

# 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 Exam	iner's Use
1	
2	
Total	

This document has 12 pages.

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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 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.

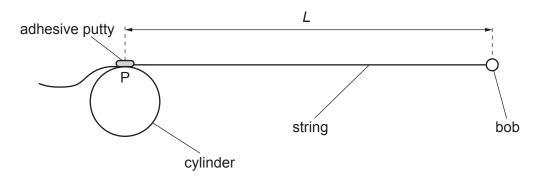


Fig. 1.1

• 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.

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

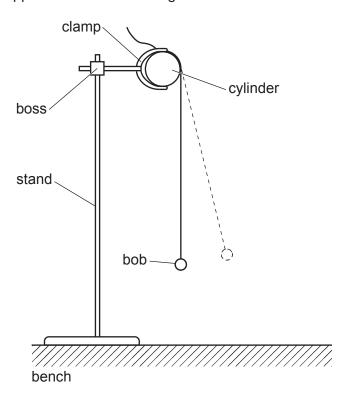
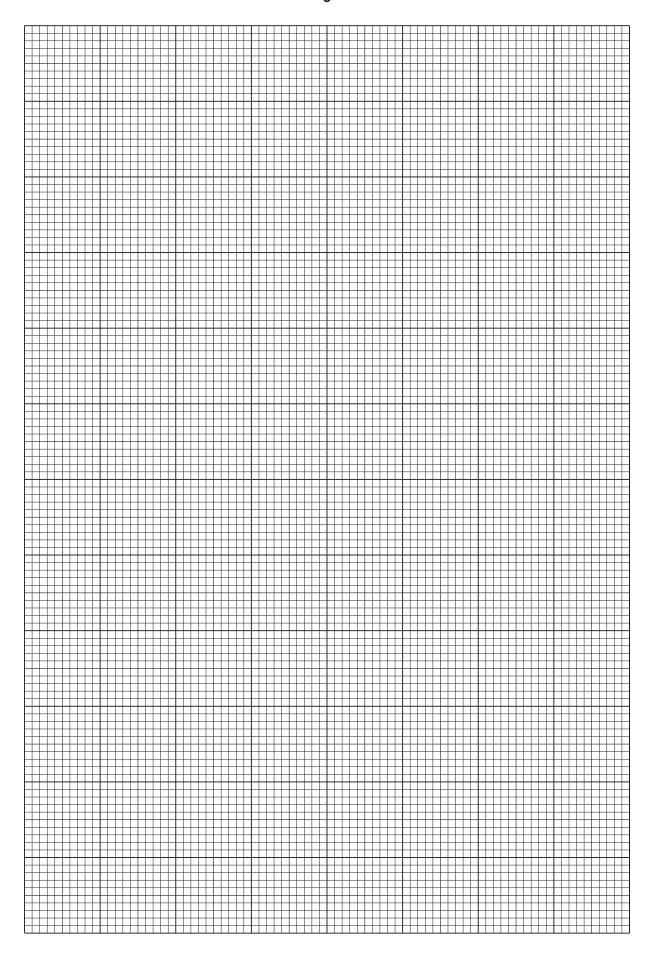


Fig. 1.2

- 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.

**(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*.

R	ecord 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 <i>y</i> -axis against $L^2$ on the <i>x</i> -axis.	[3]
(ii	) Draw the straight line of best fit.	[1]
(iii	) Determine the gradient and <i>y</i> -intercept of this line.	
	gradient =	
	<i>y</i> -intercept =	 [2]



(	(e)	It is suggested t	that the d	nuantities	T and I	are rela	ated by the	equation
۱	(C)	it is suggested t	lilat tile t	quariuucs	I allu L	are reis	ated by tile	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.

<b>⊢</b> =	 	 	
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.

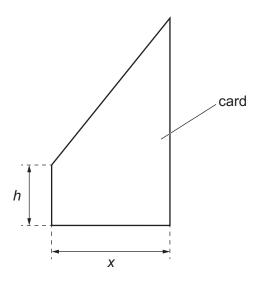


Fig. 2.1

(i) Measure and record h and x.

h	_	
п	=	 cm

(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.

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

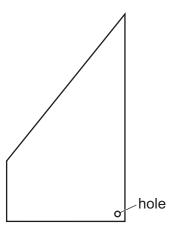


Fig. 2.2

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

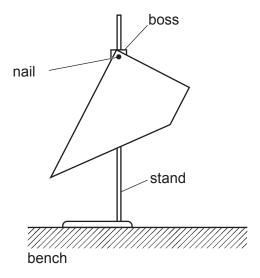


Fig. 2.3

- 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.

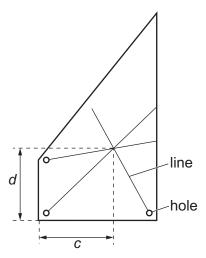


Fig. 2.4

Measure and record c and d.

c =	 	 	 	 	 	 	cm

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

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

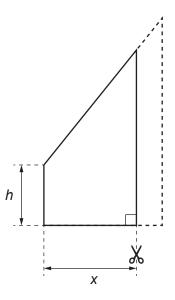


Fig. 2.5

Measure and record x.

x =		cm	[1]
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(ii) Repeat (a)(ii) and (b)(i).

$$A = \dots cm^2$$

(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 <i>k</i> .	
	first value of <i>k</i> =	
	second value of <i>k</i> =	
		[1
(e)	It is suggested that the percentage uncertainty in the values of $k$ is 5%.	
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(e)	It is suggested that the percentage uncertainty in the values of $k$ is 5%.	[1
(e)	It is suggested that the percentage uncertainty in the values of <i>k</i> is 5%.  Using this uncertainty, explain whether your results support the relationship in <b>(d)</b> .	[1

(i)	Describe <b>four</b> 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 <b>four</b> 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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