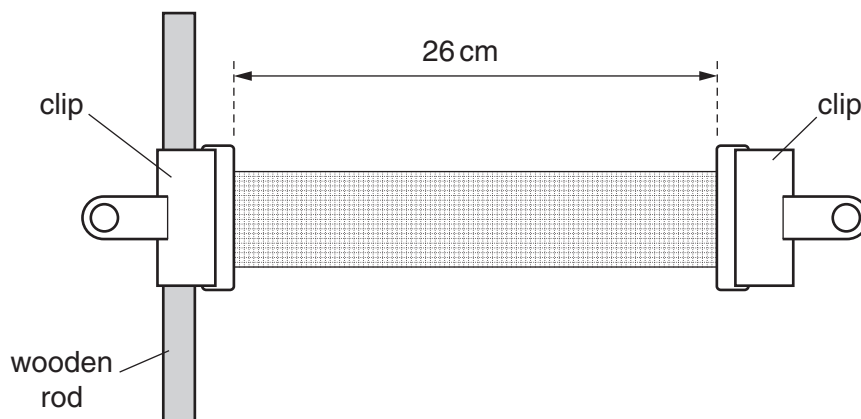
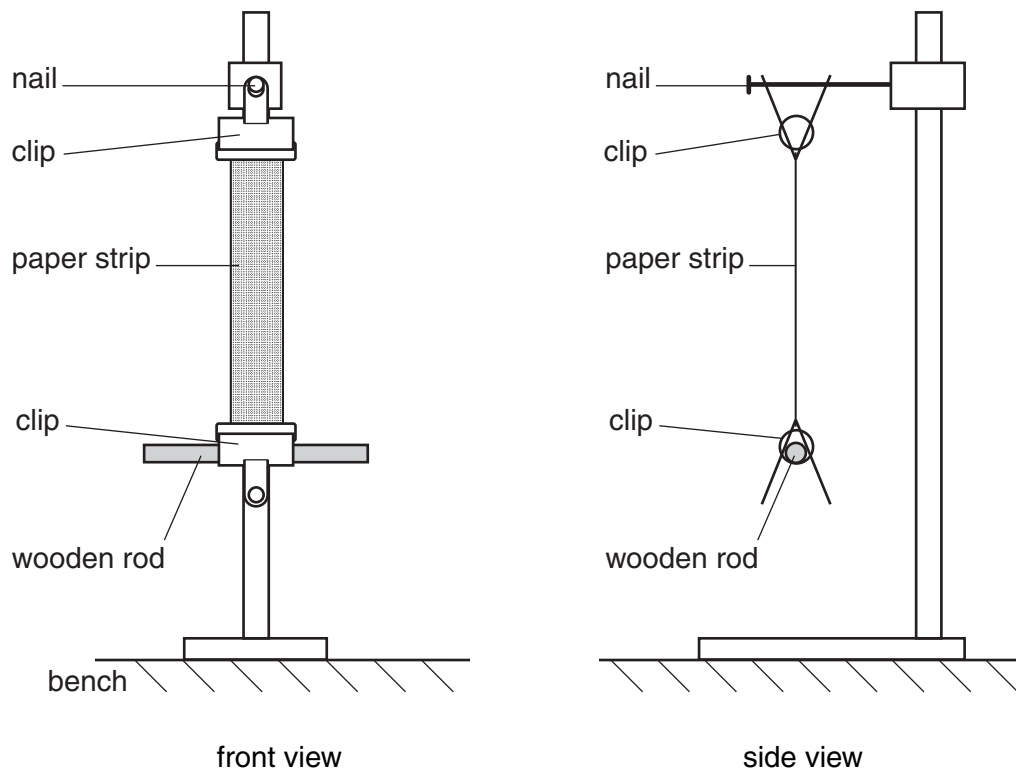


Fig. 1.2

(b) (i) Set up the apparatus with the top clip supported on the nail, as shown in Fig. 1.3.

For
Examiner's
Use



- (ii) Twist the wooden rod through an angle of approximately 45° in a horizontal plane, as shown in Fig. 1.4.

For
Examiner's
Use

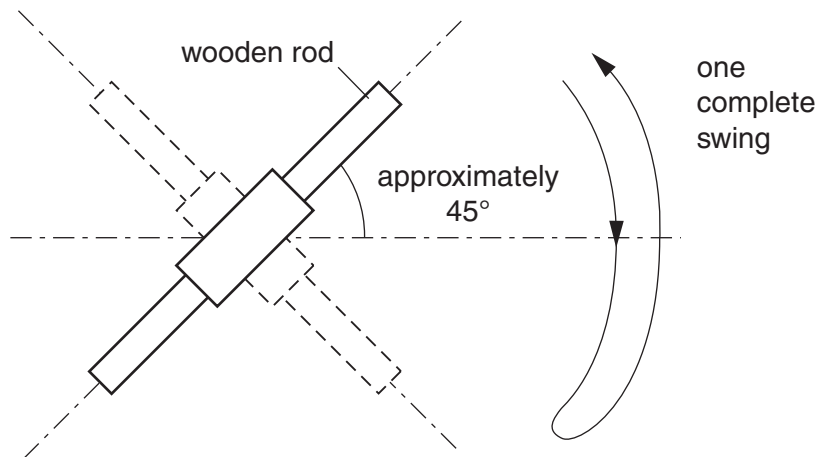


Fig. 1.4

Release the rod and watch its movement.

The wooden rod completes one swing by twisting one way and then back the other way, as shown in Fig. 1.4.

The time taken for each complete swing is T .

By timing several of these complete swings, determine an accurate value for T .

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

- (c) By cutting new strips from the graph paper, repeat (a) and (b) until you have six sets of values of x and T . Values of x should be in the range $1 \text{ cm} \leq x \leq 6 \text{ cm}$.

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

For
Examiner's
Use

☐

[9]

- (d) (i) Plot a graph of T on the y -axis against $\frac{1}{x}$ 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]

For
Examiner's
Use

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

$$T = \frac{a}{x} + b$$

where a and b are constants.

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

$a =$

$b =$

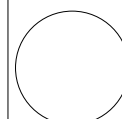
[1]

- (f) State one problem with determining an experimental value of T for $x = 15$ cm.

.....

 [1]

For
Examiner's
Use



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

For
Examiner's
Use

- 2** In this experiment you will investigate the deflection of a metre rule when a mass is suspended from its centre.

- (a) (i)** Set up the apparatus as shown in Fig. 2.1 with a distance l between the supports of approximately 95 cm.

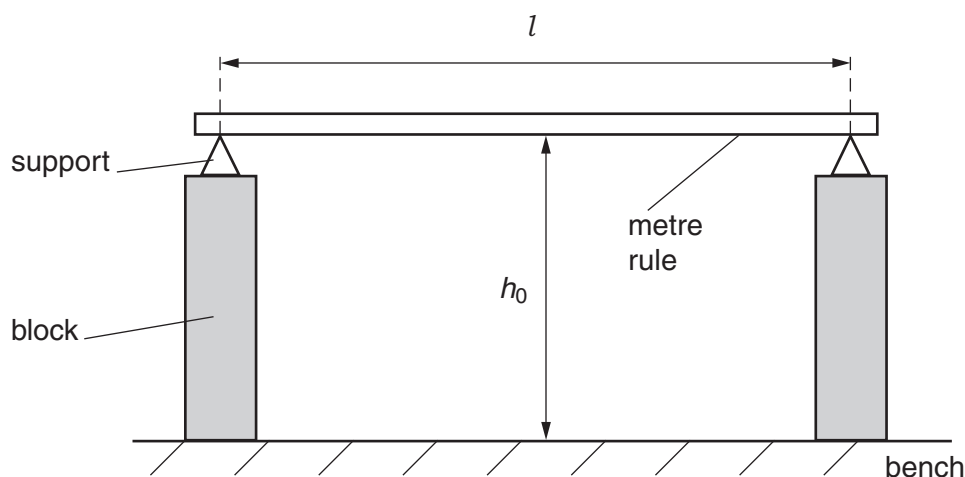


Fig. 2.1

- (ii)** Measure and record l .

$l =$ [1]

- (iii)** Midway between the supports, measure and record the height h_0 of the bottom of the rule above the bench.

$h_0 =$ [1]

- (b) (i)** Use the small loop of string to suspend the mass from the rule, midway between the supports.

- (ii)** Midway between the supports, measure and record the new height h of the bottom of the rule above the bench.

$h =$ [1]

- (iii) Calculate the deflection d of the beam where $d = h_0 - h$.

For
Examiner's
Use

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

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

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

- (d) Change l to approximately 60 cm. Repeat (a)(ii), (a)(iii) and (b).

$$l = \dots\dots\dots$$

$$h_0 = \dots\dots\dots$$

$$h = \dots\dots\dots$$

$$d = \dots\dots\dots [4]$$

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

$$d = k l^3$$

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 support the suggested relationship.

.....

 [1]

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

.....

 [1]

For
Examiner's
Use

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

For
Examiner's
Use

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.

.....

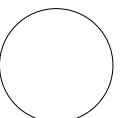
3.

.....

4.

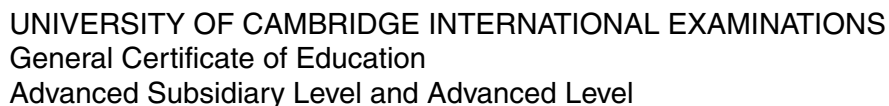
.....

[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.

University of 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.



--

--	--	--	--	--

--	--	--	--

9702/34

May/June 2011

2 hours

Additional Materials: As listed in the Confidential Instructions.

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 a soft pencil for any diagrams, graphs or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.
DO NOT WRITE IN ANY BARCODES.

You may lose marks if you do not show your working or if you do not use appropriate units.

You are reminded of the need for good English and clear presentation in your answers.

The number of marks is given in brackets [] at the end of each question or part question.

For Examiner's Use	
1	
2	
Total	



[Turn over

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

For
Examiner's
Use

- 1** In this experiment, you will investigate the angle through which a loaded beaker rolls as a turning force is applied.

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

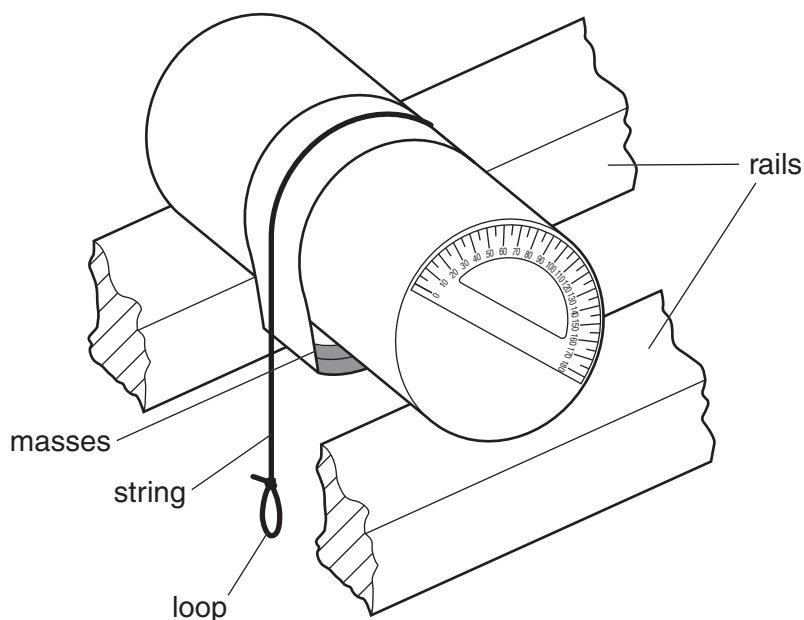


Fig. 1.1

- (b)** Make sure that the beaker is positioned so that the masses do not touch the rails.
- (c)** Using the set square, measure and record the angle x , as shown in Fig. 1.2.

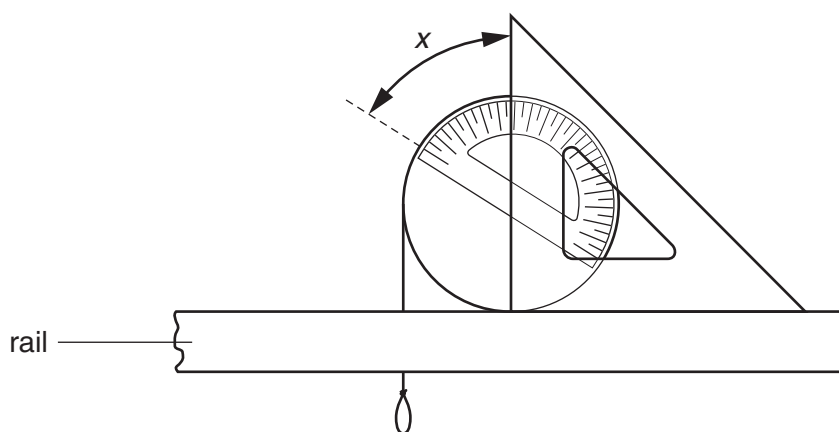


Fig. 1.2

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

- (d) (i) Hook the mass hanger on the string loop. Record the mass m that is suspended from the loop.

$m = \dots\dots\dots$

- (ii) Wait for the beaker to stop moving, making sure that the beaker is positioned so that the masses do not touch the rails.

- (iii) Using the set square, measure and record the angle y , as shown in Fig. 1.3.

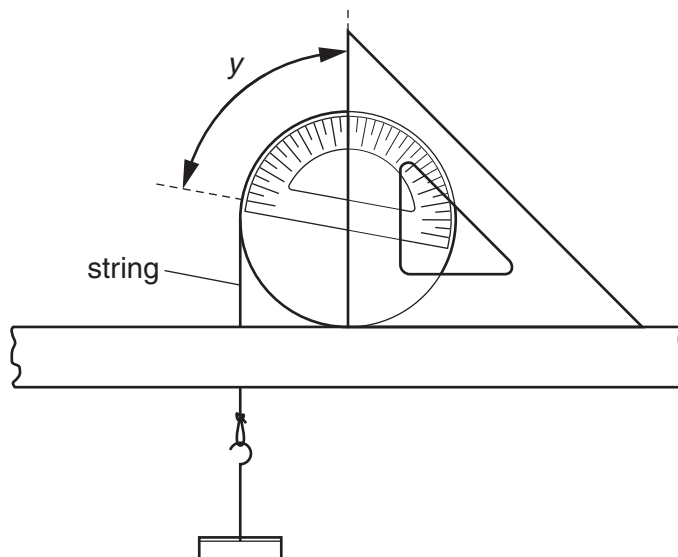


Fig. 1.3

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

- (iv) Calculate θ , where $\theta = y - x$.

$\theta = \dots\dots\dots$

For
Examiner's
Use

- (e) Change m by adding masses to the hanger and repeat (d)(ii), (d)(iii) and (d)(iv). Repeat this procedure until you have six sets of values for m (the total suspended mass) and angle y . Include in your table values for θ (using your answer from (c)) and $\sin\theta$.

For
Examiner's
Use

[9]

- (f) (i) Plot a graph of $\sin\theta$ on the y -axis against m on the x -axis.

[3]

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

[1]

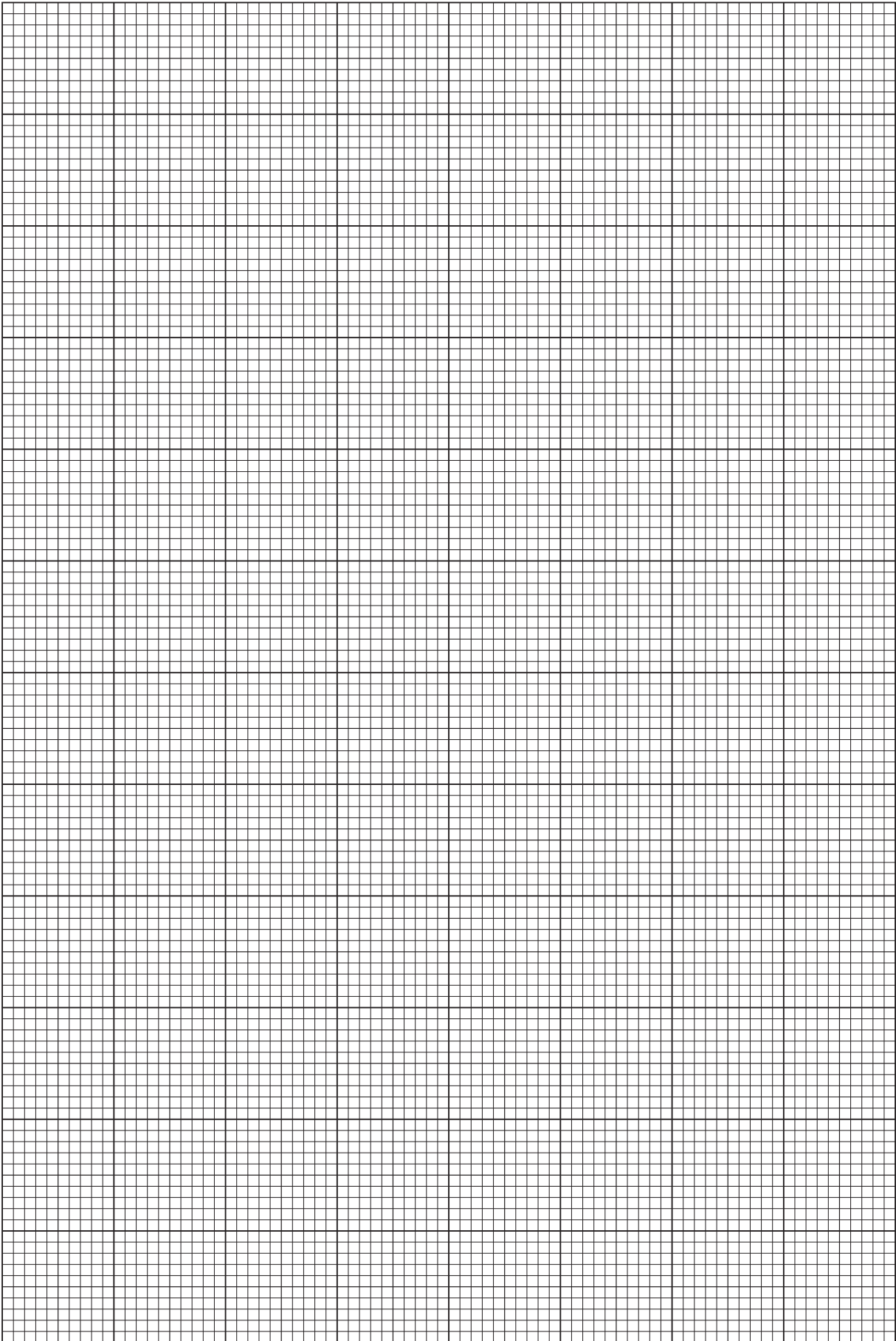
- (iii) Determine the gradient and y -intercept of this line.

gradient = ...

y -intercept = ...

[2]

For
Examiner's
Use



- (g) (i) Unhook the masses from the string loop and remove the beaker from the rails.
 (ii) Take measurements to determine the radius r of the beaker.

For
Examiner's
Use

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

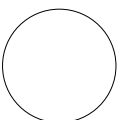
- (h) It is suggested that the relationship between θ and m is

$$\sin \theta = \frac{r m}{a} + b$$

where a and b are constants.

Using your answers from (f)(iii) and (g)(ii), determine the value of a . Give an appropriate unit.

$a = \dots\dots\dots$ [2]



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

For
Examiner's
Use

2 In this experiment you will investigate the motion of a mass suspended from a rubber band.

- (a) (i) Suspend the rubber band from the retort stand and hang the 100 g mass hanger from the rubber band, as shown in Fig. 2.1

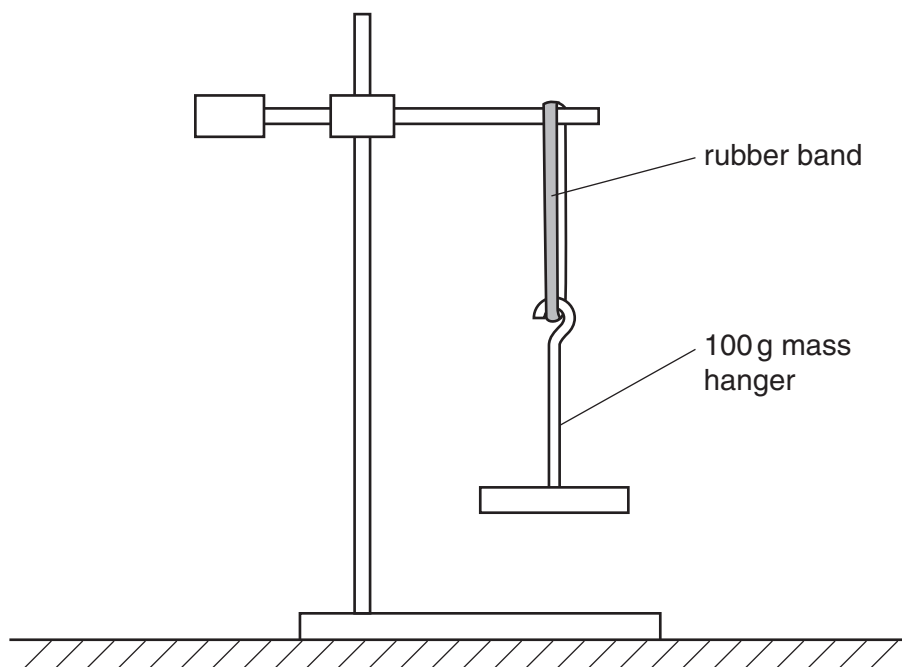


Fig. 2.1

- (ii) Determine and record the radius R of the suspended mass hanger at its widest point.

$R =$ [2]

- (iii) Estimate the percentage uncertainty in R .

percentage uncertainty = ... [1]

- (b) (i) Twist the mass hanger about half a turn and release it so that it turns between positions A and B, as shown in Fig. 2.2.

For
Examiner's
Use

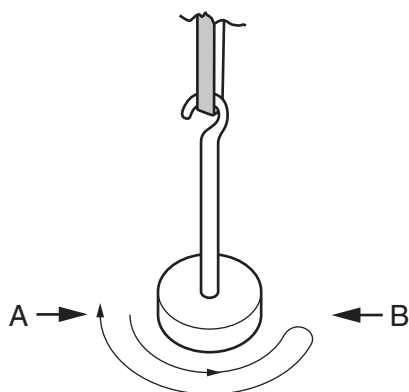


Fig. 2.2

- (ii) Take measurements to determine the time T for the mass hanger to rotate from A to B and back to A.
(This may be determined accurately by using the time for several turns.)

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

- (c) For a mass hanger of mass m and radius R , it is suggested that T is related to a quantity C , where $C = mR^2$.
Calculate the value of C for this mass hanger. Give an appropriate unit.

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

- (d) (i) Remove the 100 g mass hanger and suspend the 50 g mass hanger from the rubber band.
- (ii) Repeat (a)(ii), (b) and (c) for this new suspended mass hanger.

For
Examiner's
Use

$R =$

$T =$

$C =$

[4]

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

$$T^2 = k C$$

where k is a constant.

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 in (e)(i).

For
Examiner's
Use

.....

[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.

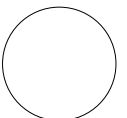
1.

 2.

 3.

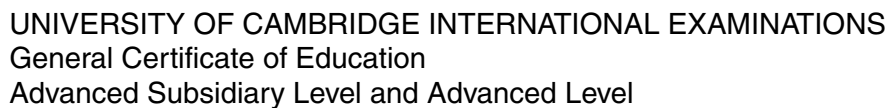
 4.

[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.

University of 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.



--

--	--	--	--	--

--	--	--	--

9702/35

May/June 2011

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 a soft pencil for any diagrams, graphs or rough working.

Do not use staples, paper clips, highlighters, 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 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.

You are reminded of the need for good English and clear presentation in your answers.

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.

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

For
Examiner's
Use

- 1** In this experiment you will investigate how the motion of two pendulums depends on the tension in a spring connecting them.

- (a)** Measure and record the unstretched length l_0 of the coiled part of the spring as shown in Fig. 1.1.

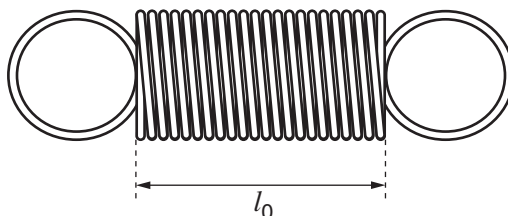


Fig. 1.1

$l_0 = \dots\dots\dots$ [1]

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

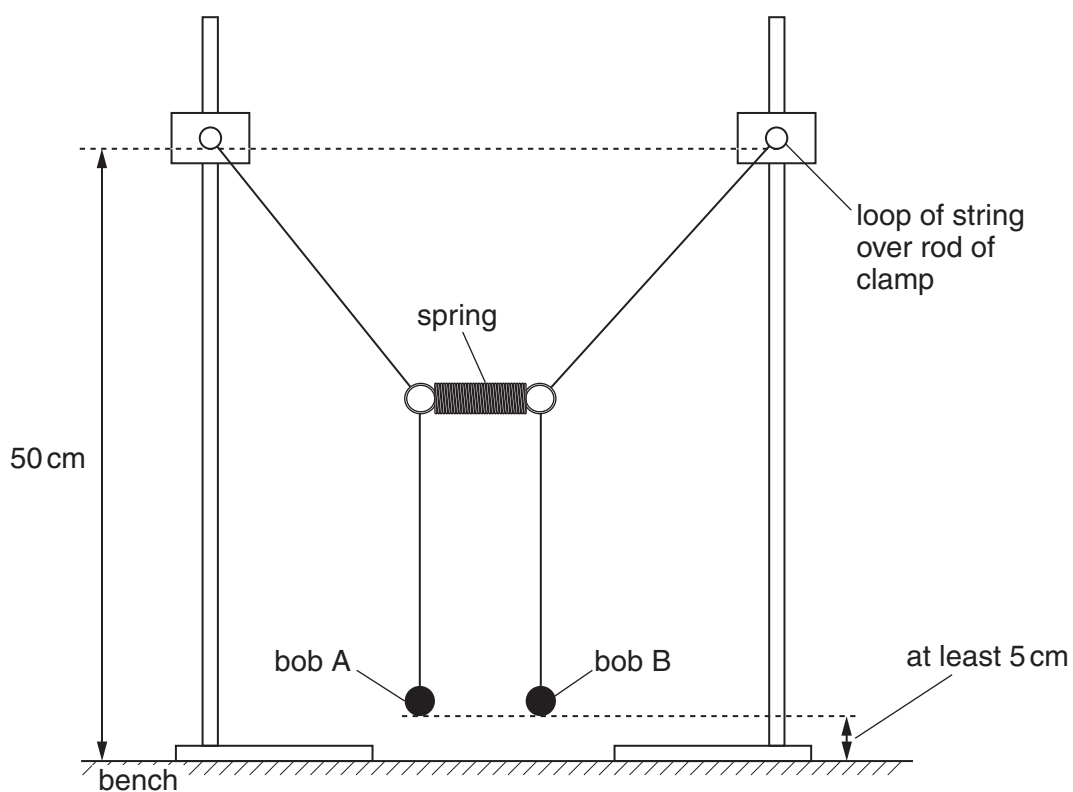


Fig. 1.2

- (ii)** Position the stands so that the coiled part of the spring has approximate length $l_0 + 2\text{ cm}$ (so that the spring is extended by approximately 2 cm).

- (iii) Measure and record the length l of the coiled part of the spring.
Calculate the extension x of the spring, where $x = l - l_0$.

For
Examiner's
Use

$l =$

$x =$

- (iv) Gently pull bob A towards you. Release the bob and watch the movement of the two bobs.

Bob A will eventually stop and start moving again. It will then stop for a second time.

Determine and record the time T between these two stops.

$T =$ [2]

- (c) By moving the stands further apart, repeat **(b)(iii)** and **(b)(iv)** until you have six sets of readings of l , x and T , with x in the range $2\text{ cm} \leq x \leq 10\text{ cm}$.

For
Examiner's
Use

☐
☐
☐
☐
☐

[9]

- (d) (i) Plot a graph of T 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]

☐
☐

For
Examiner's
Use

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

$$T = px + q$$

where p and q are constants.

Use your answers in (d)(iii) to determine the values of p and q .

Give appropriate units.

$$p = \dots\dots\dots$$

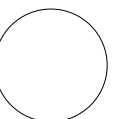
$$q = \dots\dots\dots$$

[1]

- (f) Use your values in (e) to determine the extension x that would be expected to give a value of $T = 75\text{ s}$.

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

For
Examiner's
Use

☐
☐


BLANK PAGE

Please turn over for Question 2.

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

For
Examiner's
Use

- 2** In this experiment you will drop a mass onto a rod standing in sand and investigate the distance that the rod moves into the sand.

- (a)** You have been provided with two wooden rods of different diameters. Measure and record the diameter d of the **thicker** rod.

$d = \dots\dots\dots$ [2]

- (b)** Flatten the surface of the sand. Stand the rod vertically in the sand up to the mark drawn on the rod, as shown in Fig. 2.1.

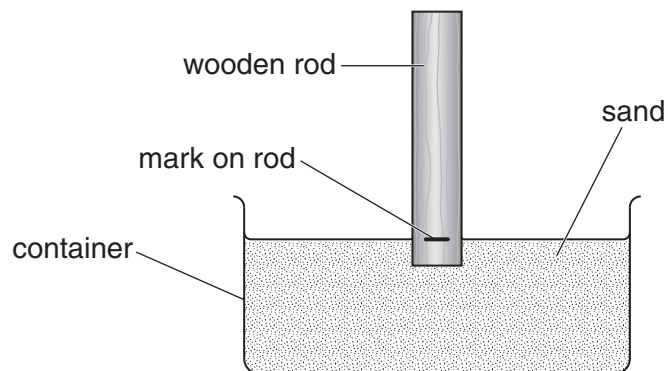


Fig. 2.1

- (c) (i) Hold the mass hanger so that the distance h between its bottom and the top of the rod is approximately 10 cm. The centre of the bottom of the mass hanger should be vertically above the wooden rod, as shown in Fig. 2.2.

For
Examiner's
Use

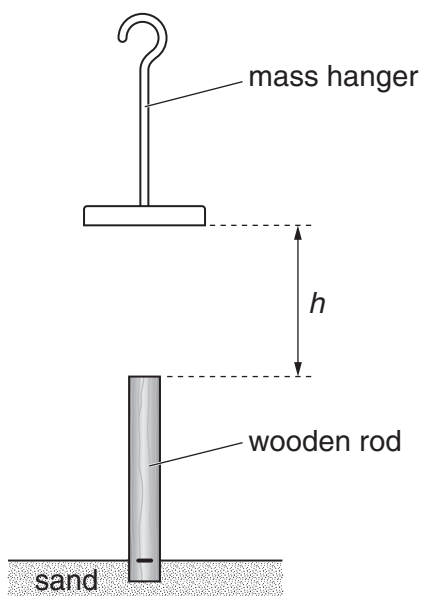


Fig. 2.2

- (ii) Measure and record the height h .

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

- (d) (i) Drop the mass hanger from this height h above the rod.
- (ii) **Without making a further mark on the rod**, determine the new length x of the rod below the surface of the sand, as shown in Fig. 2.3.

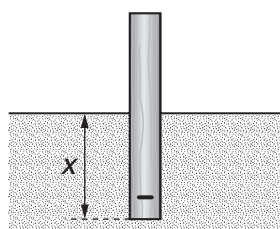


Fig. 2.3

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

- (iii) Calculate and record the change in depth y of the rod in the sand as a result of the impact of the mass hanger.

For
Examiner's
Use

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

- (e) Estimate the percentage uncertainty in your value of y .

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

- (f) Using the **thinner** rod repeat (a), (b), (c)(i), and (d).
Use the same value of h as in (c)(ii).

$d = \dots\dots\dots$

$x = \dots\dots\dots$

$y = \dots\dots\dots$

[3]

- (g) It is suggested that the quantities y and d are related by the equation

$$y = \frac{k}{d^2}$$

where k is a constant.

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

first value of k = ...

second value of k = ...

[1]

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

.....

 [1]

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

.....

 [1]

For
Examiner's
Use

☐
☐
☐

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

For
Examiner's
Use

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.

.....

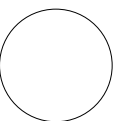
3.

.....

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.

University of 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.