



# Cambridge International AS & A Level

CANDIDATE  
NAME

CENTRE  
NUMBER

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NUMBER

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**PHYSICS**

**9702/33**

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>	

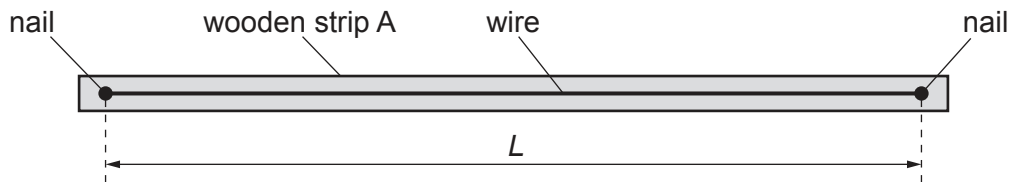
This document has **12** pages. Any blank pages are indicated.

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

**1** In this experiment, you will investigate an electrical circuit.

**(a)** You have been provided with two identical wooden strips labelled A and B.

Measure and record the length  $L$  of the wire between the nails on strip A, as shown in Fig. 1.1.



**Fig. 1.1**

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

- (b) • Set up the circuit shown in Fig. 1.2.

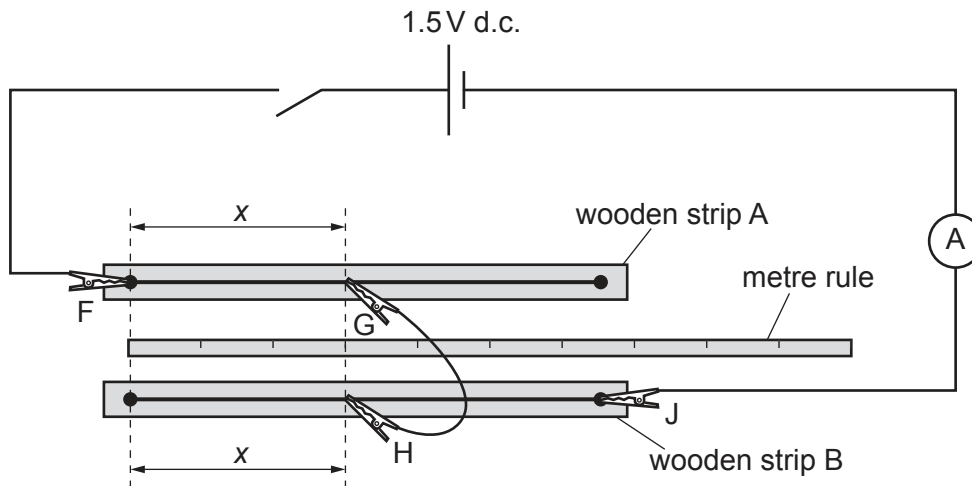


Fig. 1.2

- F, G, H and J are crocodile clips.

Attach G to the wire on wooden strip A so that the distance  $x$  between the nail on strip A and G is approximately 30 cm, as shown in Fig. 1.2.

- Attach H to the wire on wooden strip B so that it is the same distance  $x$  from the nail on strip B.
- Close the switch.
- Record  $x$  and the ammeter reading  $I$ .

$x =$  .....

$I =$  .....

- Open the switch.

[1]

(c) Vary  $x$  and repeat (b) until you have six sets of readings of  $x$  and  $I$ . Include your values from (b).

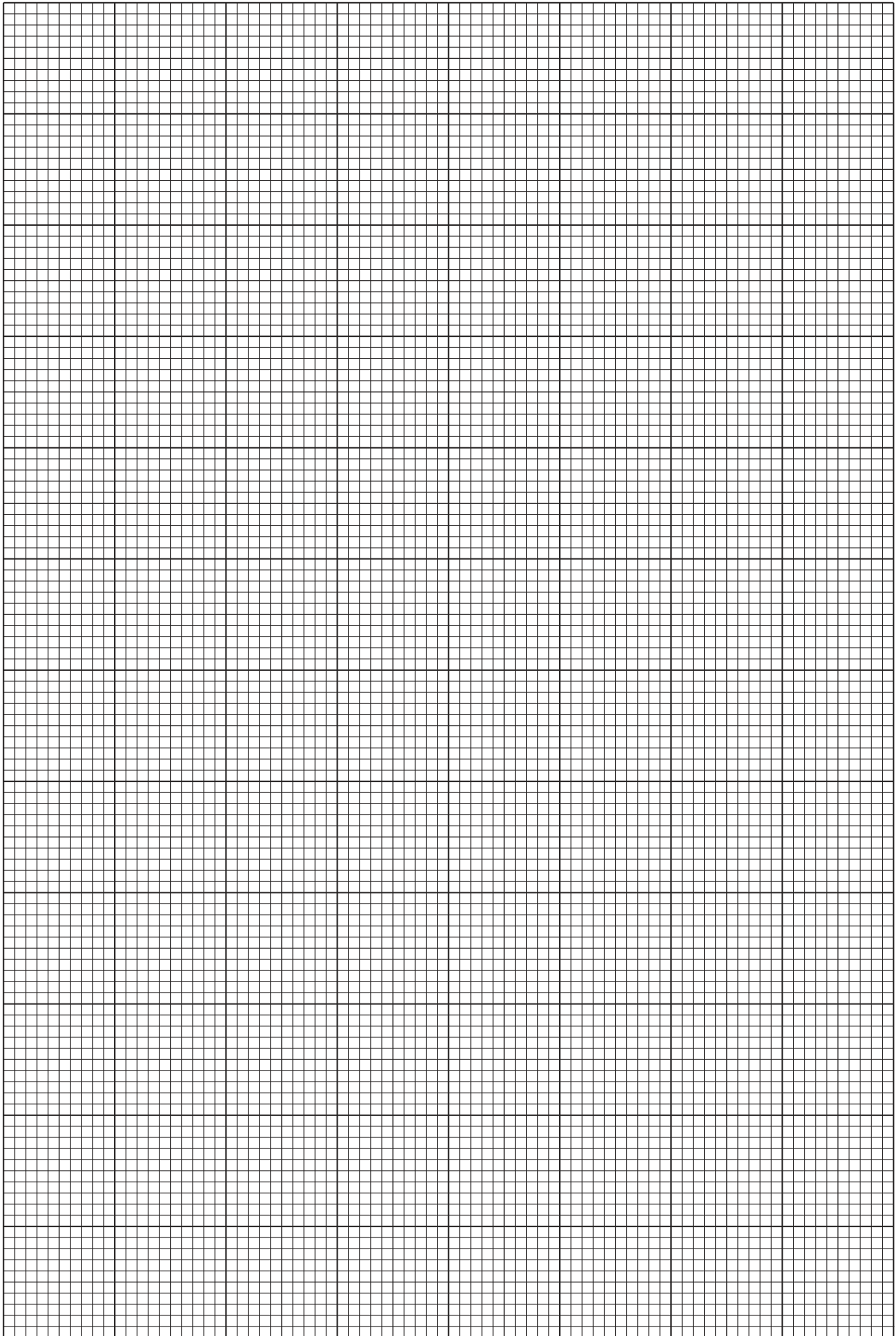
Record your results in a table. Include values of  $\frac{1}{I}$  in your table.

- (d) (i) Plot a graph of  $\frac{1}{I}$  on the  $y$ -axis against  $x$  on the  $x$ -axis. [9]
- (ii) Draw the straight line of best fit. [3]
- (iii) Determine the gradient and  $y$ -intercept of this line. [1]

gradient = .....

$y$ -intercept = .....

[2]



- (e) It is suggested that the quantities  $I$  and  $x$  are related by the equation

$$\frac{1}{I} = Px + Q$$

where  $P$  and  $Q$  are constants.

Using your answers in (d)(iii), determine values for  $P$  and  $Q$ .  
Give appropriate units.

$$P = \dots\dots\dots$$

$$Q = \dots\dots\dots$$

[2]

- (f) Theory suggests that

$$\frac{P}{Q} = \frac{\left(\frac{\rho_A}{\rho_B} - 1\right)}{L}$$

where  $\rho_A$  is the resistivity of the wire on strip A and  $\rho_B$  is the resistivity of the wire on strip B.

Calculate  $\frac{\rho_A}{\rho_B}$ .

$$\frac{\rho_A}{\rho_B} = \dots\dots\dots [1]$$

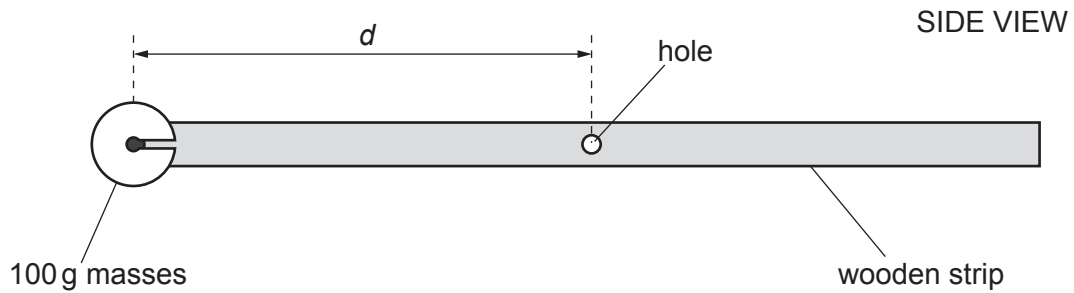
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**You may not need to use all of the materials provided.**

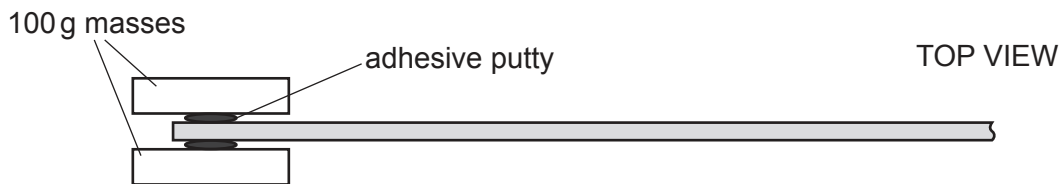
**2** In this experiment, you will investigate the oscillations of a loaded wooden strip.

**(a)** You have been provided with a rectangular wooden strip with a hole in its centre.

- Use some of the adhesive putty to attach the two 100 g masses as near as possible to one end of the strip, as shown in Fig. 2.1 and Fig. 2.2.



**Fig. 2.1**



**Fig. 2.2**

- The distance between the centre of the masses and the hole is  $d$ , as shown in Fig. 2.1.

Measure and record  $d$ .

$d = \dots\dots\dots$  [1]

**(b)** Estimate the percentage uncertainty in your value of  $d$ . Show your working.

percentage uncertainty =  $\dots\dots\dots$  [1]

- (c) (i)
- Attach the two 50 g masses to the other end of the strip so that the distance between the centres of these masses and the hole is also equal to  $d$ .
  - Set up the apparatus as shown in Fig. 2.3.

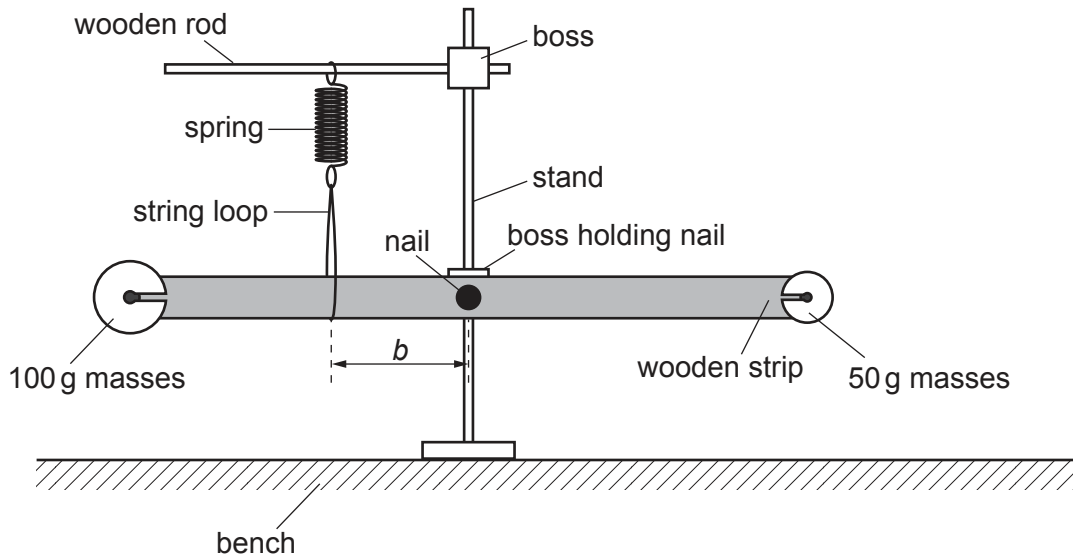


Fig. 2.3 (not to scale)

- The distance between the string loop and the nail in the centre of the strip is  $b$ . Adjust the position of the string loop and spring until  $b$  is approximately 10 cm.
- Adjust the heights of the bosses until the strip is horizontal and the spring and string loop are vertical.
- Measure and record  $b$ .

$b = \dots\dots\dots$  [1]

(ii) Calculate  $\alpha$  where

$$\alpha = \frac{b}{d}.$$

$\alpha = \dots\dots\dots$  [1]

(iii) Justify the number of significant figures that you have given for your value of  $\alpha$ .

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



- (d)
- Move the end of the strip with the 100 g masses down through a short distance.
  - Release the end of the strip. The strip will oscillate up and down.
  - Take measurements to determine the period  $T$  of these oscillations.

$T = \dots\dots\dots$  [2]

- (e)
- Change the value of  $b$  to approximately 20 cm.
  - Adjust the heights of the bosses until the strip is horizontal and the spring and string loop are vertical.
  - Measure and record  $b$ .

$b = \dots\dots\dots$

- Repeat (c)(ii) and (d).

$\alpha = \dots\dots\dots$

$T = \dots\dots\dots$  [2]

- (f) It is suggested that the relationship between  $T$  and  $\alpha$  is

$$T = \frac{C}{\alpha}$$

where  $C$  is a constant.

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

first value of  $C = \dots\dots\dots$

second value of  $C = \dots\dots\dots$

[1]

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

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

- (g) Theory suggests that

$$C = 2\pi\sqrt{\frac{3m}{k}}$$

where  $m$  is 0.100 kg and  $k$  is the spring constant of the spring.

Use your second value of  $C$  to determine a value for  $k$ . Give an appropriate unit.

$k = \dots\dots\dots$  [1]

(h) (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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