



# Cambridge International AS & A Level

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## 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.

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.

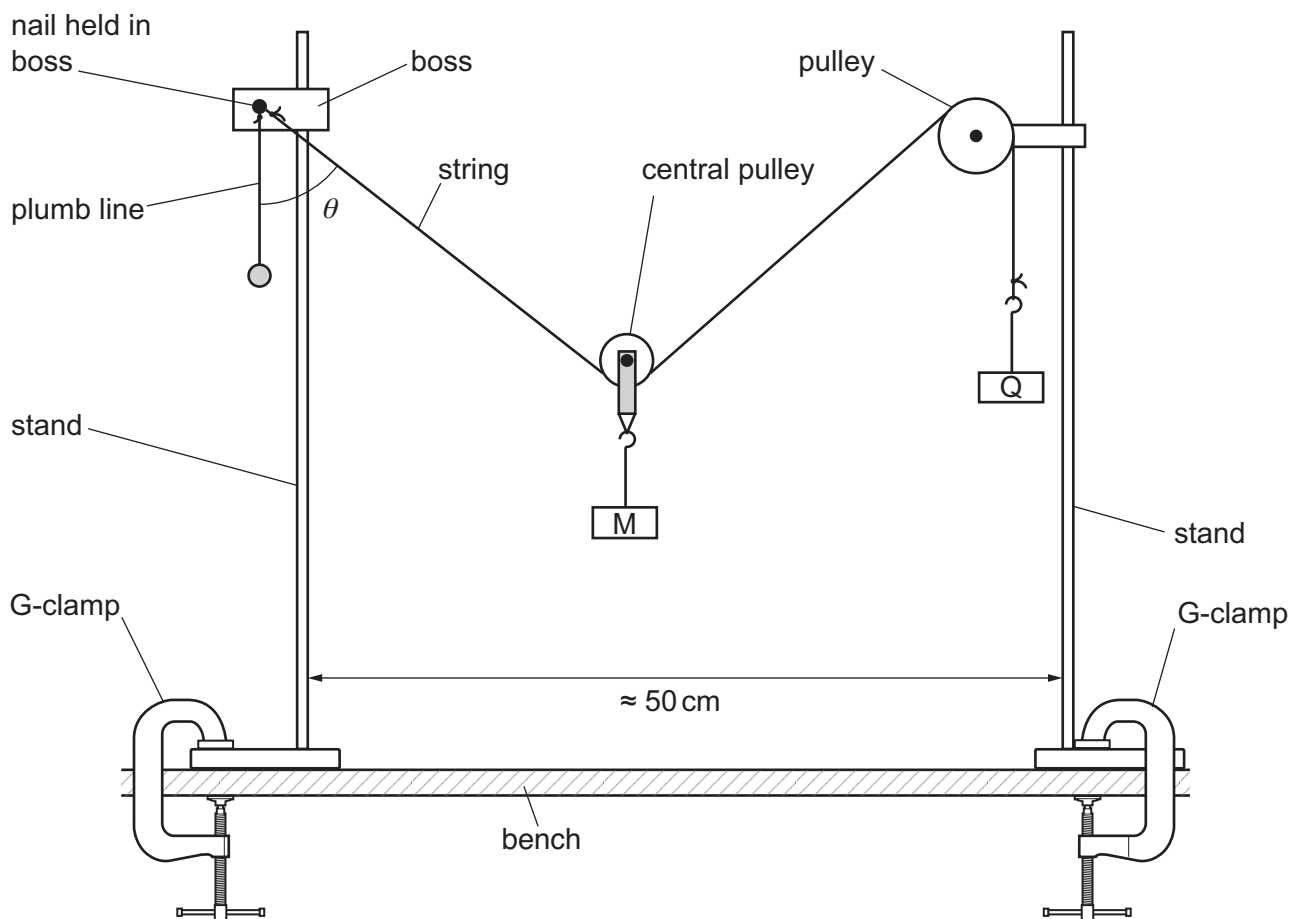


Fig. 1.1

- 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  $x$ .

$x = \dots\dots\dots$  g

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

Measure and record  $\theta$ .

$\theta = \dots\dots\dots$  °

- Carefully remove the slotted masses from Q.

[1]





- (b) By using different numbers of slotted masses, vary  $x$ . For each value of  $x$ , measure  $\theta$ .

Repeat until you have six sets of values of  $x$  and  $\theta$ .

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]

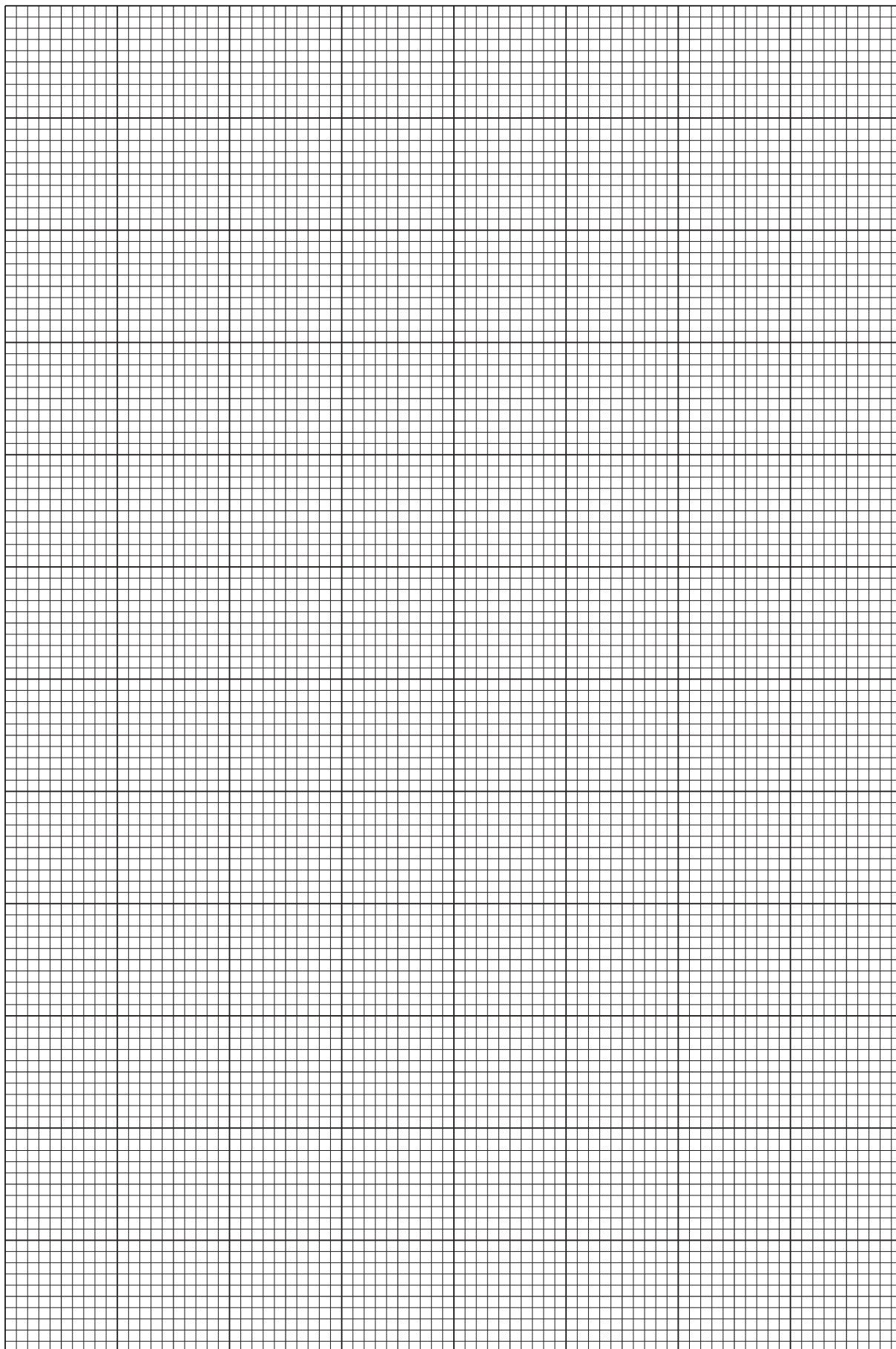
- (iii) Determine the gradient and  $y$ -intercept of this line.

gradient = .....

$y$ -intercept = .....

[2]







(d) It is suggested that the quantities  $\theta$  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.

$$a = \dots\dots\dots$$

$$b = \dots\dots\dots$$

[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  $Q$ .

$$M = \dots\dots\dots \text{ g}$$

$$Q = \dots\dots\dots \text{ g}$$

[1]

[Total: 20]



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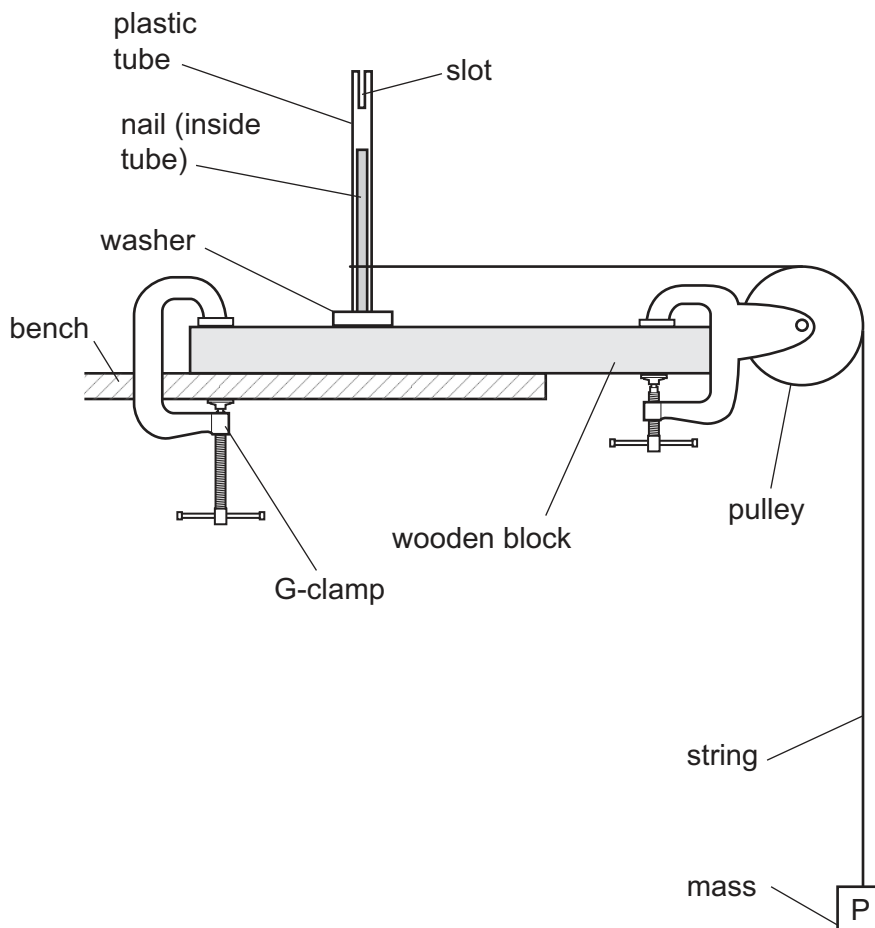




**You may not need to use all of the materials provided.**

**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.

$T_0 = \dots\dots\dots$  [2]

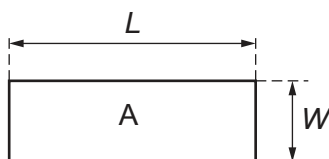




(ii) Estimate the percentage uncertainty in your value of  $T_0$ . Show your working.

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

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

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]

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