



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

CANDIDATE
NAME

CENTRE
NUMBER

--	--	--	--	--

CANDIDATE
NUMBER

--	--	--	--

PHYSICS

9702/31

Paper 31 Advanced Practical Skills 1

October/November 2009

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. The working of the answers is to be handed in.

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.

All questions in this paper carry equal marks.

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 the position of a wooden rod suspended in water as the depth of the water is varied.

Assemble the apparatus, as shown in Fig.1.1, then add water to the beaker until the mass attached to the bottom of the rod is completely covered and is not touching the bottom of the beaker.

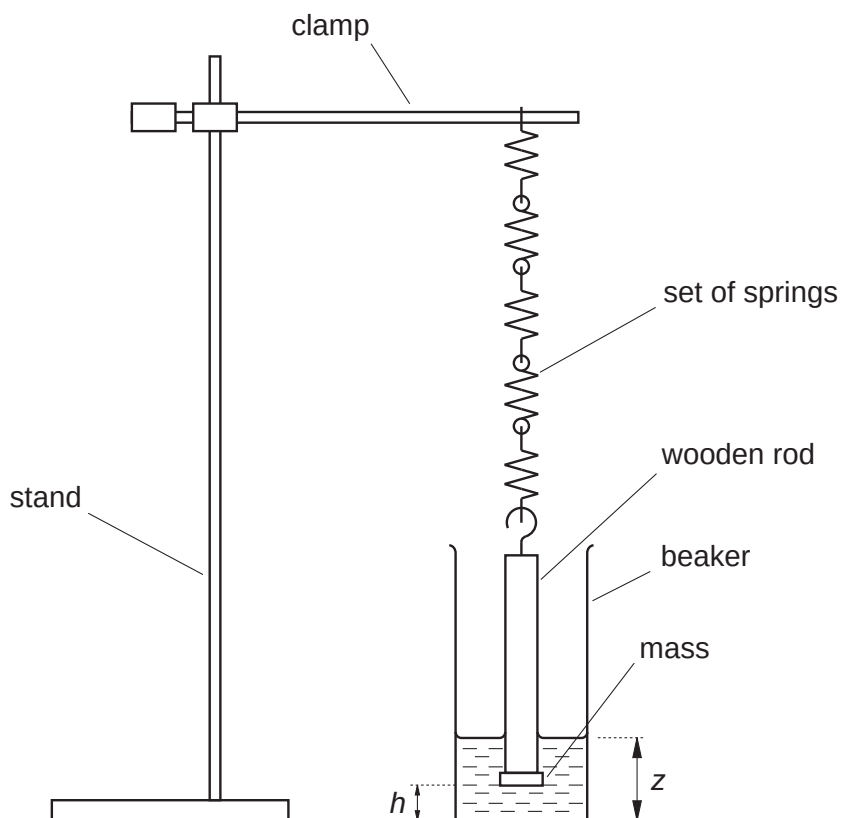


Fig. 1.1

- (a)** Record h and z , as shown in Fig.1.1.

$h = \dots\dots\dots$ cm

$z = \dots\dots\dots$ cm



- (b)** Add more water to the beaker and repeat **(a)**. Repeat this procedure until you have six sets of readings for h and z .

For
Examiner's
Use

--

--

--

--

- (c)** **(i)** Plot a graph of z on the y -axis against h on the x -axis. Draw the line of best fit.
(ii) Determine the gradient of the line.

gradient = ...

--

--

For
Examiner's
Use

- (d) (i) Use the vernier calipers to determine the diameter d of the wooden part of the rod.

For
Examiner's
Use

$d = \dots\dots\dots$

- (ii) Calculate the cross-sectional area A of the wooden part of the rod, using the relationship

$$A = \frac{\pi d^2}{4}.$$

$A = \dots\dots\dots \text{m}^2$

- (e) The relationship between z and h is

$$z = c + h \left(\frac{k}{\rho A g} + 1 \right)$$

where c is a constant, k is the spring constant, ρ is the density of water (1000 kg m^{-3}), and g is the acceleration of free fall (9.81 m s^{-2}).

Using your answers from (c)(ii) and (d)(ii), determine the value of k . Give an appropriate unit.

$k = \dots\dots\dots$

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 are provided with a ball suspended by a thread. You will investigate how the recoil distance is related to the length of the thread when the ball is struck by a moving marble.

- (a)** Assemble the apparatus, as shown in Fig. 2.1, with the thread clamped between the two wooden blocks so that l is about 50 cm.

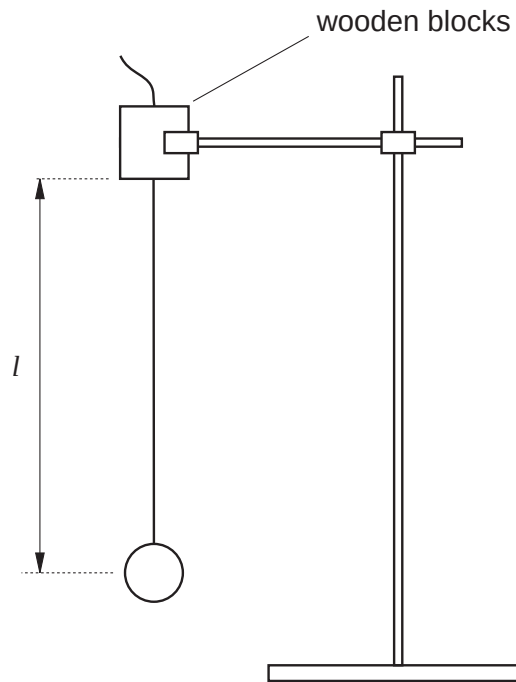


Fig. 2.1

Measure l

$l = \dots\dots\dots$



- (b) Further assemble the apparatus, as shown in Fig. 2.2. When the marble is released from rest, it rolls down the tube and hits the centre of the ball. Adjust the tilt of the tube so that the recoil distance d of the ball is about 20 cm.

For
Examiner's
Use

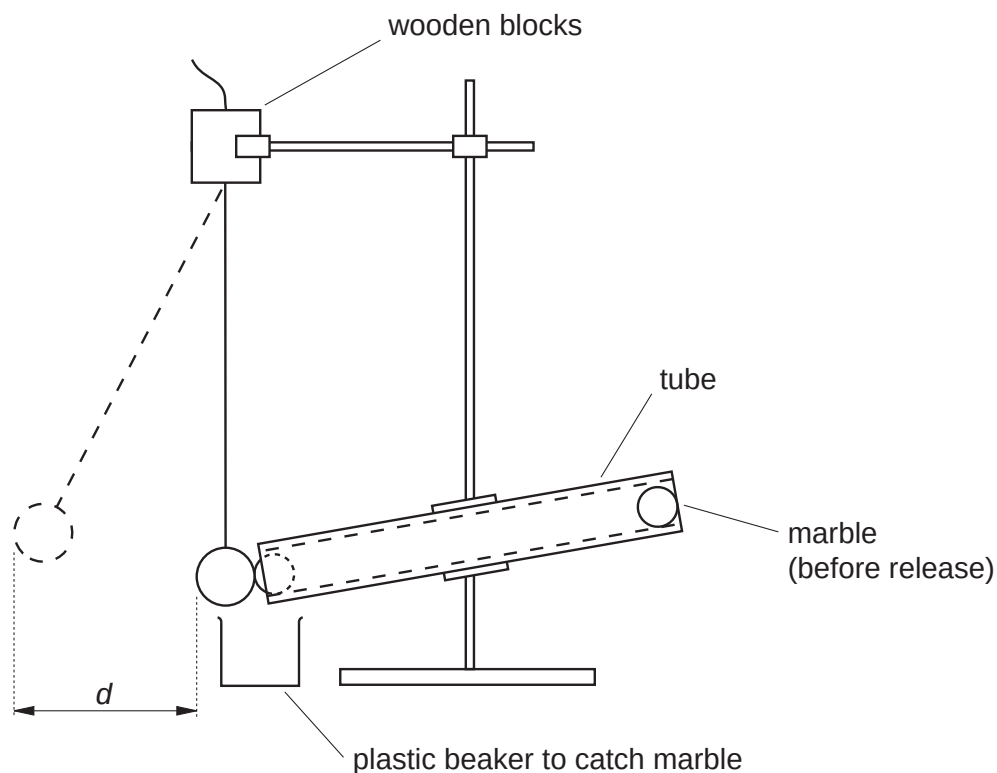


Fig. 2.2

- (i) Measure d .

$d = \dots\dots\dots$

- (ii) Explain how you used the apparatus to ensure that d was measured as accurately as possible.

.....

.....

.....

.....

.....

- (iii) Estimate the percentage uncertainty in d .

For
Examiner's
Use

percentage uncertainty in d = ...

- (c) If air resistance is ignored, theory predicts that

$$k = l - \sqrt{l^2 - d^2}$$

where k is a constant.

- (i) Calculate a value for k .

k = ...

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

.....

- (d) **Without changing the position of the tube**, shorten the thread to give a different value of l . Lower the clamp holding the thread to reposition the ball at the end of the tube, and then determine values of l , d and k for the new arrangement.

l = ...

d = ...

k = ...

- (e) By explaining whether your results indicate that k is constant, show whether the relationship in (c) is supported.

For
Examiner's
Use

.....

.....

.....

.....

☐
☐

- (f) (i) State four sources of error or limitations of the procedure in this experiment.

1.

.....

2.

.....

3.

.....

4.

.....

☐
☐
☐
☐

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

1.

.....

2.

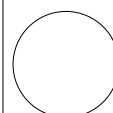
.....

3.

.....

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

Paper 32 Advanced Practical Skills 2

October/November 2009

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. The working of the answers is to be handed in.

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.

All questions in this paper carry equal marks.

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 the position of a wooden rod suspended in water as the load on it is varied.

Assemble the apparatus as shown in Fig. 1.1 and then fill the beaker to the brim with water.

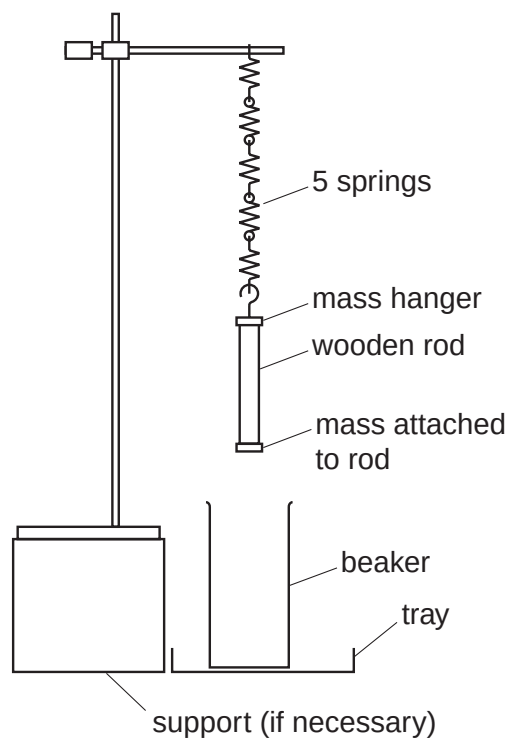


Fig. 1.1

Adjust the height of the clamp so that the rod is lowered into the water until the mass attached to the bottom of the rod is just covered, as shown in Fig. 1.2.

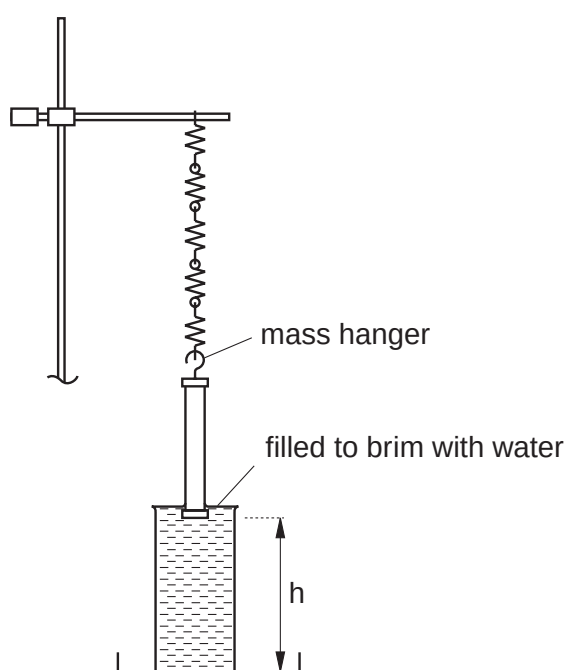


Fig. 1.2

- (a) Record h , as shown in Fig.1.2.

For
Examiner's
Use

$h = \dots\dots\dots$ cm

- (b) Add a mass m to the mass hanger and repeat (a). Repeat this procedure until you have six sets of readings for m and h . Include in your table values for W , where W is the weight of the added mass m .
(Use $g = 9.81 \text{ ms}^{-2}$.)

- (c) (i) Plot a graph of W on the y -axis against h on the x -axis, and draw the line of best fit.
(ii) Determine the gradient of the line.

gradient = $\dots\dots\dots$

For
Examiner's
Use

- (d) (i) Use the vernier calipers to determine the diameter d of the wooden part of the rod.

For
Examiner's
Use

$d = \dots\dots\dots$

- (ii) Calculate the cross-sectional area A of the wooden part of the rod, using the relationship

$$A = \frac{\pi d^2}{4}.$$

$A = \dots\dots\dots \text{m}^2$

- (e) The relationship between W and h is

$$W = c - h(k + \rho Ag)$$

where c is a constant, k is the spring constant, ρ is the density of water (1000 kg m^{-3}), and g is the acceleration of free fall (9.81 m s^{-2}).

Using your answers from (c)(ii) and (d)(ii), determine the value of k . Give an appropriate unit.

$k = \dots\dots\dots$

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 are provided with a ball suspended by a thread so that it is next to a solid vertical surface. You will investigate how the rebound distance is related to the release distance when it swings against the solid surface.

- (a)** Assemble the apparatus as shown in Fig. 2.1, with the thread clamped between the two wooden blocks so that l is about 50 cm, and with the brick positioned so that it is just touching the stationary ball.

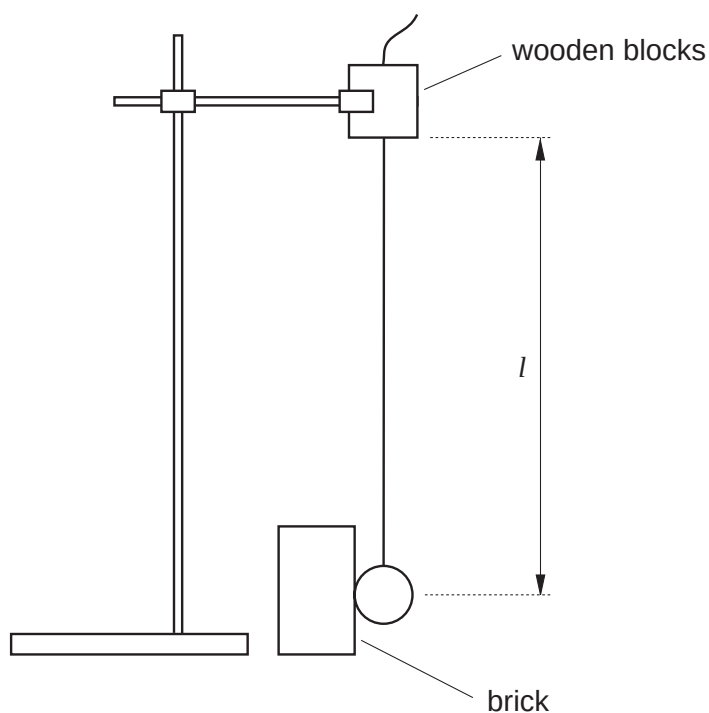


Fig. 2.1

Measure l

$l = \dots\dots\dots$



- (b) (i) Pull back the ball and measure the distance a shown in Fig. 2.2. Do not exceed $a = 25\text{ cm}$.

For
Examiner's
Use

$a = \dots\dots\dots\text{ cm}$

- (ii) Release the ball and make measurements to determine the rebound distance b shown in Fig. 2.2.

$b = \dots\dots\dots\text{ cm}$

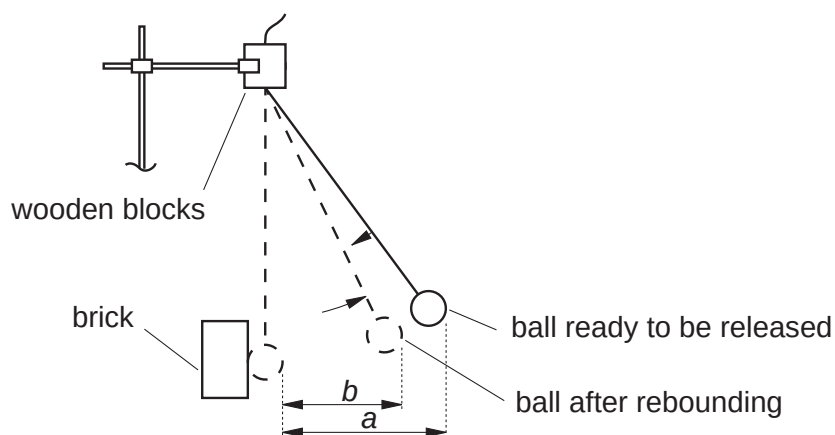


Fig. 2.2

- (c) (i) Explain how you used the apparatus to ensure that the rebound distance b was measured as accurately as possible.

.....

.....

.....

.....

.....

- (ii) Estimate the percentage uncertainty in b .

percentage uncertainty in $b = \dots\dots\dots$

- (d) For values of a less than 25 cm, theory predicts that

$$k = \frac{l - \sqrt{l^2 - b^2}}{l - \sqrt{l^2 - a^2}}$$

where k is a constant.

Calculate a value for k .

$k = \dots\dots\dots$

- (e) Repeat (b)(i), (b)(ii) and (d) using a different value of a .

$a = \dots\dots\dots$

$b = \dots\dots\dots$

$k = \dots\dots\dots$

- (f) Explain whether your results indicate that k is a constant.

.....

.....

.....

.....

For
Examiner's
Use

(g) (i) State four sources of error or limitations of the procedure in this experiment.

1.

.....

2.

.....

3.

.....

4.

.....

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

1.

.....

2.

.....

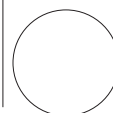
3.

.....

4.

.....

For
Examiner's
Use

☐☐☐☐☐☐☐☐

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

9702/33

Paper 31 Advanced Practical Skills 1

October/November 2009

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. The working of the answers is to be handed in.

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.

All questions in this paper carry equal marks.

For Examiner's Use

1

2

Total

This document consists of **8** printed pages and **4** blank pages.



BLANK PAGE

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

- 1** In this experiment, you will investigate the extension of one of the springs supporting a load as the load is varied.

The apparatus has been partly assembled.

Complete the assembly by suspending the mass hanger (with no masses on it) from the central loop, as shown in Fig. 1.1.

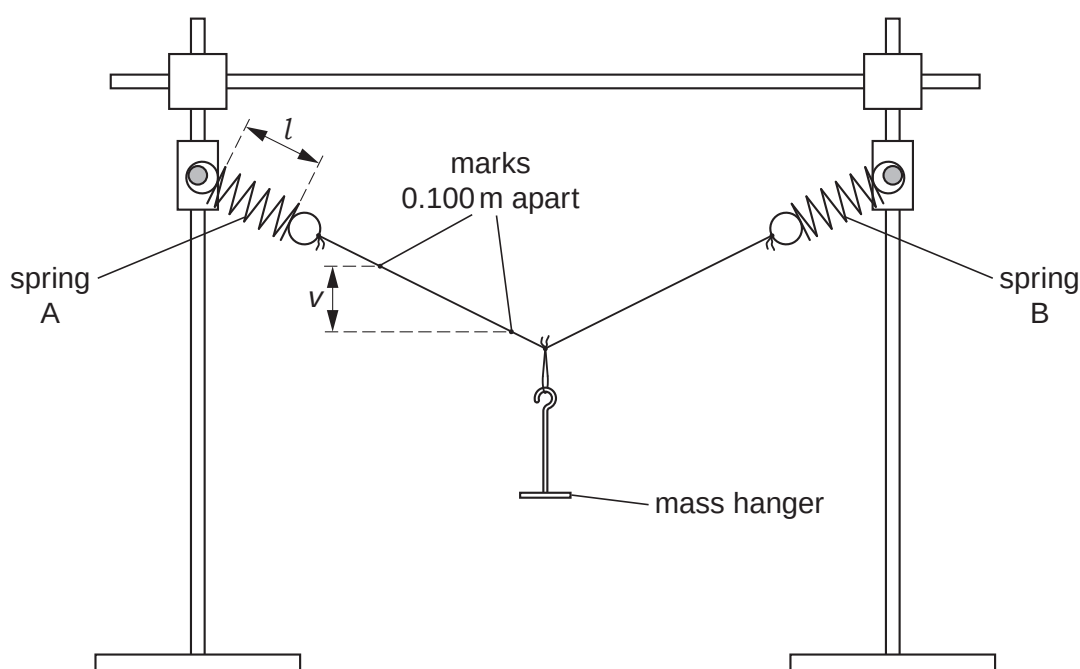


Fig. 1.1

Note that two marks 0.100 m apart have been made on the string.

- (a)** Record the suspended mass M (the mass of the mass hanger).

$$M = \dots\dots\dots \text{ kg}$$

- (b) (i)** Measure the length l of the coiled section of spring A, as shown in Fig. 1.1.

$$l = \dots\dots\dots \text{ m}$$

- (ii)** Hence calculate the extension x of the spring (the unloaded length is written on a card).

$$x = \dots\dots\dots \text{ m}$$

- (c)** Measure the heights of the marks above the bench and use these to find the vertical separation v of the marks (see Fig. 1.1).

Show your working.

$$v = \dots\dots\dots \text{ m}$$

- (d)** Add more mass to the hanger and repeat **(a)**, **(b)** and **(c)** until you have six sets of readings for M , l , x and v .

Include values of $\frac{M}{v}$ in your table.

For
Examiner's
Use

- (e)** **(i)** Plot a graph of $\frac{M}{v}$ on the y -axis against x on the x -axis.
- (ii)** Draw the line of best fit.
- (iii)** Determine the gradient and y -intercept of the line of best fit.

gradient = ...

y -intercept = ...

For
Examiner's
Use

- (f) The quantities M , v and x are related by the equation

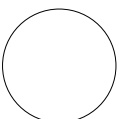
$$\frac{M}{v} = qkx + qC$$

where q is a constant, k is the spring constant (the value of k is written on a card) and C is the tension required for the initial separation of the spring's coils.

Using your answers from **(e)(iii)**, determine the value of C .

For
Examiner's
Use

$C = \dots\dots\dots$ N



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 how the frictional force between a wooden rod and nylon thread varies with the length of thread in contact with the rod.

(a) Use the vernier calipers to determine the diameter d of the wooden rod.

Show all your working.

$d =$

(b) Estimate the percentage uncertainty in d .

percentage uncertainty = ...

(c) Assemble the apparatus as shown in Fig. 2.1.

The 10g mass is already attached to one end of the thread. Attach the 50g mass hanger to the other end.

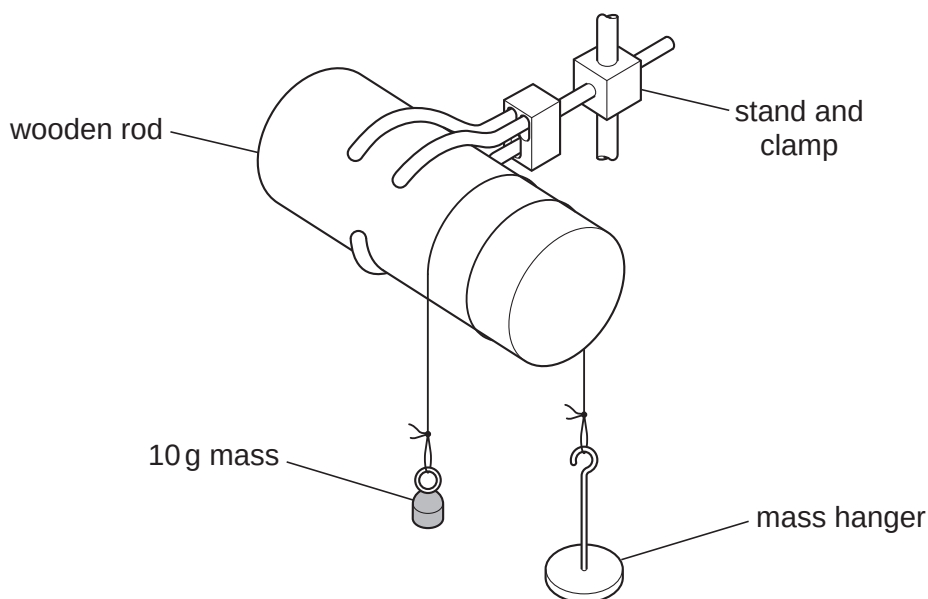


Fig. 2.1

The thread is wrapped 1.5 times around the rod.
The turns of thread must not touch each other.

(d) Use your value from **(a)** to calculate the length l of thread in contact with the rod. (Circumference of rod = πd).

Show all your working.

$l =$

- (e) Add masses to the hanger until the hanger just starts to move down to the bench.

Record this mass m (including the mass of the hanger).

$m = \dots\dots\dots$ g

- (f) Remove the masses from the hanger and then wrap the thread one more time around the rod, so that it is now wrapped around the rod 2.5 times.

Repeat steps (d) and (e).

$l = \dots\dots\dots$

$m = \dots\dots\dots$

- (g) It is suggested that m and l are related by the equation

$$m^2 = kl^3$$

where k is a constant.

By calculating values of k , explain whether your results support this relationship.

.....

.....

.....

.....

For
Examiner's
Use

- (h) (i) State and explain four sources of error or limitations of the procedure in this experiment.

1.

.....

2.

.....

3.

.....

4.

.....

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

1.

.....

2.

.....

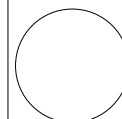
3.

.....

4.

.....

For
Examiner's
Use

☐☐☐☐☐☐☐☐

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

9702/34

Paper 32 Advanced Practical Skills 2

October/November 2009

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. The working of the answers is to be handed in.

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.

All questions in this paper carry equal marks.

For Examiner's Use

1

2

Total

This document consists of **8** printed pages and **4** 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 changes in potential difference in a circuit as one of the resistances is varied.

(a) Assemble the circuit of Fig. 1.1.

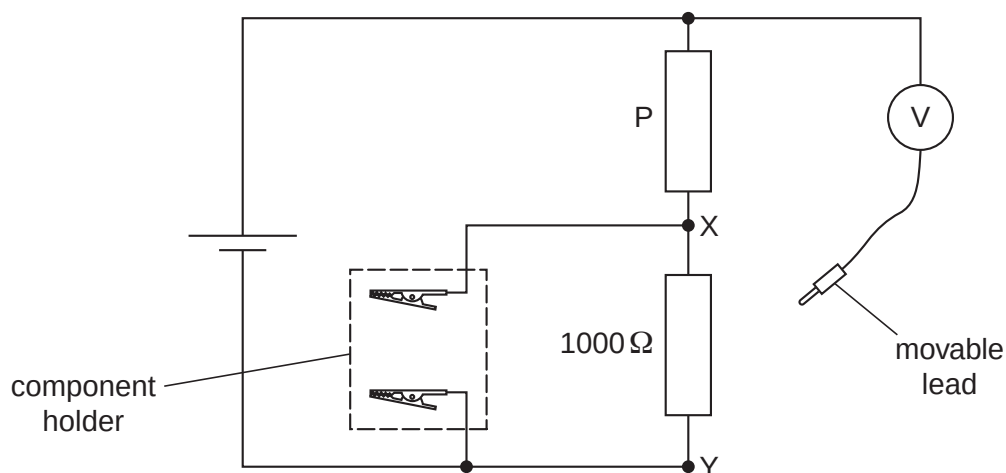


Fig. 1.1

(b) Connect the movable lead to terminal Y and record the voltmeter reading V_0 .

$V_0 =$

(c) (i) Connect the movable lead to terminal X and **leave it connected there for the rest of the experiment.**

(ii) Select one of the other labelled resistors provided and connect it between the crocodile clips on the component holder. Record the resistance R of your selected resistor and the voltmeter reading V .

$R =$ Ω

$V =$

- (d) Repeat (c)(ii) using a different labelled resistor until you have six sets of readings of R (measured in ohms) and V .

Disconnect the cell when you have finished your measurements.

In your table of results include columns for the values of $\frac{1}{V}$ and the values of $\frac{R}{(1000 + R)}$.

For
Examiner's
Use

- (e) (i) Plot a graph of $\frac{1}{V}$ on the y -axis against $\frac{R}{(1000 + R)}$ on the x -axis.
 (ii) Draw the line of best fit.
 (iii) Determine the gradient and y -intercept of the line of best fit.

gradient = ...

y -intercept = ...

For
Examiner's
Use

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

$$\frac{1}{V} = \frac{1000k}{P} \left(\frac{R}{1000 + R} \right) + k$$

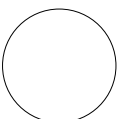
where k is a constant and P is the resistance of resistor P .

Using your answers from (e)(iii), determine the value of P .

Give an appropriate unit.

For
Examiner's
Use

$P =$



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 investigate how the length of a thread of cotton affects the amount of energy it can absorb before breaking.

- (a)** Use the boss to clamp the nail to the retort stand at a height of about 50 cm above the bench. Place the apparatus in the tray.
- (b)** **(i)** Cut a 45 cm length of thread.
- (ii)** Tie the ends of the thread together to make a large loop. Suspend the loop from the nail and slot the 50 g mass into it, securing the mass with sticky tape, as shown in Fig. 2.1.

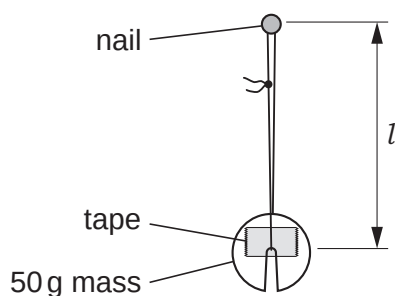


Fig. 2.1

- (c)** **(i)** Measure the length l as shown in Fig. 2.1.

$l = \dots\dots\dots$

- (ii)** Lift the 50 g mass vertically a distance h of 5 cm, as shown in Fig. 2.2. Release the mass.

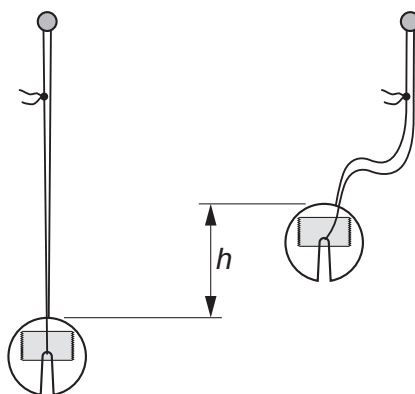


Fig. 2.2

- (iii)** Keep repeating **(c)(ii)**, each time increasing the value of h , until the thread breaks. Record the value of h at which the thread breaks.

$h_{\text{final}} = \dots\dots\dots$ cm

- (d) Estimate the percentage uncertainty in your value of h_{final} .

For
Examiner's
Use

percentage uncertainty = ...

- (e) Calculate the gravitational potential energy E_p given to the 50 g mass when it was lifted the distance h_{final} .

($E_p = mgh_{\text{final}}$ where $g = 9.81 \text{ m s}^{-2}$).

E_p J

- (f) Cut an 85 cm length of thread. Repeat (b)(ii), (c) and (e).

$l =$

$h_{\text{final}} =$ cm

$E_p =$ J

- (g) It is suggested that E_p and l are related by the equation

$$E_p = k\sqrt{l}$$

where k is a constant.

By calculating values of k , explain whether your results support this relationship.

.....

.....

.....

.....

.....

- (h) (i) State and explain four sources of error or limitations of the procedure in this experiment.

1.

.....

2.

.....

3.

.....

4.

.....

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

1.

.....

2.

.....

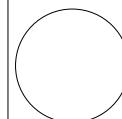
3.

.....

4.

.....

For
Examiner's
Use

☐☐☐☐☐☐☐☐

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.