

# Cambridge International AS & A Level

CANDIDATE NAME				
CENTRE NUMBER		CANDIDATE NUMBER		

PHYSICS

Paper 3 Advanced Practical Skills 1 May/June 2021

2 hours

9702/35

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	

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

- 1 In this experiment, you will investigate the motion of a pendulum bob.
  - (a) Set up the apparatus as shown in Fig. 1.1.

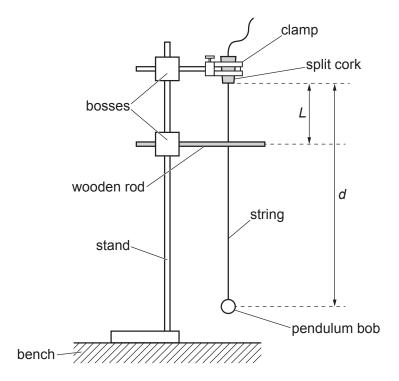


Fig. 1.1

• The distance between the bottom of the cork and the centre of the bob is *d*.

The distance between the bottom of the cork and the centre of the wooden rod is L.

Adjust the height of the rod until the value of L is approximately 10 cm. Ensure the rod is horizontal and the string is just touching the rod.

• Measure and record *L*.

*L* = ......[1]



(	b)	•	Adjust the	e strina in	the cork	until the	value of	d is a	pproximately	/ 30 cm.

• Measure and record *d*.

d –		
a =	 	

- Pull the bob towards you through a short distance at right angles to the rod.
- Release the bob. The bob will oscillate.
- Determine the period T of these oscillations.

(c) • Write down your value of *L* from (a).

L = .....

• Keeping *L* **constant**, repeat **(b)** with different values of *d* until you have five sets of values of *d* and *T*.

Record your results in a table. Include values of  $\frac{T}{\sqrt{d}}$  and  $\sqrt{\frac{(d-L)}{d}}$  in your table.

[10]

(d) (i) Plot a graph of  $\frac{T}{\sqrt{d}}$  on the *y*-axis against  $\sqrt{\frac{(d-L)}{d}}$  on the *x*-axis. [3]

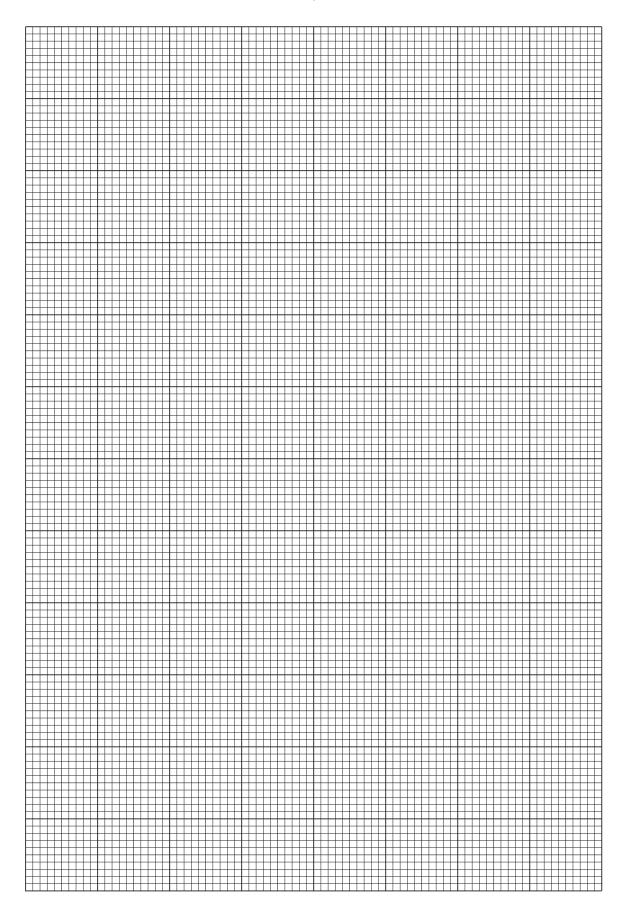
(ii) Draw the straight line of best fit. [1]

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

gradient = .....

*y*-intercept = ......[2]

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

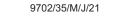
$$\frac{T}{\sqrt{d}} = P\sqrt{\frac{(d-L)}{d}} + Q$$

where P and Q are constants.

Using your answers in (d)(iii), determine the values of P and Q. Give appropriate units.

P =	 	 
O =		
_		[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 wooden strip.
  - (a) You have been provided with a wooden strip. There are three holes in the strip and string is attached to two of the holes.
    - Press the modelling clay onto the end of the strip as shown in Fig. 2.1.

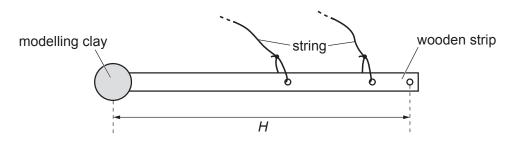


Fig. 2.1

• The distance between the centre of the modelling clay and the centre of the hole at the other end of the strip is *H*.

Using the ruler, take measurements to determine *H*.

 $H = \dots$  cm [1]

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(b) (i) ● Set up the apparatus as shown in Fig. 2.2.

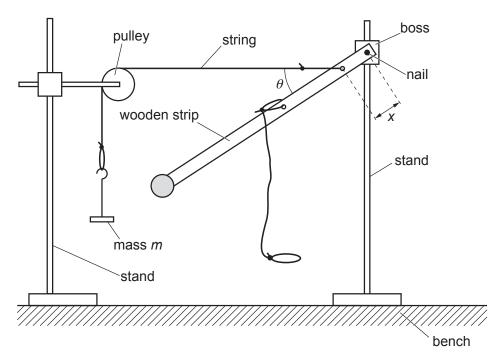


Fig. 2.2 (not to scale)

- Hang a mass *m* of 100 g from the string.
- Adjust the heights of the boss and pulley until the string between the strip and the pulley is horizontal.
- The distance between the nail and the hole through which the string is attached is x.

The angle between the strip and the horizontal string is  $\theta$ .

Measure and record x and  $\theta$ .

χ =	 cm
θ=	0
	[2]

(ii) Estimate the percentage uncertainty in your value of  $\theta$ . Show your working.

percentage uncertainty = ......[1]

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1	(iii)	Calculate x tai	$\theta$
- 1		<i>i</i> Galculate a tal	1 U.

	$x \tan \theta = \dots $ cm [1]
(iv)	Justify the number of significant figures that you have given for your value of $x \tan \theta$ .
	[1]

- (c) Remove the mass and the string from the pulley.
  - Set up the apparatus as shown in Fig. 2.3 using the other string.

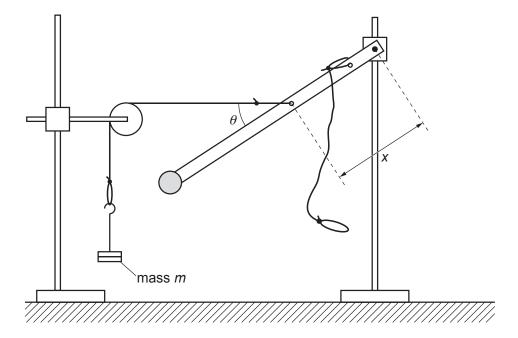


Fig. 2.3 (not to scale)

- Hang a mass m of 200 g from the string.
- Adjust the heights of the boss and pulley until the string between the strip and the pulley is horizontal.
- The distance between the nail and the hole through which the string is attached is *x*.

The angle between the strip and the horizontal string is  $\theta$ .

Measure and record x and  $\theta$ .

<i>x</i> =	 	 	 	 cm
θ=				o

• Calculate  $x \tan \theta$ .

(d)	It is suggested that the relationship between $x$ , $\theta$ and $m$ is
	$x \tan \theta = \frac{k}{m}$

where k is a constant.

(i) Using your data, calculate two values of *k*.

first value of 
$$k = \dots$$
second value of  $k = \dots$ 
[1]

(ii) Explain whether your results support the suggested relationship.

		F41
 	 	 [1]

(e) Theory suggests that

$$k = \frac{5HM}{6}$$

where *M* is the mass of the wooden strip.

Use your second value of k to calculate a value for M. Give an appropriate unit.

$$M =$$
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f)	(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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