Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME	

CENTRE NUMBER			CANDIDATE NUMBER	

3710077893

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 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. Any blank pages are indicated.

DC (PQ/SG) 313458/2

BLANK PAGE

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.

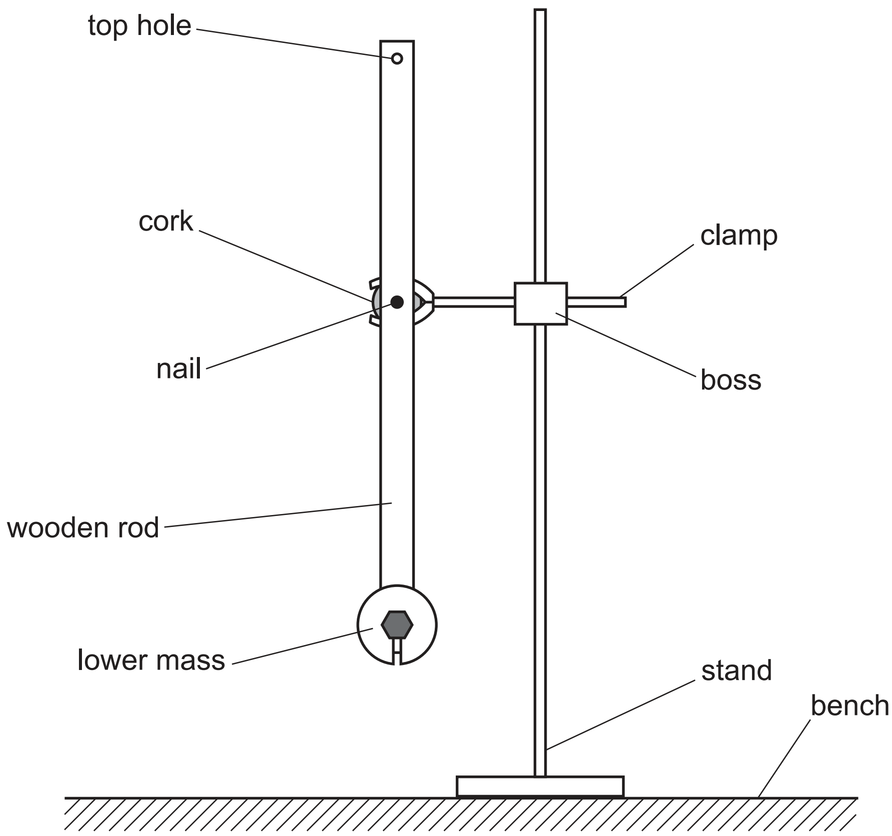

Fig. 1.1

● 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.

T = ...

[3]

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

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

[9]

(c) **(i)** Plot a graph of T^2 on the y-axis against M^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]

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

$$T^2 = aM^2 + b$$

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]

BLANK PAGE

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.

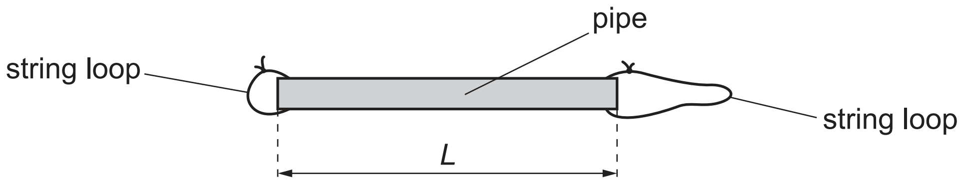

Fig. 2.1

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

L = ...

- 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.

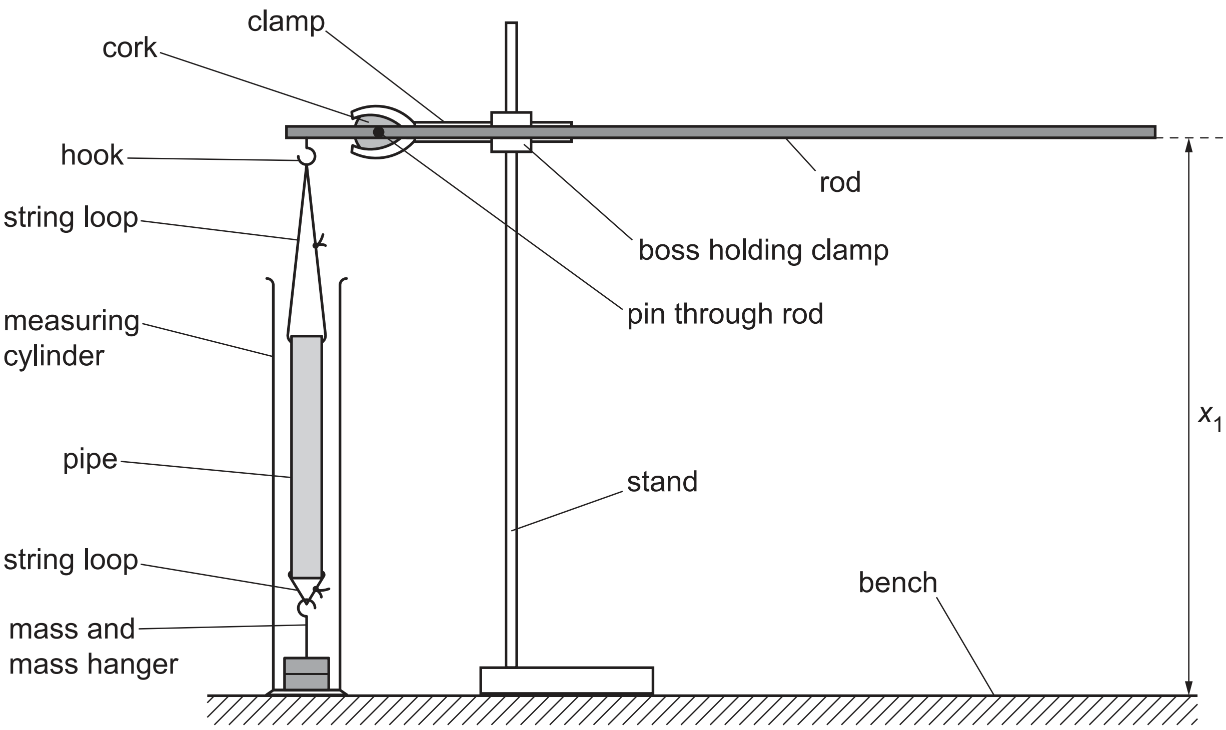

Fig. 2.2

- 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.

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 x_2 of the end of the rod above the bench.

x_2 = ...

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

[2]

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

$(x_1 - x_2)$ = ... [1]

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

percentage uncertainty = ... % [1]

(c) • Measure and record the length L of the **shorter** pipe.

L = ...

• Repeat **(b)(i)**, **(b)(ii)** and **(b)(iii)** using the shorter pipe.

x_1 = ...

T = ...

x_2 = ...

$(x_1 - x_2)$ = ...
[2]

(d) It is suggested that the relationship between x_1, x_2, L, T and T_0 is

$$k(x_1 - x_2) = L(T - T_0)$$

where k is a constant.

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

first value of k = ...

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 k is 20%.

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]