

# Cambridge International AS & A Level

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**PHYSICS**
**9702/35**

Paper 3 Advanced Practical Skills 1

**May/June 2021**
**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	
<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 motion of a pendulum bob.
- (a) • Set up the apparatus as shown in Fig. 1.1.

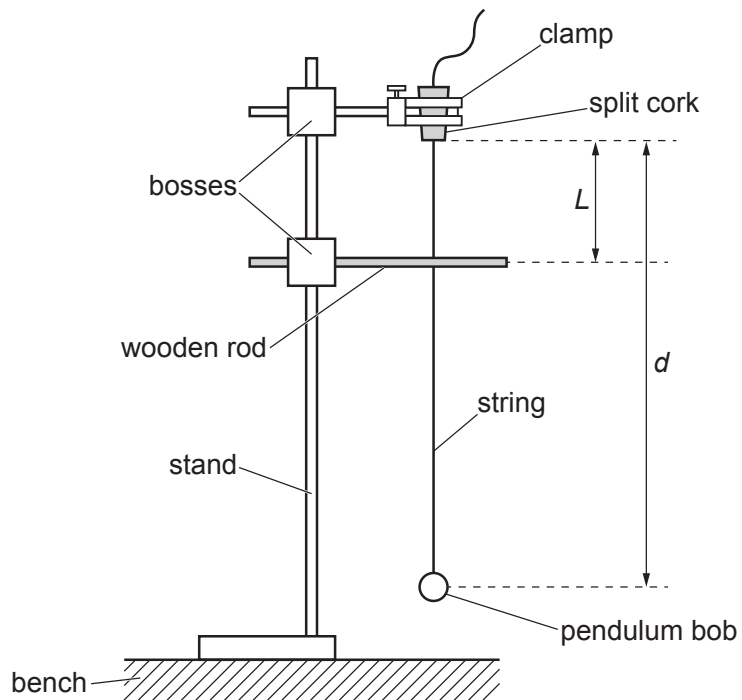


Fig. 1.1

- The distance between the bottom of the cork and the centre of the bob is  $d$ .

The distance between the bottom of the cork and the centre of the wooden rod is  $L$ .

Adjust the height of the rod until the value of  $L$  is approximately 10 cm. Ensure the rod is horizontal and the string is just touching the rod.

- Measure and record  $L$ .

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

3

- (b)
- Adjust the string in the cork until the value of  $d$  is approximately 30 cm.
  - Measure and record  $d$ .

 $d = \dots\dots\dots$ 

- Pull the bob towards you through a short distance at right angles to the rod.
- Release the bob. The bob will oscillate.
- Determine the period  $T$  of these oscillations.

 $T = \dots\dots\dots$  s  
[1]

4

- (c) • Write down your value of  $L$  from (a).

$L = \dots\dots\dots$

- Keeping  $L$  **constant**, repeat (b) with different values of  $d$  until you have five sets of values of  $d$  and  $T$ .

Record your results in a table. Include values of  $\frac{T}{\sqrt{d}}$  and  $\sqrt{\frac{(d-L)}{d}}$  in your table.

[10]

- (d) (i) Plot a graph of  $\frac{T}{\sqrt{d}}$  on the  $y$ -axis against  $\sqrt{\frac{(d-L)}{d}}$  on the  $x$ -axis.

[3]

- (ii) Draw the straight line of best fit.

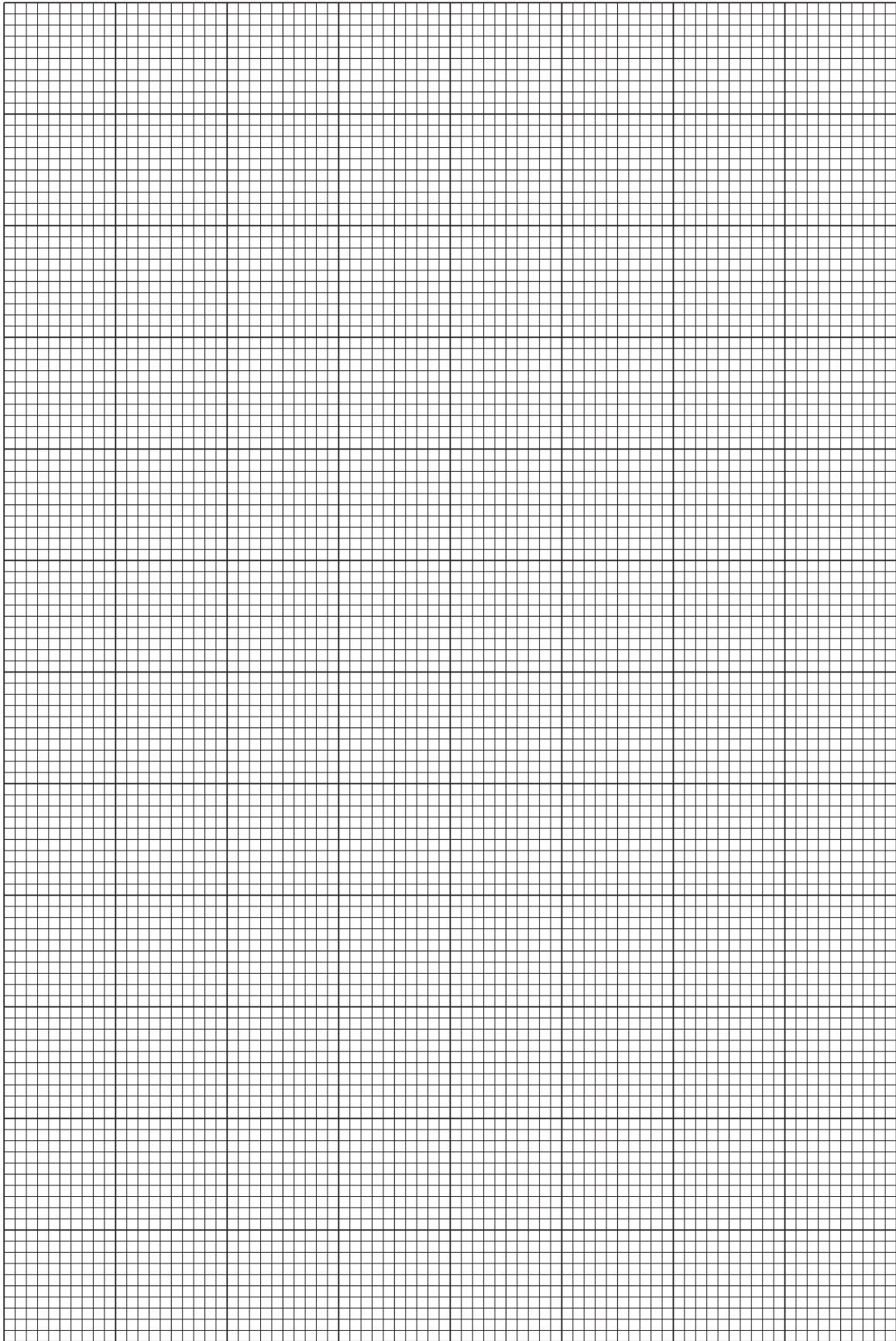
[1]

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

gradient =  $\dots\dots\dots$

$y$ -intercept =  $\dots\dots\dots$

[2]



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

$$\frac{T}{\sqrt{d}} = P\sqrt{\frac{(d-L)}{d}} + Q$$

where  $P$  and  $Q$  are constants.

Using your answers in (d)(iii), 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 equilibrium of a wooden strip.

(a) You have been provided with a wooden strip. There are three holes in the strip and string is attached to two of the holes.

- Press the modelling clay onto the end of the strip as shown in Fig. 2.1.

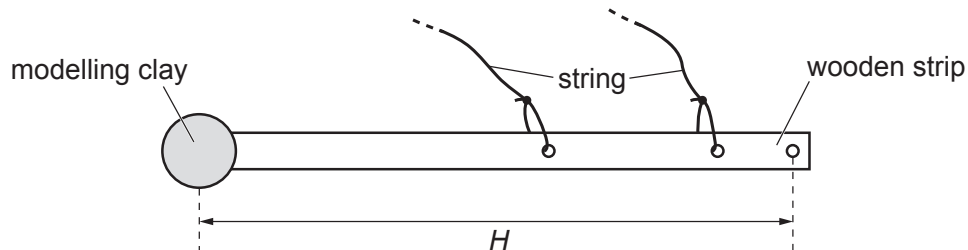


Fig. 2.1

- The distance between the centre of the modelling clay and the centre of the hole at the other end of the strip is  $H$ .

Using the ruler, take measurements to determine  $H$ .

$H = \dots\dots\dots$  cm [1]

- (b) (i) • Set up the apparatus as shown in Fig. 2.2.

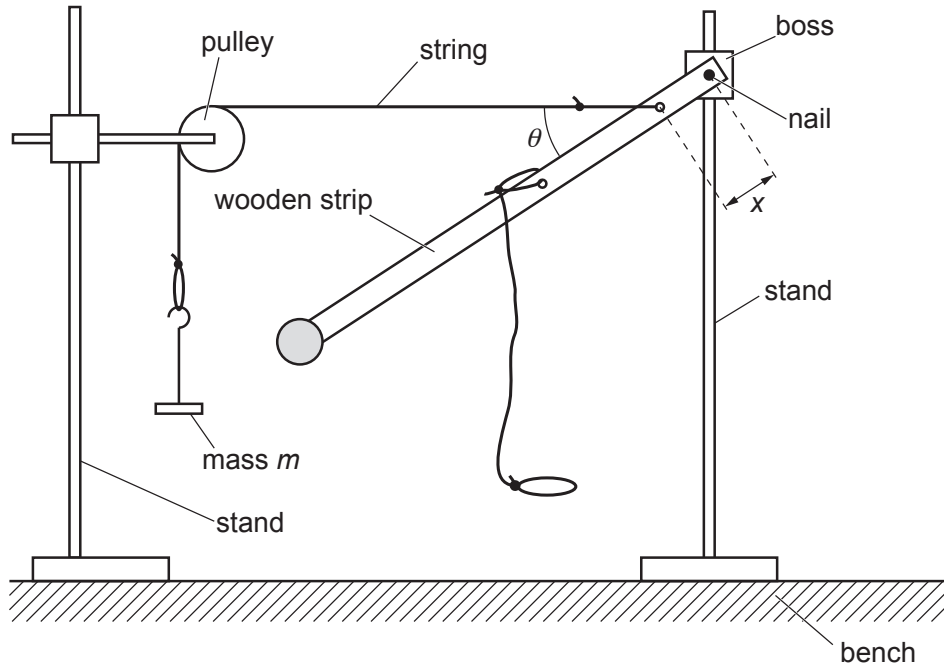


Fig. 2.2 (not to scale)

- Hang a mass  $m$  of 100 g from the string.
- Adjust the heights of the boss and pulley until the string between the strip and the pulley is horizontal.
- The distance between the nail and the hole through which the string is attached is  $x$ .  
The angle between the strip and the horizontal string is  $\theta$ .  
Measure and record  $x$  and  $\theta$ .

$x =$  ..... cm

$\theta =$  .....<sup>o</sup>  
[2]

- (ii) Estimate the percentage uncertainty in your value of  $\theta$ . Show your working.

percentage uncertainty = ..... [1]



(iii) Calculate  $x \tan \theta$ .

$x \tan \theta = \dots\dots\dots$  cm [1]

(iv) Justify the number of significant figures that you have given for your value of  $x \tan \theta$ .

.....  
.....  
..... [1]

- (c)
- Remove the mass and the string from the pulley.
  - Set up the apparatus as shown in Fig. 2.3 using the other string.

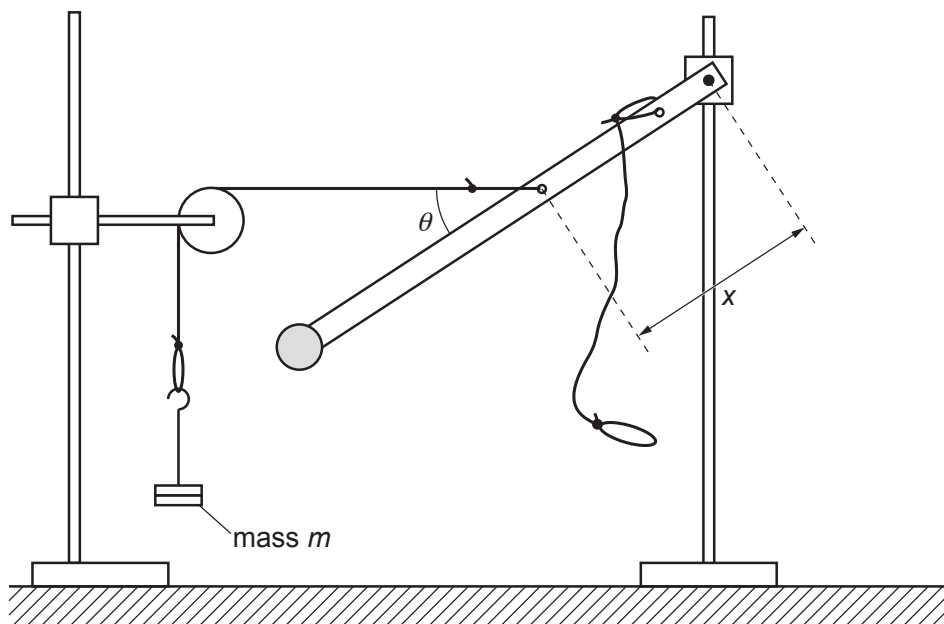


Fig. 2.3 (not to scale)

- Hang a mass  $m$  of 200 g from the string.
- Adjust the heights of the boss and pulley until the string between the strip and the pulley is horizontal.
- The distance between the nail and the hole through which the string is attached is  $x$ .

The angle between the strip and the horizontal string is  $\theta$ .

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

$x = \dots\dots\dots$  cm

$\theta = \dots\dots\dots$  °

- Calculate  $x \tan \theta$ .

$x \tan \theta = \dots\dots\dots$  cm  
[3]

(d) It is suggested that the relationship between  $x$ ,  $\theta$  and  $m$  is

$$x \tan \theta = \frac{k}{m}$$

where  $k$  is a constant.

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

first value of  $k$  = .....

second value of  $k$  = .....

[1]

(ii) Explain whether your results support the suggested relationship.

.....  
 .....  
 .....  
 ..... [1]

(e) Theory suggests that

$$k = \frac{5HM}{6}$$

where  $M$  is the mass of the wooden strip.

Use your second value of  $k$  to calculate a value for  $M$ .

Give an appropriate unit.

$M$  = ..... [1]

(f) (i) Describe four sources of uncertainty or limitations of the procedure for this experiment.

- 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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