Cambridge International Examinations
Cambridge International Advanced Subsidiary and Advanced Level

CANDIDATE NAME	

CENTRE NUMBER		CANDIDATE NUMBER	

4393613873

PHYSICS **9702/33**

Paper 3 Advanced Practical Skills 1 **October/November 2016**

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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1	
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Total	

This document consists of **12** printed pages.

DC (LEG/FD) 117495/2

CAMBRIDGE International Examinations

[Turn over

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

1 In this experiment, you will investigate an electrical circuit.

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

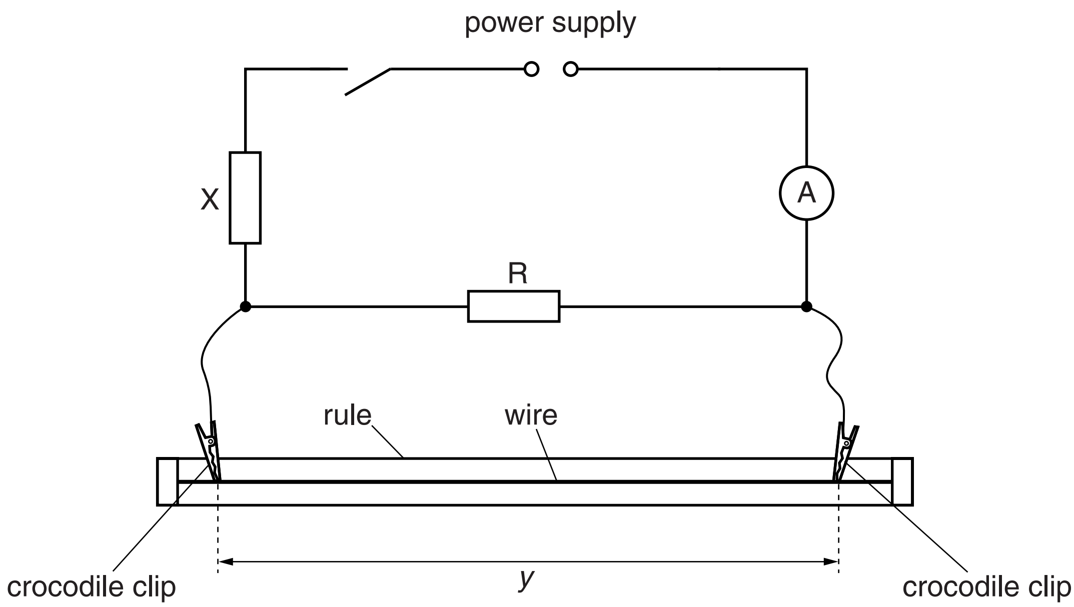

Fig. 1.1

The distance y between the crocodile clips should be approximately 80 cm.
The resistor in the component holder labelled R should have a resistance R of 10 Ω.

(ii) Record the value of R.

R = ... Ω

(iii) Measure and record y.

y = ...

(iv) Close the switch.

(v) Record the ammeter reading I.

I = ... [1]

(vi) Open the switch.

(b) **(i)** Remove the resistor in the component holder labelled R.
Select a different resistor labelled with a numerical value and connect it in the component holder labelled R.
Record the value of resistance *R*.

R = ... Ω

(ii) Close the switch.

(iii) Adjust the position of the crocodile clips on the wire until the ammeter reading I has the **same** value as in **(a)(v)**.

(iv) Measure and record *y*.

y = ...

(v) Open the switch.

(c) Repeat **(b)** until you have six sets of readings of R and y.

Include values of $\frac{1}{y}$ and $\frac{1}{R}$ in your table.

[10]

(d) **(i)** Plot a graph of $\frac{1}{y}$ on the y-axis against $\frac{1}{R}$ 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) The quantities y and R are related by the equation

$$\frac{1}{y} = -\frac{P}{R} + Q$$

where P and Q are constants.

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

P = ...

Q = ... [2]

(f) **(i)** The e.m.f. E of the d.c. power supply is given on the card.
Record E.

E = ...V

(ii) Theory suggests that

$$Q = \frac{PI}{E - XI}$$

where X is the resistance of resistor X.

Use values in **(a)(v)**, **(e)** and **(f)(i)** to determine the value of X.

X = ... Ω [1]

[Total: 20]

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

2 In this experiment, you will investigate the motion of an oscillating mass.

(a) Set up the apparatus as shown in Fig. 2.1.

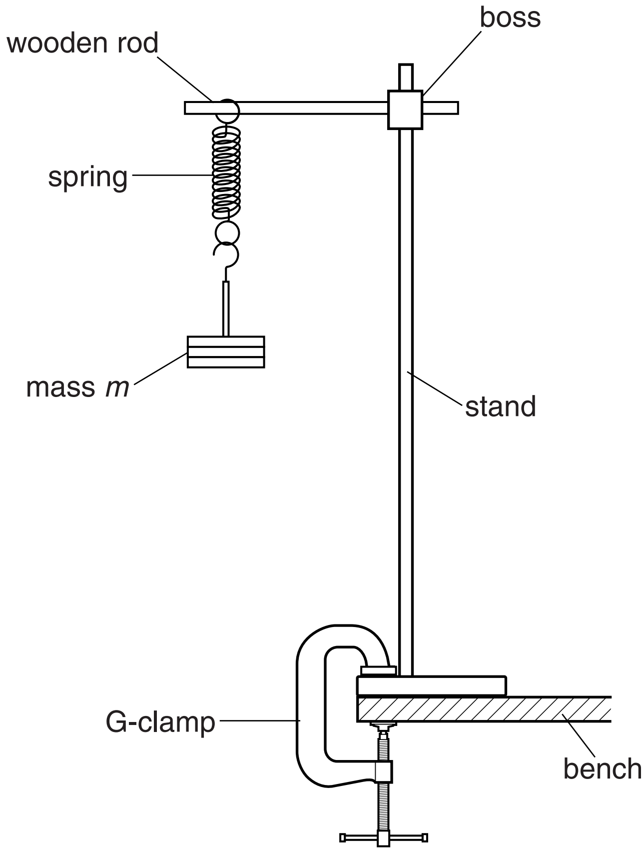

Fig. 2.1

The value of m should be 300 g.

(b) (i) Record m.

$m =$ ....

(ii) Pull the mass hanger down through a short distance.

Release the mass hanger and watch the vertical oscillations.

(iii) Take measurements to determine the period T of the vertical oscillations.

Record T. Your value of T should be less than 1 s.

$T =$ .... [2]

(c) (i) Calculate the value of l using the equation

$$l = \frac{gT^2}{\pi^2}$$

where $g = 9.81\,\text{m}\,\text{s}^{-2}$.

$l =$ .... m [1]

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

....

....

.... [1]

(d) (i) Set up the apparatus shown in Fig. 2.2 using some of the string.

The length *d* is the distance from the top of the string to the centre of the masses.

Tie knots so that length *d* is approximately equal to your calculated value of *l*.

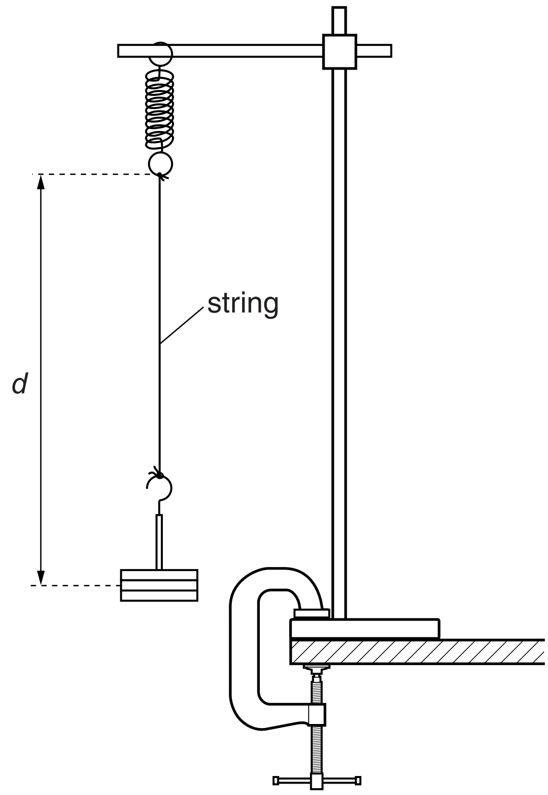

Fig. 2.2

(ii) Measure and record *d*.

d = ... m [1]

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

percentage uncertainty = ... [1]

(e) **(i)** Displace the mass approximately 10 cm to the right.

Release the mass. The mass will move to the left and back again.

Now ignore the movement of the mass and **watch the coils of the spring**.

Observe the coils moving further apart, then closer, further apart then closer.

At certain times the coils appear to stay the same distance apart.

(ii) Determine the time interval t between two consecutive times when the coils appear to stay the same distance apart.
Record t.

t = ... [1]

(iii) Remove the string from the mass and spring.

(f) Using a mass m of 400 g, set up the apparatus as shown in Fig. 2.1.
Repeat **(b)**, **(c)(i)**, **(d)(i)**, **(d)(ii)** and **(e)**.

m = ...

T = ...

l = ... m

d = ... m

t = ...
[3]

(g) It is suggested that the relationship between t and m is

$$t = km$$

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. ....

....

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

2311490546

PHYSICS **9702/34**

Paper 3 Advanced Practical Skills 2 **October/November 2016**

2 hours

Candidates answer on the Question Paper.

Additional Materials: As listed in the Confidential Instructions.

READ THESE INSTRUCTIONS FIRST

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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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DC (NF/FD) 117497/3

CAMBRIDGE International Examinations

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

1 In this experiment, you will investigate the oscillations of a wooden strip.

(a) Set up the apparatus as shown in Fig. 1.1, with the distance x approximately equal to 25 cm.

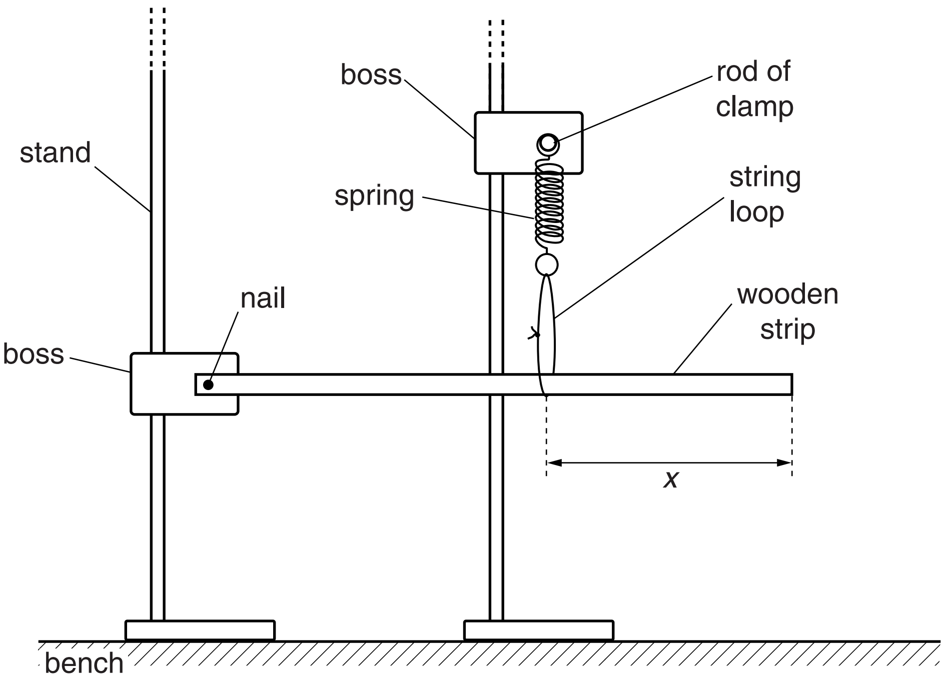

Fig. 1.1

(b) (i) Ensure that the spring is vertical and the wooden strip is parallel to the bench.

(ii) Measure and record the distance x between the string loop and the end of the wooden strip, as shown in Fig. 1.1.

x = ... [1]

(iii) Push down the free end of the wooden strip by approximately 2 cm. Release it so that it oscillates.

(iv) Take measurements to find the period T of the oscillations.
Record T.

T = ... s [2]

(c) Vary x by moving the string loop along the wooden strip and repeat **(b)** until you have six sets of values for x and T.
Do **not** use values of x less than 15 cm.

Include values for $\frac{1}{T^2}$ in your table.

[9]

(d) **(i)** Plot a graph of $\frac{1}{T^2}$ on the y-axis against x on the x-axis. [3]

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

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

gradient = ...

y-intercept = ...
[2]

(e) The quantities x and T are related by the equation

$$\frac{1}{T^2} = px + q$$

where p and q are constants.

Use your answers from **(d)(iii)** to determine the values of p and q.
Give appropriate units.

p = ...

q = ...
[2]

[Total: 20]

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

2 In this experiment, you will investigate the movement of a metre rule on two sliding supports.

(a) Set up the apparatus with the metre rule resting on the rods of the clamps, as shown in Fig. 2.1. The metre rule should be parallel to the bench.

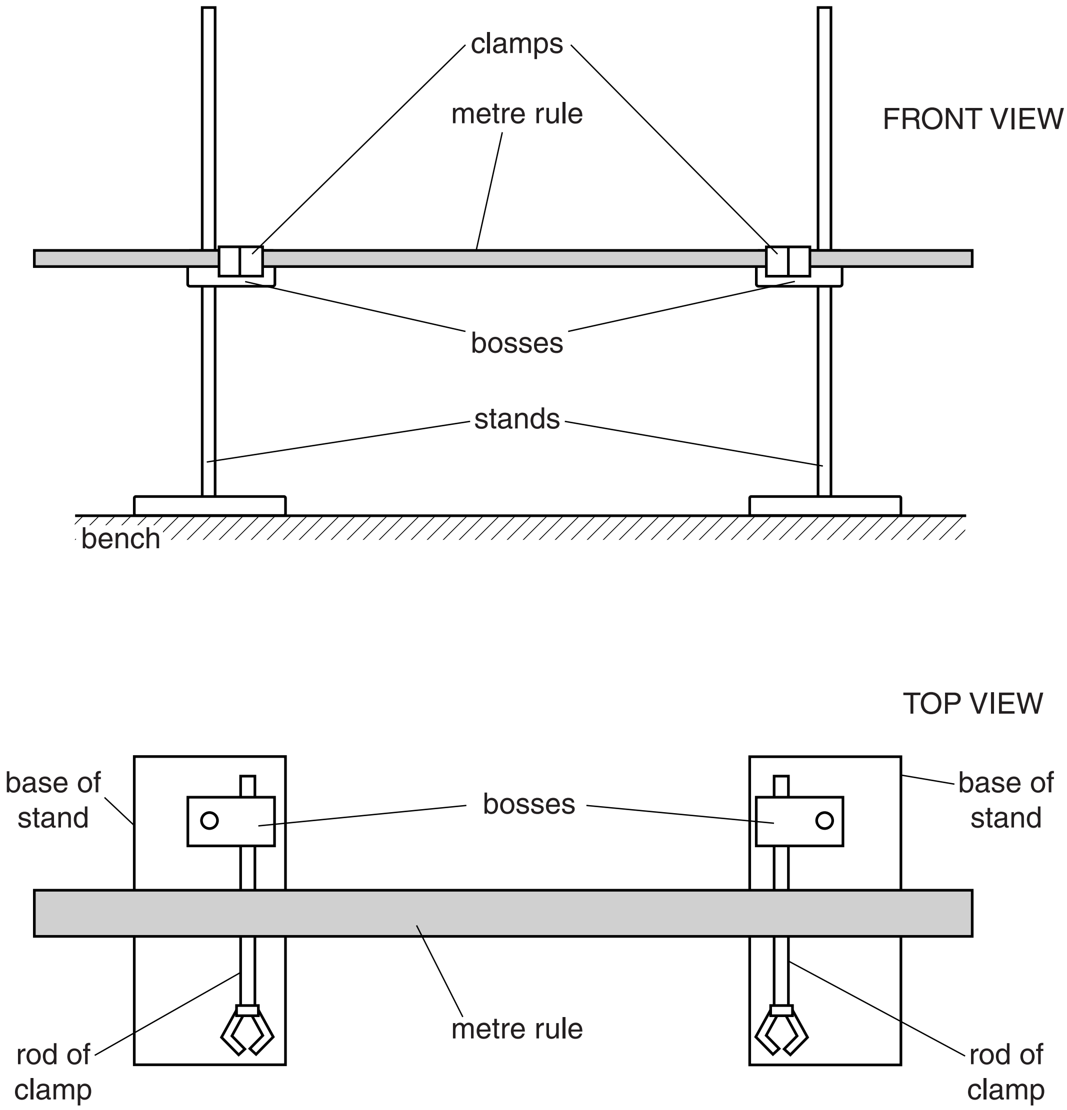

Fig. 2.1 (not to scale)

(b) Measure and record the length *L* of the wooden strip labelled A.

L = ... [1]

(c) **(i)** Position the stands so that the rod of one of the clamps is supporting the metre rule at the 10 cm mark, and the rod of the other clamp is supporting the metre rule at the 90 cm mark.

(ii) Using Blu-Tack, fix the wooden strip labelled A to the metre rule at the 0 cm end, as shown in Fig. 2.2.

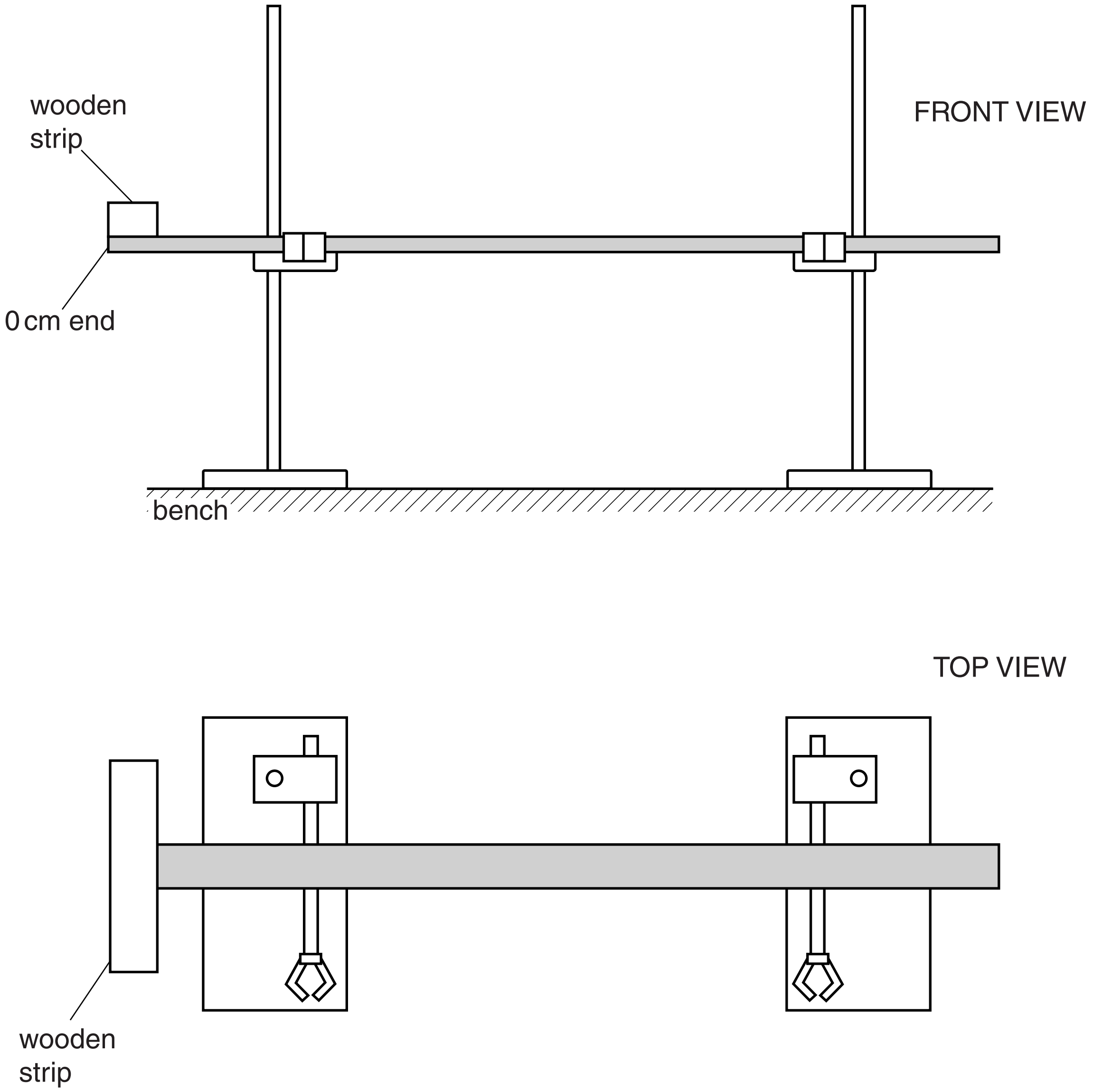

Fig. 2.2 (not to scale)

(iii) Without touching the metre rule, slowly slide the stands towards each other until their bases touch each other, as shown in Fig. 2.3.

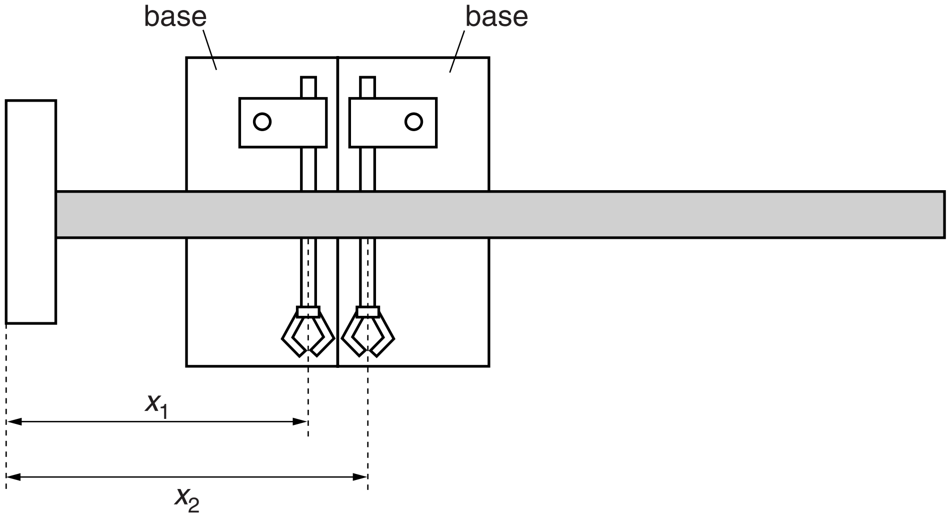

Fig. 2.3 (not to scale)

(iv) Measure and record the distances x_1 and x_2 of the points of contact from the end of the rule, as shown in Fig. 2.3.

x_1 = ... cm

x_2 = ... cm
[2]

(v) Calculate the value of X, where $X = \frac{(x_1 + x_2)}{2}$.

X = ... cm [1]

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

percentage uncertainty = ... [1]

(e) Repeat **(b)** and **(c)** using the wooden strip labelled B.

L = ...

x_1 = ... cm

x_2 = ... cm

X = ... cm
[3]

(f) It is suggested that the relationship between L and X is

$$LX = k(d - X)$$

where d = 50.0 cm and 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 **(f)(i)** support the suggested relationship.

....

....

....

.... [1]

(g) Suggest the value of *X* you would expect to obtain if the experiment was repeated with an identical wooden strip fixed at each end of the metre rule.

X = ... cm [1]

Question 2 continues on the next page.

(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. ....

....

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	

6669258492

PHYSICS **9702/35**

Paper 3 Advanced Practical Skills 1 **October/November 2016**

2 hours

Candidates answer on the Question Paper.

Additional Materials: As listed in the Confidential Instructions.

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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 bottle in water.

(a) You have been provided with a bottle with a mass attached, a measuring cylinder, a jug of water and a large cylindrical container of water.

(i) Use water from the jug and the measuring cylinder to determine the maximum volume V_F of water held by the bottle.

Record V_F.

(1 ml = 1 cm^3)

V_F = ... cm^3 [1]

(ii) Return any water to the jug.
Do **not** change the volume of water in the large cylindrical cylinder.

(b) **(i)** Add volume V of water to the bottle where V is approximately 100 cm^3.

(ii) Record V.

V = ... cm^3

(iii) Screw the cap on the bottle so that no water leaks out of the bottle when the bottle is inverted.

(c) **(i)** Place both rubber bands around the top of the large cylindrical container.

(ii) Gently push the bottle into the water in the large cylindrical container until the top is just on the water surface as shown in Fig. 1.1.

Keep the bottle in this position using one hand.

(iii) Use your other hand to slide one of the rubber bands down so that it is level with the bottom of the mass.

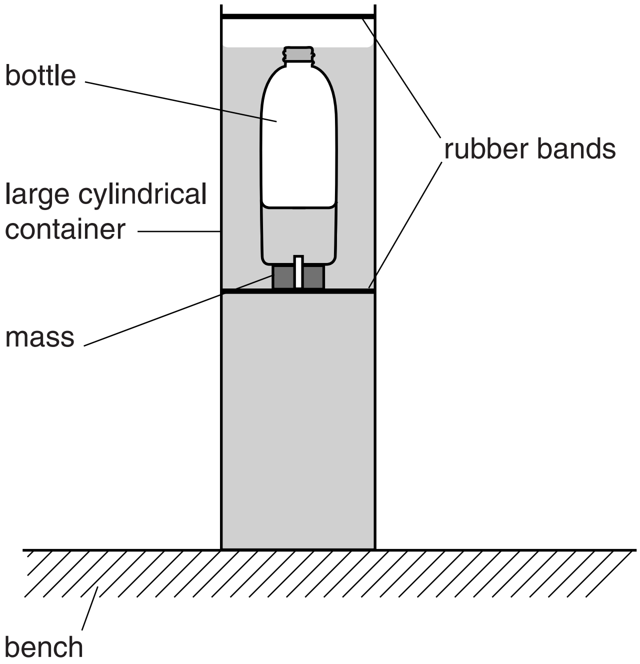

Fig. 1.1

(iv) Release the bottle. The bottle will move upwards and then move downwards.

Place the other rubber band so that it is level with the highest position of the bottom of the mass as shown in Fig. 1.2. You should repeat this several times before you decide on the position of this rubber band.

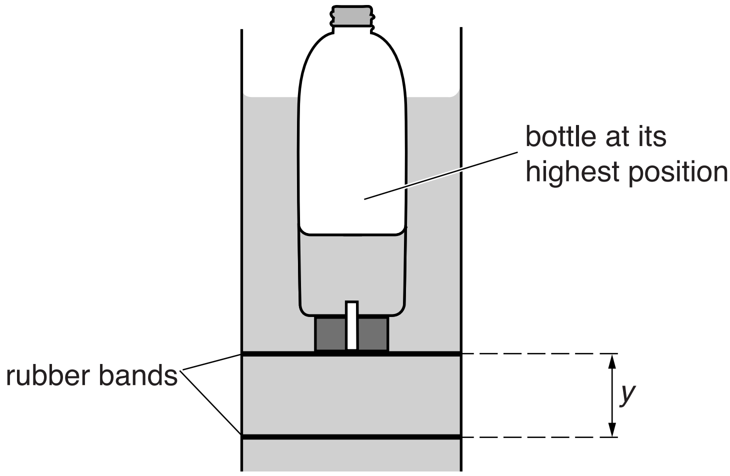

Fig. 1.2

The maximum distance moved upwards by the bottle is y as shown in Fig. 1.2.

(v) Measure and record y.

y = ... cm [1]

(d) **(i)** Calculate $\frac{2V_F}{3}$.

$\frac{2V_F}{3}$ = ... cm^3

(ii) Increase V and repeat **(b)(ii)**, **(b)(iii)**, **(c)(ii)**, **(c)(iv)** and **(c)(v)** until you have six sets of values of V and y.

Do **not** use a value of V greater than $\frac{2V_F}{3}$.

[8]

(e) **(i)** Plot a graph of y on the y-axis against V 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) The quantities y and V are related by the equation

$$y = PV + Q$$

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) **(i)** Use your values from **(f)** to calculate the value of V when $y = 0$.

V = ... cm^3 [1]

(ii) Explain why it is impossible to repeat the experiment using the value of V calculated in **(g)(i)**.

....

....

....

.... [1]

[Total: 20]

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

2 In this experiment, you will investigate the deflection of a loaded wooden strip.

(a) (i) Clamp the wooden strip as shown in Fig. 2.1.

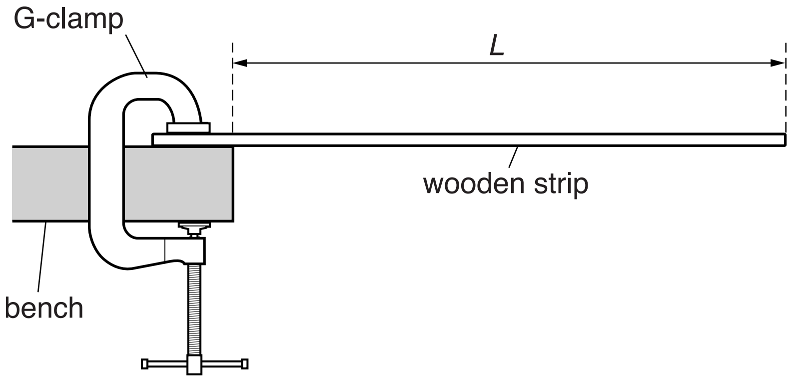

Fig. 2.1 (not to scale)

The distance L that the wooden strip extends beyond the edge of the bench should be approximately 80 cm.

(ii) Measure and record L.

L = ... [1]

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

percentage uncertainty = ... [1]

(b) **(i)** Place the 100g mass on the end of the wooden strip as shown in Fig. 2.2.

The vertical distance between the floor and the bottom of the end of the wooden strip is d_1.

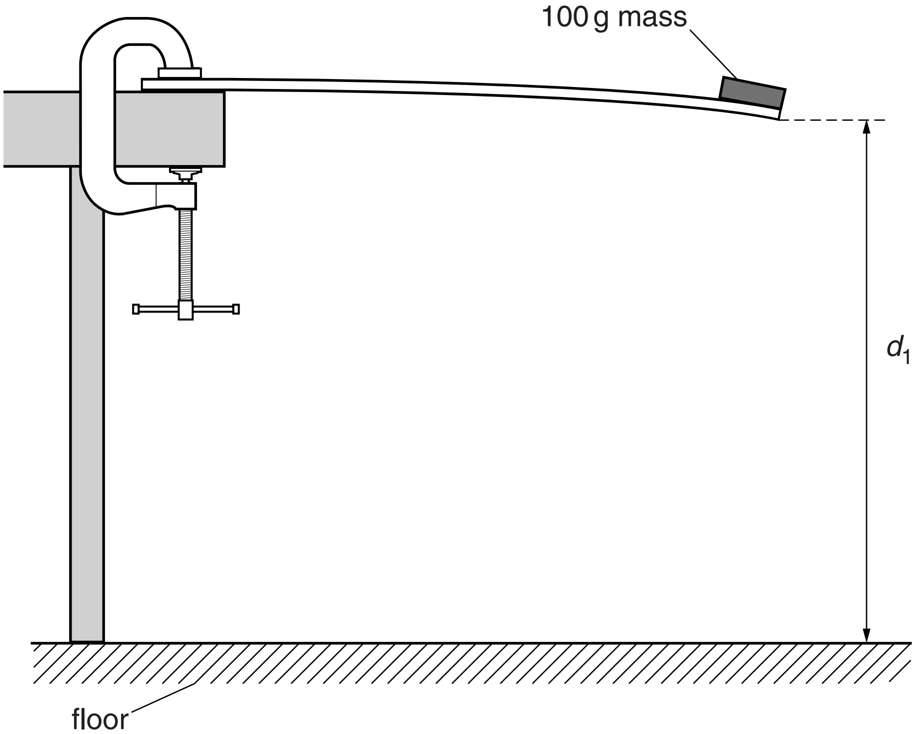

Fig. 2.2 (not to scale)

(ii) Measure and record d_1.

d_1 = ... [1]

(iii) Remove the 100g mass from the wooden strip.

(c) **(i)** Use ten 10g masses to evenly distribute a total mass of 100g along the length of the wooden strip.

(ii) The distance between the floor and the bottom of the end of the wooden strip is d_2.

Measure and record d_2.

d_2 = ... [1]

(iii) Calculate $(d_2 - d_1)$.

$(d_2 - d_1)$ = ... [1]

(iv) The mass per unit length M added to the wooden strip is given by

$$M = \frac{m}{L}$$

where the total added mass m is 0.100kg.

Calculate M.

M = ... [1]

(d) Justify the number of significant figures that you have given for your value of M.

....

....

.... [1]

(e) Repeat **(b)** using the 50 g mass and repeat **(c)** using five 10 g masses to evenly distribute 50 g along the length of the wooden strip.

For this mass the value of m is 0.050 kg.

d_1 = ...

d_2 = ...

$(d_2 - d_1)$ = ...

M = ...
[3]

(f) It is suggested that the relationship between $(d_2 - d_1)$ and M is

$$(d_2 - d_1) = kM$$

where k is a constant.

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

first value of k = ...

second value of k = ...
[1]

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

....

....

....

.... [1]

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

1. ....

....

2. ....

....

3. ....

....

4. ....

....
[4]

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

1. ....

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2. ....

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3. ....

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4. ....

....
[4]

[Total: 20]

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Cambridge International AS & A Level

Cambridge International Examinations
Cambridge International Advanced Subsidiary and Advanced Level

CANDIDATE NAME			
CENTRE NUMBER		CANDIDATE NUMBER	

PHYSICS **9702/36**

Paper 3 Advanced Practical Skills 2 **October/November 2016**

2 hours

Candidates answer on the Question Paper.

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CAMBRIDGE International Examinations

[Turn over

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

1 In this experiment, you will investigate the current in an electrical circuit.

(a) Connect the circuit shown in Fig. 1.1.

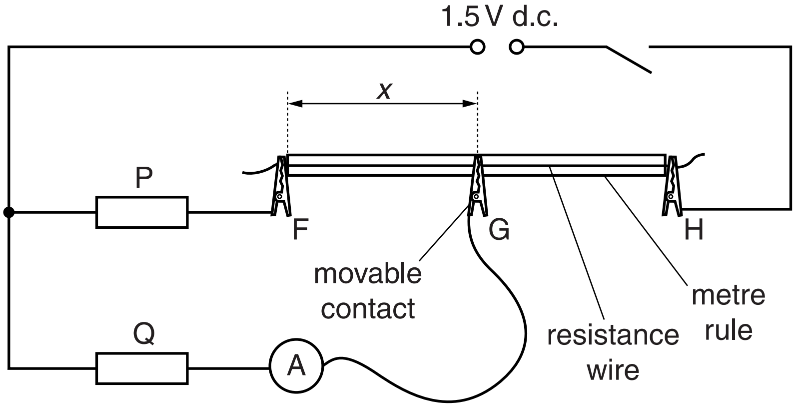

Fig. 1.1

F, G and H are crocodile clips. The crocodile clip G is used as a movable contact.
Position G approximately half-way along the resistance wire.

(b) (i) The distance between F and G is x, as shown in Fig. 1.1.
Measure and record x.

x = ... cm [1]

(ii) Close the switch.

(iii) Record the ammeter reading I.

I = ... [1]

(iv) Open the switch.

(c) Vary x and repeat **(b)** until you have six sets of values for x and I.

[8]

(d) **(i)** Plot a graph of I on the y-axis against x on the x-axis. [3]

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

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

gradient = ...

y-intercept = ...

[2]

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

$$I = Sx + T$$

where S and T are constants.

Use your answers from **(d)(iii)** to determine the values of S and T.
Give appropriate units.

S = ...

T = ...
[2]

(f) The resistance per unit length r of the resistance wire can be found from

$$r = \frac{PS}{T}$$

where $P = 15\,\Omega$ (the resistance of resistor P).

Calculate r in $\Omega\,\text{cm}^{-1}$.
Give your answer to a suitable number of significant figures.

r = ... $\Omega\,\text{cm}^{-1}$ [2]

[Total: 20]

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

2 In this experiment, you will investigate a balanced metre rule.

(a) **(i)** Set up the apparatus as shown in Fig. 2.1.
Use some of the Blu-Tack to fix the pivot to the empty beaker.

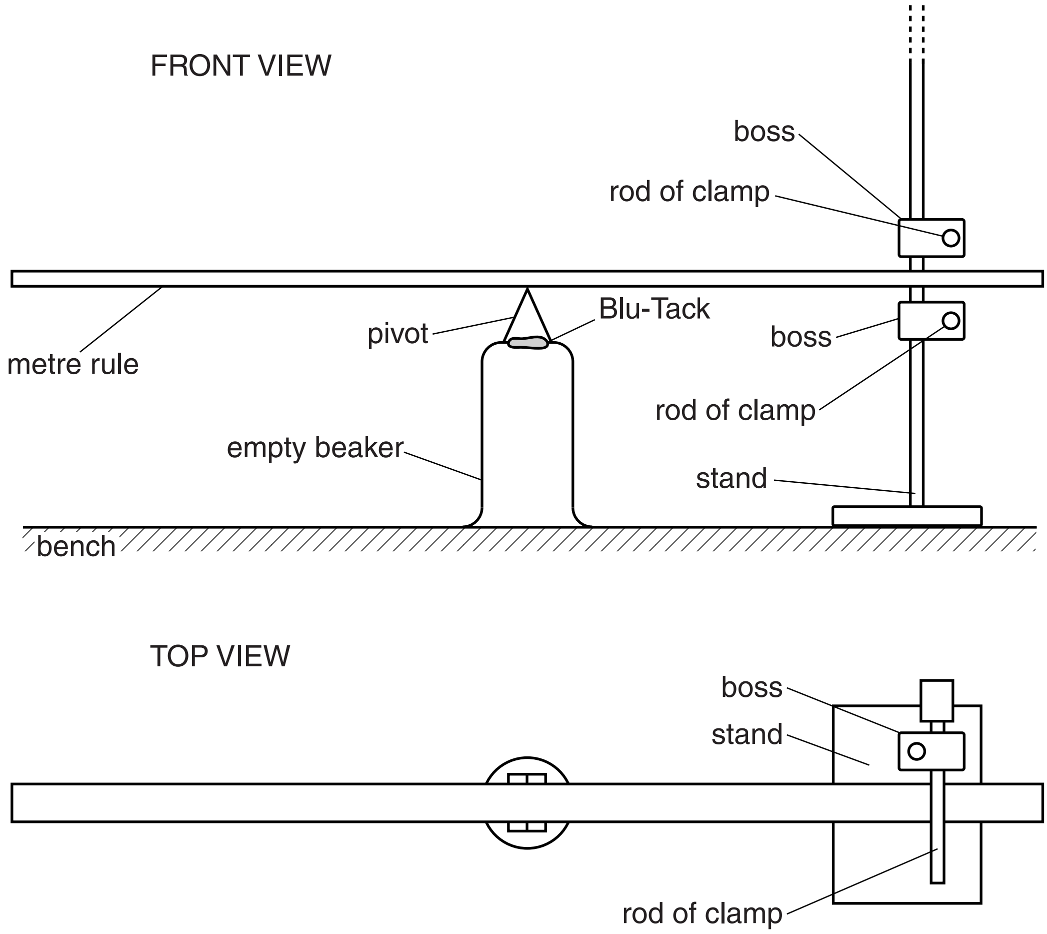

Fig. 2.1

(ii) The rods of the clamps act as stops to prevent the metre rule tilting too far.
Adjust them so that one is approximately 3 cm higher than the pivot and the other is approximately 3 cm lower than the pivot.

(iii) Position the metre rule with its 50.0 cm mark at the pivot. If necessary, add Blu-Tack to one end of the rule to balance it.

(b) You are provided with two glass spheres fixed to string loops.

(i) Suspend the larger sphere from the metre rule at a distance of 10.0 cm from the pivot. Balance the rule by suspending the other sphere a distance x_1 from the pivot, as shown in Fig. 2.2.

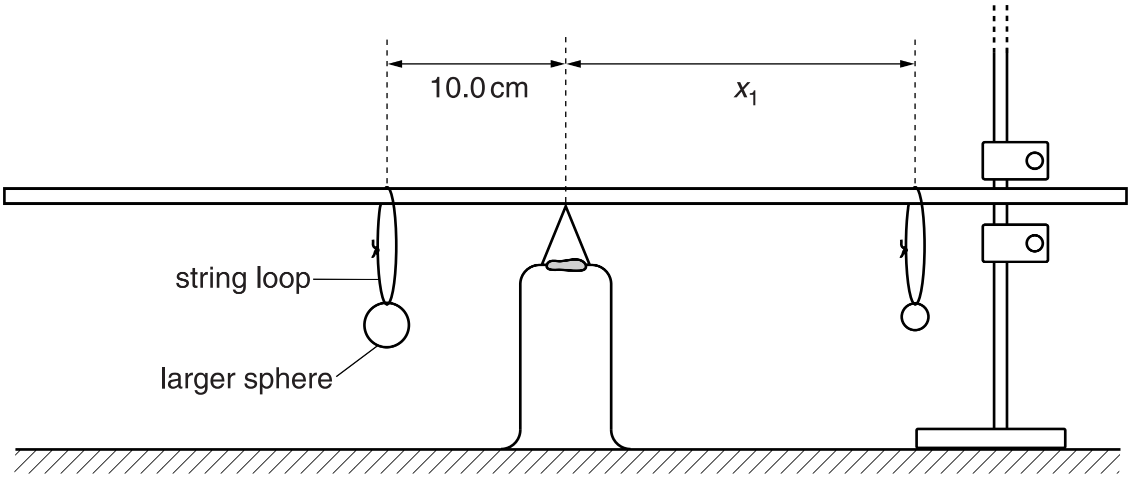

Fig. 2.2

(ii) Measure and record x_1.

x_1 = ... cm [1]

(c) Immerse the larger sphere in water at a distance of 10.0 cm from the pivot, as shown in Fig. 2.3.
Balance the rule by moving the smaller sphere.
Measure and record the distance x_2.

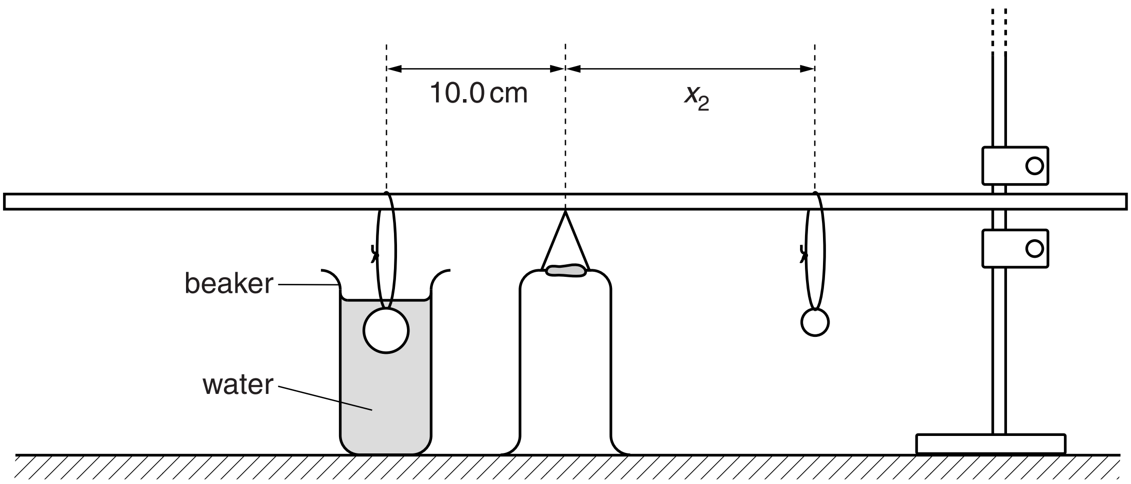

Fig. 2.3

x_2 = ... cm [1]

(d) **(i)** Repeat **(b)** with the spheres changed around, with the smaller sphere suspended at a distance of 40.0 cm from the pivot, as shown in Fig. 2.4.

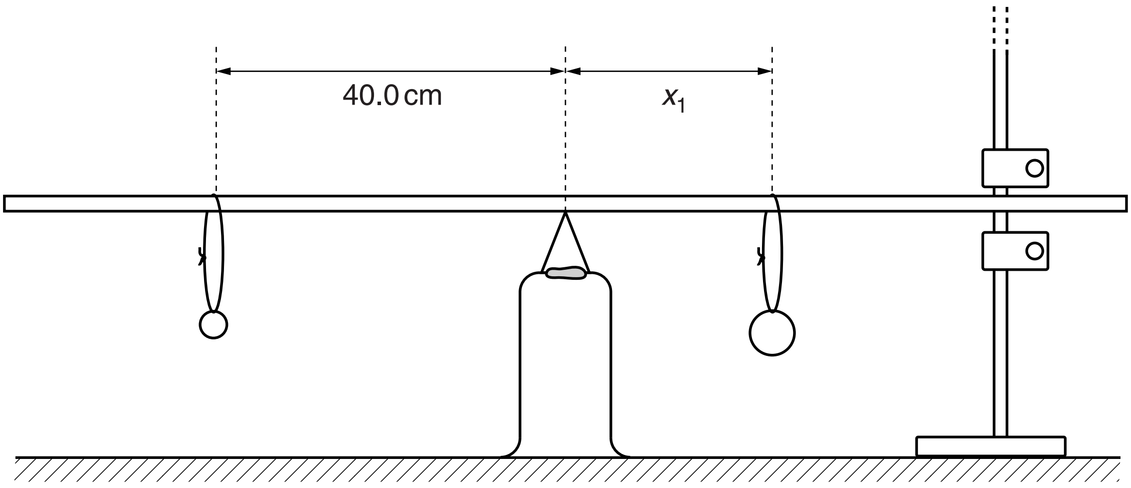

Fig. 2.4

x_1 = ... cm [1]

(ii) Immerse the smaller sphere in water at a distance of 40.0 cm from the pivot, as shown in Fig. 2.5.
Balance the rule by moving the larger sphere.
Measure and record x_2.

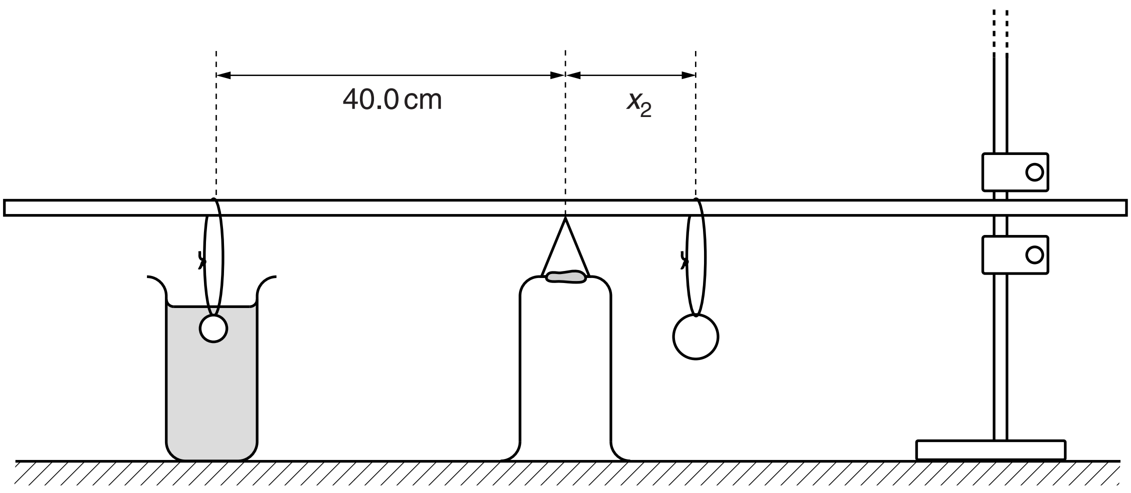

Fig. 2.5

x_2 = ... cm [1]

(e) It is suggested that the relationship between x_1 and x_2 is

$$x_1 = k(x_1 - x_2)$$

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 you have given for your values of k.

....

....

....[1]

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

....

....

....

....[1]

(f) **(i)** Measure and record the diameter D of the smaller sphere.

D = ... cm [2]

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

percentage uncertainty = ... [1]

(iii) Calculate the volume V of the smaller sphere, where $V = \frac{\pi D^3}{6}$.

V = ... cm^3 [1]

(iv) The mass M of the smaller sphere is given by $M = k\rho V$ where $\rho = 1.0\,g\,cm^{-3}$.
Using one of your values of k, calculate M.

M = ... g [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]

[Total: 20]