

Cambridge International AS & A Level

CANDIDATE NAME					
CENTRE NUMBER			CANDIDATE NUMBER		

37100778

PHYSICS 9702/34

Paper 3 Advanced Practical Skills 2

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 guestion 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. Any blank pages are indicated.

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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 pendulum.
 - (a) Assemble the apparatus as shown in Fig. 1.1 with the nail held securely in the cork. Check that the wooden rod can swing freely.

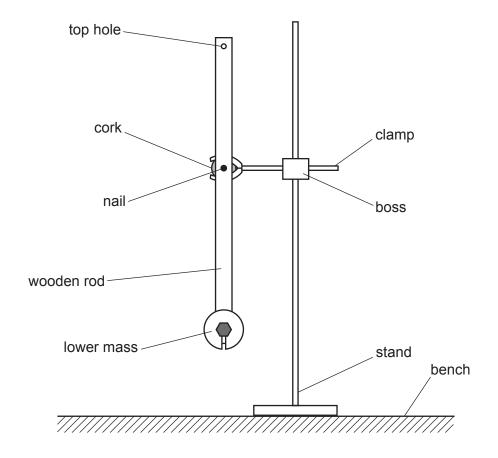


Fig. 1.1

- You have been provided with one 50 g and four 10 g slotted masses. Use the bolt and nut to attach some of the 10 g slotted masses to the top hole.
- Record the total mass *M* of the slotted masses that are attached to the top hole.

M =

- Push the bottom of the wooden rod a small distance to one side.
- Release the wooden rod so that it oscillates.
- Take measurements to determine the period T of the oscillations.

(b)	Change M and determine	Т.	Repeat	until	you	have	six	sets	of	values	of	Μ	and	Т.	Do	not
	change the lower mass.															

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

(c) (i) Plot a graph of T² on the y-axis against M² on the x-axis. [3]
(ii) Draw the straight line of best fit. [1]

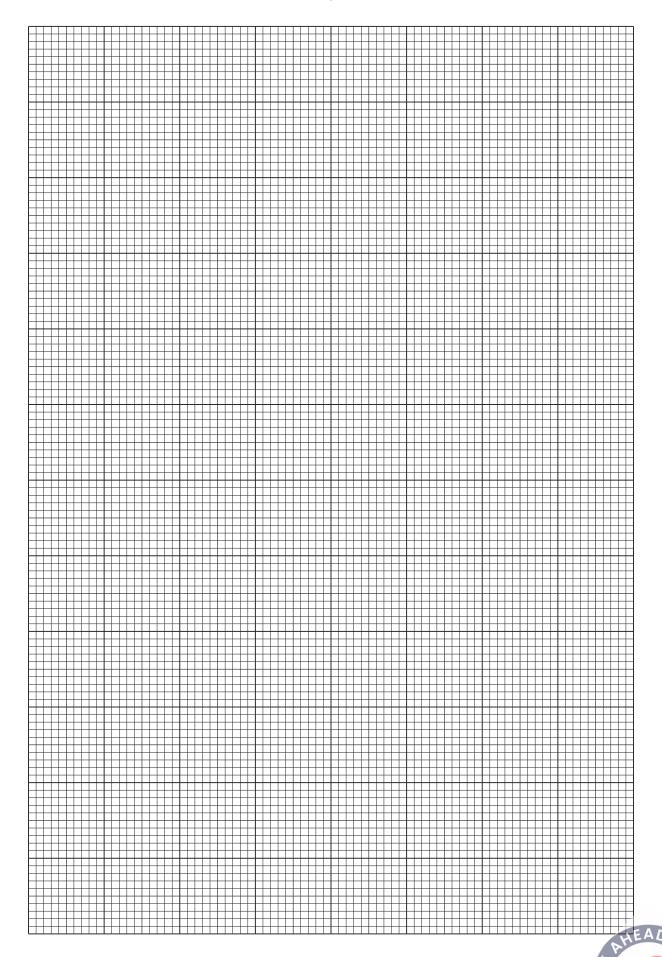
(iii) Determine the gradient and *y*-intercept of this line.

gradient =

y-intercept =



[9]



	(d)	It is suggested that the	guantities	T and M are	related by the	equation
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$$T^2 = aM^2 + b$$

where a and b are constants.

Using your answers in (c)(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 the thermal expansion of plastic.
 - (a) You have been provided with two plastic pipes. Each pipe has a string loop attached at each end, as shown in Fig. 2.1.

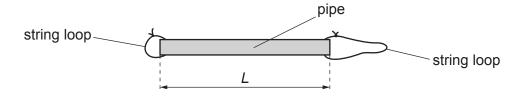


Fig. 2.1

Measure and record the length L of the longer pipe, as shown in Fig. 2.1.

• Place the thermometer on the bench. Record the room temperature T_0 .

$$T_0 =$$
 [2]

- (b) (i) You have been provided with a wooden rod supported by a pin.
 - Using the longer pipe, assemble the apparatus as shown in Fig. 2.2.

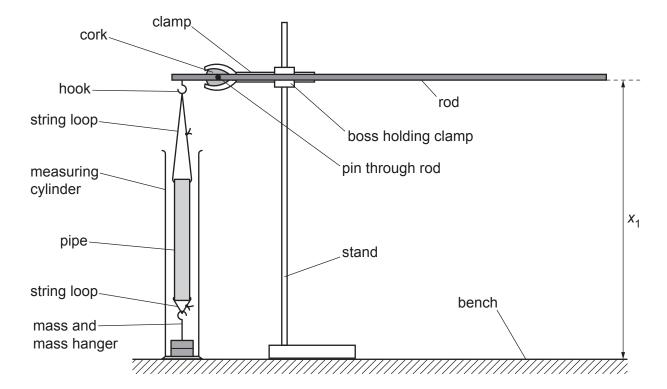


Fig. 2.2



•	Adjust the apparatus so that the rod is parallel to the bench and the mass hanger
	rests on the bottom of the measuring cylinder.

•	Measure and record the height x_1 of the end of the rod above the bench, as shown
	in Fig. 2.2.

$$x_1 =$$
 [1]

- (ii) Slowly pour boiling water into the measuring cylinder until it covers the pipe.
 - Place the thermometer in the water. Record the temperature *T*.

- Remove the thermometer from the water.
- The expansion of the pipe causes the end of the rod to move down. Measure the new height x₂ of the end of the rod above the bench.

 Carefully remove the pipe and mass hanger (the masses will be very hot) and pour the hot water into the sink.

[2]

(iii) Calculate $(x_1 - x_2)$.

$$(x_1 - x_2) = \dots$$
 [1]

(iv) Estimate the percentage uncertainty in your value of $(x_1 - x_2)$. Show your working.



(c)	•	Measure and record the length <i>L</i> of the shorter pipe.

(c) •

L = Repeat (b)(i), (b)(ii) and (b)(iii) using the shorter pipe. *x*₁ = *T* =

$$(x_1 - x_2) = \dots$$
 [2]



		11	
(d)	It is	suggested that the relationship between x_1 , x_2 , L , T and T_0 is	
		$k(x_1 - x_2) = L(T - T_0)$	
	whe	ere <i>k</i> is a constant.	
	(i)	Using your data, calculate two values of <i>k</i> .	
		final value of to-	
		first value of <i>k</i> =	
		second value of k =	[1]
	(ii)	Justify the number of significant figures that you have given for your values of k .	
			[1]
(e)	It is	suggested that the percentage uncertainty in the values of <i>k</i> is 20%.	
	Usi	ng this uncertainty, explain whether your results support the relationship in (d).	



(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

[Total: 20]

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