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9702/31

October/November 2012

2 hours

Additional Materials: As listed in the Confidential Instructions.

Write your Centre number, candidate number and name on all 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.

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2	
Total	

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

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For
Examiner's
Use

- 1** In this experiment, you will investigate how the extension of a spring depends on the load applied to it.

(a) Set up the apparatus as shown in Fig. 1.1 where the mass m is 200 g.

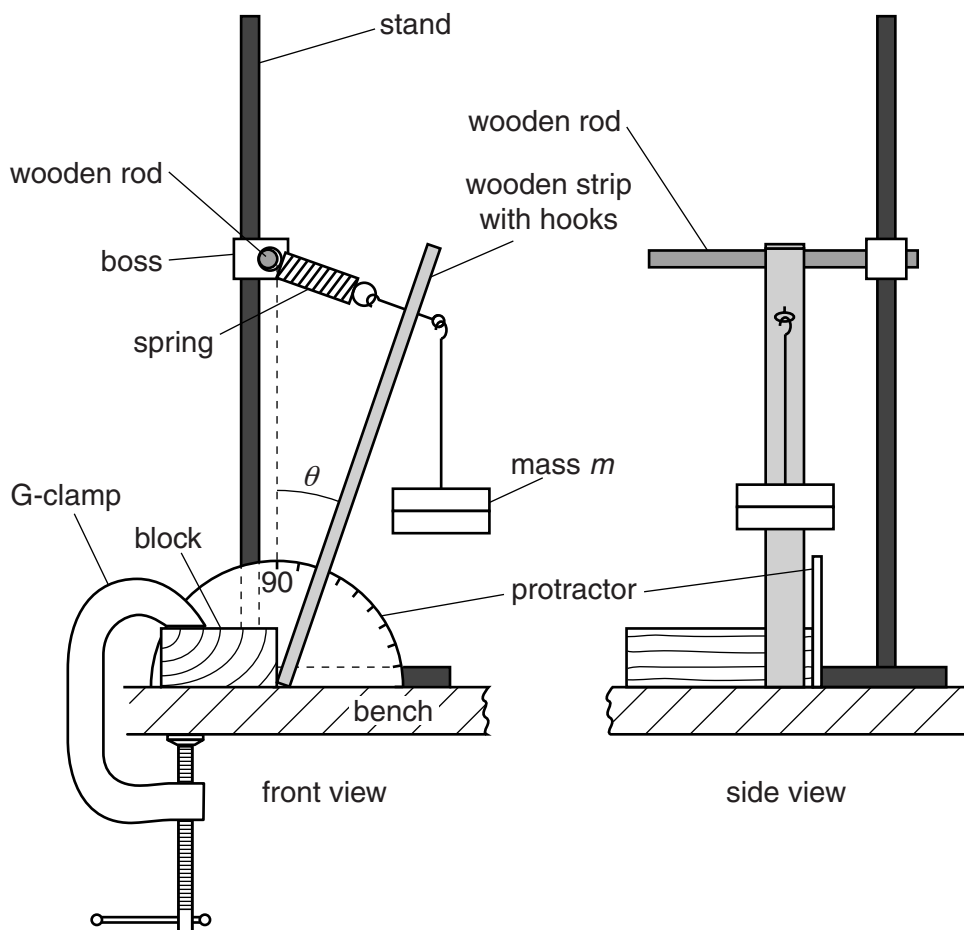


Fig. 1.1

Use the Blu-Tack to attach the protractor to the edge of the block along the 90° line.

Use the ruler to ensure that the wooden rod is directly above the edge of the block as shown. Clamp the block to the bench with the G-clamp.

The boss should be clamped **tightly** to the stand to prevent the rod from rotating.

- (b) (i) Adjust the height of the boss so that the spring is perpendicular to the wooden strip. Use the set square to check that the strip and spring are perpendicular to each other by placing it **gently** as shown in Fig. 1.2. Any contact of the set square with the strip will cause the apparatus to move.

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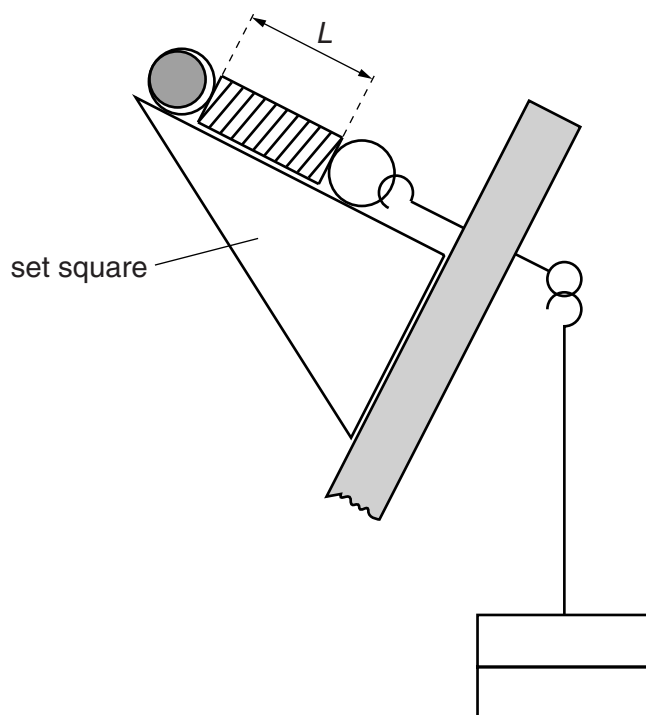


Fig. 1.2

- (ii) Measure and record the length L of the coiled part of the spring as shown in Fig. 1.2.

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

- (iii) Measure and record the angle θ between the strip and the vertical line on the protractor as shown in Fig. 1.1.

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

- (c) Change m and repeat (b) until you have five sets of values of m , L and θ .
For each set of readings the spring and strip should be perpendicular to each other.

Include values of $m \sin \theta$ in your table.

For
Examiner's
Use

[10]

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

[3]

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

[1]

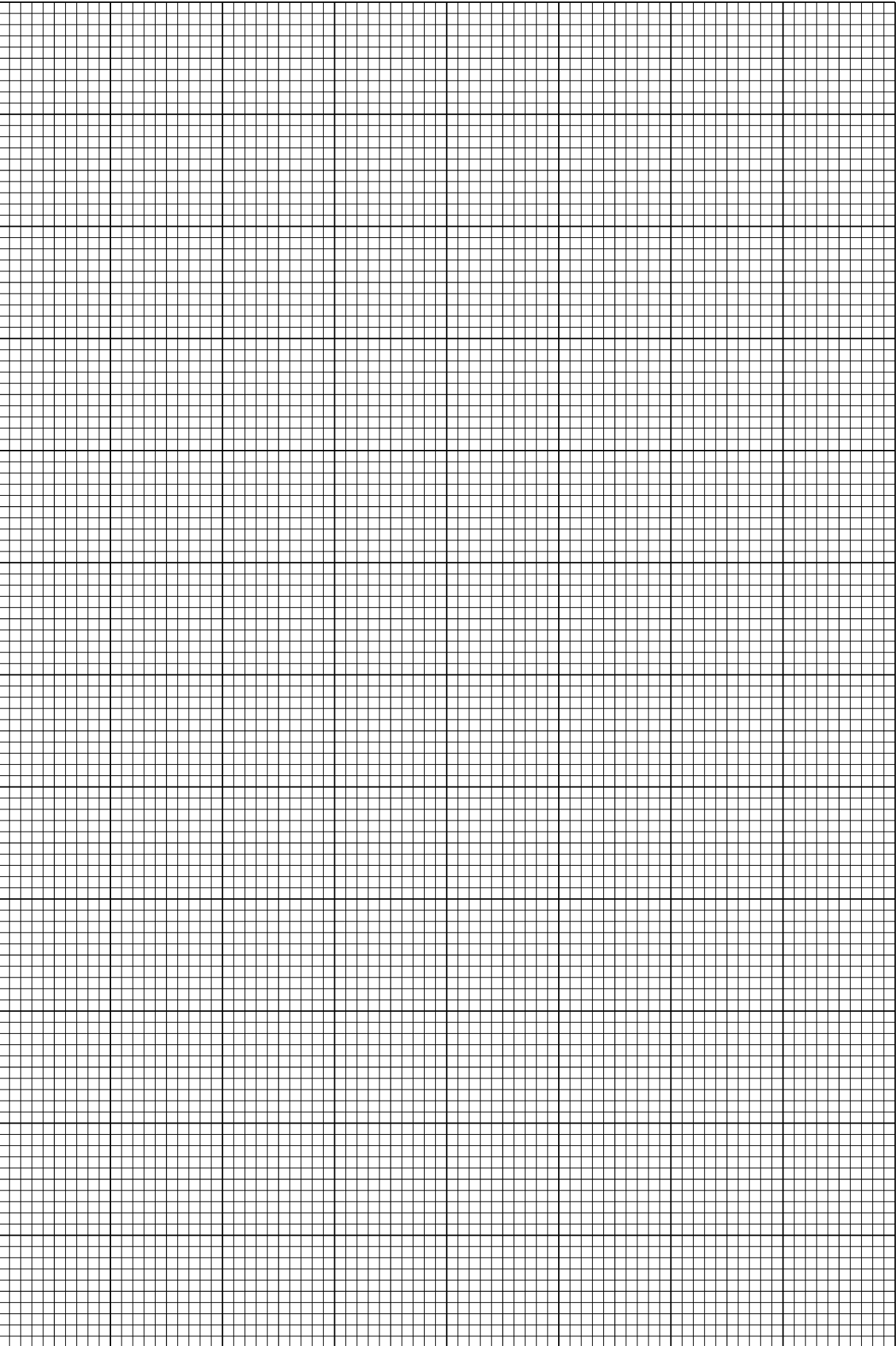
- (iii) Determine the gradient and y -intercept of this line.

gradient = ...

y -intercept = ...

[2]

For
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Use



- (e) The quantities L , m and θ are related by the equation

$$L = P m \sin \theta + Q$$

where P and Q are constants.

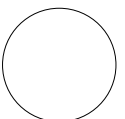
Using your answers in (d)(iii), determine the values of P and Q .
Give appropriate units.

For
Examiner's
Use

$P =$

$Q =$

[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 rule depends on its mass.

(a) (i) Tie one of the lengths of string into a loop of circumference approximately 40 cm.

(ii) Measure and record the value of the circumference of the loop.

circumference = ...[1]

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

percentage uncertainty = ...[1]

(iv) Tie the other length of string into a loop of the same circumference.
Measure and record the value of the circumference of the loop.

circumference = ...[1]

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

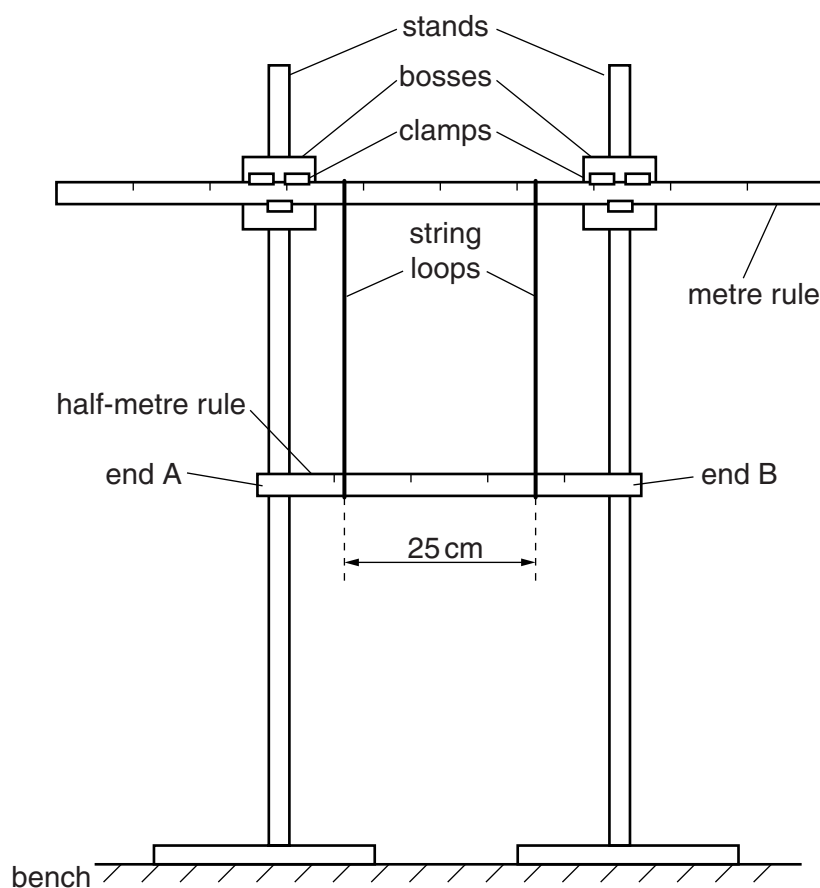


Fig. 2.1

Both rules should have their markings facing you.

The strings should be looped over the metre rule and support the half-metre rule.

The strings should be vertical, 25 cm apart and equal distances from the centre of the lower rule.

- (ii) Move the end A of the half-metre rule towards you and the end B away from you. Release the rule and watch the movement. End A of the half-metre rule will move away from you and back towards you, completing a swing. The time taken for one complete swing is T . By timing several of these complete swings, determine an accurate value for T .

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

- (c) (i) Repeat (b) with the half-metre rule at the top and the metre rule supported by the strings.

For
Examiner's
Use

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

- (ii) Repeat (b) with the 30 cm ruler supported by the strings.

$$T = \dots\dots\dots [1]$$

- (d) It is suggested that the relationship between T and the mass m of the supported rule is

$$T = km$$

where k is a constant assuming the loops are of equal circumference. The value of T also depends on the value of this circumference.

- (i) Copy the data from the card.

Mass of metre rule = ...g

Mass of half-metre rule = ...g

Mass of 30 cm ruler = ...g

- (ii) Using your data from (b)(ii), (c)(i) and (c)(ii) and the data on the card, calculate three values of k .

For
Examiner's
Use

first value of k = ...

second value of k = ...

third value of k = ...

[2]

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

.....
.....
..... [1]

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

.....
.....
.....
..... [1]

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

For
Examiner's
Use

1.

.....

2.

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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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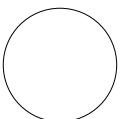
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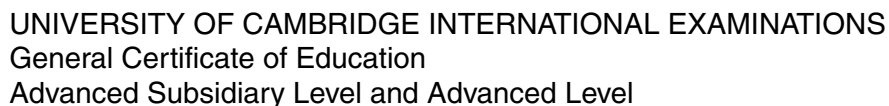
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9702/33

October/November 2012

2 hours

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- 1** In this experiment, you will investigate how the motion of a thin card shape depends on where the shape is supported.

- (a)** You are provided with a T-shaped card. The card has a mark on it and 14 holes. Label the holes on the card, 1 to 14, starting from the top end as shown in Fig. 1.1.

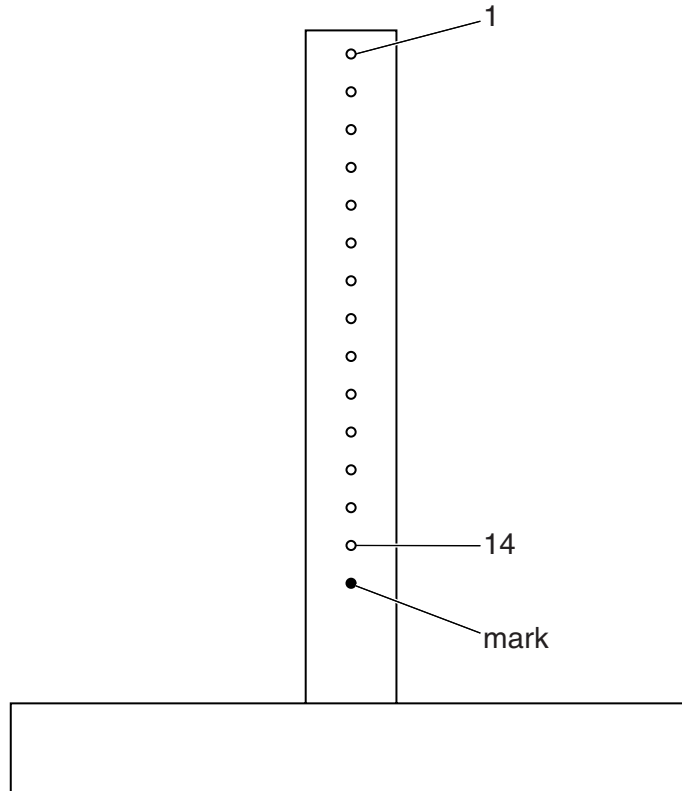


Fig. 1.1

- (b) (i) Set up the apparatus, placing the pin through hole number 9, as shown in Fig. 1.2.

For
Examiner's
Use

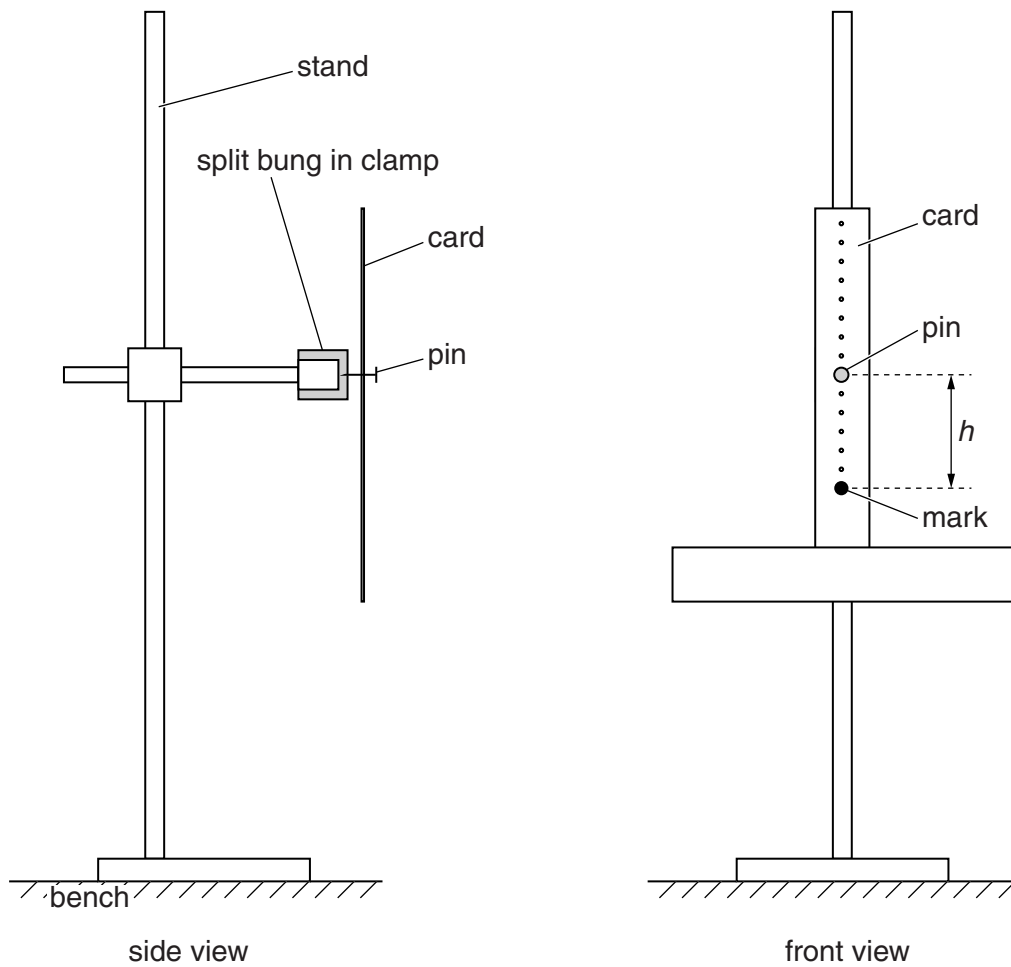


Fig. 1.2

- (ii) Measure and record the distance h between the pin and the mark.

$h =$ m [1]



- (c) Displace the card shape to the left. Release the shape and watch its movement. The shape will move to the right and then to the left again, completing a swing as shown in Fig. 1.3.

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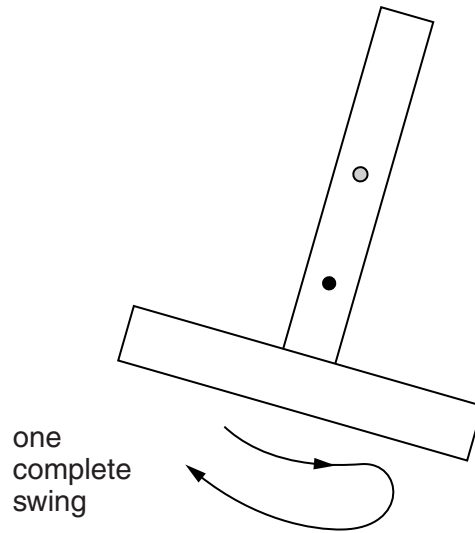


Fig. 1.3

Measure and record the time for at least 10 swings.
Record enough readings to determine an accurate value for the time T taken for one complete swing.

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

- (d) Vary h , by changing the hole through which the pin is placed, and repeat (b)(ii) and (c) until you have six sets of values of h and T .

Include values of T^2h and h^2 in your table.

For
Examiner's
Use

☐

[9]

- (e) (i) Plot a graph of T^2h on the y -axis against h^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

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

$$T^2h = Ph^2 + Q$$

where P and Q are constants.

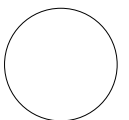
Using your answers from (e)(iii), determine the values of P and Q .
Give appropriate units.

For
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Use

$P =$

$Q =$

[2]



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- 2** In this experiment, you will investigate how the stopping distance of a model vehicle depends on its mass.

(a) (i) Record the mass m of the model. This information is given on the card.

$m = \dots\dots\dots$ g

(ii) Measure and record the total length L of the model, as shown in Fig. 2.1.

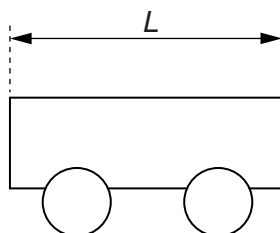


Fig. 2.1

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

(b) (i) Support the board as shown in Fig. 2.2.

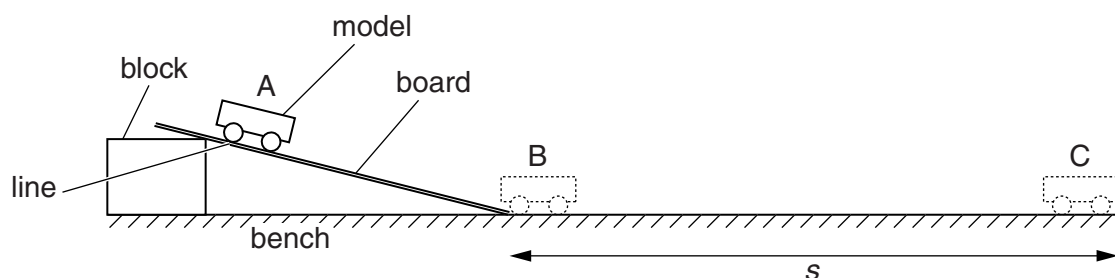


Fig. 2.2

Place the **back** wheels of the model on the line. This is position A.

Release the model. It travels a distance of 40 cm down the board until all the wheels are on the bench. This is position B.

The model moves a distance along the bench before stopping. This is position C.

Distance s is measured from the end of the board to the front of the model as shown in Fig. 2.2.

- (ii) Repeat **(b)(i)** until s is approximately 60 cm.
It may be necessary to adjust the slope of the board before releasing the model.

Do not adjust the slope of the board throughout the remainder of the experiment.

Measure and record the distance s .

$s =$ [2]

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

percentage uncertainty = ... [1]

- (iv) Use your values from **(a)(ii)** and **(b)(ii)** to determine the distance x moved by the model between B and C, where

$$x = s - L.$$

$x =$ [1]

- (c) Replace the model at A.
Release the model.
Measure and record the time t taken to move from B to C and the distance s .
Calculate x .

$t =$

$s =$

$x =$ [1]

- (d) (i) Calculate the average speed v of the model between B and C using the relationship

$$v = \frac{x}{t}.$$

$v =$ [1]

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

.....

 [1]

For
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- (e) (i) Fix the 100g mass on top of the model using the Blu-Tack.

- (ii) Calculate and record the total mass M of the model and the 100g mass.

$M =$ g

- (iii) Repeat (c) and (d)(i).

$t =$

$s =$

$x =$

$v =$

[3]

☐
☐
☐

- (f) It is suggested that v remains constant when M is changed.

Explain whether your results support the suggested relationship.

.....

 [1]

☐

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

For
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Use

1.

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[4]

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

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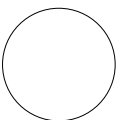
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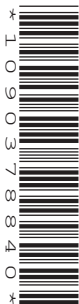
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NUMBER

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NUMBER

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PHYSICS

9702/34

Paper 3 Advanced Practical Skills 2

October/November 2012

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 [] after each question or part question.

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Examiner's
Use

- 1 In this experiment, you will investigate the variation of current in a circuit for different contact positions on a wire loop.

(a) (i) Assemble the circuit of Fig. 1.1.

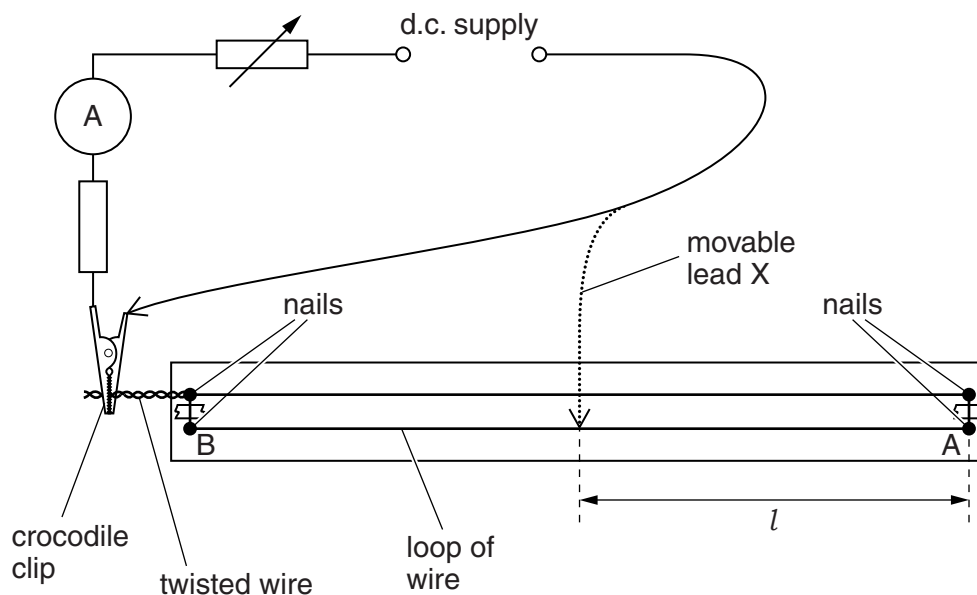


Fig. 1.1

- (ii) With lead X pressed on to the crocodile clip as shown in Fig. 1.1, adjust the rheostat until the ammeter reading is in the range 160–190 mA.
- (iii) Record the ammeter reading I_0 when the lead X is pressed on to the crocodile clip.

$$I_0 = \dots\dots\dots [1]$$

- (b) Move lead X and press it on to the wire approximately half way between A and B. Record its distance l from A and record the ammeter reading I .

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

$$I = \dots\dots\dots [1]$$

- (c) Repeat (b) with the lead X at different distances from A until you have six sets of values of l and I .

Include values of $\frac{1}{I}$ and l^2 in your table.

For
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Use

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[10]

- (d) (i) Plot a graph of $\frac{1}{I}$ on the y -axis against l^2 on the x -axis.

[3]

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

[1]

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

gradient = ...

y -intercept = ...

[2]

For
Examiner's
Use

- (e) The quantities I and l are related by the equation

$$\frac{1}{I} = al^2 + b$$

where a and b are constants.

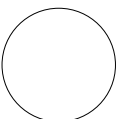
Using your answers from (d)(iii), determine the values of a and b .
Give appropriate units.

For
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Use

$a =$

$b =$

[2]



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

For
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- 2** In this experiment, you will investigate the time taken for a ball to roll a fixed distance down an inclined track.

(a) You are provided with a straight track with two marks A and B as shown in Fig. 2.1.

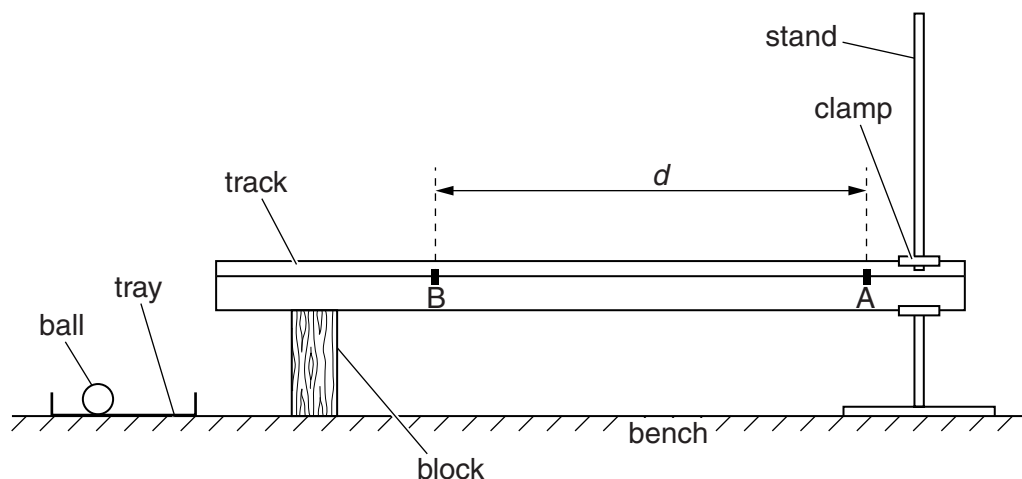


Fig. 2.1

Measure and record the distance d between the marks A and B.

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

- (b)** Place the ball on the track at A and then adjust the clamp to raise that end of the track as shown in Fig. 2.2, until the ball just starts to roll.

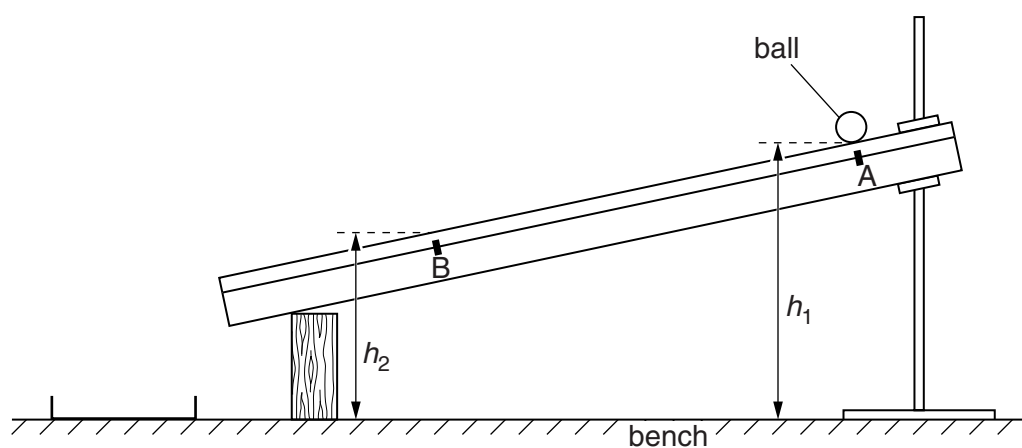


Fig. 2.2

- (c) (i) Measure and record the height h_1 of the track above the bench at A, and the height h_2 of the track above the bench at B.

For
Examiner's
Use

$h_1 = \dots\dots\dots$

$h_2 = \dots\dots\dots$

[1]

- (ii) The angle that the track makes with the horizontal is θ .

Calculate the value of $\sin \theta$ using the relationship

$$\sin \theta = \frac{h_1 - h_2}{d}.$$

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

- (d) Justify the number of significant figures you have given for your value of $\sin \theta$.

$\dots\dots\dots$

$\dots\dots\dots$

$\dots\dots\dots$ [1]

- (e) Place the ball on the track at A and take measurements to find the time t taken for the ball to roll from rest to B.

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

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

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

(g) (i) Adjust the clamp to raise the track so that h_1 increases by approximately 15 mm.

(ii) Repeat (c) and (e).

$$h_1 = \dots\dots\dots$$

$$h_2 = \dots\dots\dots$$

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

$$t = \dots\dots\dots$$

[3]

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

$$t = \frac{k}{\sqrt{\sin \theta}}$$

where k is a constant.

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

$$\text{first value of } k = \dots\dots\dots$$

$$\text{second value of } k = \dots\dots\dots$$

[1]

For
Examiner's
Use

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

For
Examiner's
Use

.....

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.....

[1]

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

1.

.....

2.

.....

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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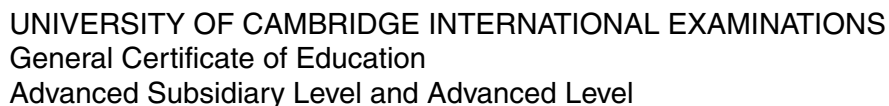
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- 1 In this experiment, you will measure the currents at two different points in the same circuit and investigate how the currents depend on the total resistance of the circuit.

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

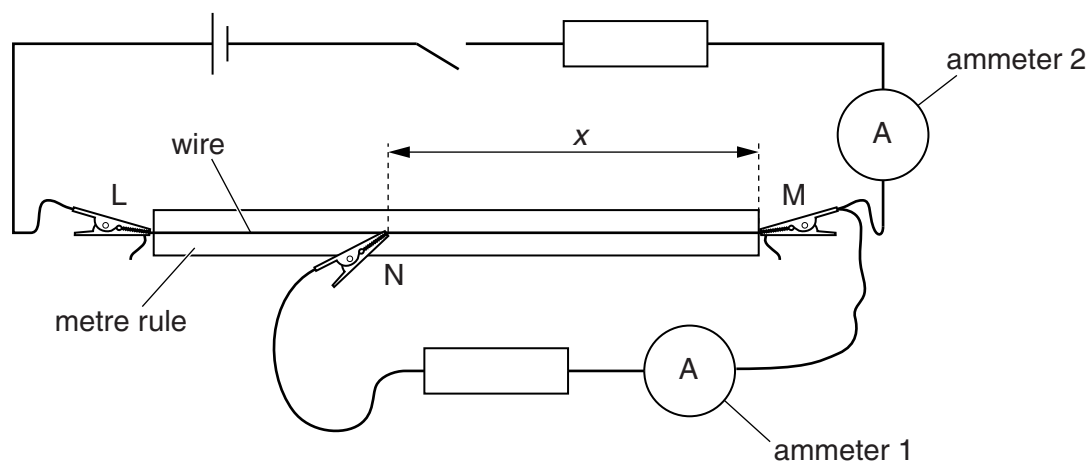


Fig. 1.1

There are crocodile clips at L, M and N.

Place the crocodile clip at N so that the length x from N to M is approximately 60 cm.

(ii) Measure and record the value of x .

$x =$

(iii) Close the switch.

(iv) Record the current I_1 given by ammeter 1.

$I_1 =$ [1]

(v) Record the current I_2 given by ammeter 2.

$I_2 =$ [2]

(vi) Open the switch.

- (b) Change x and repeat (a) until you have six sets of readings of x , I_1 and I_2 where x is in the range $0.200\text{ m} \leq x \leq 0.800\text{ m}$.

Include values of $\frac{I_2}{I_1}$ and $\frac{1}{x}$ in your table.

For
Examiner's
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[9]

- (c) (i) Plot a graph of $\frac{I_2}{I_1}$ 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]

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(d) The quantities I_1 , I_2 and x are related by the equation

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

where P and Q are constants.

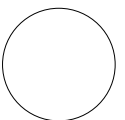
Using your answers from (c)(iii), determine the values of P and Q .
Give appropriate units.

$P =$

$Q =$

[2]

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

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2 In this experiment, you will investigate how the motion of a spring depends on its length.

- (a) (i) Measure and record the diameter D of the coiled part of the spring as shown in Fig. 2.1.

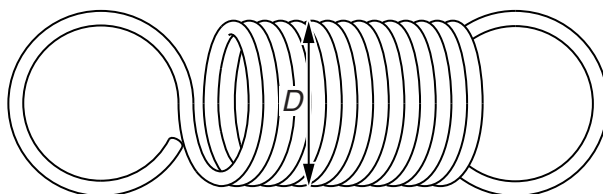


Fig. 2.1

$D =$ [1]

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

percentage uncertainty = ... [1]

- (b) (i) Place the metal strip through the spring as shown in Fig. 2.2.

The length x of the coiled part of the spring below the metal strip should be approximately 1.5 cm.

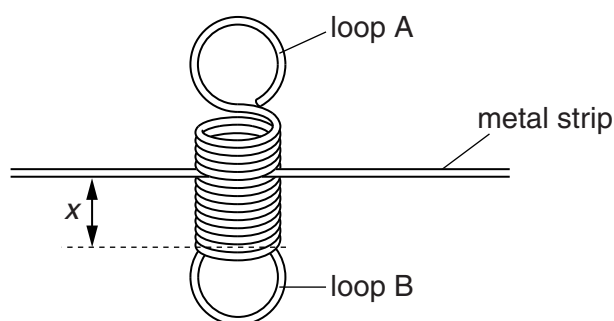


Fig. 2.2

- (ii) Measure and record x .

$x =$ [1]

- (iii) Calculate the volume V inside the coiled part of the spring below the metal strip using

$$V = \frac{\pi D^2 x}{4}.$$

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Use

$V = \dots\dots\dots$ [1]

- (c) (i) Clamp the metal strip so that it is horizontal with loop A of the spring at the top. Gently hang a mass of 300 g from loop B, as shown in Fig. 2.3. Ensure that the base of the mass hangs approximately 20 cm above the bench.

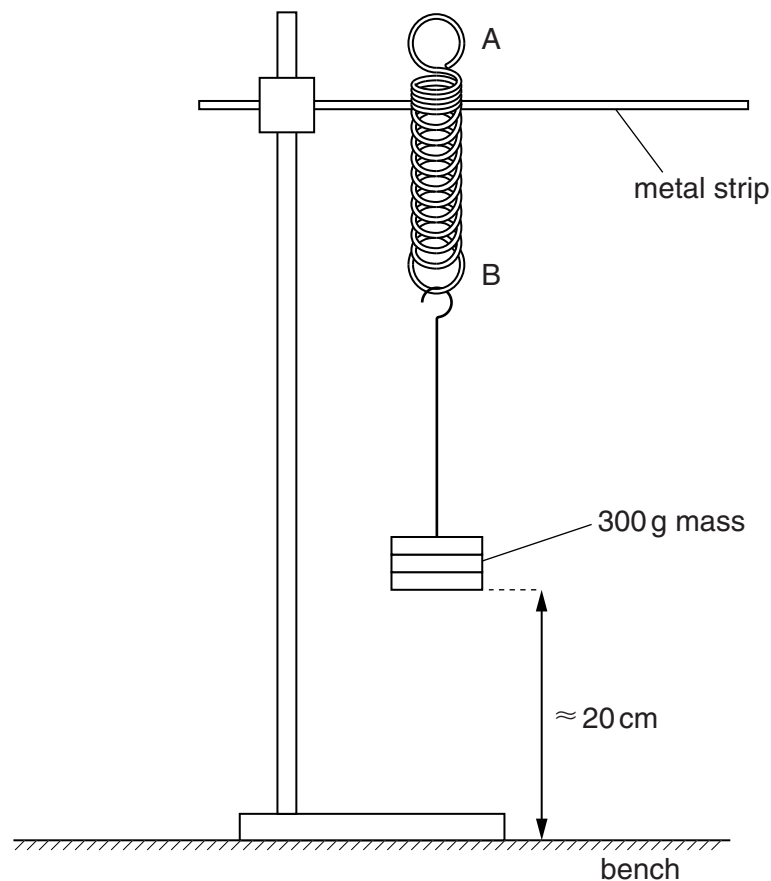


Fig. 2.3

- (ii) Slowly and gently pull the mass towards the bench by approximately 1 cm.
- (iii) Release the mass and watch its movement.
The mass will move up and then down, completing a cycle, as shown in Fig. 2.4.

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Use

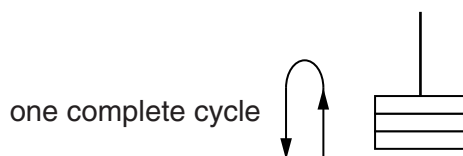


Fig. 2.4

- (iv) Measure and record the time for at least 10 cycles.
Record enough readings to determine an accurate value for the time T taken for one complete cycle.

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

- (d) (i) Remove the mass from the spring.
- (ii) Remove the spring from the metal strip.
- (iii) Repeat **(b)(i)** making x approximately 1.0 cm.
- (iv) Measure and record x .

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

(e) Repeat (b)(iii) and (c).

For
Examiner's
Use

$V =$

$T =$

[2]

(f) It is suggested that the relationship between T and V is

$$T^2 = kV$$

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 (f)(i) support the suggested relationship.

For
Examiner's
Use

.....

 [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]

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PHYSICS

9702/36

Paper 3 Advanced Practical Skills 2

October/November 2012

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 [] after each question or part question.

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1	
2	
Total	

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



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

For
Examiner's
Use

- 1** In this experiment, you will investigate how the light intensity incident on a light sensor varies with distance from the light source.

- (a)** You are provided with a lamp mounted inside one end of a black paper tube, together with a light sensor in the form of a light-dependent resistor (LDR) mounted on a half-metre rule, as shown in Fig. 1.1.

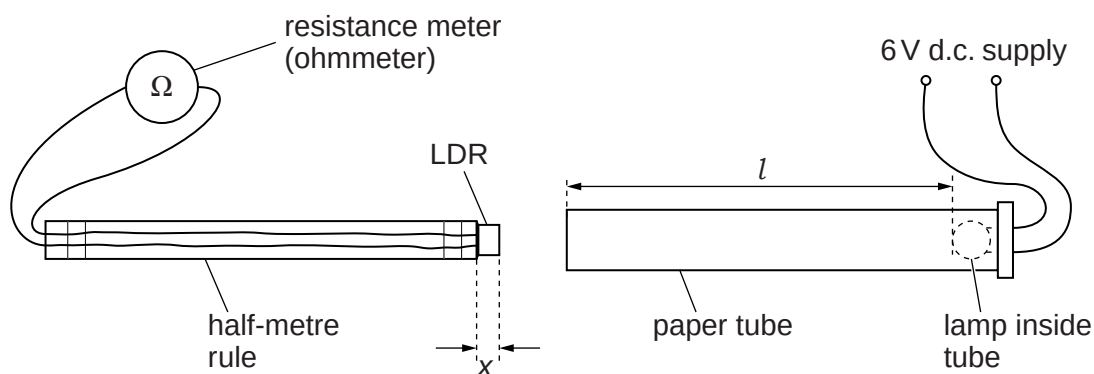


Fig. 1.1

- (b) (i)** Measure and record the distance l from the lamp to the open end of the tube, as shown in Fig. 1.1.

$l = \dots\dots\dots$

- (ii)** Measure and record the distance x from the front of the LDR to the end of the half-metre rule, as shown in Fig. 1.1.

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



- (c) (i) Push the rule into the tube until the LDR is approximately half way along the tube, as shown in Fig. 1.2.

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Use

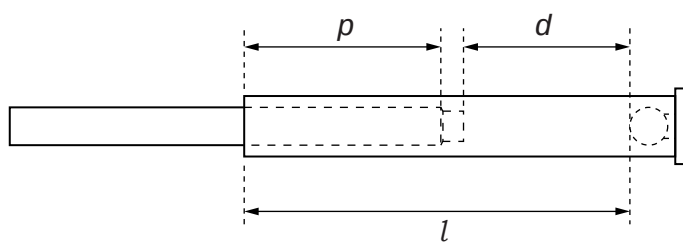


Fig. 1.2

- (ii) Record the length p of the half-metre rule inside the tube.

$p =$

- (iii) Calculate the distance d of the LDR from the lamp using $d = l - (x + p)$.

$d =$

- (iv) Switch on the lamp and record the resistance reading R on the resistance meter.

$R =$ $\text{k}\Omega$ [1]



- (d) Repeat (c) using different values of p until you have six sets of values of p and R for $p \leq 20\text{ cm}$.
In your table of results include values for d and $d^{1.5}$ ($d^{1.5} = \sqrt{d^3}$).

For
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Use

☐

[10]

- (e) (i) Plot a graph of R on the y -axis against $d^{1.5}$ on the x -axis.
(ii) Draw the straight line of best fit.
(iii) Determine the gradient and y -intercept of this line.

[3]

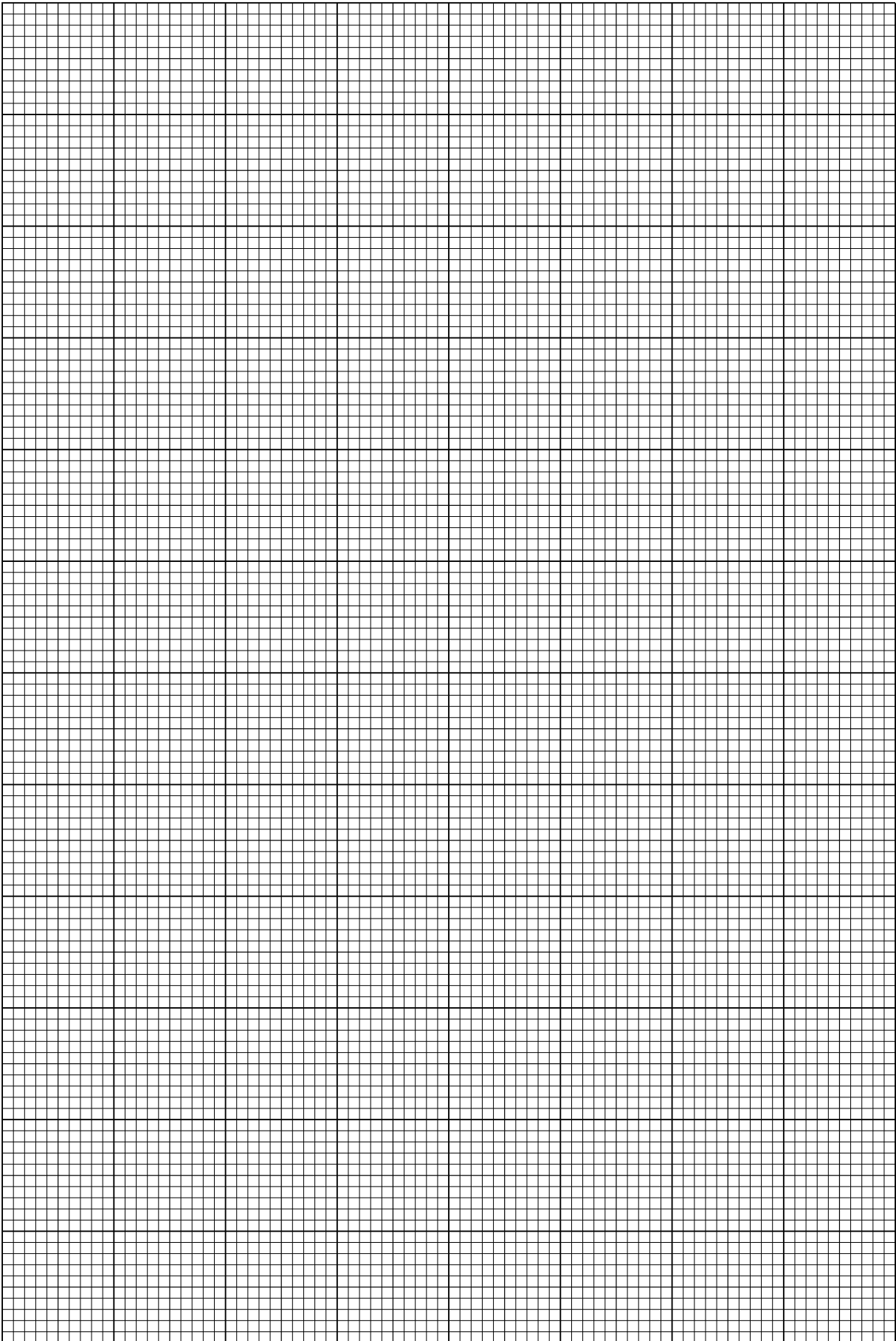
[1]

gradient = ...

y -intercept = ...

[2]

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- (f) The quantities R and d are related by the equation

$$R = ad^{1.5} + b$$

where a and b are constants.

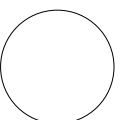
Using your answers from (e)(iii), determine the values of a and b .
Give appropriate units.

For
Examiner's
Use

$a =$

$b =$

[2]



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

For
Examiner's
Use

2 In this experiment, you will investigate the speed of a cylindrical piston moving through water.

- (a) (i)** You are provided with a container of water and a piece of modelling clay which can be moulded into a cylindrical piston. You are also provided with a card on which is written the internal diameter d_0 of the container, together with two other values A and B .

Mould the piece of modelling clay into a cylinder with a diameter approximately equal to value A .

Measure and record the diameter d of this cylinder.

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

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

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

- (iii)** You are also provided with a string running over a pulley. The string has a mass X attached to one end and a paperclip at the other end.

Push the paperclip into the centre of your clay cylinder and lower it into the container of water, as shown in Fig. 2.1, with the clay cylinder axis vertical.

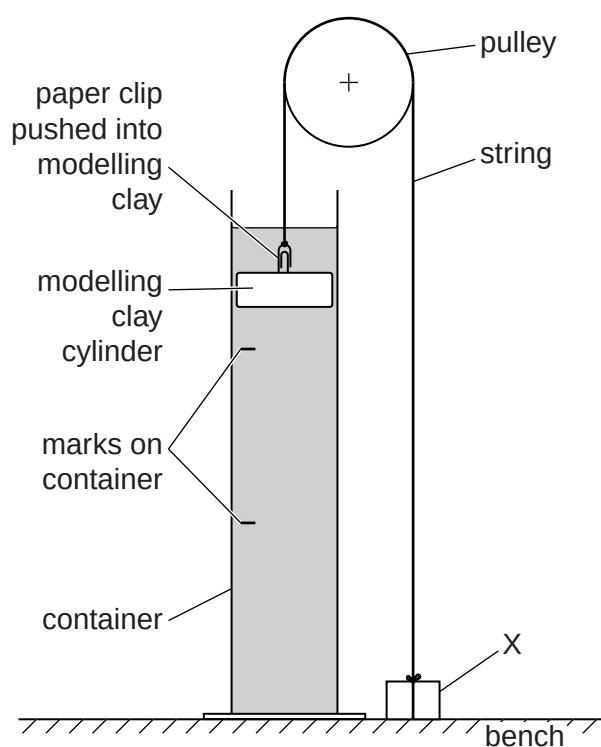


Fig. 2.1

- (iv) Measure and record the distance h between the marks on the container of water.

For
Examiner's
Use

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

- (b) (i) Raise X until the clay cylinder reaches the bottom of the container of water. Release X and take measurements to determine the time t taken for the clay cylinder to rise from the lower mark to the higher mark.

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

- (ii) Calculate the average speed v of the clay cylinder between the marks using $v = \frac{h}{t}$.

$$v = \dots\dots\dots [1]$$

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

.....

.....

..... [1]

- (c) (i) Remove the modelling clay from its paperclip and re-mould it into a cylinder with a diameter approximately equal to value B from the card. Measure and record the diameter d of the cylinder.

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

- (ii) Push the paperclip into the centre of your clay cylinder again and lower it into the container of water. Repeat **(b)(i)** and **(b)(ii)**.

For
Examiner's
Use

$t =$

$v =$

[2]

- (d) (i) It is suggested that the relationship between v and d is

$$v = k (d_0 - d)$$

where k is a constant and d_0 is given on your card.

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]

- (e) (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.

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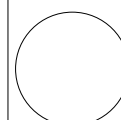
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