Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME	

CENTRE NUMBER							CANDIDATE NUMBER					

1583679674

PHYSICS **9702/33**

Paper 3 Advanced Practical Skills 1 **May/June 2020**

2 hours

You must answer on the question paper.

You will need: The materials and apparatus listed in the confidential instructions

INSTRUCTIONS
- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You will be allowed to work with the apparatus for a maximum of 1 hour for each question.
- You should record all your observations in the spaces provided in the question paper as soon as these observations are made.
- You may use a calculator.
- You should show all your working and use appropriate units.

INFORMATION
- The total mark for this paper is 40.
- The number of marks for each question or part question is shown in brackets [ ].

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2	
Total	

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DC (ST/JG) 182457/2

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

1 In this experiment, you will investigate the equilibrium of a metre rule.

(a) You have been provided with a metre rule with a string attached to it.

- Set up the apparatus as shown in Fig. 1.1.

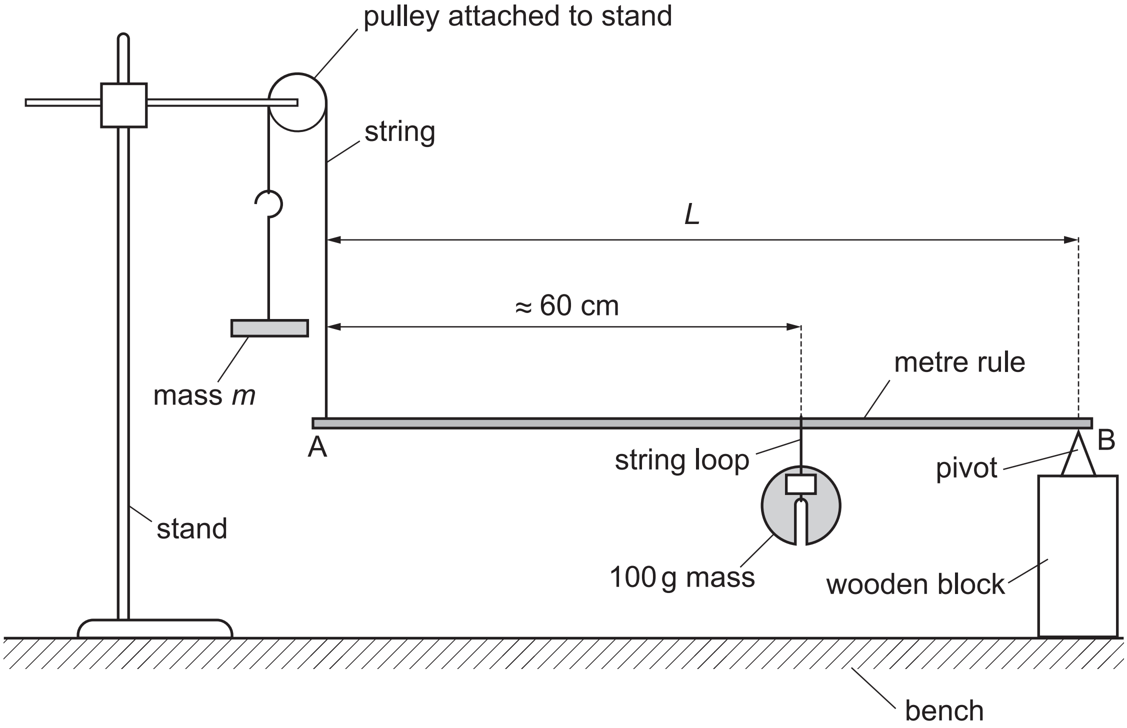

Fig. 1.1

- Add masses to the mass hanger so that mass m is 80 g.
- Adjust the pivot so that it is 5 mm from end B of the rule. The distance between the string at end A and the pivot is L.
- Measure and record L.

L = ...

- Adjust the string loop supporting the 100 g mass so that it is approximately 60 cm from end A.
- Hold the rule at end A so that the rule is approximately horizontal.

- Adjust the position of the string loop to find the position where end A is just about to move **upwards** when the rule is released. The distance between the string at end A and the string loop is y_1 as shown in Fig. 1.2.

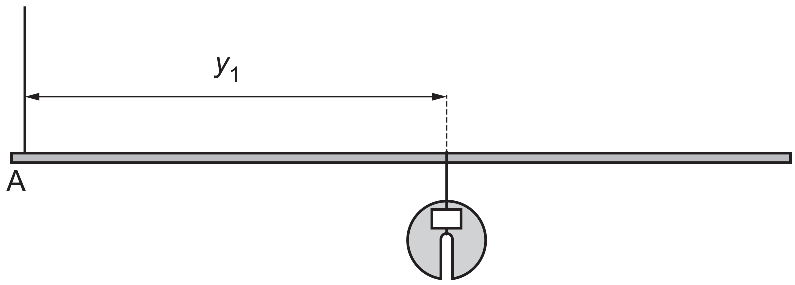

Fig. 1.2

- Measure and record y_1.

y_1 = ...

- Adjust the position of the string loop to find the position where end A is just about to move **downwards** when the rule is released. The distance between the string at end A and the string loop is y_2.

- Measure and record y_2.

y_2 = ...

- Calculate y where

$$y = \frac{y_1 + y_2}{2}.$$

y = ...
[3]

(b) Increase m. Measure the new values of y_1 and y_2.

Repeat until you have five sets of values of m, y_1 and y_2.

Record your results in a table. Include values of y in your table.

[8]

(c) **(i)** Plot a graph of y on the y-axis against 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.

gradient = ...

y-intercept = ...

[2]

(d) It is suggested that the quantities y and m are related by the equation

$$y = Am + B$$

where A and B are constants.

Using your answers in **(c)(iii)**, determine the values of A and B.
Give appropriate units.

A = ...

B = ...
[2]

(e) Theory suggests that

$$B = L - \frac{RA}{2}$$

where R is the mass of the metre rule.

Determine a value for R.
Give your answer to three significant figures.

R = ... [1]

[Total: 20]

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

2 In this experiment, you will investigate the result of a collision between two cylinders.

(a) • The wooden cylinder labelled A has diameter D.

Measure and record D.

D = ...

• The wooden cylinder labelled B has diameter d.

Measure and record d.

d = ...
[2]

(b) (i) You have been provided with a wooden strip with a line drawn on one face.

• Use the stand, boss and clamp to set up the wooden strip in the position shown in Fig. 2.1. The end near the line should touch the bench and the other end should be approximately 5 cm above the bench.

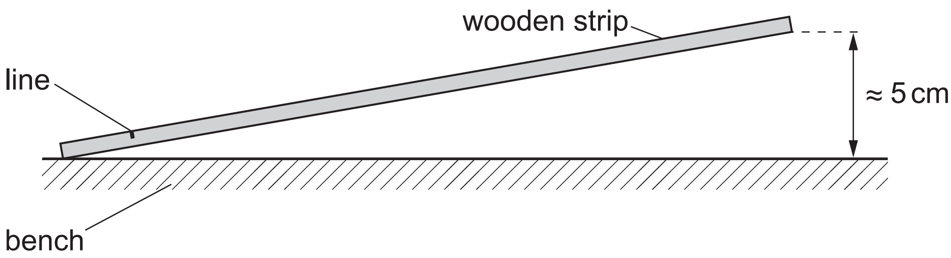

Fig. 2.1

• Place cylinder B approximately 30 cm from the end of the strip.

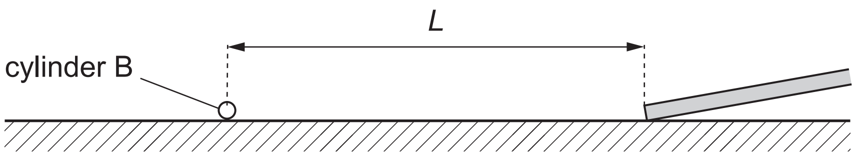

Fig. 2.2

• The distance between the end of the strip and B is L, as shown in Fig. 2.2.

Measure and record L.

L = ... [1]

(ii) • Place cylinder A on the line on the strip as shown in Fig. 2.3.

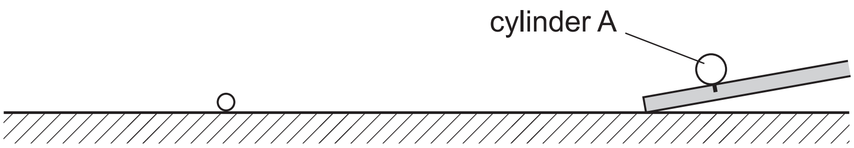

Fig. 2.3

• Release A.

• A will roll down the strip and along the bench until it collides with B.

B will roll and then come to rest as shown in Fig. 2.4.

The distance between B and the end of the strip is l, as shown in Fig. 2.4.

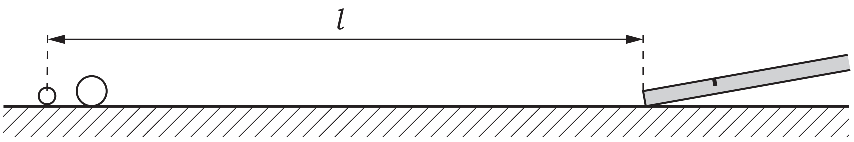

Fig. 2.4

Measure and record l.

l = ... [2]

(iii) Estimate the percentage uncertainty in your value of l. Show your working.

percentage uncertainty = ... [1]

(iv) Calculate $(l - L)^2$.

$(l - L)^2$ = ... [1]

(c) • Measure and record the diameter D of cylinder C.

D = ...

• Using cylinder C instead of cylinder A on the wooden strip, repeat **(b)(i)**, **(b)(ii)** and **(b)(iv)**.

L = ...

l = ...

$(l - L)^2$ = ...
[3]

(d) It is suggested that the relationship between l, L, D and d is

$$(l - L)^2 = k(D - d)^3$$

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]

(e) **(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. ....

....

3. ....

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4. ....

....

[4]

[Total: 20]

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Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME		
CENTRE NUMBER		
CANDIDATE NUMBER		

0060080096

PHYSICS **9702/34**

Paper 3 Advanced Practical Skills 2 **May/June 2020**

2 hours

You must answer on the question paper.

You will need: The materials and apparatus listed in the confidential instructions

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You will be allowed to work with the apparatus for a maximum of 1 hour for each question.
- You should record all your observations in the spaces provided in the question paper as soon as these observations are made.
- You may use a calculator.
- You should show all your working and use appropriate units.

INFORMATION

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

1 In this experiment, you will investigate the balance of a pivoted rule.

(a) The apparatus has been partially assembled for you.

- Add the mass M to the apparatus as shown in Fig. 1.1. The mass M should be suspended approximately 15 cm from the nail.

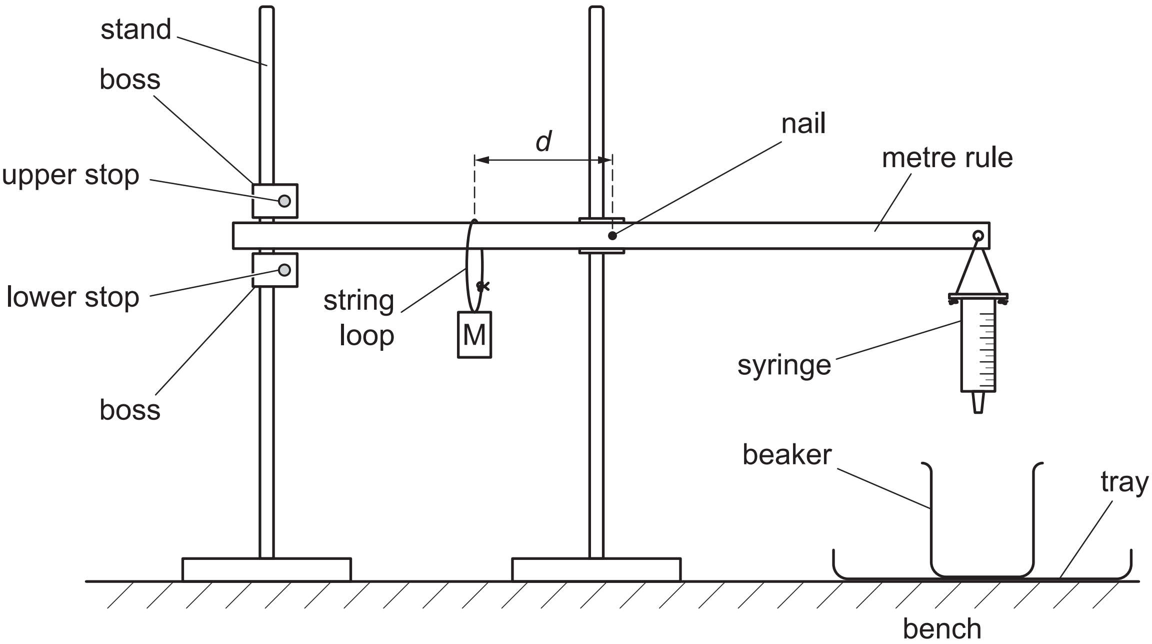

Fig. 1.1

- The distance between the nail and the string loop attached to M is *d*, as shown in Fig. 1.1.

  Measure and record *d*.

d = ... cm [1]

(b)
- Pour water into the syringe until it is full. The rule will tilt until it touches the upper stop. The water will flow out of the syringe.

- The time between the water level passing the 50 cm^3 mark on the syringe and the rule losing contact with the upper stop is *t*.

  Measure and record *t*.

t = ... s [2]

(c) Change d by moving M. All values of d should be less than 25 cm.

Measure d and t. Repeat until you have six sets of values of d and t.

Record your results in a table. Include values of $\frac{1}{d}$ and t^2 in your table.

[9]

(d) **(i)** Plot a graph of t^2 on the y-axis against $\frac{1}{d}$ 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 d are related by the equation

$$t^2 = \frac{a}{d} + b$$

where a and b are constants.

Use your answers in **(d)(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 amplitude of oscillations of a mass suspended from a spring.

(a) (i) • Assemble the apparatus as shown in Fig. 2.1.

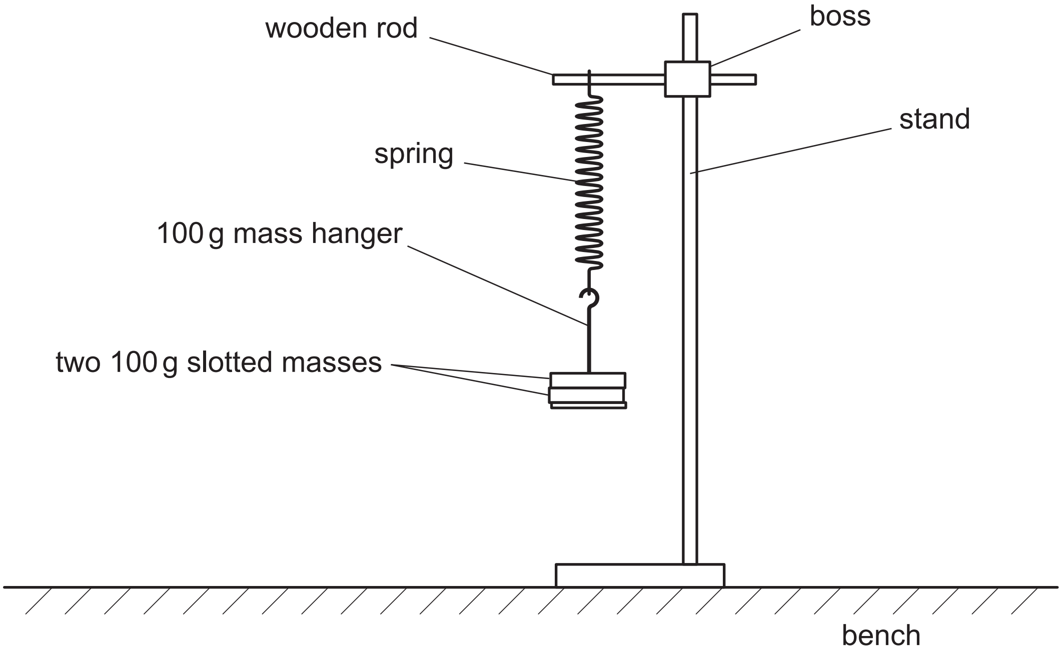

Fig. 2.1

• Pull the mass hanger and slotted masses down through a short distance. Release them so that they oscillate vertically.

• Measure and record the period T of the oscillations.

T = ... s [1]

(ii) Calculate the spring constant k using

$$k = \frac{4\pi^2 M}{T^2}$$

where M = 0.300 kg.

k = ... N m^{-1} [1]

(b) • Slide the two 100 g slotted masses to the top of the mass hanger as shown in Fig. 2.2.

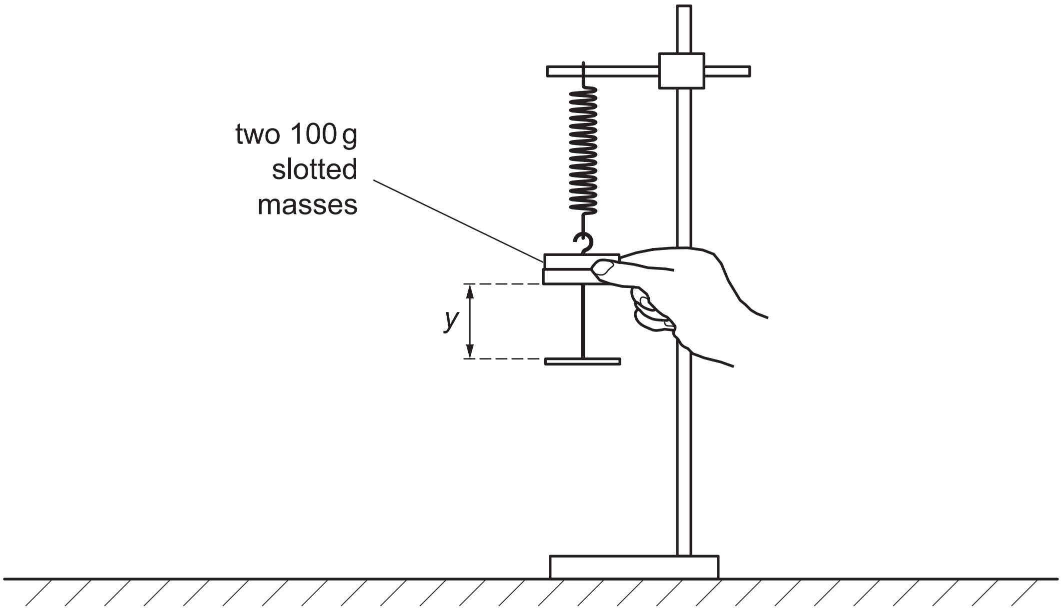

Fig. 2.2

• The height of the slotted masses above the base of the mass hanger is y, as shown in Fig. 2.2.

Measure and record y.

y = ... m [1]

(c) • Drop the two 100 g slotted masses. The masses and the mass hanger will oscillate vertically, as shown in Fig. 2.3.

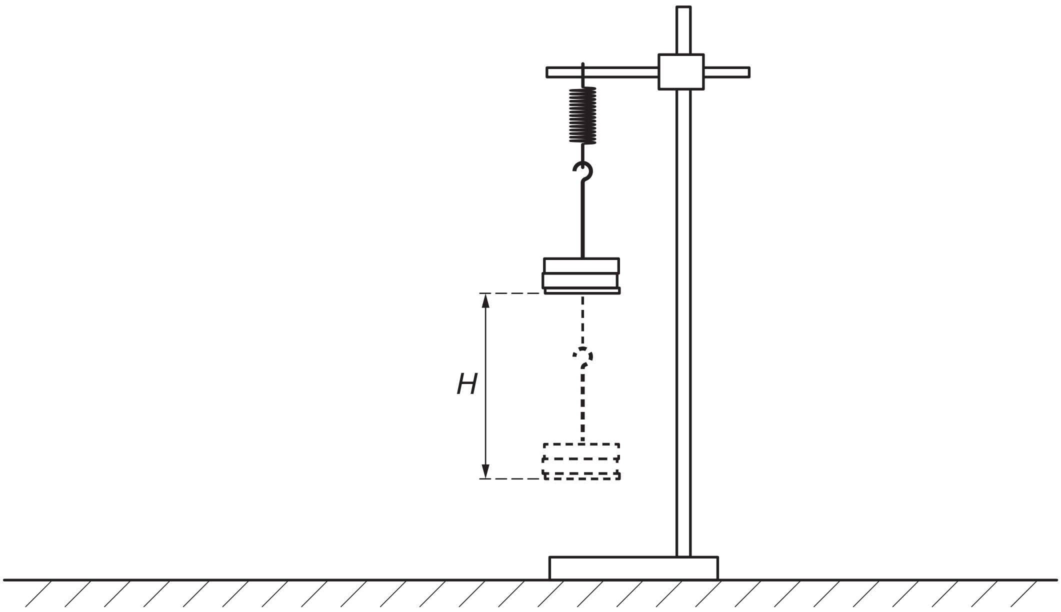

Fig. 2.3

- The distance between the lowest and highest positions of the oscillating mass hanger is *H*, as shown in Fig. 2.3.

  Measure and record *H*.

H = ... m [2]

(d) Estimate the percentage uncertainty in your value of *H*. Show your working.

percentage uncertainty = ... [1]

(e) Repeat **(b)** and **(c)** but this time sliding the two slotted masses approximately half-way up the mass hanger.

y = ... m

H = ... m
[2]

(f) It is suggested that the relationship between H and y is

$$H = c\sqrt{y}$$

where c is a constant.

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

first value of c = ...

second value of c = ...
[1]

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

....

....

.... [1]

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

....

....

.... [1]

(g) Theory suggests that an approximate value for the acceleration of free fall g is given by

$$g = \frac{c^2k}{8m}$$

where $m = 0.200\,\text{kg}$.

Use your value of k from **(a)(ii)** and your first value of c to calculate g. Include an appropriate unit.

g = ... [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 Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME	

CENTRE NUMBER						CANDIDATE NUMBER					

6242748188

PHYSICS **9702/35**

Paper 3 Advanced Practical Skills 1 **May/June 2020**

2 hours

You must answer on the question paper.

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INSTRUCTIONS

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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 spring and a mass.

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

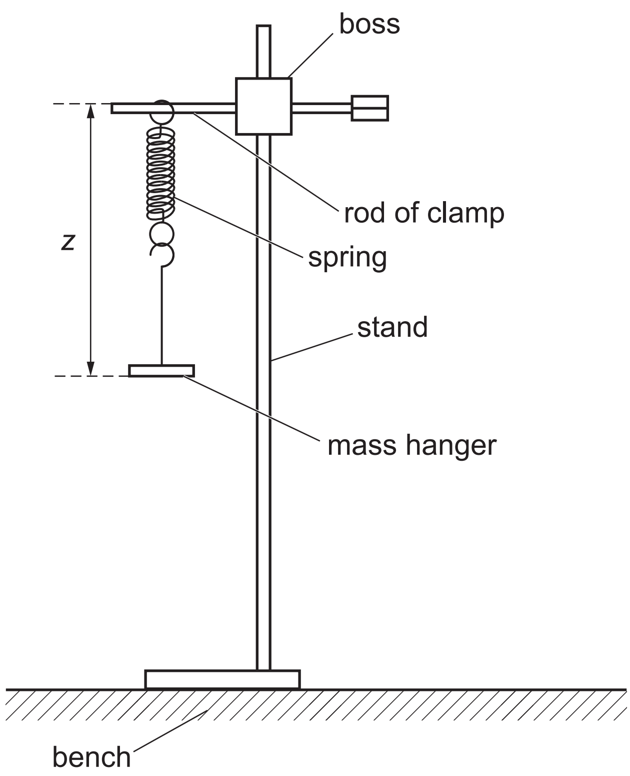

Fig. 1.1

● The distance between the top of the rod of the clamp and the bottom of the mass hanger is z, as shown in Fig. 1.1.

Measure and record z.

z = ...

● Add mass m to the mass hanger where m = 0.300 kg. Gently lower the mass to stretch the spring.

● Record the total **added** mass m (do not include the mass of the hanger).

m = ... kg

- Pull the bottom of the mass hanger **horizontally** through a short distance.
- Release the mass hanger. The mass hanger and masses will oscillate as shown in Fig. 1.2.

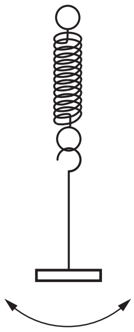

Fig. 1.2

- Determine the period *T* of these oscillations.

T = ... s [1]

(b) By changing the total mass added to the mass hanger, vary m. Measure T and repeat until you have six sets of values of m and T. Include your values from **(a)**. Do **not** use m = 0.

Record your results in a table. Include values of $\frac{T^2}{m}$ and $\frac{1}{m}$ in your table.

[10]

(c) **(i)** Plot a graph of $\frac{T^2}{m}$ 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.

gradient = ...

y-intercept = ...
[2]

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

$$\frac{T^2}{m} = \frac{A}{m} + B$$

where A and B are constants.

Using your answers in **(c)(iii)**, determine the values of A and B.
Give appropriate units.

A = ...

B = ...
[2]

(e) A student repeats the experiment using two springs in series, as shown in Fig. 1.3.

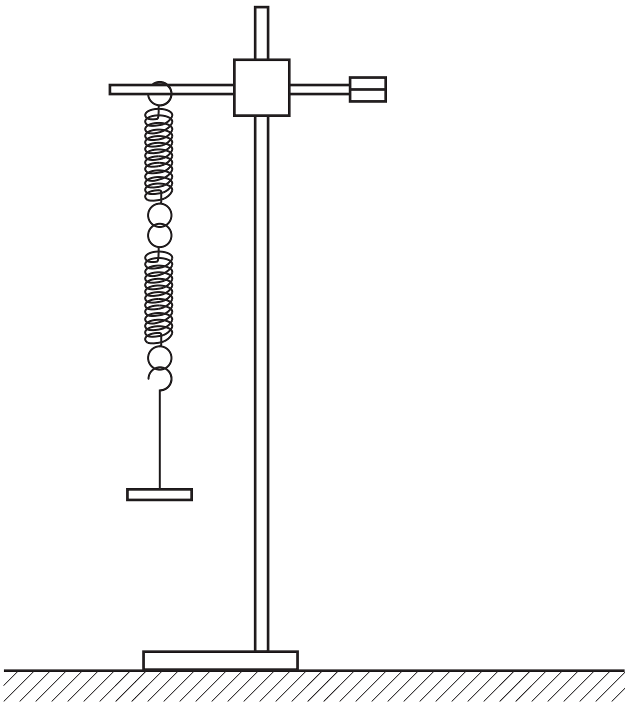

Fig. 1.3

Using two springs connected in series halves the value of the spring constant of the system.

Theory suggests that A is proportional to z and that B is inversely proportional to the spring constant of the system.

For this experiment, draw a second line on the graph to show the expected results.
Label this line W.

[1]

[Total: 20]

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

2 In this experiment, you will investigate a potential divider circuit.

(a) (i) • Connect the voltmeter across the cell as shown in Fig. 2.1.

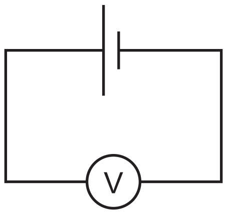

Fig. 2.1

• The reading on the voltmeter is the electromotive force (e.m.f.) E of the cell.

Record E.

E = ...

• Measure and record the diameter d of wire A.

d = ...
[1]

(ii) Calculate Ed^2.

Ed^2 = ... [1]

(iii) Justify the number of significant figures that you have given for your value of Ed^2.

....

....

.... [1]

(b) **(i)** You have been provided with a wooden strip with some wire connected between two nails.

- Set up the circuit shown in Fig. 2.2.

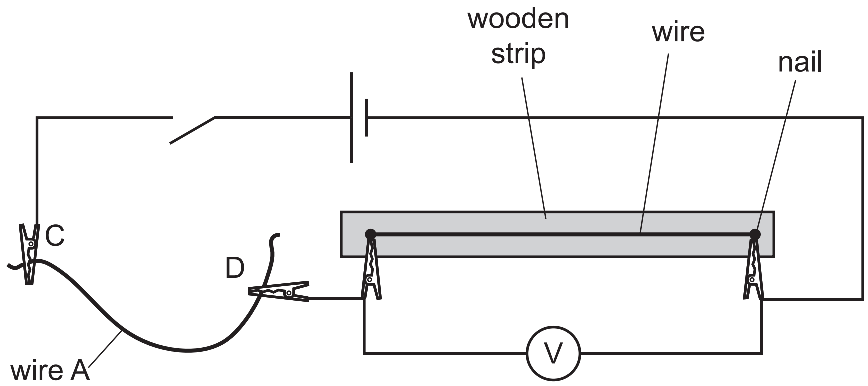

Fig. 2.2

- C and D are crocodile clips.

  Place the clips on wire A so that the length L of wire between C and D is equal to the length of wire between the two nails.

- Measure and record L.

L = ... [1]

(ii) Estimate the percentage uncertainty in your value of L. Show your working.

percentage uncertainty = ... [1]

(c)
- Close the switch.
- Record the voltmeter reading V.

V = ...

- Open the switch.
- Remove the wire between C and D.

[1]

(d)
- Measure and record the diameter d of wire B.

d = ...

- Calculate Ed^2.

Ed^2 = ...

- Connect length L of wire B between C and D and repeat **(c)**.

V = ...

[3]

(e) It is suggested that the relationship between V, E and d is

$$\frac{1}{V} = \frac{k}{Ed^2} + \frac{1}{E}$$

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]

(f) Theory suggests that

$$k = D^2$$

where D is the diameter of the wire on the wooden strip.

Use your second value of k to calculate a value for D.

D = ... [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]

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