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9702/31

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

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*For
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Use*

- 1** In this experiment, you will investigate how the motion of a pendulum whose swing is interrupted depends on its length.

- (a) (i)** Lay the pendulum next to the rule and use the pen to make a mark on the string so that the distance L is 0.180 m, as shown in Fig. 1.1.

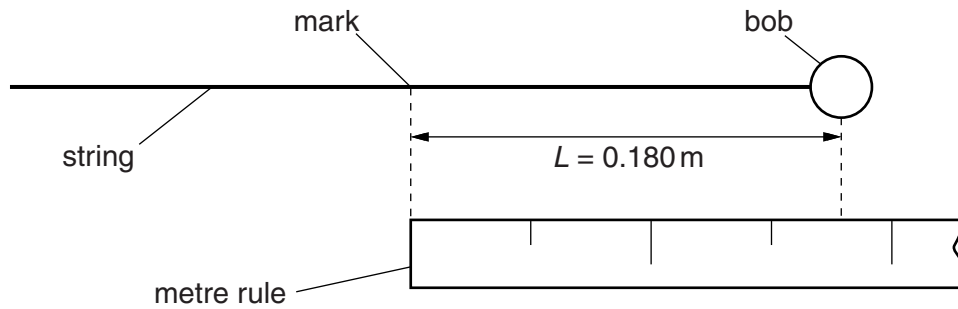


Fig. 1.1

- (ii) Set up the apparatus, fixing the string in the split bung so that the string is just touching the wooden rod at the mark you have made.

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Use

Fig. 1.2 shows a side view and a front view of the apparatus.

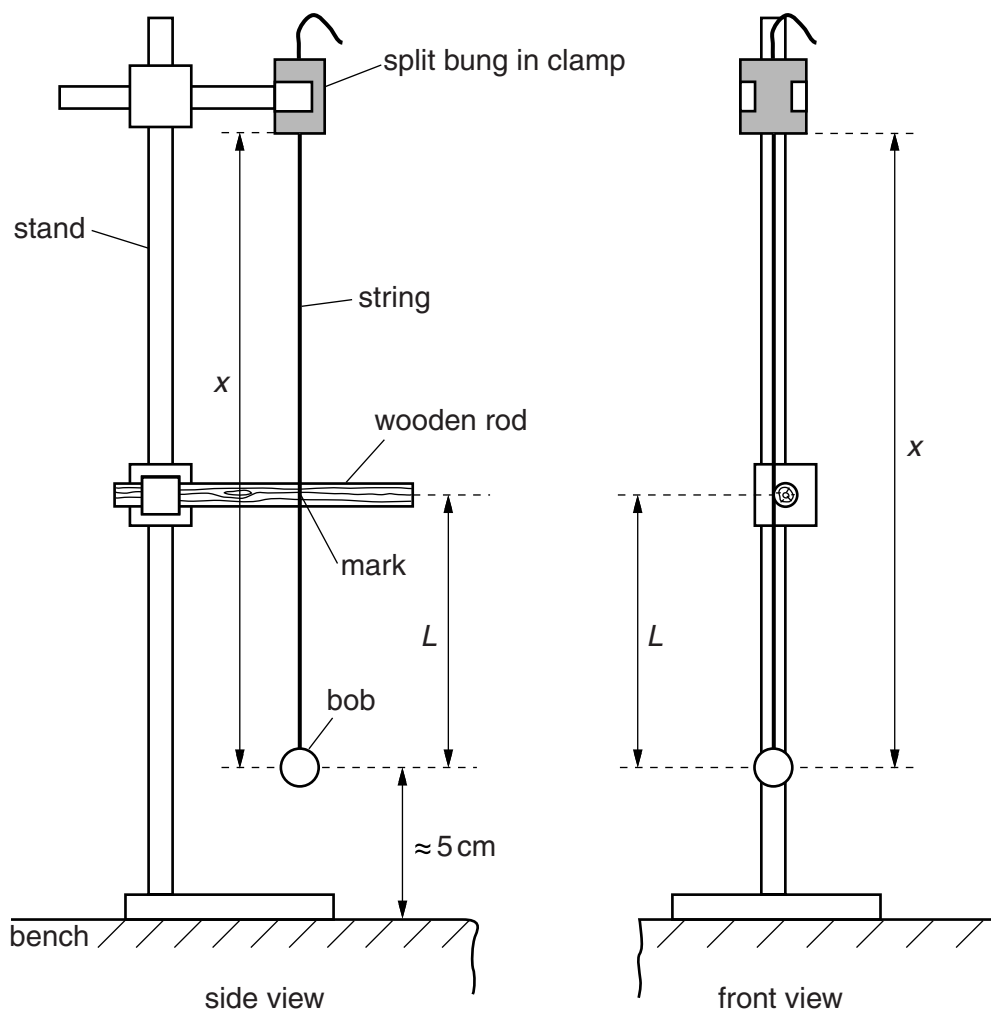


Fig. 1.2

The centre of the bob should be approximately 5 cm above the bench.

The distance x between the bottom of the bung and the centre of the bob should be approximately 55 cm.

The mark on the string should be level with the centre of the rod.

- (iii) Measure and record the distance x .

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

- (b) (i) Move the bob sideways through a distance of approximately 5 cm, as shown in Fig. 1.3.

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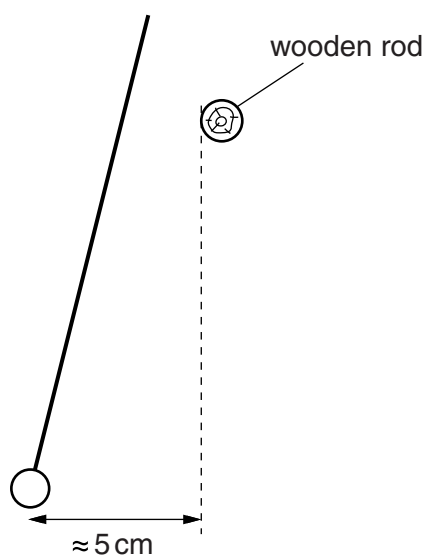


Fig. 1.3

- (ii) Release the bob and watch its movement. The bob will move to the right and then to the left again completing a swing, as shown in Fig. 1.4. Let the pendulum swing to and fro, counting the number of swings.

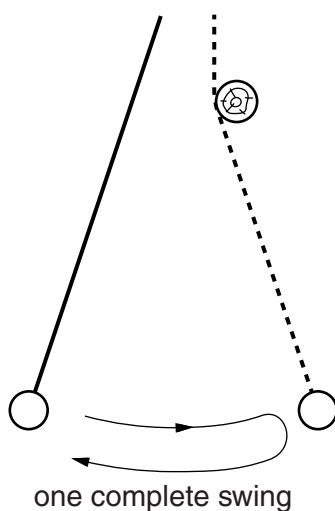


Fig. 1.4

Measure and record the time for at least 10 consecutive swings.

Record enough readings to determine an accurate value for the time T taken for one complete swing.

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

- (c) Reduce the distance x . Keep L constant, by adjusting the height of the wooden rod if necessary. Repeat (a)(iii) and (b) until you have six sets of values of x and T .

Include values of $\sqrt{x}$ in your table.

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Use

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[9]

- (d) (i) Plot a graph of T on the y -axis against $\sqrt{x}$ 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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Examiner's
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- (e) The quantities T and x are related by the equation

$$T = P\sqrt{x} + Q$$

where P and Q are constants.

Using your answers from (d)(iii), determine the values of P and Q .

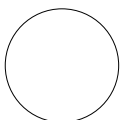
Give appropriate units.

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$P =$

$Q =$

[2]



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- 2** In this experiment, you will investigate how the force required to pull a block up an inclined plane depends on the angle between the inclined plane and the bench.

(a) (i) Place the board on the bench.

(ii) Place the block with attached masses on the board, and attach the newton-meter as shown in Fig. 2.1.

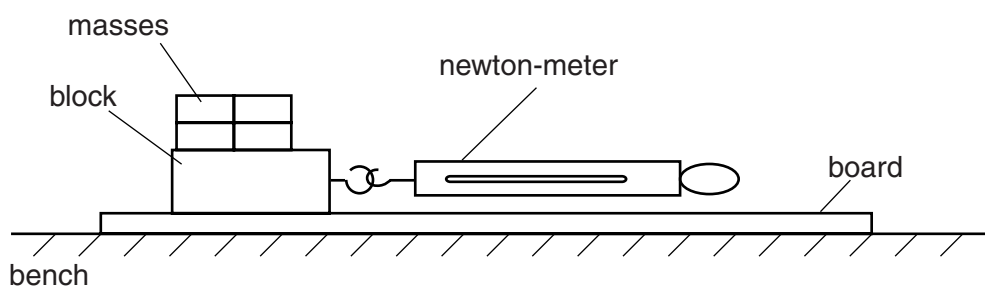


Fig. 2.1

(iii) Gently pull the newton-meter until the block just starts to move.

Measure and record the reading F_0 on the newton-meter, at the instant the block just starts to move.

$F_0 = \dots\dots\dots$ [2]

(iv) Estimate the percentage uncertainty in your value of F_0 .

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

(v) Calculate μ where $\mu = \frac{F_0}{W}$.

W is the value of the weight of the block and masses written on the card.

$\mu = \dots\dots\dots$ [1]

- (b) (i) Place the board and supporting block as shown in Fig. 2.2. The longer edge of the supporting block should be vertical.

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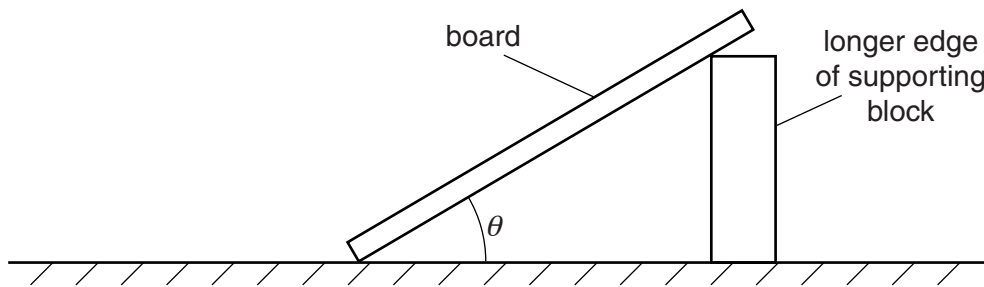


Fig. 2.2

- (ii) Using the protractor, measure and record the angle θ between the board and the bench.

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

- (iii) Using your values from (a)(v) and (b)(ii), calculate $(\sin \theta + \mu \cos \theta)$.

$(\sin \theta + \mu \cos \theta) = \dots\dots\dots$ [1]

- (c) (i) Place the block with masses on the board and attach it to the newton-meter, as shown in Fig. 2.3.

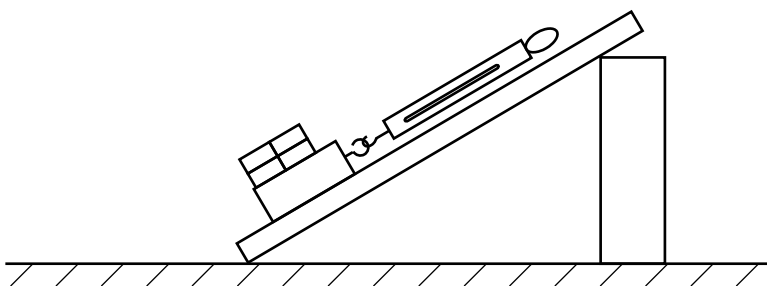


Fig. 2.3

- (ii) Pull the newton-meter until the block just starts to move.
Measure and record the reading F on the newton-meter.

$F = \dots\dots\dots$ [1]

- (d) Place the supporting block as shown in Fig. 2.4 with a shorter edge vertical.

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

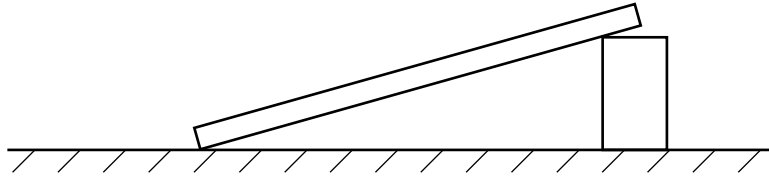


Fig. 2.4

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

$$(\sin \theta + \mu \cos \theta) = \dots\dots\dots$$

$$F = \dots\dots\dots$$

[3]

- (e) It is suggested that the relationship between F and θ is

$$F = k (\sin \theta + \mu \cos \theta)$$

where k is a constant and μ is the value calculated in (a)(v).

- (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]

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

.....

[1]

For
Examiner's
Use

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

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- (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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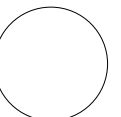
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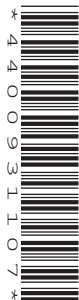
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PHYSICS

9702/32

Paper 3 Advanced Practical Skills 2

May/June 2012

2 hours

Candidates answer on the Question Paper.

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Answer **both** questions.

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- 1** In this experiment, you will investigate the equilibrium position of a suspended mass.

The apparatus has been set up as shown in Fig. 1.1.

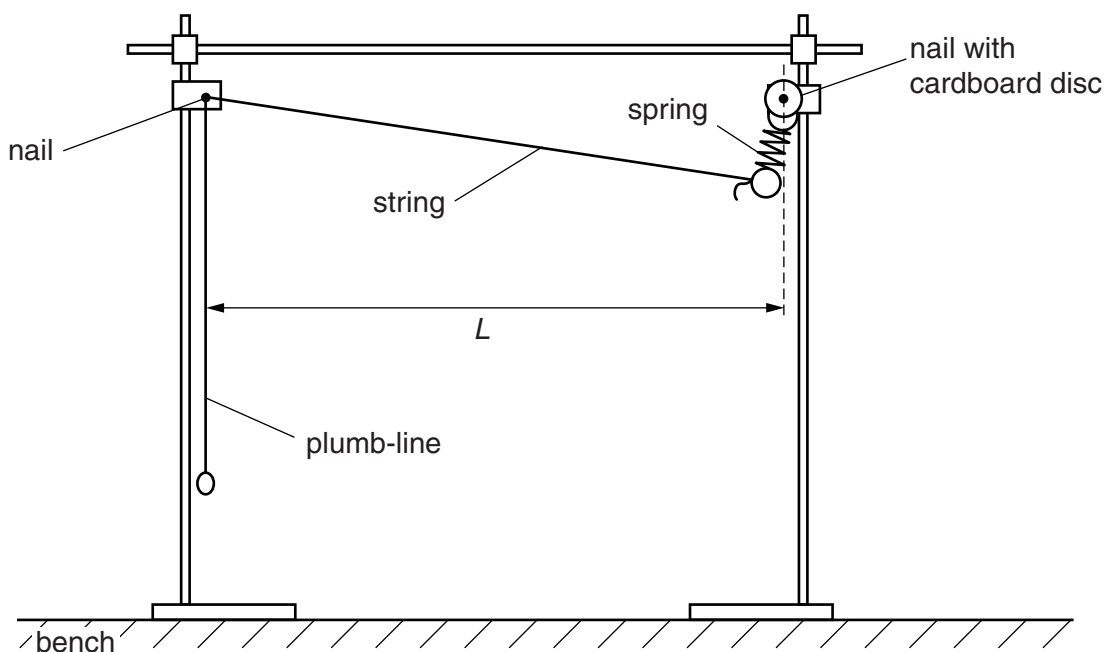


Fig. 1.1

- (a)** Measure and record the distance L between the two nails.

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

- (b) (i)** Attach the crocodile clip to the string so that the string passes through the gap between the jaws of the crocodile clip, as shown in Fig. 1.2.

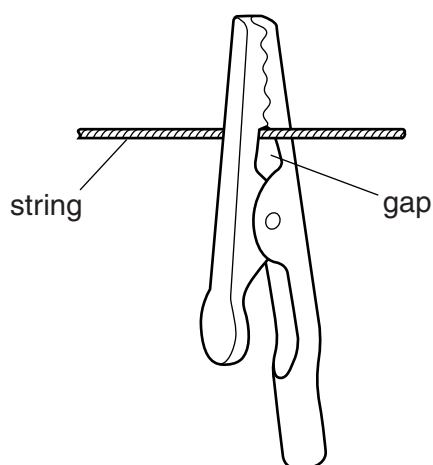


Fig. 1.2

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Suspend the mass hanger and masses from the loop attached to the crocodile clip. Adjust the position of the crocodile clip so that the distance d from the plumb-line to the string loop is about 30 cm, as shown in Fig. 1.3.

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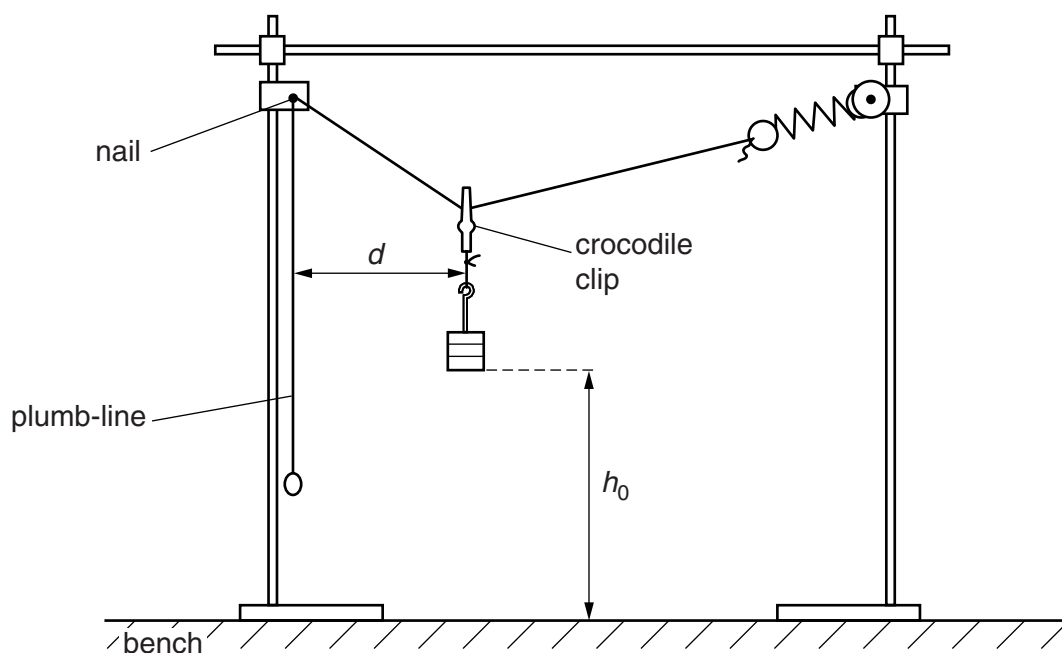


Fig. 1.3

(ii) Measure and record d .

$d = \dots\dots\dots$ m

(iii) Measure and record the initial height h_0 of the bottom of the mass above the bench, as shown in Fig. 1.3.

$h_0 = \dots\dots\dots$ m [1]

- (c) Reduce d by moving the crocodile clip **closer** to the plumb-line, ensuring that the string passes through the gap as shown in Fig. 1.2. Measure and record d and the new height h of the bottom of the mass above the bench. Repeat until you have six sets of values for d and h , with d in the range 5 cm to 30 cm.

Include values of $\left(\frac{L}{2} - d\right)^2$ and $(h - h_0)$ in your table.

For
Examiner's
Use

[10]

- (d) (i) Plot a graph of $\left(\frac{L}{2} - d\right)^2$ on the y -axis against $(h - h_0)$ 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 relationship between d and h is

$$\left(\frac{L}{2} - d\right)^2 = a(h - h_0) + b$$

where a and b are constants.

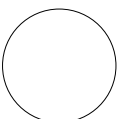
Using your answers from (d)(iii), determine the values of a and b .
Give appropriate units.

For
Examiner's
Use

$a =$

$b =$

[2]



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Please turn over for Question 2.

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Use

2 In this experiment, you will investigate the adhesive strength of Blu-Tack.

- (a) (i) You have been provided with two plastic rulers, one with a loop of string attached. Take the ruler without string and clamp it along the edge of the bench with a flat face uppermost.
- (ii) Use some of the Blu-Tack to make a ball of diameter about 8 mm.
- (iii) Using the calipers provided, measure and record the diameter of the ball.

ball diameter = ...

- (iv) Place the ball of Blu-Tack on the clamped ruler with a thin rod each side of it. Press the flat face of the second ruler on to the Blu-Tack until the ruler touches the rods. The Blu-Tack will form a disc, as shown in Fig. 2.1.

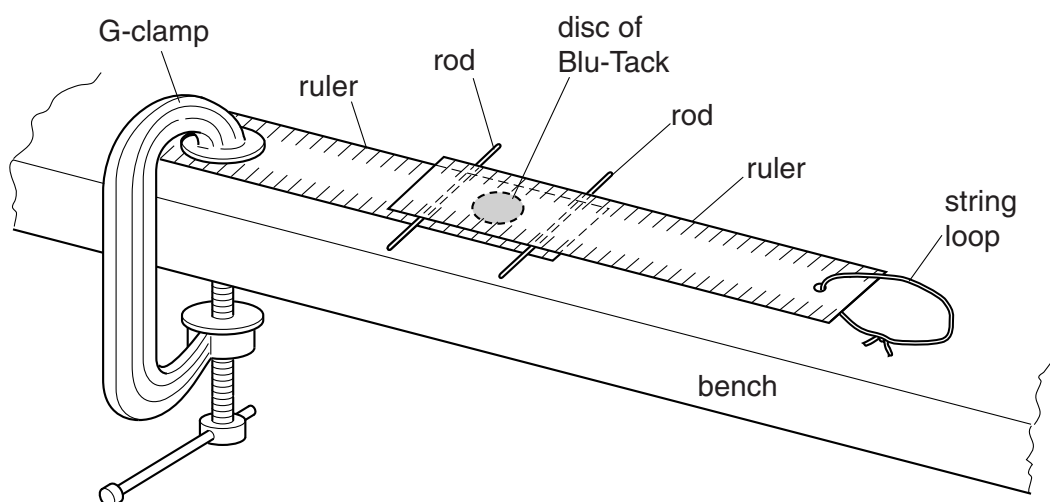


Fig. 2.1

- (b) (i) Measure and record the diameter d of the disc of Blu-Tack.

$d =$ [2]

- (ii) Estimate the percentage uncertainty in d .

percentage uncertainty = ... [1]

- (iii) Calculate the contact area A using $A = \frac{\pi d^2}{4}$.

$A =$ [1]

- (c) (i) Attach the newton-meter to the string loop and lay it horizontally on the bench.

- (ii) Pull the newton-meter horizontally (parallel to the rulers). Measure and record the force F when the top ruler detaches.

$F =$ [2]

- (d) (i) Remove the Blu-Tack from the rulers.

- (ii) Make a ball with a slightly different diameter and repeat (a)(iii), (a)(iv), (b)(i), (b)(iii) and (c).

You should be aware that a large change in diameter could result in a reading outside the range of the newton-meter.

ball diameter = ...

$d =$ [1]

$A =$ [1]

$F =$ [2]

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Use

- (e) It is suggested that the relationship between F and A is

$$F = kA$$

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]

For
Examiner's
Use

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

For
Examiner's
Use

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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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PHYSICS

9702/33

Paper 3 Advanced Practical Skills 1

May/June 2012

2 hours

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- 1** In this experiment, you will investigate how the extension of an arrangement of springs depends on the loads applied to it.

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

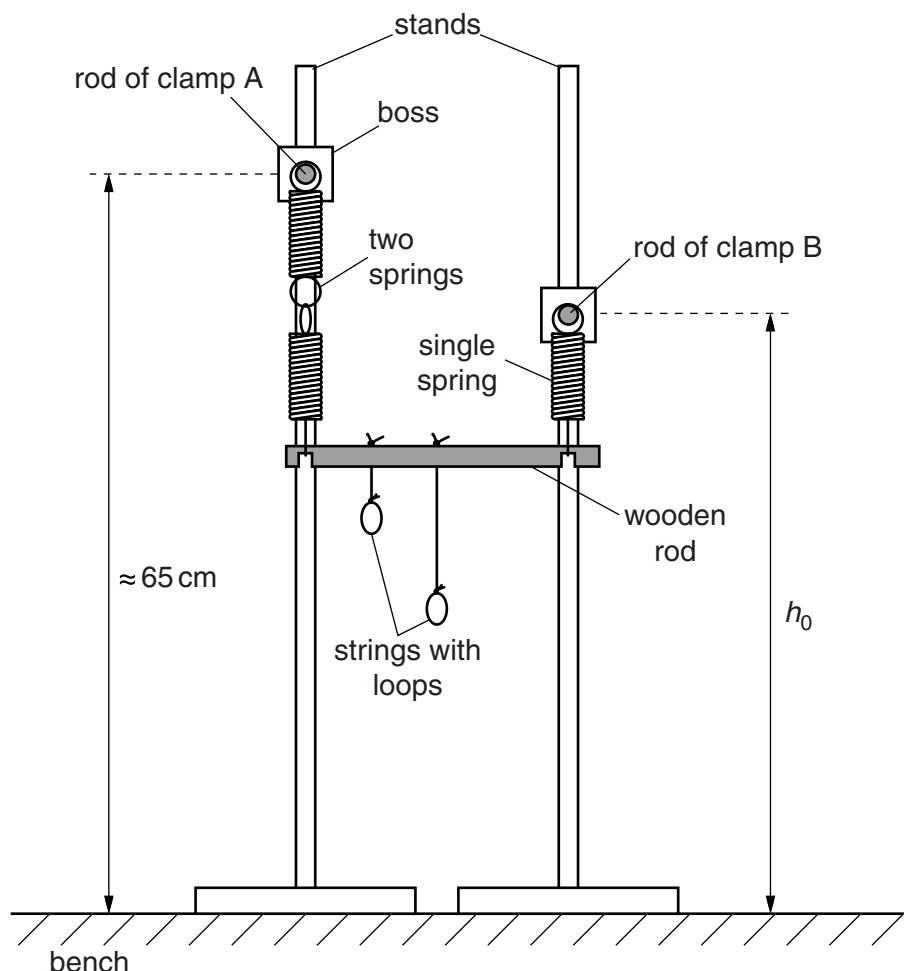


Fig. 1.1

Place the rod of clamp A, supporting the two springs, approximately 65 cm above the bench.

Once fixed do not change the position of the rod of clamp A throughout the experiment.

Suspend the wooden rod, with strings attached, using the springs as shown. Adjust the position of the rod of clamp B until the wooden rod is horizontal. Ensure the springs hang vertically.

- (ii)** Measure and record the distance h_0 between the centre of the rod of clamp B (supporting the single spring) and the bench.

$h_0 = \dots\dots\dots$ m [1]

- (b) (i) Add masses to the wooden rod as shown in Fig. 1.2. The 100 g mass hanger should be attached to the longer, central string.

For
Examiner's
Use

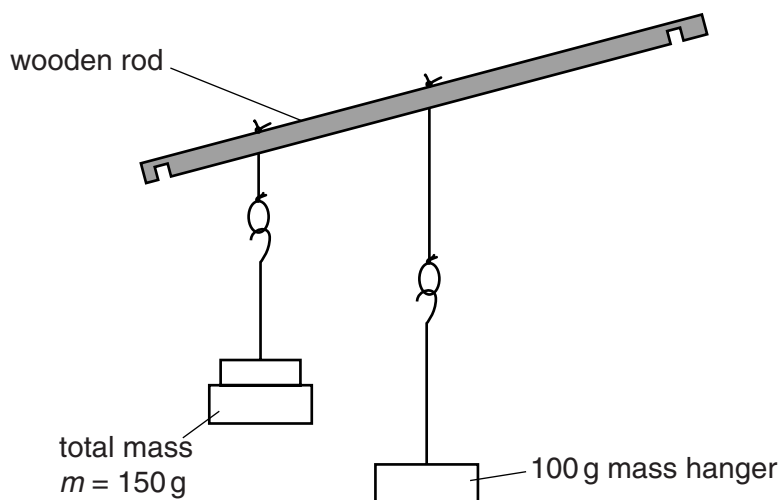


Fig. 1.2

- (ii) Adjust the height of the rod of clamp B until the wooden rod is horizontal.
- (iii) Measure and record the distance h between the centre of the rod of clamp B and the bench, as shown in Fig. 1.3.

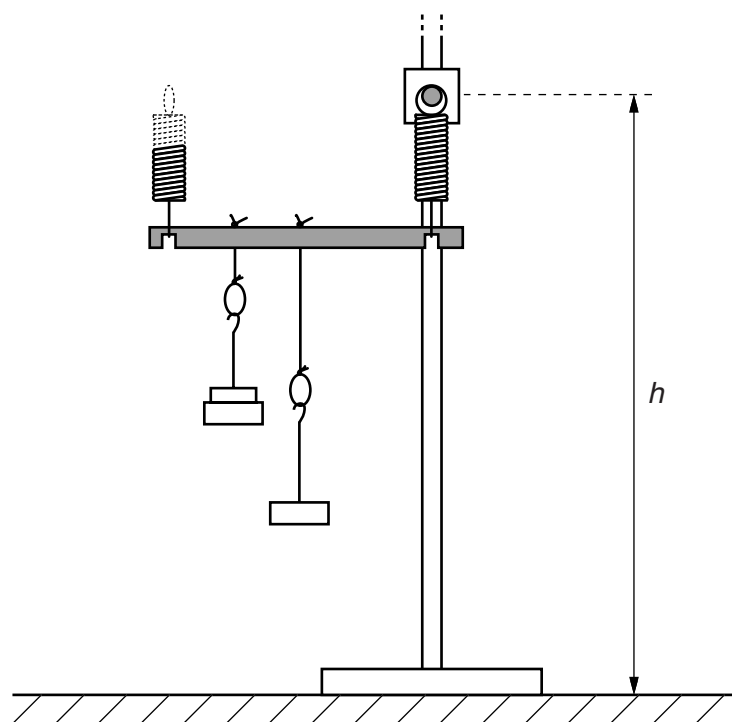


Fig. 1.3

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

- (iv) Calculate the value of $(h_0 - h)$.

$$(h_0 - h) = \dots\dots\dots$$

- (c) By increasing the mass m , repeat **(b)(ii)**, **(b)(iii)** and **(b)(iv)** until you have five sets of values of m and h . Do not change the mass attached to the longer, central string.

Include values of $\frac{(h_0 - h)}{m}$ and $\frac{1}{m}$ in your table.

For
Examiner's
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[10]

- (d) (i) Plot a graph of $\frac{(h_0 - h)}{m}$ on the y-axis against $\frac{1}{m}$ on the x-axis.

[3]

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

[1]

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

$$\text{gradient} = \dots\dots\dots$$

$$\text{y-intercept} = \dots\dots\dots$$

[2]

☐
☐

For
Examiner's
Use

- (e) The quantities h and m are related by the equation

$$\frac{(h_0 - h)}{m} = \frac{P}{m} + Q$$

where P and Q are constants.

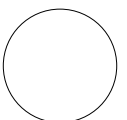
Use your answers in (d)(iii) to determine the values of P and Q .
Give appropriate units.

For
Examiner's
Use

$P =$

$Q =$

[2]



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

For
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Use

- 2** In this experiment, you will investigate how the cooling rate of a hot liquid depends on the surface area of the liquid exposed to air.

- (a)** **(i)** Pour cold water into the beaker up to the 200 ml mark.
- (ii)** Pour the water into the cup and use the pen to place a mark on the inside surface of the cup, level with the water surface.
- (iii)** Empty out the cold water.
- (iv)** Repeat **(a)(i)**, **(a)(ii)** and **(a)(iii)** for the bowl.
- (b)** **(i)** Pour boiling water into the cup up to the mark.
- (ii)** When the temperature of the water falls to approximately 75 °C, start the stopwatch.

Record this starting temperature θ_0 .

$\theta_0 = \dots\dots\dots$ [1]

- (iii)** After two minutes, measure and record the temperature θ .

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

- (iv)** Calculate the change in temperature $\Delta\theta = (\theta_0 - \theta)$.

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

- (c)** **(i)** Measure and record the diameter d of the water surface.

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

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

For
Examiner's
Use

percentage uncertainty = ...[1]

- (d) Repeat (b) and (c)(i) for the bowl.

$\theta_0 =$

$\theta =$

$\Delta\theta = (\theta_0 - \theta) =$

$d =$

[4]

- (e) It is suggested that the relationship between $\Delta\theta$ and d is

$$\Delta\theta = k d^2$$

where k is a constant.

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

first value of k = ...

second value of k = ... [1]

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

.....

 [1]

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

.....

 [1]

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

For
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- (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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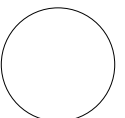
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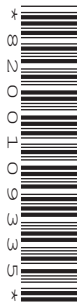
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PHYSICS

9702/34

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At the end of the examination, fasten all your work securely together.

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

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1

2

Total

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- 1 In this experiment, you will investigate the change in current in a circuit as its resistance is changed.

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

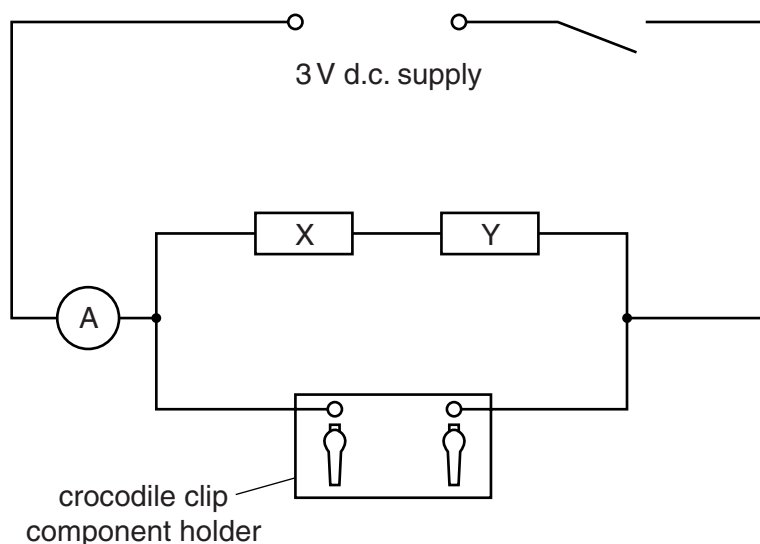


Fig. 1.1

- (ii) Close the switch.
(iii) Record the ammeter reading I_0 .

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

- (iv) Open the switch.

- (b) (i) Select one of the resistors labelled with a numerical value and connect it between the crocodile clips on the component holder. Record the resistance R of your selected resistor.

$R = \dots\dots\dots$ k Ω

- (ii) Close the switch and record the ammeter reading I .
Open the switch.

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

- (c) Repeat (b) using different labelled resistors until you have six sets of values of R and I .
Include values of $\frac{1}{R}$ in your table.

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[10]

- (d) (i) Plot a graph of I on the y -axis against $\frac{1}{R}$ on the x -axis.
(ii) Draw the straight line of best fit.
(iii) Determine the gradient and y -intercept of this line.

[3]

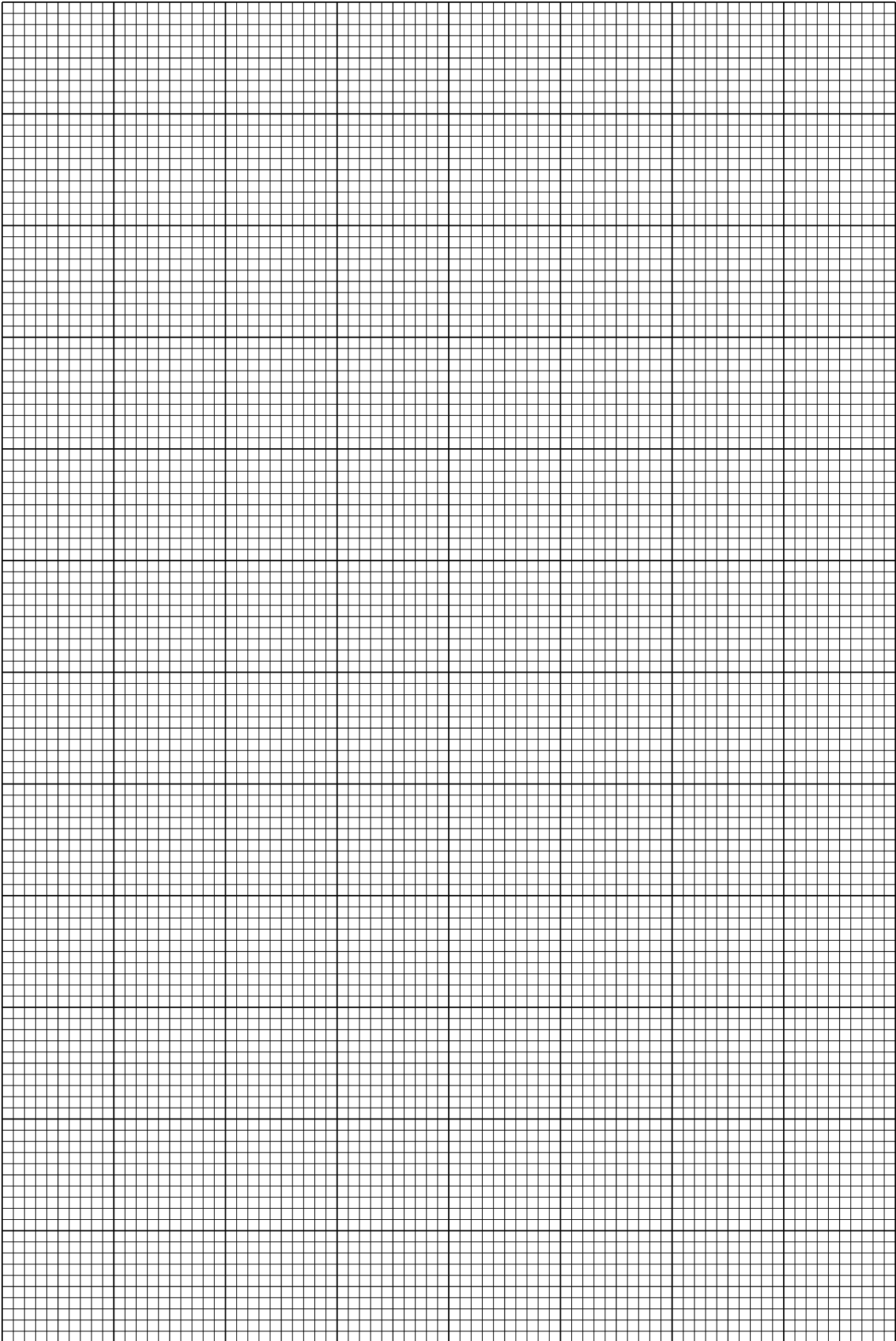
[1]

gradient = ...

y -intercept = ...

[2]

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

$$I = \frac{a}{R} + \frac{a}{b}$$

where a and b are constants.

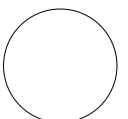
Using your answers from (d)(iii), determine the values of a and b .
Give appropriate units.

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Use

$a =$

$b =$

[2]



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- 2 In this experiment, you will investigate how the amount of energy needed to bend a copper wire depends on its diameter.
- (a) You are provided with a pendulum which can be used to hit and bend a wire specimen. Attach the wooden pointer to the pendulum using Blu-Tack. Align the pointer with the 90° position on the protractor when the pendulum is hanging freely, as shown in Fig. 2.1. Check that the pendulum swings freely.

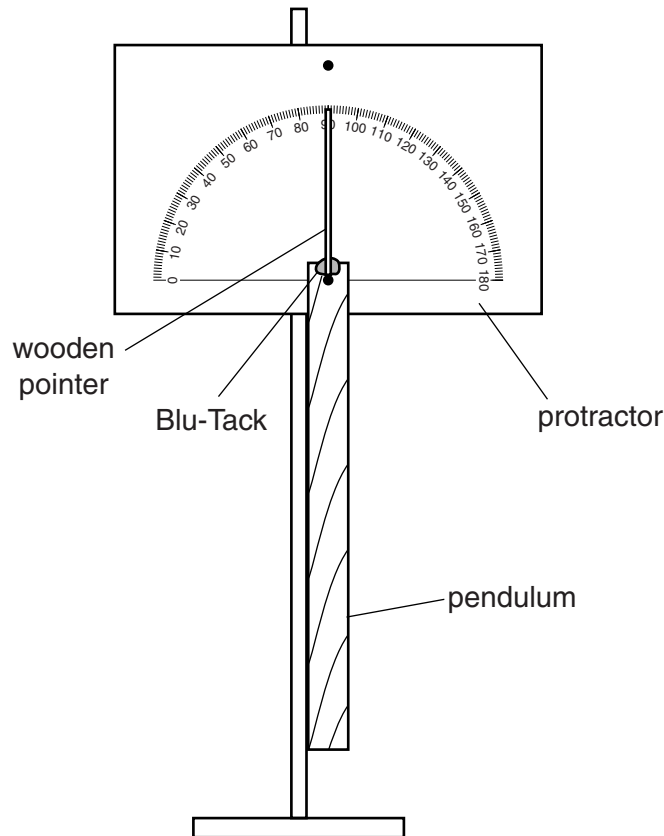


Fig. 2.1

- (b) You are provided with copper wire specimens of two different diameters. Using the micrometer, measure and record the diameter d of one of the thicker wires.

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

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

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

- (d) (i) Fit the wire fully into the hole in the wooden block. The wire should project about 2 cm above the surface of the block.
- (ii) Position the wooden block so that the wire just touches the edge of the pendulum, as shown in Fig. 2.2.

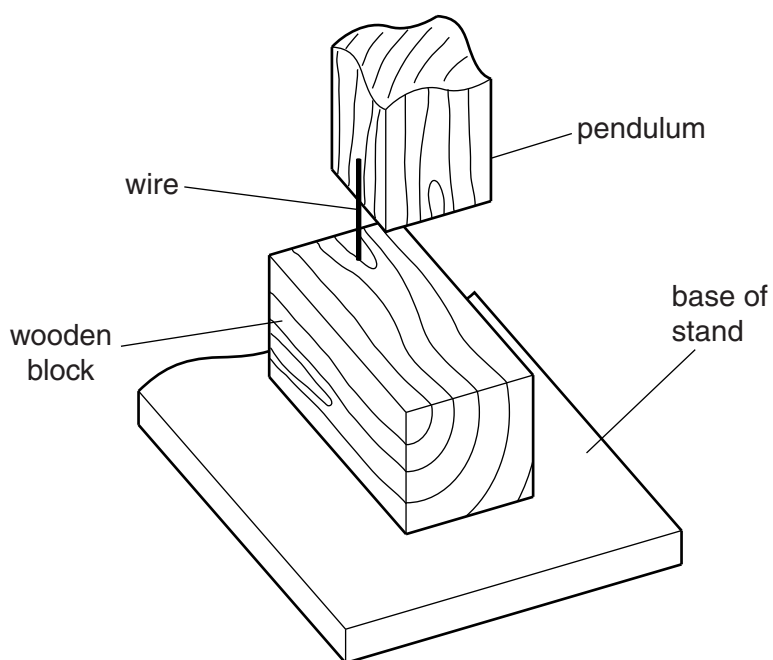


Fig. 2.2

- (iii) Lift the pendulum so that the pointer is aligned with the 0° position on the protractor.
- (iv) While holding the block in position, release the pendulum and record the maximum angle θ reached by the pointer after the pendulum has bent the wire.

$$\theta = \dots\dots\dots [2]$$

- (v) The energy used to bend the wire is proportional to the value of $\sin(180^\circ - \theta)$. Calculate this value, giving your answer to an appropriate number of significant figures.

$$\sin(180^\circ - \theta) = \dots\dots\dots [2]$$

(e) Repeat (b) and (d) using the thinner wire specimens.

For
Examiner's
Use

$d =$

$\theta =$

$\sin(180^\circ - \theta) =$

[3]

(f) It is suggested that the relationship between θ and d is

$$\sin(180^\circ - \theta) = kd^2$$

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.

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.

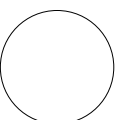
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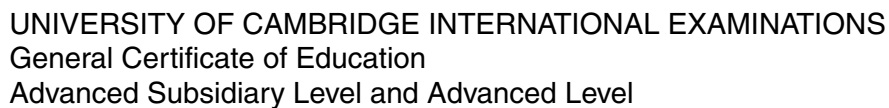
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9702/35

May/June 2012

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.

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- 1 In this experiment, you will investigate how the current in a circuit depends on the resistance of the circuit.
- (a) Set up the circuit as shown in Fig. 1.1. The crocodile clip should be positioned so that **three** of the resistors from the chain are included in the circuit.

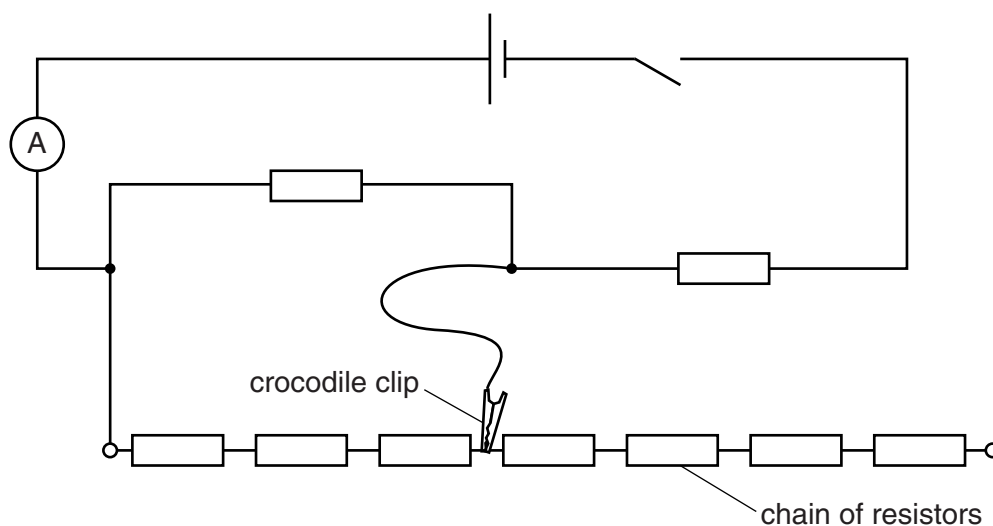


Fig. 1.1

All the resistors have the same value of resistance R .

- (b) (i) Close the switch.
- (ii) Record the ammeter reading I and the number n of resistors from the chain included in the circuit.

$I =$

$n =$

[1]

- (iii) Open the switch.

- (c) By attaching the crocodile clip to different junctions and terminals on the chain of resistors, repeat (b) until you have six sets of readings of I and n .

Include values of $\frac{(n+1)}{I}$ in your table.

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Use

[10]

- (d) (i) Plot a graph of $\frac{(n+1)}{I}$ on the y -axis against n 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 I and n is

$$\frac{(n+1)}{I} = Pn + Q$$

where P and Q are constants.

Use your answers in (d)(iii) to determine values for P and Q .

$P =$

$Q =$ [1]

- (f) Disconnect the circuit.
Connect the voltmeter across the cell.
Measure and record the voltage V across the cell.

$V =$ V [1]

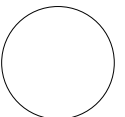
- (g) The constant P is related to R and V by

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

Using your answers in (e) and (f), calculate a value for R .

$R =$ [1]

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- 2** In this experiment, you will investigate how the rotational motion of an object depends on its mass.

(a) Mould the modelling clay into a solid disc that is identical in shape to that of the 100g slotted mass. You will not need to use all of the modelling clay. The modelling clay should keep this shape throughout the experiment.

- (b) (i)** Place the metre rule on the pivot so that it balances, as shown in Fig. 2.1.

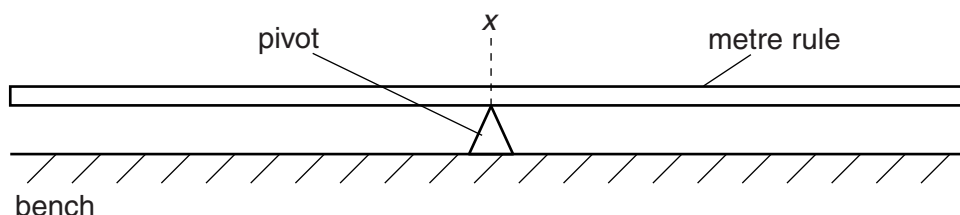


Fig. 2.1

- (ii)** Record the metre rule reading x at the pivot.

$x =$ [1]

- (iii)** Remove the metre rule from the pivot and lay it flat on the bench.

- (c) (i)** Place the disc you made in **(a)** at the 100cm end of the metre rule as shown in Fig. 2.2.

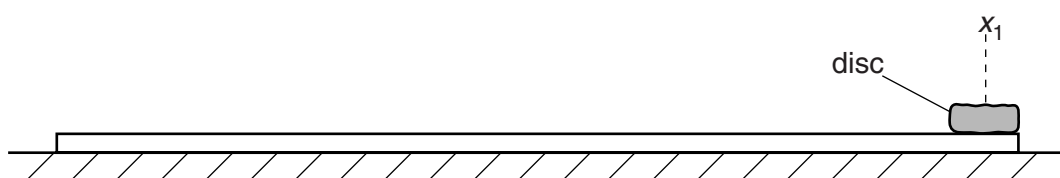


Fig. 2.2

- (ii)** Record the metre rule reading x_1 at the centre of the disc.

$x_1 =$ [1]

- (iii)** Calculate the distance d_1 , where $d_1 = (x_1 - x)$.

$d_1 =$ [1]

- (iv) Estimate the percentage uncertainty in your value of d_1 .

For
Examiner's
Use

percentage uncertainty = ... [1]

- (d) (i) **With the disc still at x_1** , carefully place the metre rule so that the pivot is again under your value of x on the metre rule from (b)(ii). Use the 100 g mass to balance the rule, as shown in Fig. 2.3.

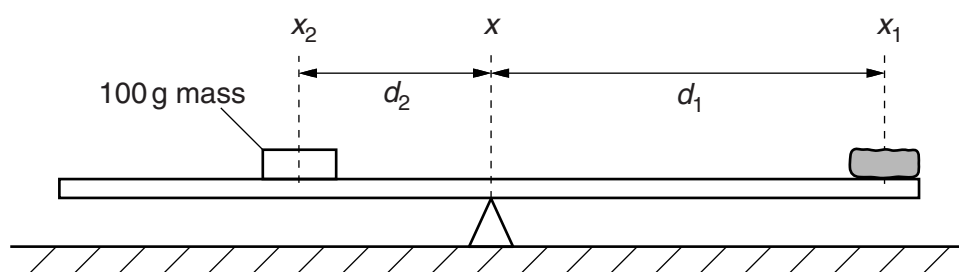


Fig. 2.3

- (ii) Record the metre rule reading x_2 at the centre of the 100 g mass.

$x_2 =$ [1]

- (iii) Calculate the distance d_2 , where $d_2 = (x - x_2)$.

$d_2 =$

- (iv) Carefully remove the 100 g mass and disc from the rule.

- (e) (i) Place the 100 g mass on the wire hanger and suspend it from the rubber band, as shown in Fig. 2.4.

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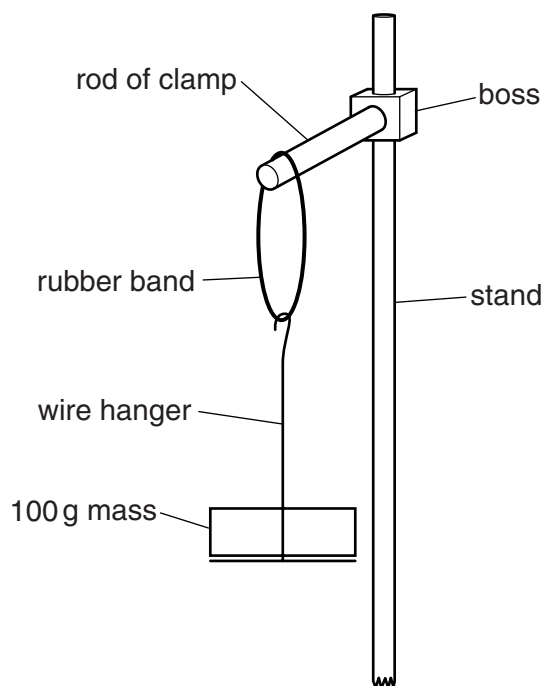


Fig. 2.4

- (ii) Hold the 100 g mass and slowly twist it horizontally through 90° .
 (iii) Release the 100 g mass and watch its movement.
 The mass completes one oscillation by moving as shown in Fig. 2.5.

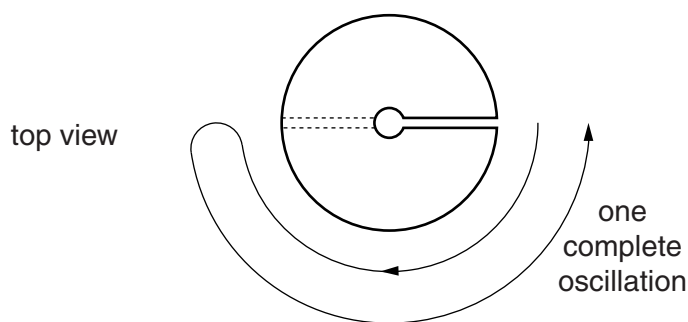


Fig. 2.5

The time taken for one complete oscillation is T .
 By timing several of these complete oscillations, determine an accurate value for T .

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

(f) Repeat (e) using the disc.

For
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Use

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

(g) For an oscillating mass it is suggested that the relationship between T and d is

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

where k is a constant.

(i) Using your data, complete the table in Fig. 2.6 and calculate two values of k .

object	distance from pivot	T/s	k
disc	$d_1 = \dots\dots\dots$	$\dots\dots\dots$	$\dots\dots\dots$
100 g mass	$d_2 = \dots\dots\dots$	$\dots\dots\dots$	$\dots\dots\dots$

Fig. 2.6

[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.

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Use

1.

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2.

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3.

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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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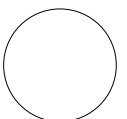
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