



# Cambridge International AS & A Level

CANDIDATE  
NAME

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CENTRE  
NUMBER

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NUMBER

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## 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	

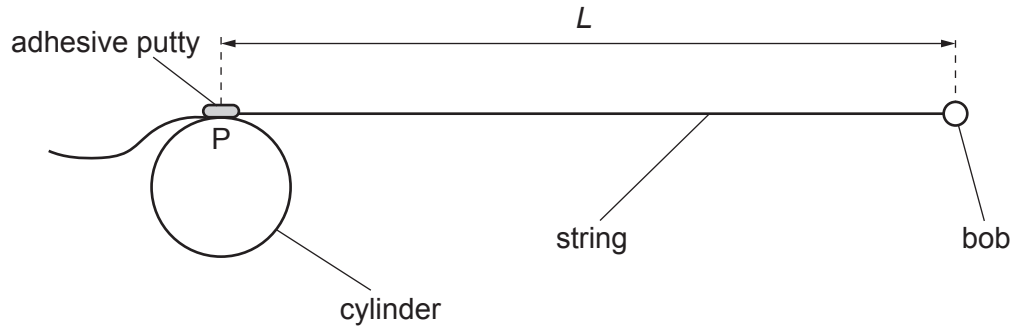
This document has **12** pages.

**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.

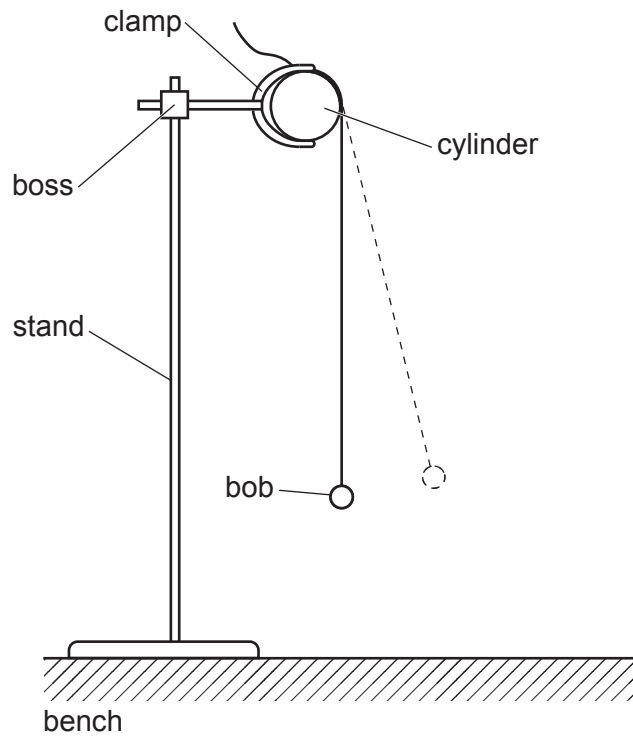


Fig. 1.2

- 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.

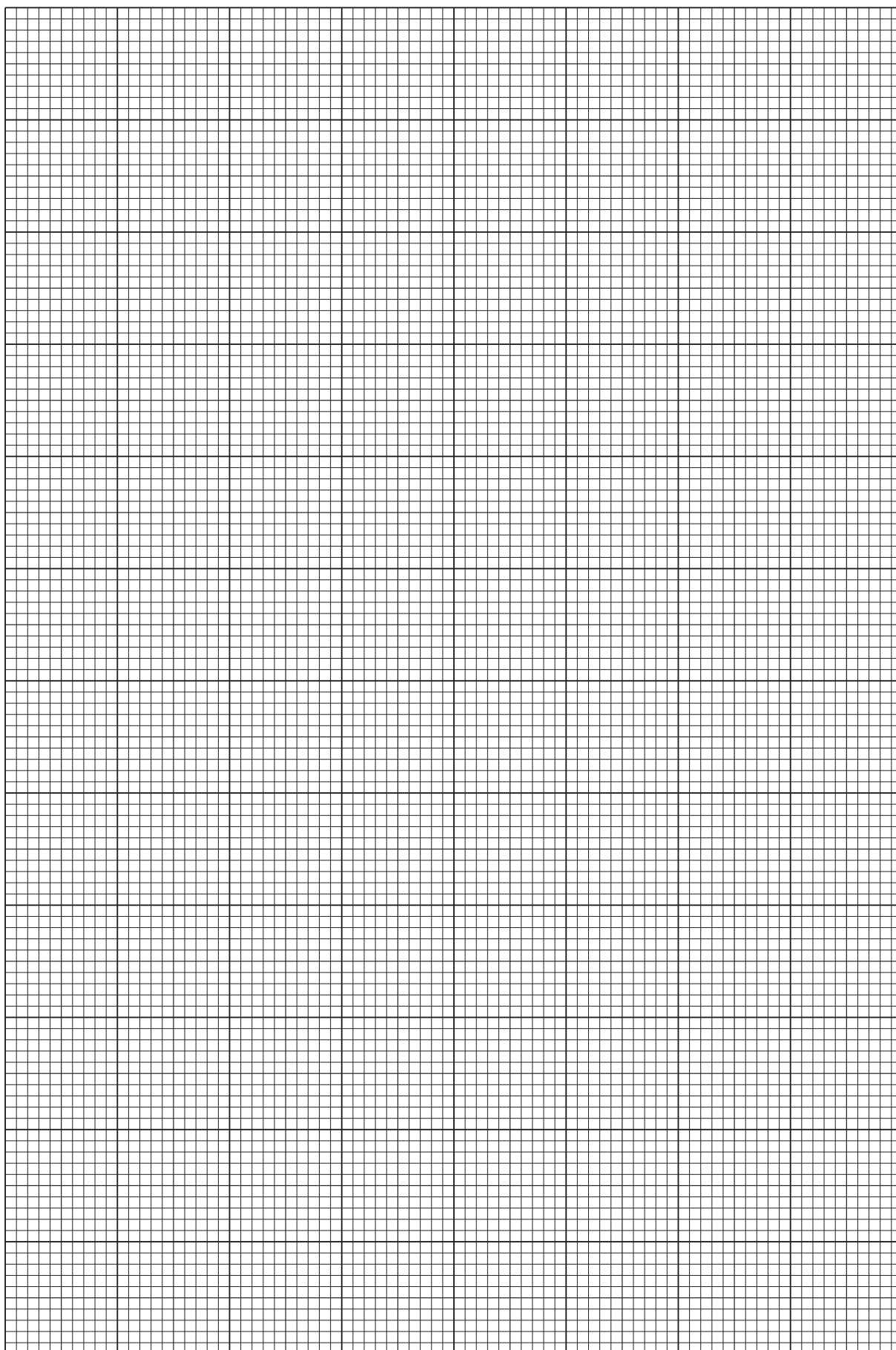
[1]

- (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]

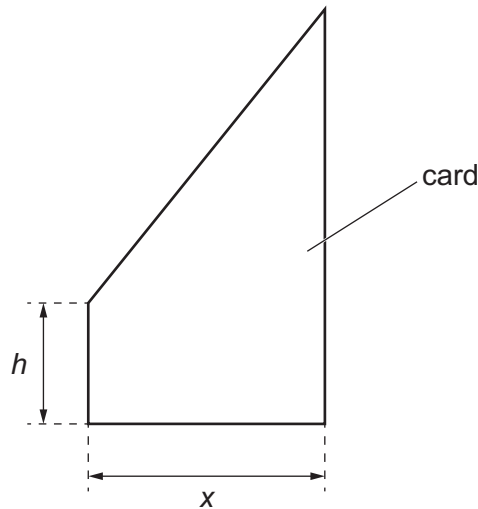
[Total: 20]

**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<sup>2</sup> [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.

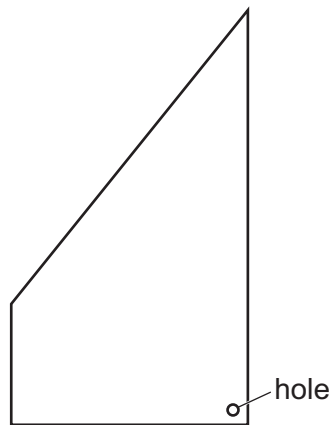


Fig. 2.2

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

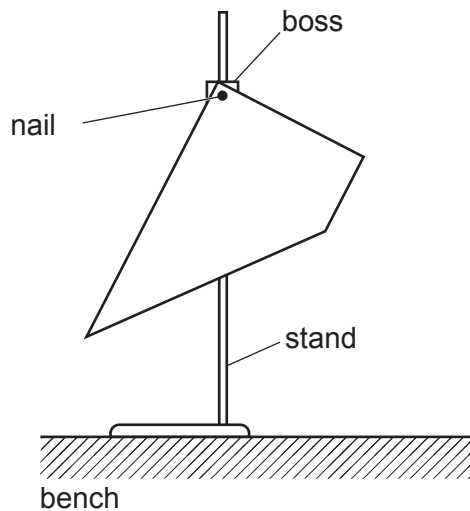


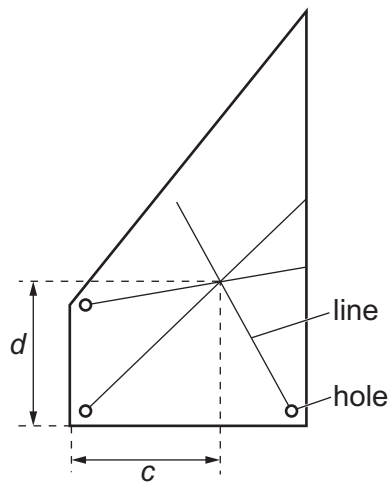
Fig. 2.3

- 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.

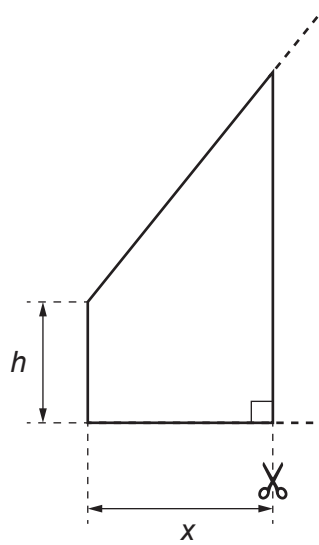


Fig. 2.5

- Measure and record  $x$ .

$x =$  ..... cm [1]

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

$A =$  ..... cm<sup>2</sup>

$c =$  ..... 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]

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