Cambridge International AS & A Level

Cambridge International Examinations
Cambridge International Advanced Subsidiary and Advanced Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

3133103509

PHYSICS **9702/36**

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

For Examiner's Use	
1	
2	
Total	

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

1 In this experiment, you will investigate the oscillations of a wire shape.

(a) Measure and record the length L of the wire shape, as shown in Fig. 1.1.

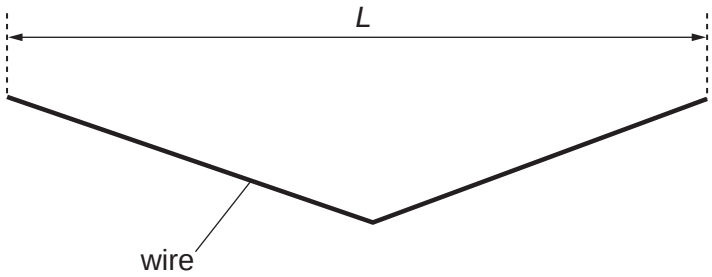


Fig. 1.1

L = ... cm

(b) (i) Assemble the apparatus as shown in Fig. 1.2.
The rods of the clamps should be **parallel to each other and at the same height above the bench**. The wire shape should be placed centrally on the rods.

Adjust the apparatus so that the distance between the centres of the rods is approximately 22 cm.

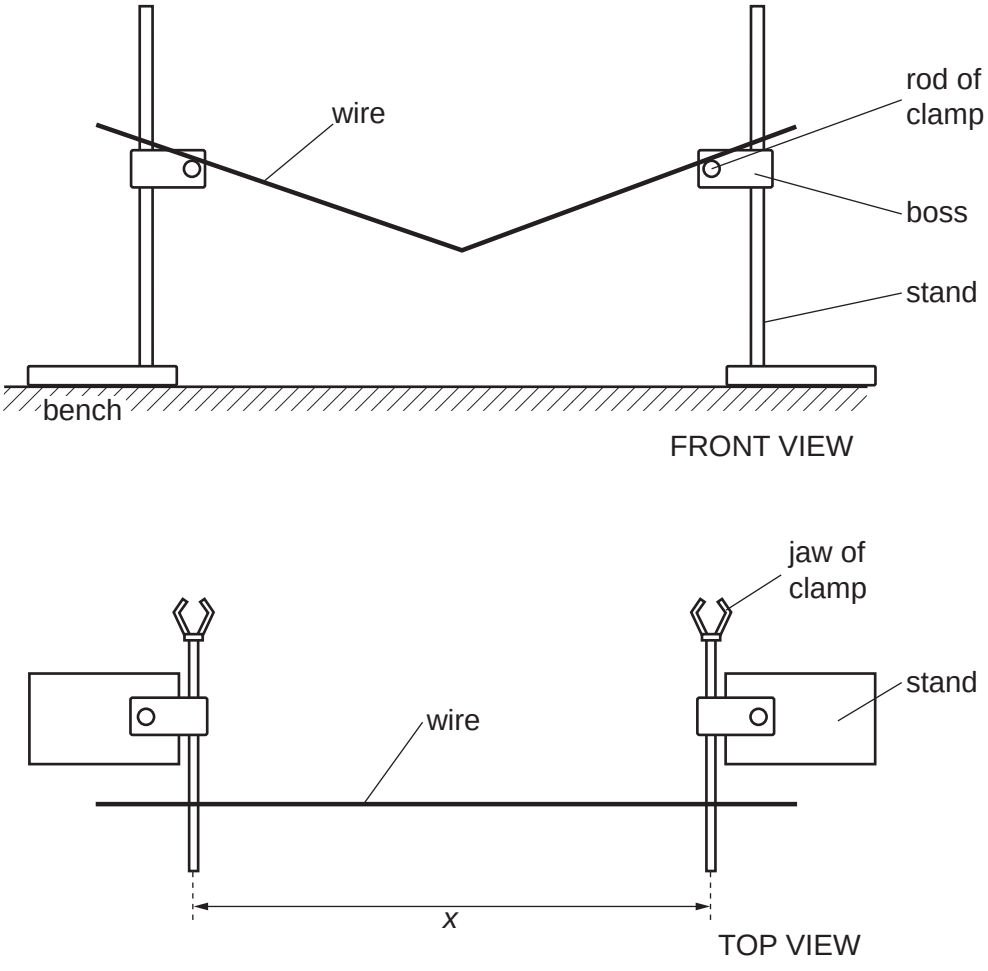


Fig. 1.2

(ii) The distance between the centres of the rods is x. Measure and record x.

x = ... cm

(c) **(i)** Push the centre of the wire a small distance away from you.
Release it so that it oscillates.

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

T = ... [2]

(d) For values of x less than $\frac{L}{2}$, the wire shape inverts as shown in Fig. 1.3.

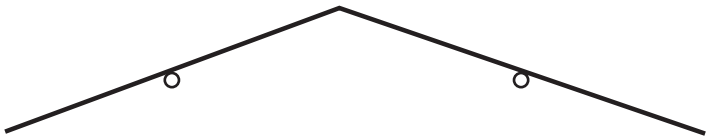


Fig. 1.3

Calculate $\frac{L}{2}$.

$\frac{L}{2}$ = ... cm

(e) Vary x in the range $\frac{L}{2} < x < 24\,\text{cm}$. Repeat **(b)(ii)** and **(c)** until you have six sets of values of x and T.

Record your results in a table. Include your values from **(b)(ii)** and **(c)**. Also include values of $\left(x - \frac{L}{2}\right)$ and $\frac{1}{T^2}$ in your table.

[10]

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

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

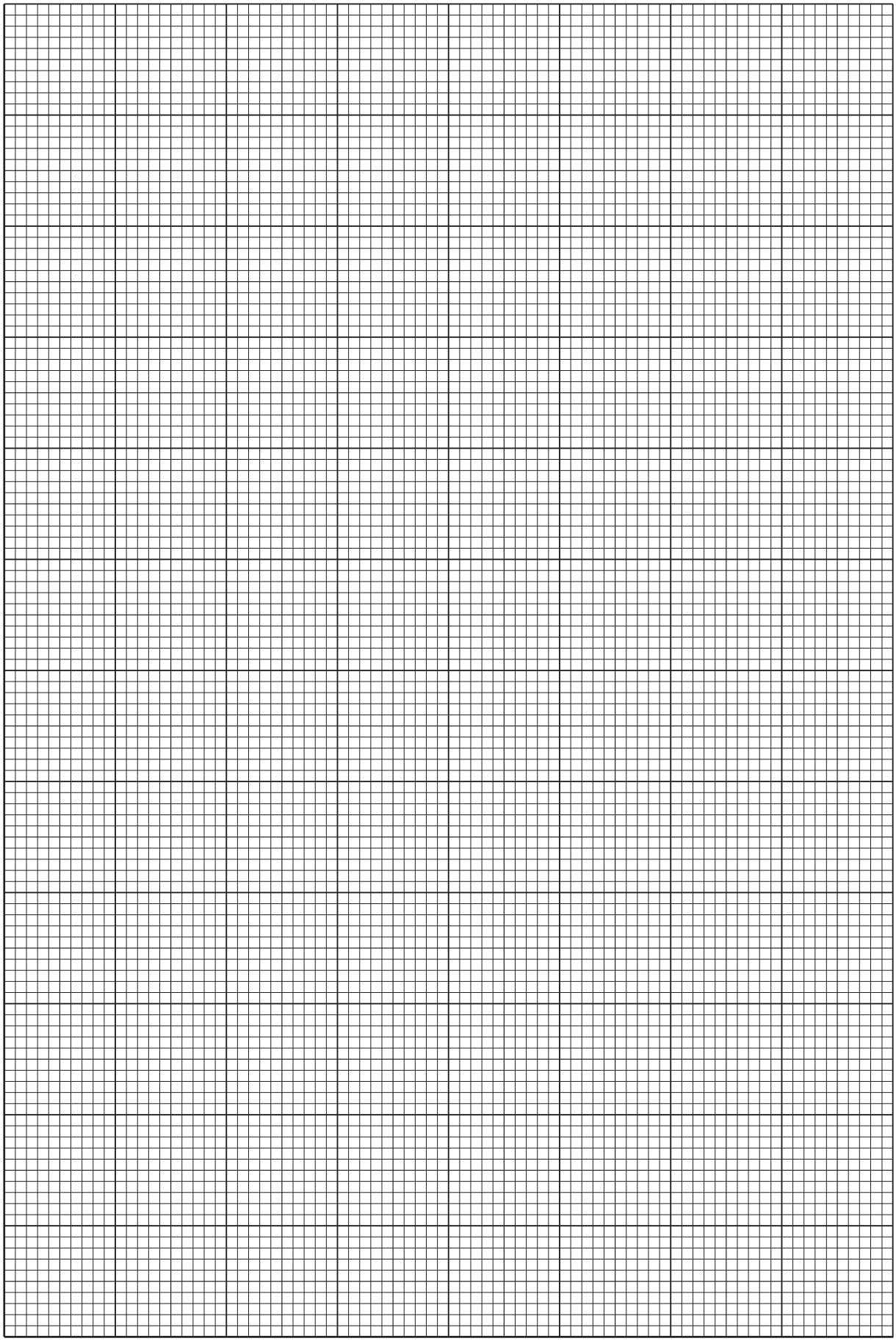
(iii) Determine the gradient and y-intercept of this line.

gradient = ...

y-intercept = ...

[2]

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

$$\frac{1}{T^2} = a\left(x - \frac{L}{2}\right) + b$$

where a and b are constants.

Using your answers in **(f)(iii)**, determine the values of a and b.
Give appropriate units.

a = ...

b = ...

[2]

[Total: 20]

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

2 In this experiment, you will investigate how the deflection of a wooden strip depends on the distribution of the load on the strip.

(a) (i) Lay the wooden strip flat on the bench.
Place the ten slotted masses along the strip, as shown in Fig. 2.1.

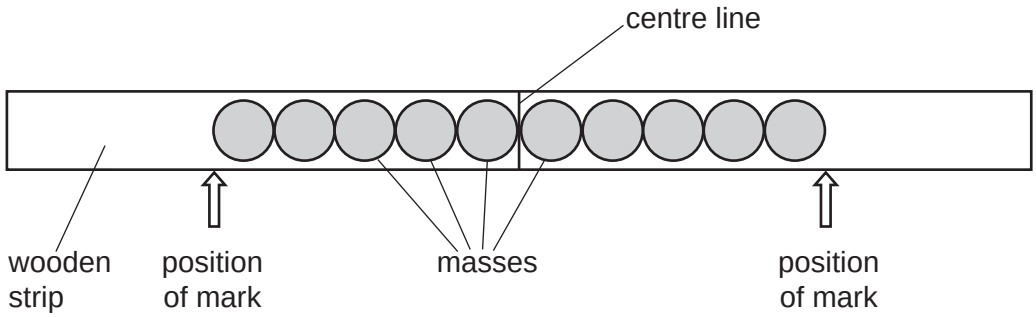


Fig. 2.1

(ii) Using the pen, make a small mark on the edge of the strip at each end of the row of masses, as shown in Fig. 2.1.

(iii) Remove the masses.

(iv) Measure and record the distance *D* between the marks, as shown in Fig. 2.2.

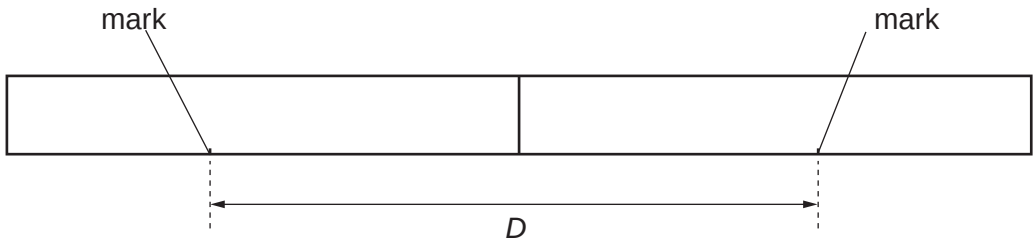


Fig. 2.2

D = ... [1]

(b) **(i)** Place the strip on the two wooden blocks with the inner edges of the blocks at the marks, as shown in Fig. 2.3.

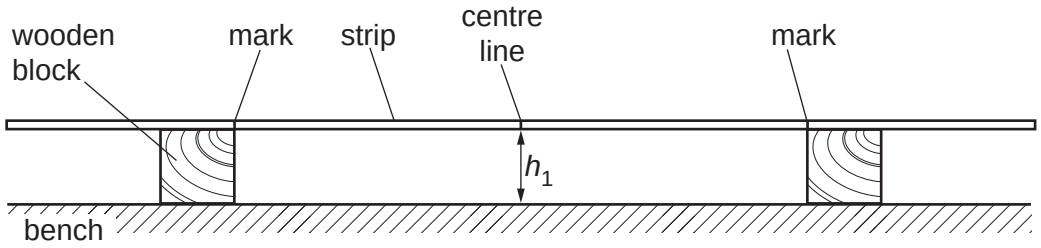


Fig. 2.3

(ii) Measure and record the height h_1 of the **bottom** of the strip at the centre line, as shown in Fig. 2.3.

h_1 = ... [1]

(c) Estimate the percentage uncertainty in your value of h_1.

percentage uncertainty = ... [1]

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(d) (i) Replace the masses on the strip and ensure the blocks are still positioned at the marks. Measure and record the height h_2 of the bottom of the strip at the centre line, as shown in Fig. 2.4.

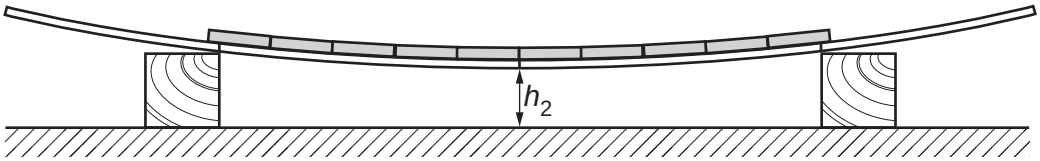


Fig. 2.4

h_2 = ...

(ii) Calculate d, where $d = h_1 - h_2$.

d = ... [1]

(e) (i) Remove the masses from the strip.

(ii) Ensure the blocks are still positioned at the marks. Measure and record the height h_3 of the bottom of the strip at the centre line.

h_3 = ...

(iii) Place all the masses at the centre line, as shown in Fig. 2.5.

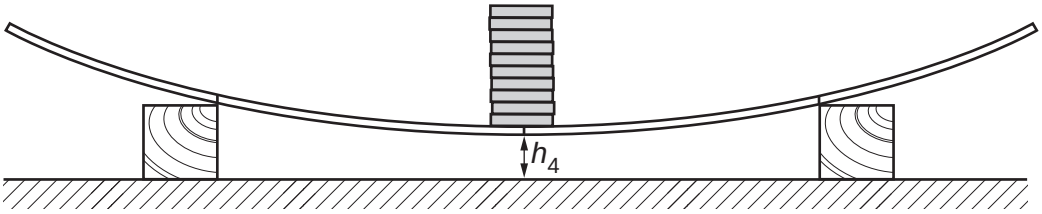


Fig. 2.5

(iv) Ensure the blocks are still positioned at the marks, then measure and record the height h_4 of the bottom of the strip at the centre line.

h_4 = ...

(v) Calculate p, where $p = h_3 - h_4$.

p = ...

(f) **(i)** Remove the masses.

(ii) Measure the thickness t and the width w of the strip, as shown in Fig. 2.6.

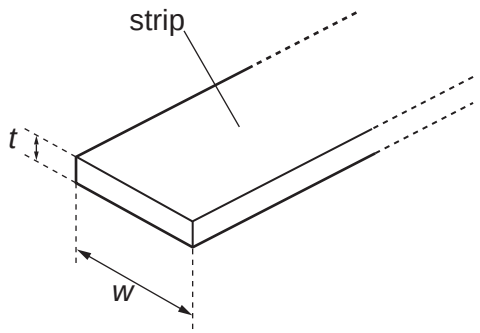


Fig. 2.6

t = ...

w = ...
[1]

(iii) Calculate the Young modulus E for the material of the strip using

$$E = \frac{FD^3}{4pwt^3}$$

where F = 10.0 N.

E = ... [1]

(g) Repeat **(a)**, **(b)**, **(d)** and **(e)** using **eight** masses.

D = ...

h_1 = ...

h_2 = ...

d = ...

h_3 = ...

h_4 = ...

p = ...
[3]

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(h) It is suggested that the relationship between d and p is

$$d = kp$$

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 **(h)(i)** support the suggested relationship.

.....

.....

.....

.....[1]

(i) **(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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