Cambridge International Examinations
Cambridge International Advanced Subsidiary and Advanced Level

CANDIDATE NAME	

CENTRE NUMBER		CANDIDATE NUMBER	

4791138932

PHYSICS **9702/33**

Paper 3 Advanced Practical Skills 1 **May/June 2017**

2 hours

Candidates answer on the Question Paper.

Additional Materials: As listed in the Confidential Instructions.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **both** questions.
You will be allowed to work with the apparatus for a maximum of one hour for each question.
You are expected to record all your observations as soon as these observations are made, and to plan the presentation of the records so that it is not necessary to make a fair copy of them.
You are reminded of the need for good English and clear presentation in your answers.

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

Additional answer paper and graph paper should be used only if it becomes necessary to do so.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

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Total	

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DC (LK/SW) 127170/3

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

1 In this experiment, you will investigate the motion of a chain of paper clips.

(a) You have been provided with a chain of fifteen paper clips with a sphere of modelling clay attached to one end of the chain.

Measure and record the length L of one paper clip as shown in Fig. 1.1.

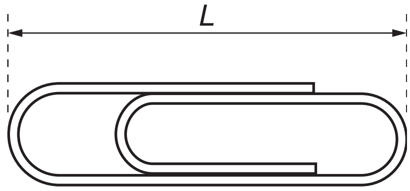

Fig. 1.1

L = ... [1]

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

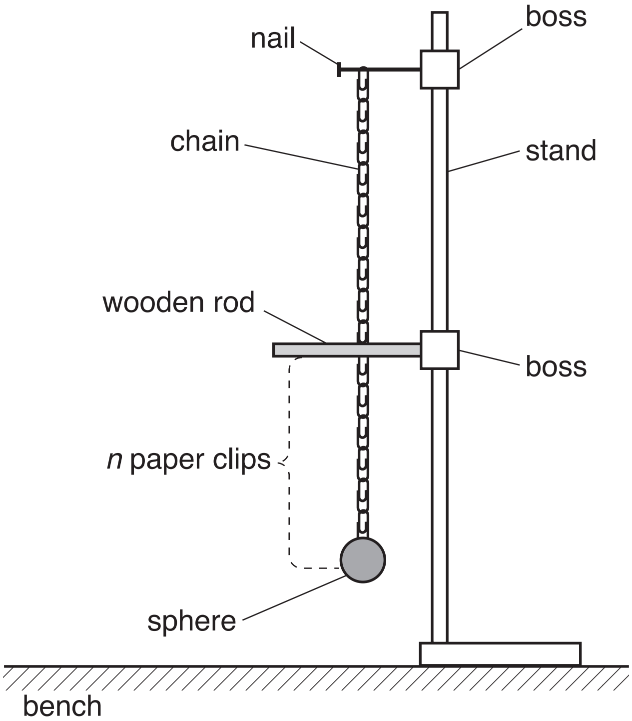

Fig. 1.2

The chain should be suspended from the nail.

The wooden rod should be positioned so that the chain, when hanging vertically, just touches the rod with 6 paper clips below the rod.

(ii) Record the number n of paper clips below the rod.

n = ...

(c) Move the sphere towards you through a distance of approximately 10 cm.
Release the sphere. The chain will oscillate and hit the rod during these oscillations.

Determine the period T of the oscillations.

T = ... [2]

(d) Change n by moving the wooden rod vertically and repeat **(b)(ii)** and **(c)** until you have six sets of values of n and T.

Record your results in a table. Include values of $\sqrt{n}$ to three significant figures in your table.

[8]

(e) **(i)** Plot a graph of T on the y-axis against $\sqrt{n}$ 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]

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

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

where P and Q are constants.

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

P = ...

Q = ...
[2]

(g) Theory suggests that

$$P = \pi\sqrt{\frac{L}{g}}$$

where g is the acceleration of free fall.

Use your values in **(a)** and **(f)** to determine a value for g.
Give an appropriate unit.

g = ... [1]

[Total: 20]

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

2 In this experiment, you will investigate the equilibrium of a balanced metre rule and determine its mass.

(a) You have been provided with a metre rule with a hole close to each end as shown in Fig. 2.1.

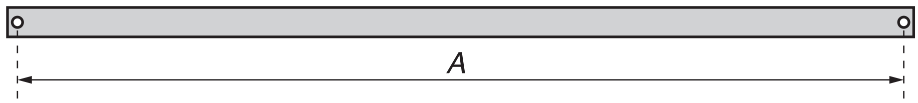

Fig. 2.1

The distance between the centres of the holes is *A*.

Measure and record *A*.

A = ... [1]

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

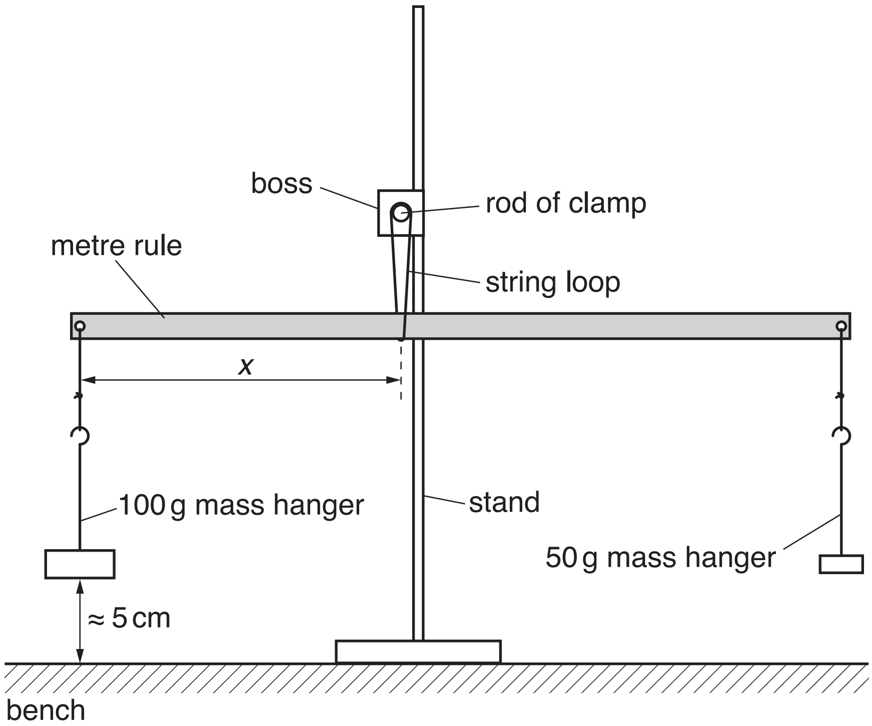

Fig. 2.2

Adjust the position of the rule until it is balanced.

The distance between the centre of the hole from which the 100 g mass hanger is supported and the position of the central string loop is *x*.

(ii) Measure and record *x*.

x = ... [1]

(c) (i) Add a 10 g slotted mass to each mass hanger.

(ii) Adjust the position of the rule until it is balanced.
The distance between the centre of the hole from which the 100 g mass hanger is supported and the position of the central string loop is now y as shown in Fig. 2.3.

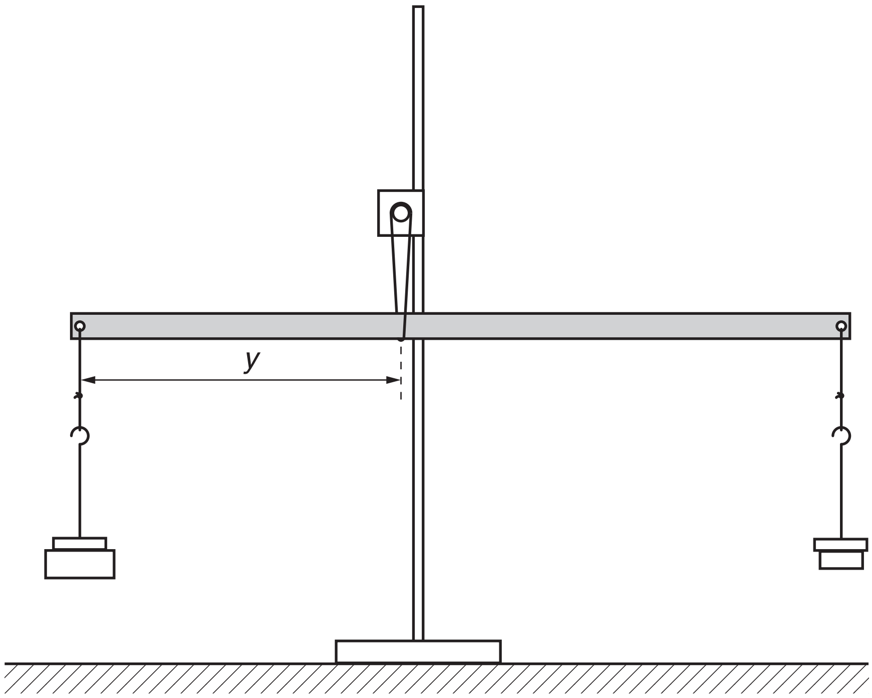

Fig. 2.3

(iii) Measure and record y.

y = ... [1]

(iv) Calculate $(y - x)$.

$(y - x)$ = ... [1]

(v) Estimate the percentage uncertainty in your value of $(y - x)$.

percentage uncertainty = ... [1]

(d) **(i)** Calculate $m(A-2y)$ where $m = 10.0\,g$.

$m(A-2y)$ = ... [1]

(ii) Justify the number of significant figures that you have given for your value of $m(A-2y)$.

....

....

.... [1]

(e) **(i)** Add another 10 g mass to each of the mass hangers and repeat **(c)(ii)**, **(c)(iii)** and **(c)(iv)**.

y = ...

$(y-x)$ = ...
[2]

(ii) Calculate $m(A-2y)$ where $m = 20.0\,g$.

$m(A-2y)$ = ...

(f) It is suggested that the relationship between y, x, m and A is

$$(y - x) = km(A - 2y)$$

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 in **(f)(i)** support the suggested relationship.

....

....

....

....[1]

(g) Using your second value of k, calculate the mass M of the metre rule using the relationship

$$k = \frac{1}{B + M}$$

where B = 150 g.

M = ... g [1]

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

1. ....

....

2. ....

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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.

1. ....

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2. ....

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3. ....

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4. ....

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[4]

[Total: 20]

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Cambridge International AS & A Level

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Cambridge International Advanced Subsidiary and Advanced Level

CANDIDATE NAME	

CENTRE NUMBER						CANDIDATE NUMBER					

7337664815

PHYSICS **9702/34**

Paper 3 Advanced Practical Skills 2 **May/June 2017**

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.
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DO **NOT** WRITE IN ANY BARCODES.

Answer **both** questions.
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[Turn over

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

1 In this experiment, you will investigate the oscillation of a mass-spring system.

(a) Assemble the apparatus as shown in Fig. 1.1, with the rods of both clamps at an equal height of approximately 50 cm above the bench.

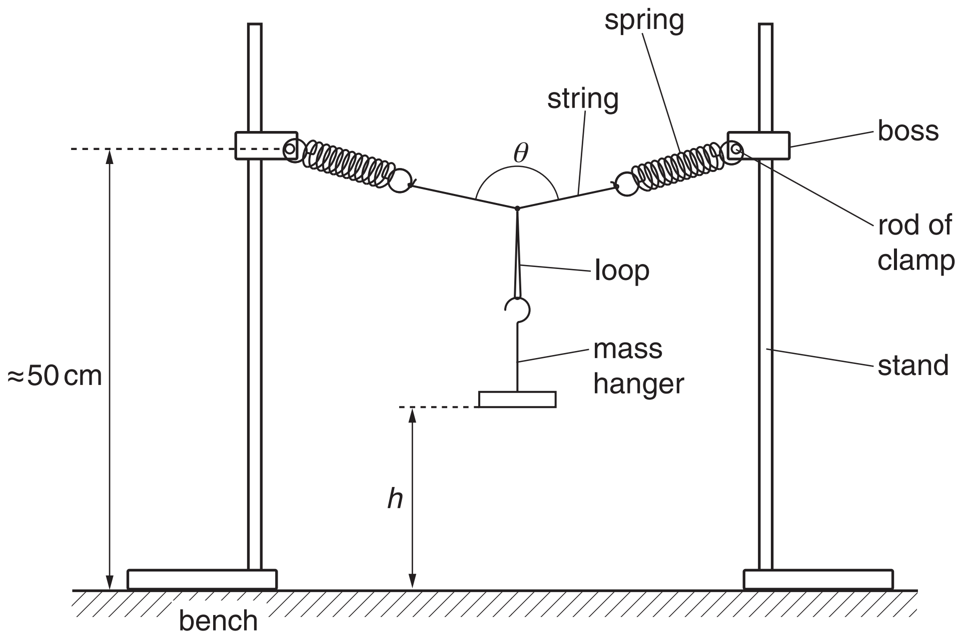

Fig. 1.1

(i) The angle between the two lengths of string is θ, as shown in Fig. 1.1. Adjust the positions of the stands so that θ is approximately 165°.

Use the two G-clamps to secure the stands to the bench.
The stands should remain in these positions for the rest of the experiment.

(ii) Add 200 g to the mass hanger.

(iii) Record the total mass *M* of the mass hanger and added mass.

M = ...

(iv) Measure and record the height *h* of the bottom of the mass hanger above the bench.

h = ... cm

(v) Pull down the mass hanger through a distance of approximately 2 cm. Release the mass hanger so that it oscillates vertically.

Determine the period *T* of the vertical oscillations.

T = ... s [2]

(b) Change M and repeat **(a)(iii)**, **(a)(iv)** and **(a)(v)** until you have six sets of values of M, h and T.
Record your results in a table.
Include values of T^3 in your table.

[10]

(c) **(i)** Plot a graph of T^3 on the y-axis against h on the x-axis. [3]

(ii) Draw the straight line of best fit. [1]

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

gradient = ...

y-intercept = ...
[2]

(d) It is suggested that the quantities T and h are related by the equation

$$T^3 = ah + b$$

where a and b are constants.

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

a = ...

b = ...
[2]

[Total: 20]

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

2 In this experiment, you will investigate the equilibrium position of a pivoted wooden strip and determine the density of water.

(a) Assemble the apparatus as shown in Fig. 2.1. The nail should pass through the hole in the wooden strip and be held in the boss. The bottom of the plastic pipe should be approximately 2 cm above the bottom of the container.

Position the string loop with paper clips so that the wooden strip is parallel to the bench.

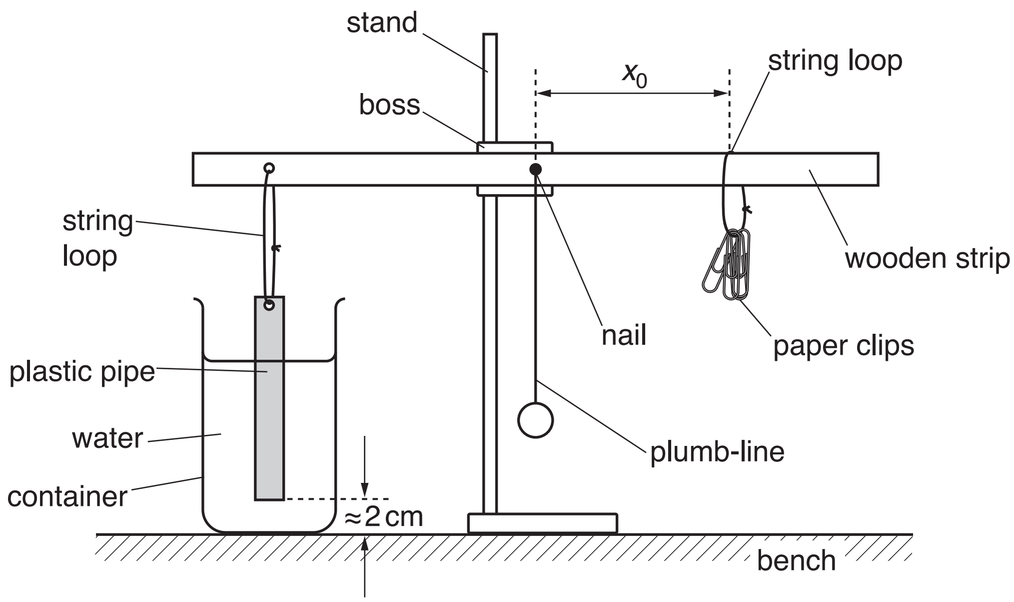

Fig. 2.1 (not to scale)

The distance from the nail to the string loop holding the paper clips is x_0, as shown in Fig. 2.1.

Measure and record x_0.

x_0 = ... cm [1]

(b) (i) Move the string loop holding the paper clips approximately 4 cm further from the nail. Let the wooden strip settle at an angle, as shown in Fig. 2.2.

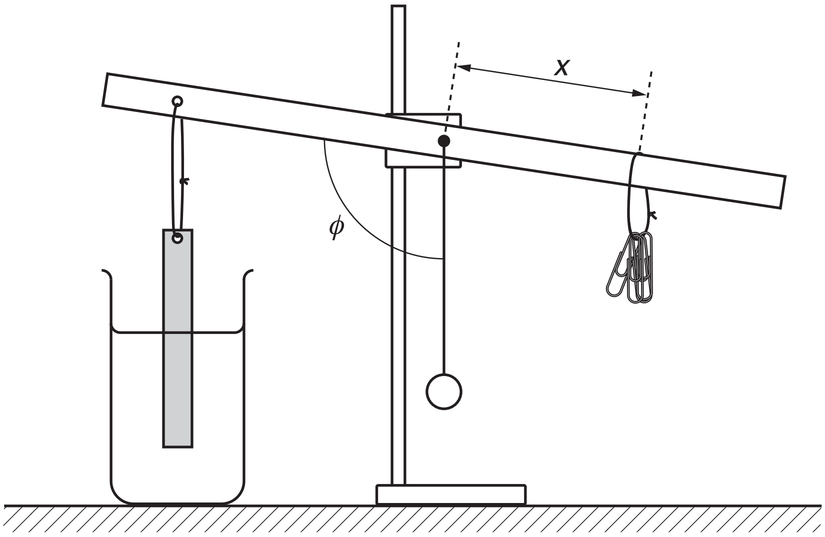

Fig. 2.2 (not to scale)

(ii) Measure and record the new distance x from the nail to the string loop holding the paper clips, as shown in Fig. 2.2.

x = ... cm [1]

(iii) Measure and record the larger angle ϕ between the wooden strip and the plumb-line, as shown in Fig. 2.2.

ϕ = ... ° [1]

(iv) Calculate $(\phi - 90°)$.

$(\phi - 90°)$ = ... °

(v) Estimate the percentage uncertainty in your value of $(\phi - 90°)$.

percentage uncertainty = ...[1]

(c) **(i)** Move the string loop holding the paper clips approximately 3 cm further from the nail. Let the wooden strip settle at a new angle.

(ii) Repeat **(b)(ii)**, **(b)(iii)** and **(b)(iv)**.

x = ... cm

ϕ = ... °

$(\phi - 90°)$ = ... °

[3]

Question 2 continues on page 10.

(d) It is suggested that the relationship between ϕ, x_0 and x is

$$\sin(\phi - 90°) = k(x - x_0)$$

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 you have given for your values of k.

....

....

.... [1]

(iii) Explain whether your results in **(d)(i)** support the suggested relationship.

....

....

....

.... [1]

(e) (i) Remove the plastic pipe from the water.

(ii) Measure and record the outside diameter D and the inside diameter d of the pipe, as shown in Fig. 2.3.

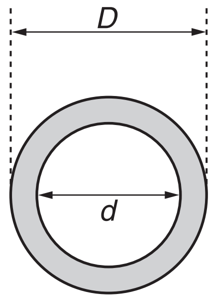

Fig. 2.3

D = ... cm

d = ... cm [1]

(iii) The mass m of the paper clips and string loop is written on the card. Record m.

m = ... g

(iv) Using your second value of k, calculate the density ρ of the water using the relationship

$$\rho = \frac{m}{Ck(D^2 - d^2)}$$

where $C = 201\,\text{cm}^2$.

ρ = ... g cm^{-3} [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. ....

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3. ....

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4. ....

....
[4]

[Total: 20]

Cambridge International AS & A Level

Cambridge International Examinations
Cambridge International Advanced Subsidiary and Advanced Level

CANDIDATE NAME			
CENTRE NUMBER		CANDIDATE NUMBER	

8973624404

PHYSICS **9702/35**

Paper 3 Advanced Practical Skills 1 **May/June 2017**

2 hours

Candidates answer on the Question Paper.

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[Turn over

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

1 In this experiment, you will investigate the motion of a supported copper wire.

(a) You have been provided with a copper wire and two spheres of modelling clay.

(i) Bend the wire about its midpoint so that the two lengths are perpendicular to each other, as shown in Fig. 1.1.

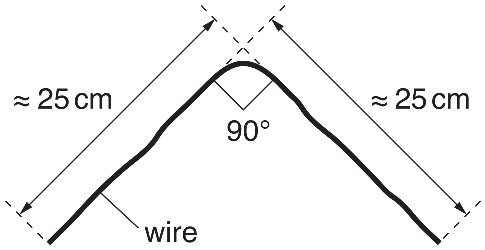

Fig. 1.1

(ii) Push each end of the wire through the centre of a sphere of modelling clay.
Place the spheres approximately half-way along each length of the wire as shown in Fig. 1.2.

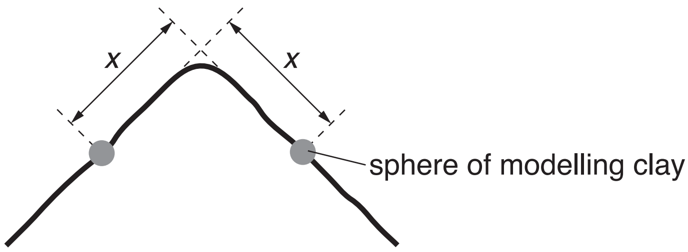

Fig. 1.2

The centres of the spheres should each be the same distance from the midpoint of the wire.
Gently press the modelling clay onto the wire to ensure the spheres stay in position.

(iii) Measure and record the distance x from the midpoint of the wire to the centre of a sphere.

x = ... [1]

(b) (i) Set up the apparatus as shown in Fig. 1.3.

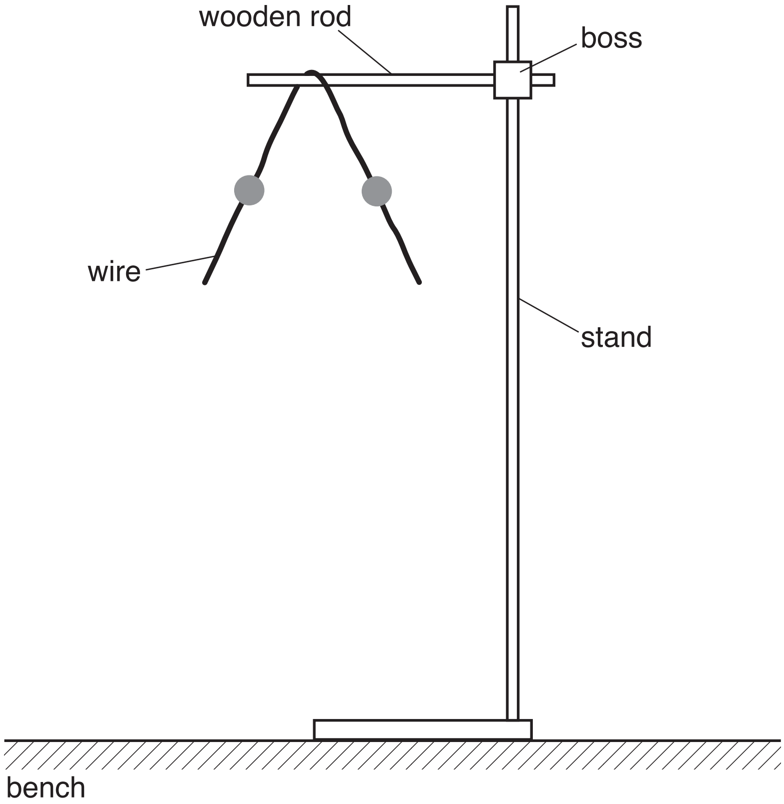

Fig. 1.3

(ii) Move one end of the wire down through a short distance.
Release the wire.

The wire will oscillate.

Determine the period *T* of these oscillations.

T = ...[1]

(c) Vary x and repeat **(a)(iii)** and **(b)** until you have six sets of values of x and T.

Record your results in a table. Include values of x^2 in your table.

[9]

(d) **(i)** Plot a graph of T on the y-axis against x^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]

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

$$T = Px^2 + Q$$

where P and Q are constants.

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

P = ...

Q = ...
[2]

(f) **(i)** Remove the spheres from the wire.

(ii) Repeat **(b)(ii)**.

T = ...

(iii) Calculate the value of x that corresponds to the value of T in **(f)(ii)**.

x = ...[1]

[Total: 20]

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

2 In this experiment, you will investigate the equilibrium of a system of three identical springs.

(a) Measure the length L of the unstretched coiled section of one of the springs as shown in Fig. 2.1.

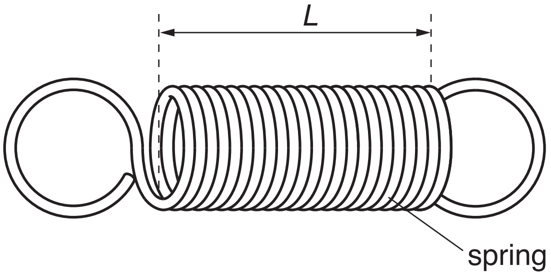

Fig. 2.1

L = ...[1]

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

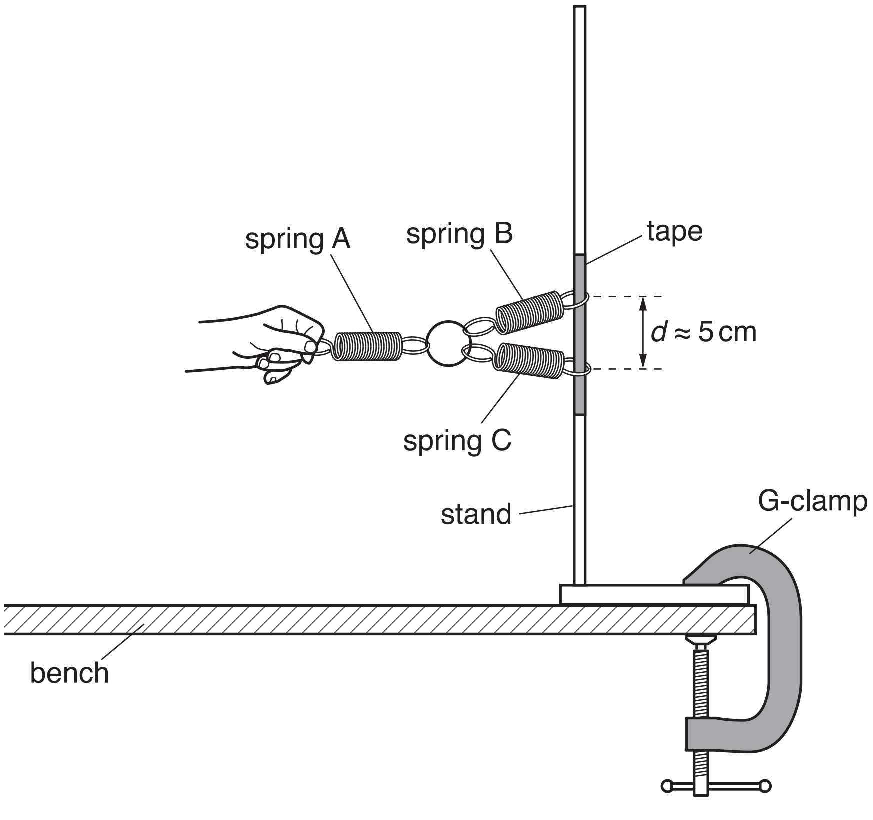

Fig. 2.2 (not to scale)

The springs are identical. Hold spring A as shown in Fig. 2.2.

The distance d between the loops of springs B and C on the stand should be approximately 5 cm as shown in Fig. 2.2. Do not mark the tape.

(c) **(i)** Pull spring A until the length of its coiled section is 15 cm as shown in Fig. 2.3.

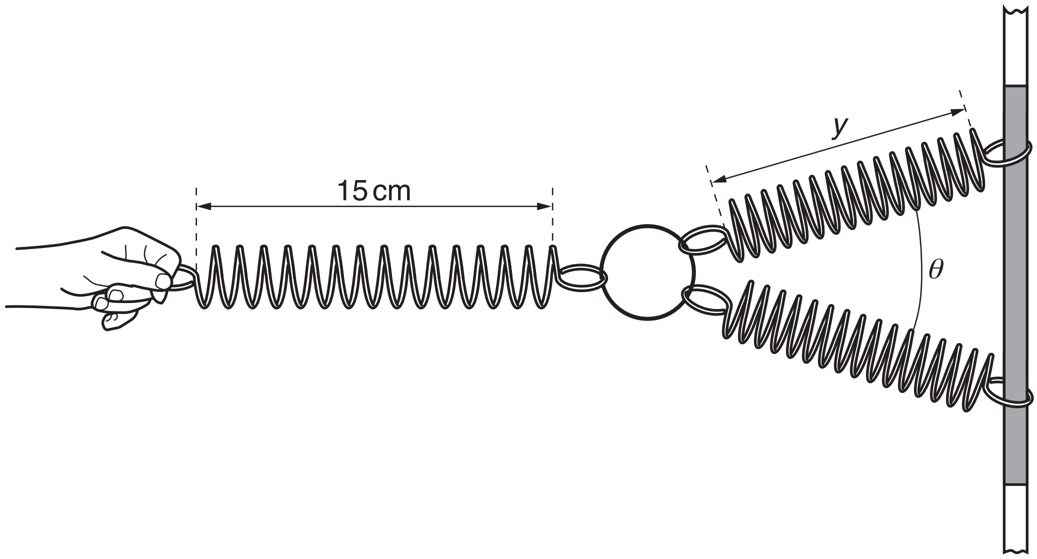

Fig. 2.3 (not to scale)

The length of the coiled section of spring B is y. The angle between springs B and C is θ.

(ii) Measure and record y.

y = ...[1]

(iii) Measure and record θ.

θ = ... ° [1]

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

percentage uncertainty = ... [1]

(e) **(i)** Calculate $(y - L)$.

$(y - L) =$ ....[1]

(ii) Calculate $\cos\left(\frac{\theta}{2}\right)$.

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

(iii) Justify the number of significant figures that you have given for your value of $\cos\left(\frac{\theta}{2}\right)$.

....

....

.... [1]

(f) Increase d to approximately 10 cm and repeat **(c)**, **(e)(i)** and **(e)(ii)**.

$y =$ ....

$\theta =$ .... °

$(y - L) =$ ....

$\cos\left(\frac{\theta}{2}\right) =$ ....
[3]

(g) It is suggested that the relationship between θ, y and L is

$$\cos\left(\frac{\theta}{2}\right) = \frac{k}{(y - L)}$$

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]

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

1. ....

....

2. ....

....

3. ....

....

4. ....

....
[4]

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

1. ....

....

2. ....

....

3. ....

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4. ....

....
[4]

[Total: 20]

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