Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

PHYSICS **9702/34**

Paper 3 Advanced Practical Skills 2 **May/June 2024**

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.

[Turn over

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

1 In this experiment, you will investigate the equilibrium position of a pulley system.

(a) • Assemble the apparatus as shown in Fig. 1.1 with the rods of the stands approximately 50 cm apart.

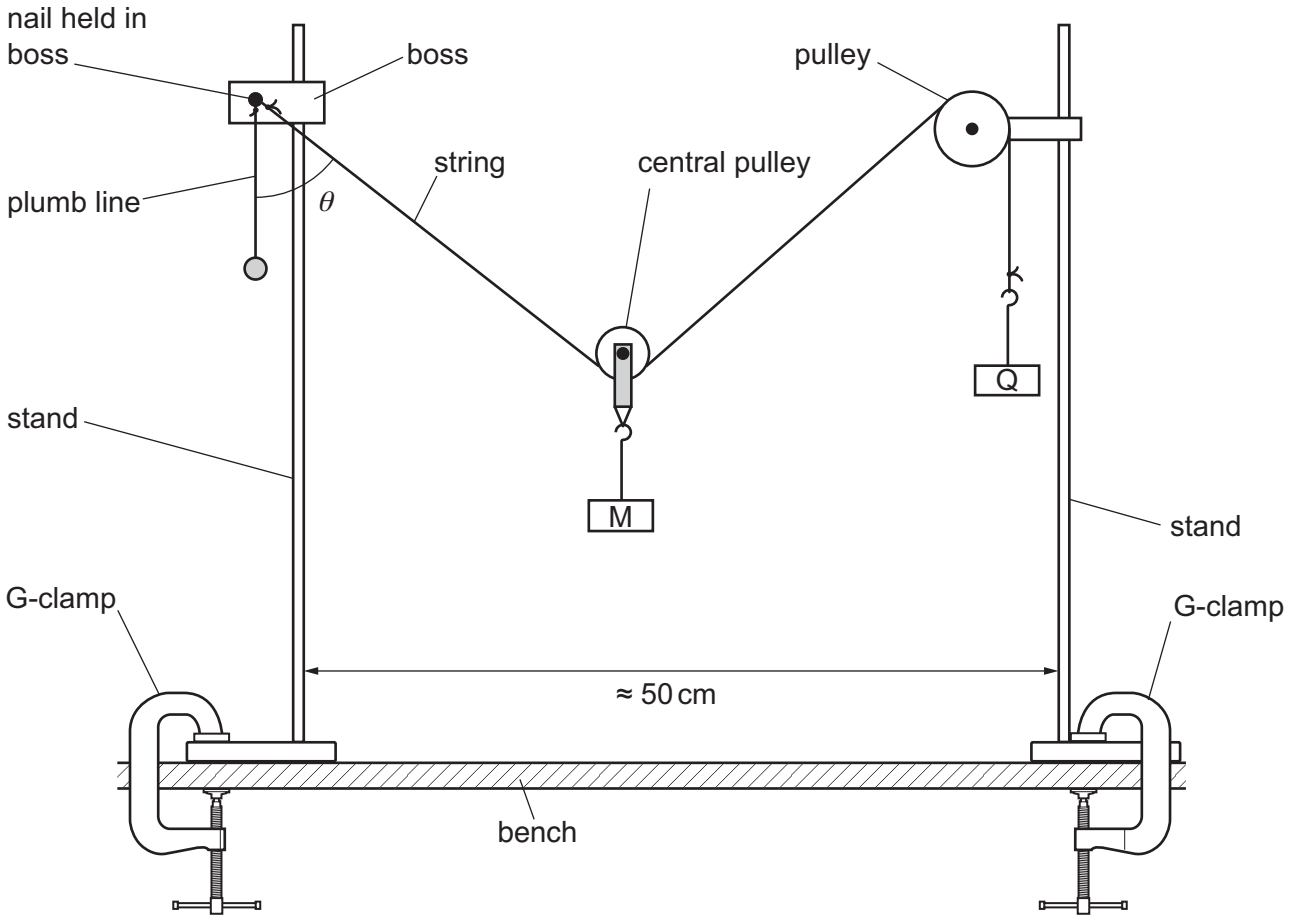


Fig. 1.1

- Adjust the pulley fixed to the stand so that the top of the pulley is approximately 60 cm above the bench.
- Adjust the boss holding the nail so that the nail is approximately 60 cm above the bench.

- Use some of the slotted masses to add a mass of 70 g to Q.
- The mass added to Q is x. Record the value of x.

x = ... g

- The angle between the plumb line and the string is θ, as shown in Fig. 1.1.

  Measure and record θ.

θ = ... °

- Carefully remove the slotted masses from Q.

[1]

(b) By using different numbers of slotted masses, vary x. For each value of x, measure θ.

Repeat until you have six sets of values of x and θ.

Record your results in a table. Include values of $\frac{1}{\cos\theta}$ in your table.

[10]

(c) (i) Plot a graph of $\frac{1}{\cos\theta}$ on the y-axis against x on the x-axis. [3]

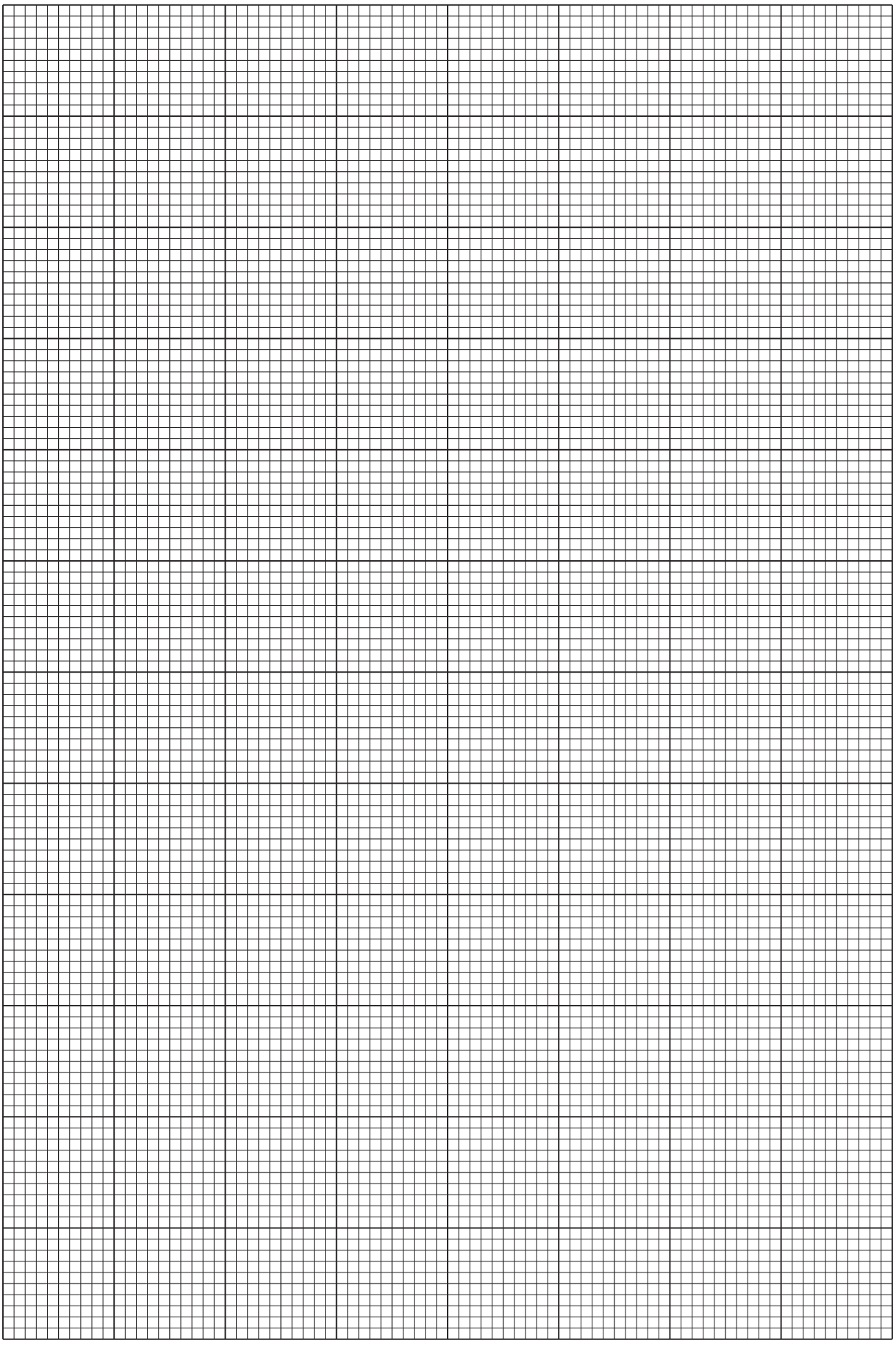
(ii) Draw the straight line of best fit. [1]

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

gradient = ...

y-intercept = ...

[2]



(d) It is suggested that the quantities θ and x are related by the equation

$$\frac{1}{\cos\theta} = ax + b$$

where a and b are constants.

Use your answers in **(c)(iii)** to determine the values of a and b.
Give appropriate units.

a = ...

b = ...
[2]

(e) The mass of M is M and the mass of Q is Q.

The constants a and b are related to M and Q by

$$a = \frac{2}{M} \text{ and } b = \frac{2Q}{M}.$$

Calculate values for M and Q.

M = ... g

Q = ... g
[1]

[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 effect of air resistance on a spinning card.

(a) (i) ● Assemble the apparatus as shown in Fig. 2.1, with the washer and plastic tube over the nail.

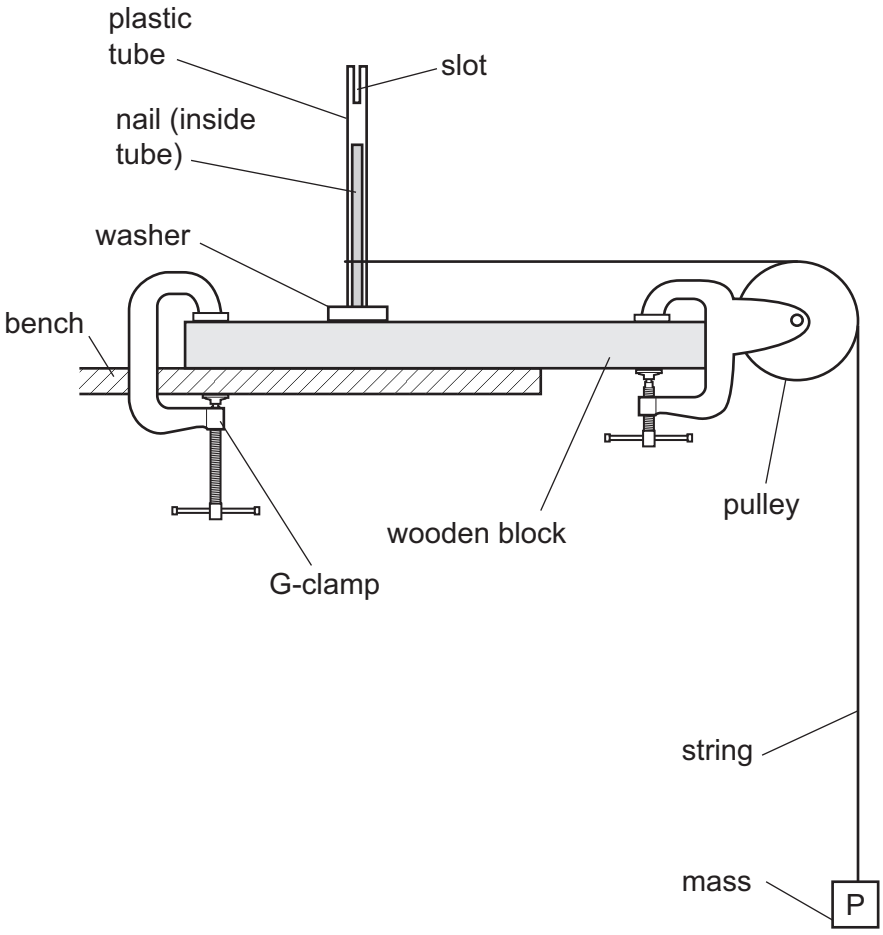

Fig. 2.1

- Rotate the plastic tube so that P rises until it just touches the pulley.
- Release the plastic tube so that P falls.
- Measure and record the time T_0 for P to reach the end of its fall.

T_0 = ... [2]

(ii) Estimate the percentage uncertainty in your value of T_0. Show your working.

percentage uncertainty = ... % [1]

(b) (i) Fig. 2.2 shows card A.

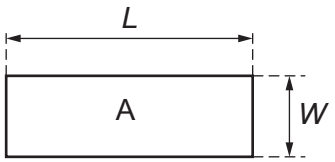

Fig. 2.2

Measure and record the length L and the width W of the card, as shown in Fig. 2.2.

L = ...

W = ...
[1]

(ii)
- Insert the card centrally into the slot at the top of the plastic tube with its length horizontal. If necessary, use a small piece of adhesive putty to fix it securely in the slot.
- Rotate the plastic tube so that P rises until it just touches the pulley.
- Release the plastic tube and measure the time T for P to reach the end of its fall.

T = ... [2]

(c) Repeat **(b)** using the card marked B.

L = ...

W = ...

T = ...
[3]

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

$$k(T - T_0) = L^2W$$

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 15%.

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]