Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

2617779585

PHYSICS **9702/35**

Paper 3 Advanced Practical Skills 1 **October/November 2022**

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 [ ].

For Examiner's Use	
1	
2	
Total	

This document has **16** pages. Any blank pages are indicated.

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

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

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

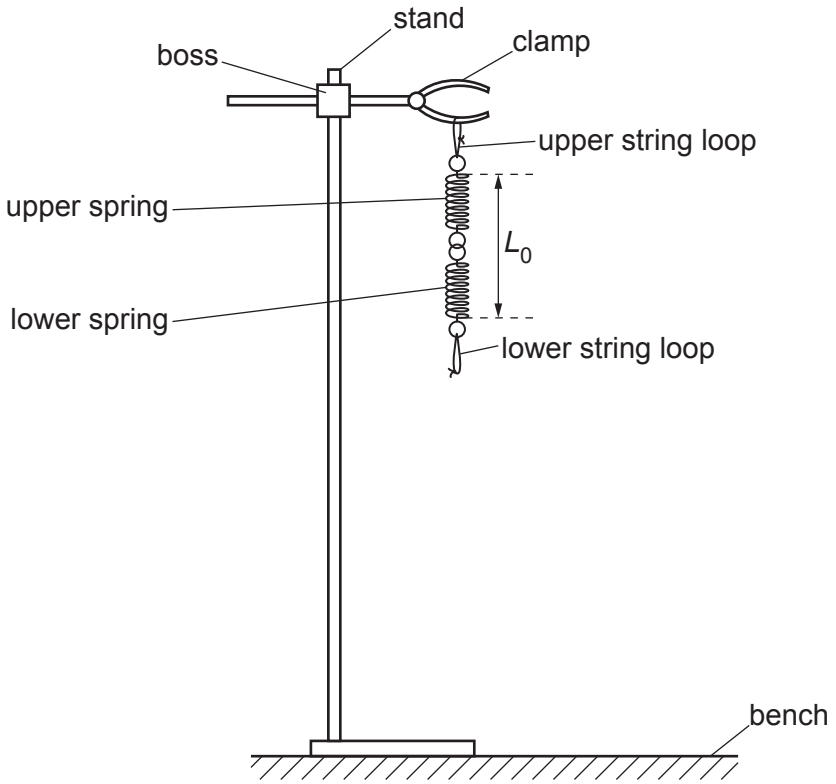


Fig. 1.1

● The length L_0 of the spring combination is measured between the top coil of the upper spring and the bottom coil of the lower spring, as shown in Fig. 1.1.

Measure and record L_0.

L_0 = ... cm

- Use the lower string loop to suspend a total mass of 200 g, as shown in Fig. 1.2.

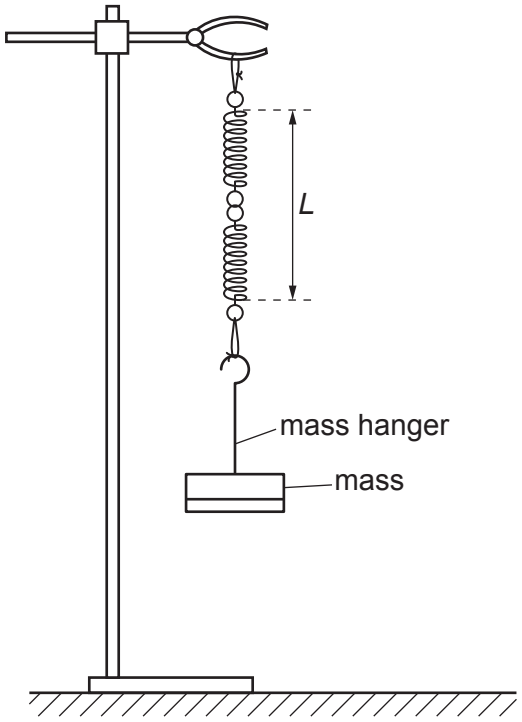


Fig. 1.2

- The new length of the spring combination is L.

  Measure and record L.

  L = ... cm

- The spring constant k of the spring combination is given by the equation

$$k = \frac{W}{(L - L_0)}$$

  where W is 1.96 N.

  Calculate k.

  k = ...
  [2]

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

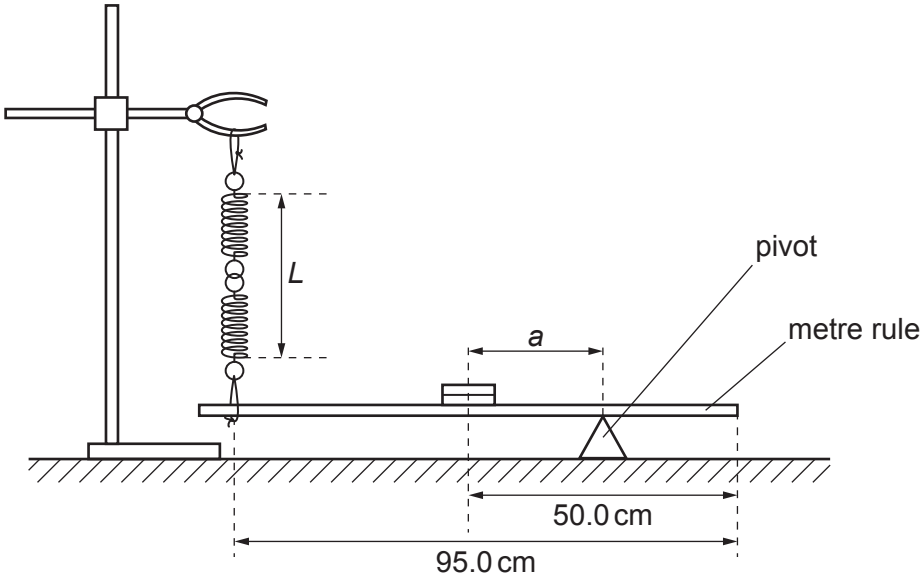


Fig. 1.3

- Use the adhesive putty to fix two 100 g slotted masses with their centres above the 50.0 cm mark on the rule. The masses must remain at this position throughout the experiment.
- Place the lower string loop at the 5.0 cm mark on the rule.
- The distance between the pivot and the midpoint of the rule is *a*.

  Adjust the pivot so that *a* is approximately 25 cm.
- Adjust the stand, boss and clamp so that the springs are vertical and the rule is horizontal.
- Measure and record *a* and *L*.

a = ...

L = ...

- The extension of the spring combination is given by the equation

$$e = L - L_0.$$

  Calculate *e*.

e = ...

- Change a by moving the pivot. Adjust the stand, boss and clamp so that the springs are vertical and the rule is horizontal. Measure a and L. Repeat until you have six sets of values of a and L.
  Do not include values of a less than 15.0 cm.

  Record your results in a table. Include values of e, $\frac{1}{a}$ and $\frac{1}{e}$ in your table.

[9]

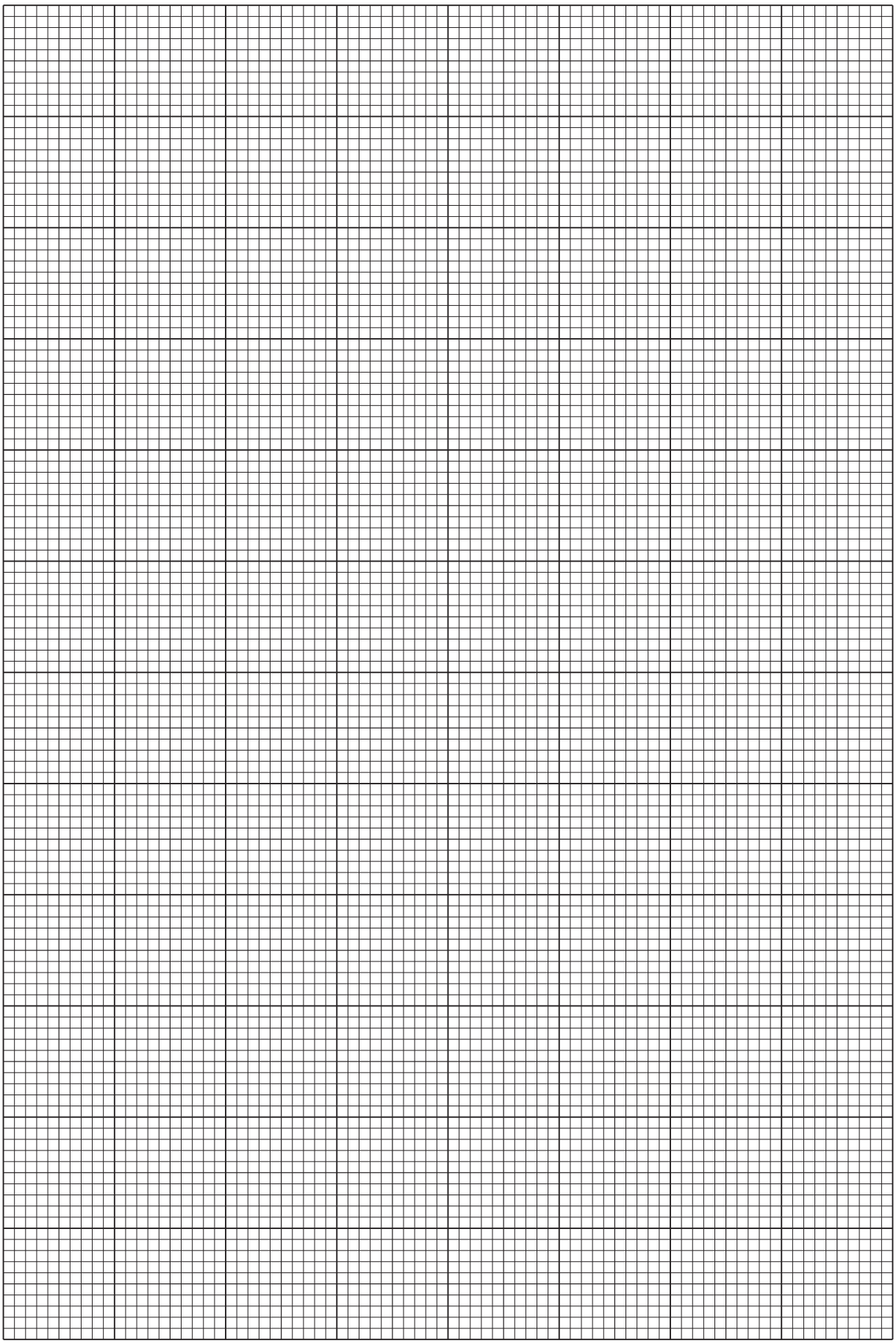
(c) (i) Plot a graph of $\frac{1}{e}$ on the y-axis against $\frac{1}{a}$ on the x-axis. [3]

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

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

gradient = ...

y-intercept = ...
[2]



(d) (i) It is suggested that the quantities e and a are related by the equation

$$\frac{1}{e} = B\frac{1}{a} + C$$

where B and C are constants.

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

B = ...

C = ...
[2]

(ii) Theory suggests that

$$C = \frac{k}{(R + W)}$$

where R is the weight of the rule and W is 1.96 N.

Using your answers in **(a)** and **(d)(i)**, determine a value for R.

R = ... N [1]

[Total: 20]

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

2 In this experiment, you will investigate the oscillations of a triangular card.

(a) ● Determine the midpoint M of the shortest side of the triangle.

● Draw a line from M to the opposite corner of the triangle, as shown in Fig. 2.1.

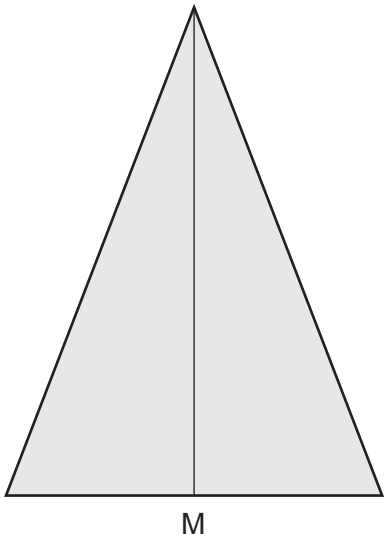


Fig. 2.1 (not to scale)

● Determine the midpoint N of one of the longer sides.

● Draw a line from N to the opposite corner of the triangle, as shown in Fig. 2.2.

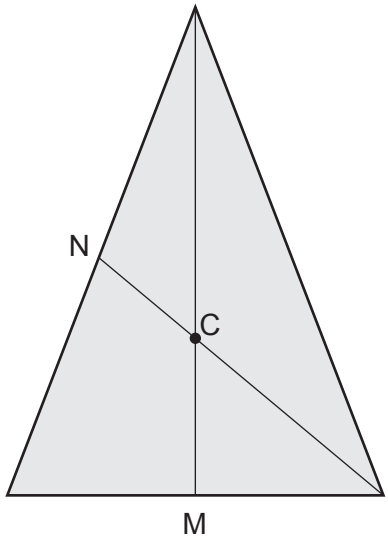


Fig. 2.2 (not to scale)

● Mark the point C where the two lines cross.

● The distance between C and M is *d*.

Measure and record *d.*

d = ... m [1]

(b) (i) ● On the line from M to the opposite corner, mark a point P a distance of approximately 0.06 m from C, as shown in Fig. 2.3.

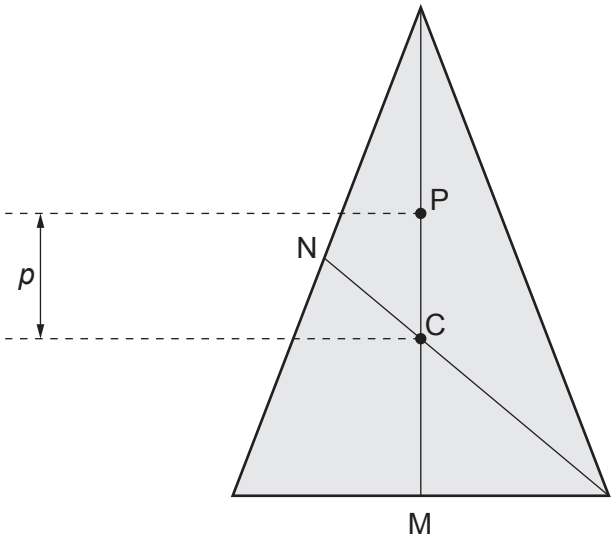


Fig. 2.3 (not to scale)

● The distance between C and P is *p*, as shown in Fig. 2.3.

Measure and record *p* in metres.

p = ... m

● Place the card on the cork so that P is above the cork. Use the pin to carefully pierce a small hole in the card at P.

● Set up the apparatus as shown in Fig. 2.4.

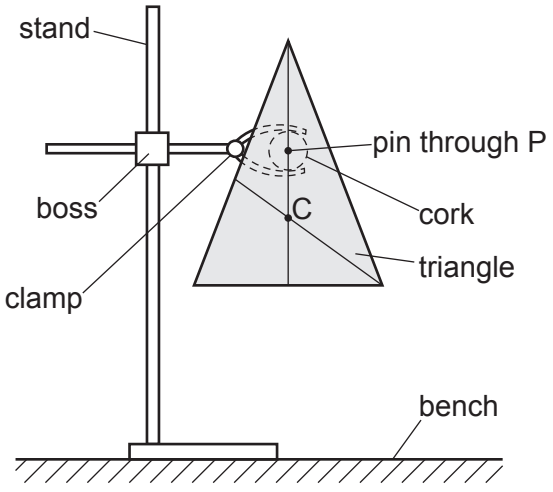


Fig. 2.4

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- Displace the base of the triangle through a small distance to the side. Release it so that it oscillates as shown in Fig. 2.5.

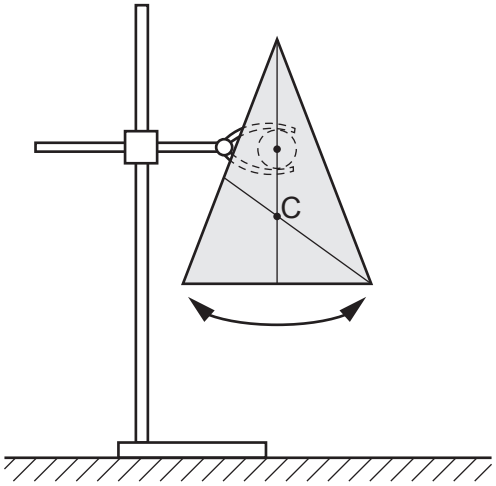


Fig. 2.5

- Take measurements to determine the period T of the oscillations.

T = ... s
[3]

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

percentage uncertainty = ... % [1]

(iii) Calculate p^2 and T^2p.

p^2 = ...

T^2p = ...
[1]

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[Turn over

(iv) Justify the number of significant figures that you have given for your value of T^2p.

.....

.....

..... [1]

(v) Repeat **(b)(i)** and **(b)(iii)** with a distance p of approximately 0.12 m.

p = ... m

T = ... s

p^2 = ...

T^2p = ...
[2]

(c) It is suggested that the relationship between T and p is

$$T^2p = qp^2 + S$$

where S has the value 0.015 m s^2 and q is a constant.

Using your data, calculate two values of q.

first value of q = ...

second value of q = ...
[1]

(d) It is suggested that the percentage uncertainty in the values of q is 15%.

Using this uncertainty, explain whether your results support the relationship in **(c)**.

.....

.....

.....

..... [1]

(e) Theory suggests that

$$q = \frac{4\pi^2}{g}$$

where g is the acceleration of free fall.

Use your second value of q to determine g.
Give an appropriate unit.

g = ... [1]

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

For any uncertainties in measurement that you describe, you should state the quantity being measured and a reason for the uncertainty.

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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