Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME	

CENTRE NUMBER						CANDIDATE NUMBER				

PHYSICS **9702/33**

Paper 3 Advanced Practical Skills 1 **May/June 2023**

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 **12** pages.

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

1 In this experiment, you will investigate the motion of a pendulum.

You have been provided with a cylinder and a pendulum.

(a) ● Use adhesive putty to attach the string to the cylinder as shown in Fig. 1.1.

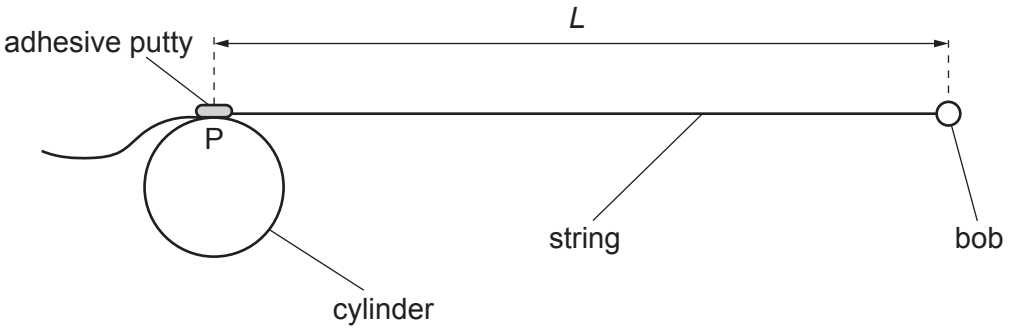


Fig. 1.1

- P is the point at which the string is attached to the cylinder.

  The distance between P and the centre of the bob is *L*.

  Adjust the adhesive putty and string so that *L* is approximately 45 cm.

- Measure and record *L*.

L = ... [1]

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

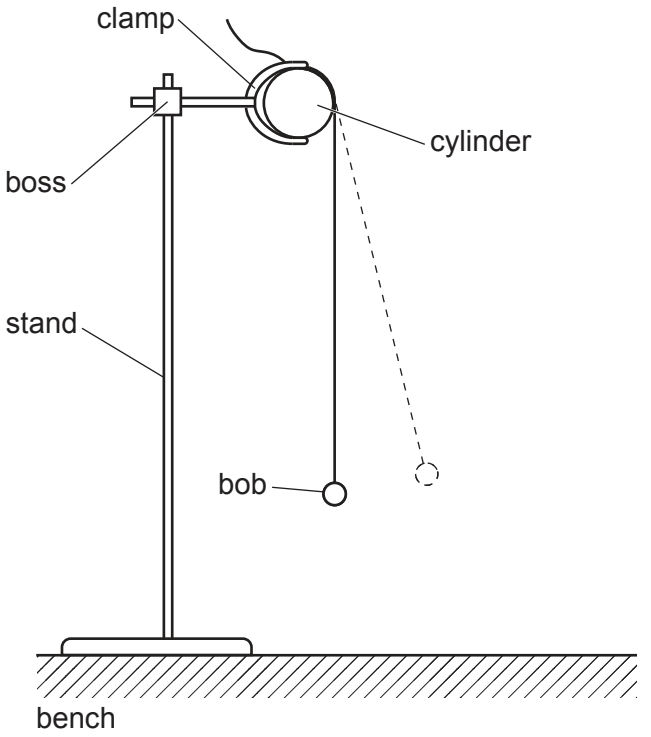


Fig. 1.2

- Move the bob a short distance **away** from the stand, as shown in Fig. 1.2.
- Release the bob. The bob will oscillate.
- Determine the period T of the oscillations of the bob.

T = ... [2]

(c) Change L by attaching a different point on the string to the cylinder and determine T. Repeat until you have six sets of values of L and T.

Record your results in a table. Include values of T^3 and L^2 in your table.

[9]

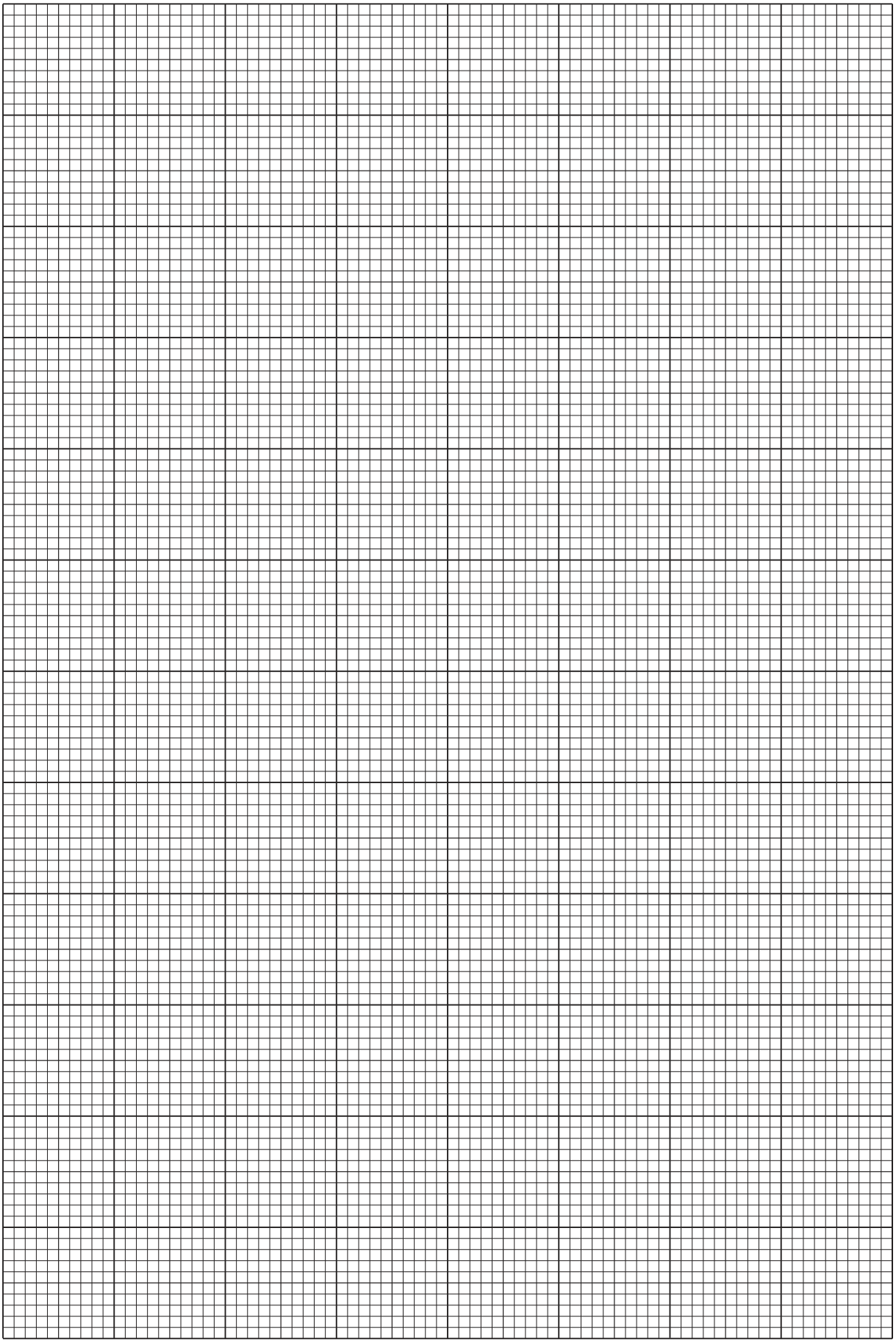
(d) **(i)** Plot a graph of T^3 on the y-axis against L^2 on the x-axis. [3]

(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 L are related by the equation

$$T^3 = EL^2 + F$$

where E and F are constants.

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

E = ...

F = ...
[2]

[Total: 20]

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

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

You have been provided with a card.

(a) The card has one edge of length h and another edge of length x, as shown in Fig. 2.1.

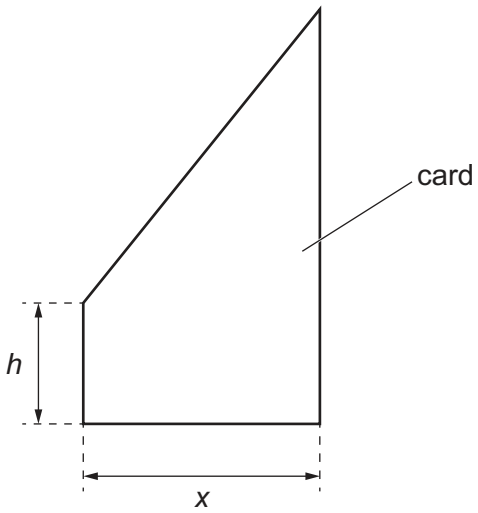


Fig. 2.1

(i) Measure and record h and x.

h = ... cm

x = ... cm [1]

(ii) Calculate the area A of the card, where

$$A = hx + \frac{5x^2}{8}.$$

A = ...cm^2 [1]

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

.....

.....

..... [1]

(b) (i) ● Use the nail to make a hole close to one corner of the card, as shown in Fig. 2.2.

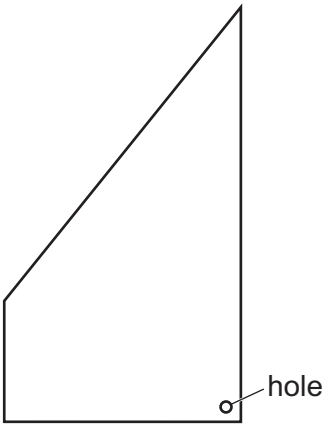


Fig. 2.2

● Set up the apparatus as shown in Fig. 2.3.

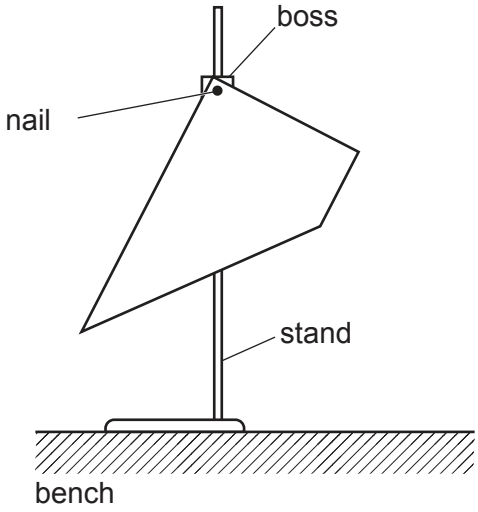


Fig. 2.3

● Push the nail through the hole in the card.

● Fix the nail in the boss.

● Ensure that the card swings freely from the nail.

● Use the set square and the ruler to draw a vertical line on the card below the nail.

● Repeat using **two** more holes close to two other corners of the card.

- Fig. 2.4 shows an example of the card with three lines drawn on it.

  The three lines cross at distances *c* and *d* from the two edges of the card shown in Fig. 2.4.

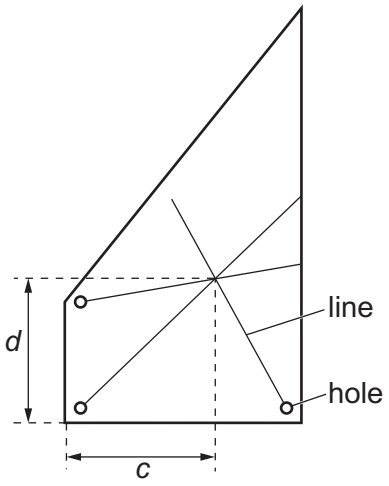


Fig. 2.4

Measure and record *c* and *d*.

c = ... cm

d = ... cm
[2]

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

percentage uncertainty = ... % [1]

(c) (i) ● Cut the card as shown in Fig. 2.5 so that x is approximately 9 cm.

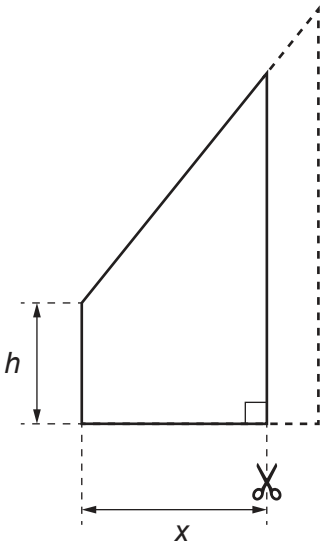


Fig. 2.5

● Measure and record x.

x = ... cm [1]

(ii) Repeat **(a)(ii)** and **(b)(i)**.

A = ... cm^2

c = ... cm

d = ... cm
[3]

(d) It is suggested that the relationship between c, A, h and x is

$$cA = \frac{hx^2}{2} + kx^3$$

where k is a constant.

Using your data, calculate two values of k.

first value of k = ...

second value of k = ...
[1]

(e) It is suggested that the percentage uncertainty in the values of k is 5%.

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

.....

.....

.....

..... [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]