



# Cambridge International AS & A Level

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## PHYSICS

9702/33

Paper 3 Advanced Practical Skills 1

February/March 2026

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. Do **not** use correction fluid or tape.
- 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            |  |
| <b>Total</b> |  |

This document has **12** pages.

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

**1** In this experiment, you will investigate the equilibrium of forces.

- (a)**
- Assemble the apparatus as shown in Figure 1.1.
  - Pass the nail through the central hole in the metre rule. Secure the nail in the boss.
  - Attach one end of the paper clip chain to the string loop.
  - Attach the loop of the plumb line to the nail.

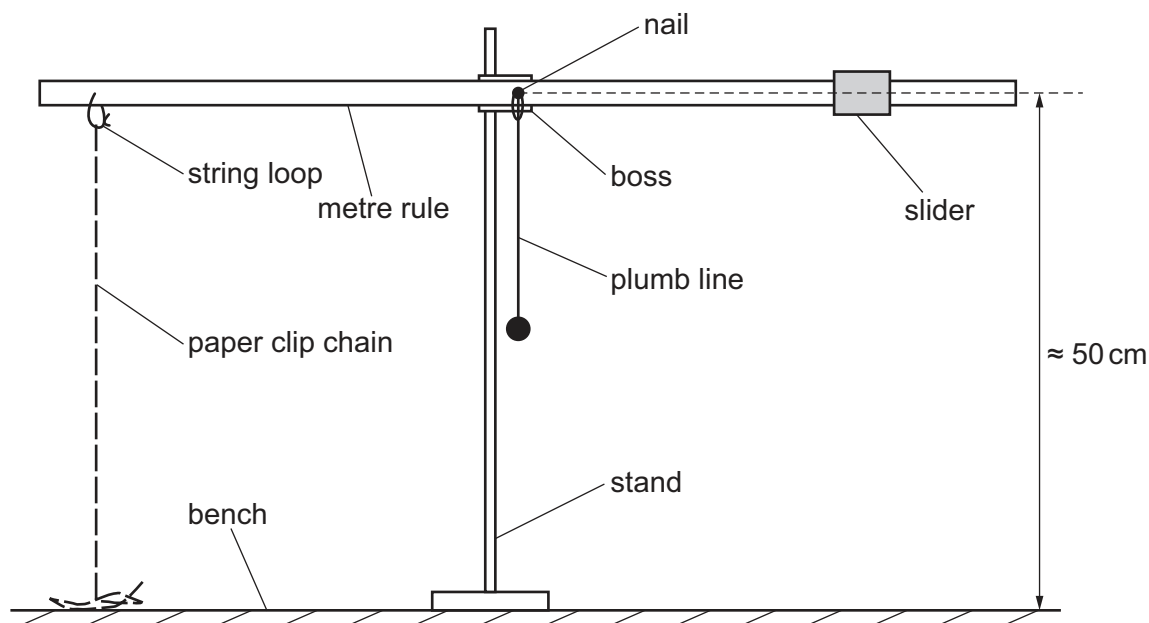


**Figure 1.1**

- Adjust the height of the boss so that the nail is approximately 50 cm above the bench.
- Check that the metre rule swings freely.
- Adjust the position of the slider until the metre rule is approximately parallel to the bench, as shown in Figure 1.1.



- Increase the distance between the nail and the slider by approximately 5 cm. Wait for the metre rule to settle into its new equilibrium position, as shown in Figure 1.2.

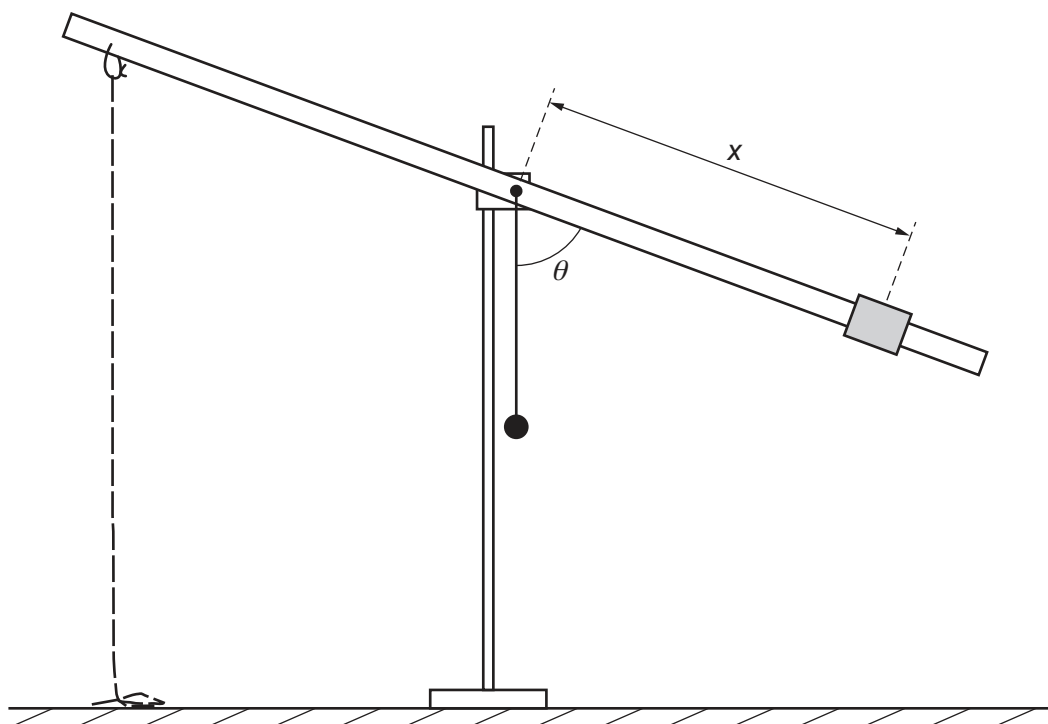


Figure 1.2

- The distance between the nail and the centre of the slider is  $x$ .

The angle between the plumb line and the metre rule is  $\theta$ , as shown in Figure 1.2.

Measure and record  $x$  and  $\theta$ .

$x =$  .....

$\theta =$  .....<sup>°</sup>  
[2]



- (b) Move the slider to a new position. Ensure that at least one paper clip is touching the bench and  $\theta$  is less than  $90^\circ$ . Measure and record  $x$  and  $\theta$ .

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

Record your results in a table. Include values of  $\sin(90 - \theta)$  in your table. Give all values of  $\sin(90 - \theta)$  to three significant figures.

[10]

- (c) (i) Plot a graph of  $\sin(90 - \theta)$  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.

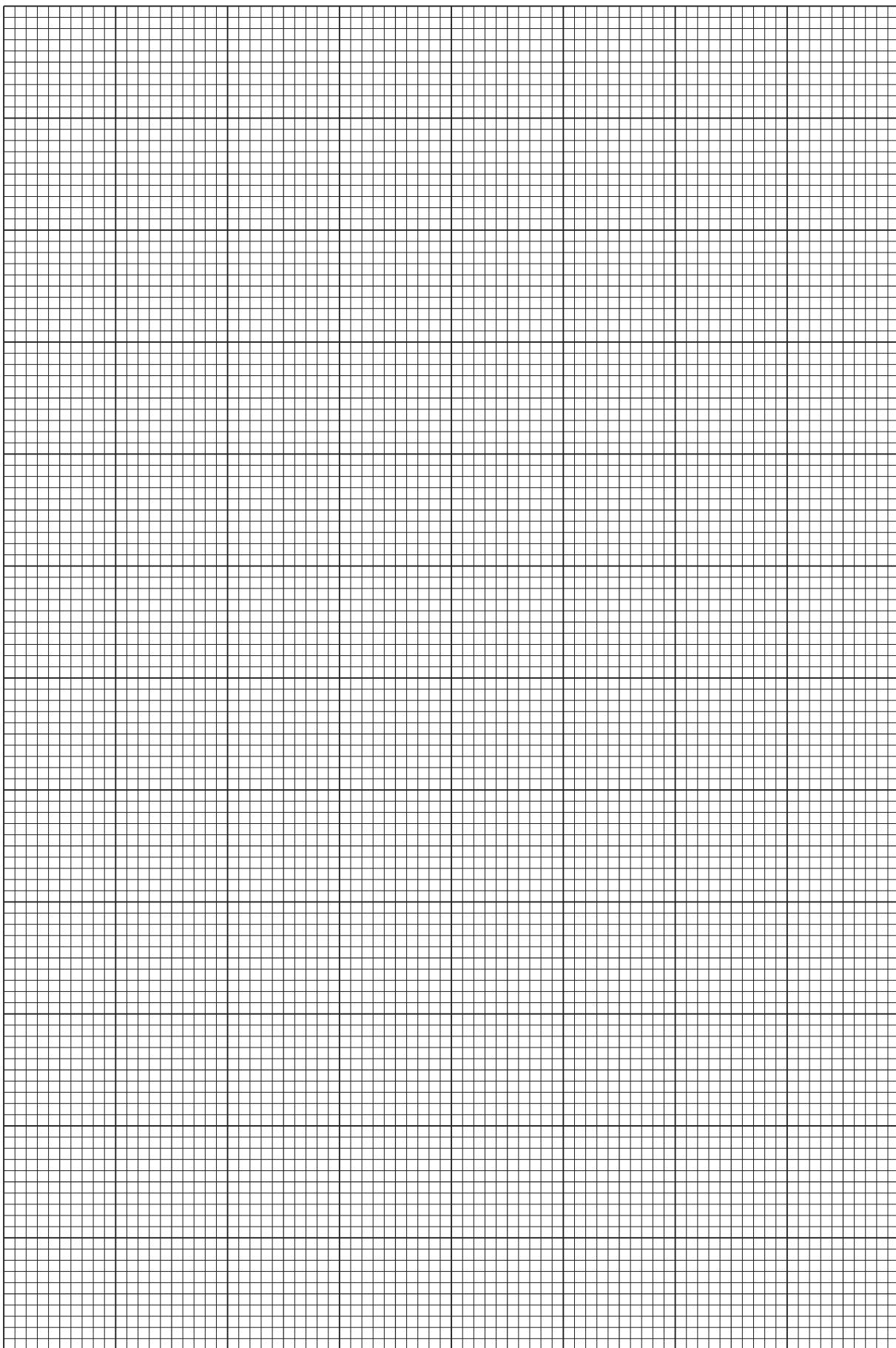
gradient = .....

y-intercept = .....

[2]



DO NOT WRITE IN THIS MARGIN





(d) It is suggested that the quantities  $\theta$  and  $x$  are related by the equation

$$\sin(90 - \theta) = px + q$$

where  $p$  and  $q$  are constants.

Use your answers in **1(c)(iii)** to determine the values of  $p$  and  $q$ .

Give appropriate units.

$p =$  .....

$q =$  .....

[2]

[Total: 20]



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

**2** In this experiment, you will investigate the vibrations of a hacksaw blade.

**(a) (i)** • Clamp the hacksaw blade between the two wooden blocks as shown in Figure 2.1.

The length of the blade outside the blocks should be at least 26 cm.

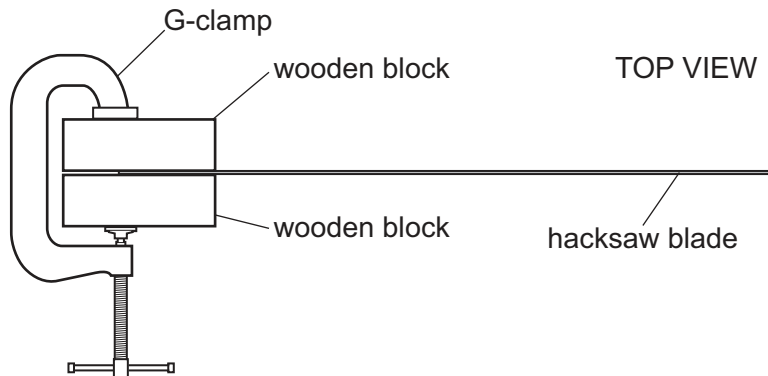


**Figure 2.1**

• Clamp the wooden blocks to the bench as shown in Figure 2.2.

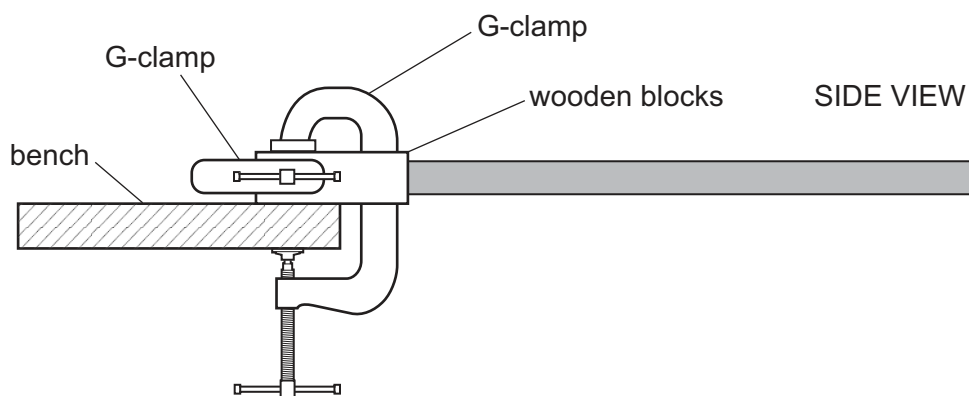


**Figure 2.2**

- Pass the screw through the two slotted masses. Loosely attach the wing nut to the screw.
- Position the slotted masses either side of the hacksaw blade with the screw resting on the top of the hacksaw blade as shown in Figure 2.3.

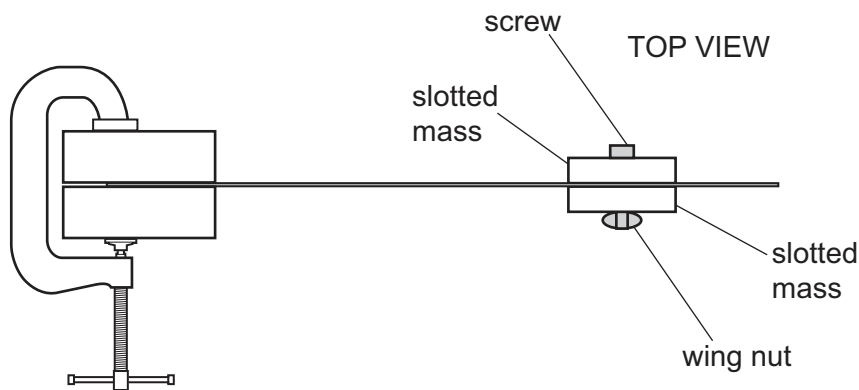


Figure 2.3

- Tighten the wing nut.
- Place the string of the pendulum over the hacksaw blade approximately 3 cm from the wooden blocks.
- The distance between the bottom of the hacksaw blade and the centre of the pendulum bob is  $L$  as shown in Figure 2.4.

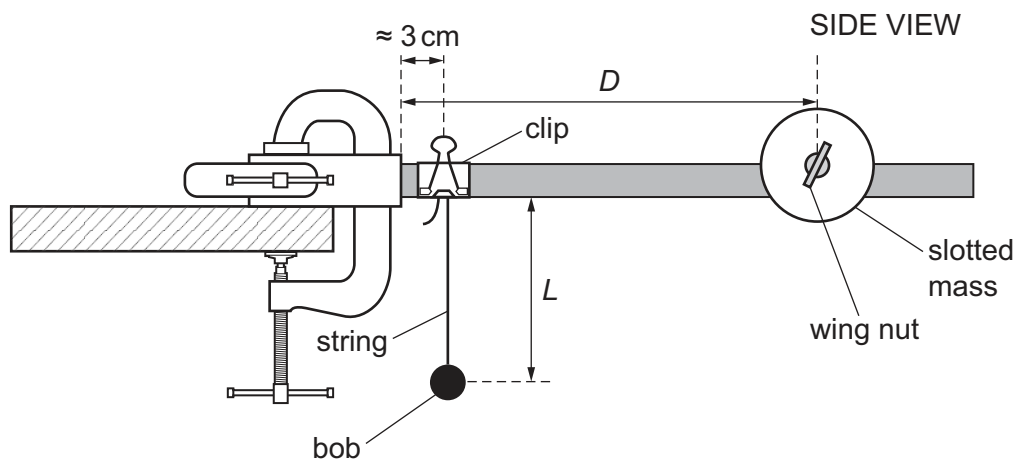


Figure 2.4

- Adjust the string so that  $L$  is approximately 4 cm. Secure the string with the clip, as shown in Figure 2.4.
- Measure and record  $L$ .

$L = \dots\dots\dots$  [1]



- (ii) • Move the free end of the hacksaw blade horizontally to one side and release it so that it oscillates. The movement will cause the pendulum to oscillate.
- Change the position of the slotted masses on the hacksaw blade and repeat until the amplitude of the pendulum oscillations is a maximum. Secure the masses.
- The distance between the centre of the masses and the wooden blocks is  $D$ , as shown in Figure 2.4.

Measure and record  $D$ .

$D =$  ..... [1]

- (iii) Estimate the percentage uncertainty in your value of  $D$ . Show your working.

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

- (b) (i) • Adjust the length of the pendulum until  $L$  is approximately 25 cm.
- Measure and record  $L$ .

$L =$  ..... [1]

- (ii) Repeat 2(a)(ii).

$D =$  ..... [2]





- (c) It is suggested that the relationship between  $D$  and  $L$  is

$$D^3 = kL$$

where  $k$  is a constant.

- (i) Using your data, calculate **two** values for  $k$ .

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]

- (d) 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 **2(c)**.

.....

.....

..... [1]



- (e) (i) The width of the hacksaw blade is  $w$  and the thickness of the blade is  $t$  as shown in Figure 2.5.



Figure 2.5

Measure and record  $w$  and  $t$ .

$w =$  ..... cm

$t =$  ..... cm  
[2]

- (ii) The Young modulus of the steel used to make the hacksaw blade is  $E$ .

Calculate  $E$  using the second value of  $k$  in the expression

$$E = \frac{Rk}{t^3 w}$$

where  $R$  has the value 7.85 N.

$E =$  .....  $\text{Ncm}^{-2}$  [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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