



# Cambridge International AS & A Level

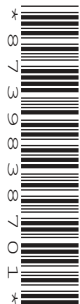
CANDIDATE  
NAME

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**PHYSICS**

**9702/36**

Paper 3 Advanced Practical Skills 2

**October/November 2020**

**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. 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)
- Connect any one of the eight resistors labelled with values in the component holder.
  - Assemble the circuit shown in Fig. 1.1.

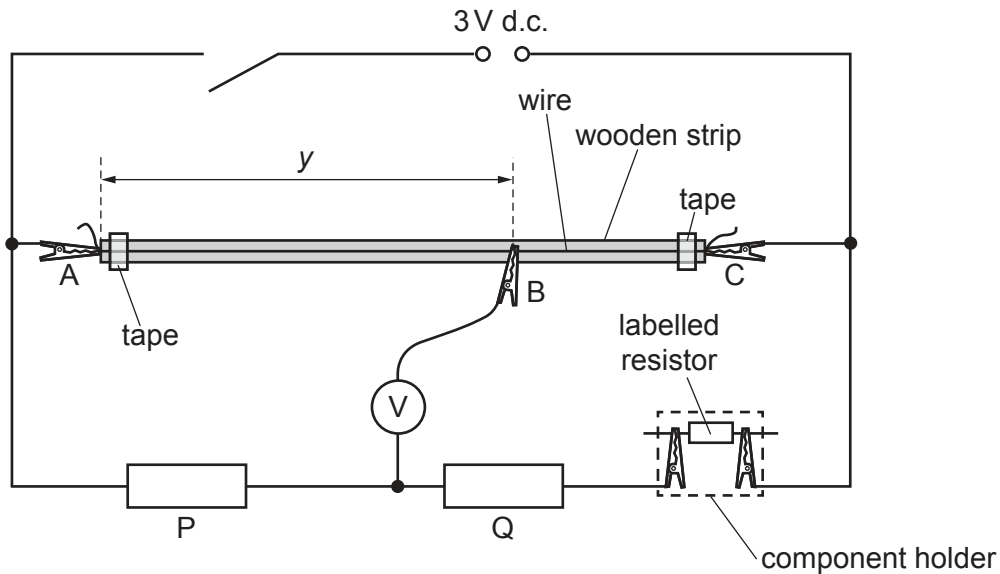


Fig. 1.1

- Record the resistance  $R$  of the labelled resistor in the component holder.

$$R = \dots\dots\dots \Omega$$

- Close the switch. The voltmeter reading will be non-zero.
- A, B and C are crocodile clips.

Adjust the position of B on the wire until the voltmeter reading is as close as possible to zero.

- The distance between A and B is  $y$ , as shown in Fig. 1.1.

Measure and record  $y$ .

$$y = \dots\dots\dots \text{cm}$$

- Open the switch.

[1]

- (b) Change the labelled resistor and determine the value of  $y$ . Repeat until you have six sets of values of  $R$  and  $y$ .

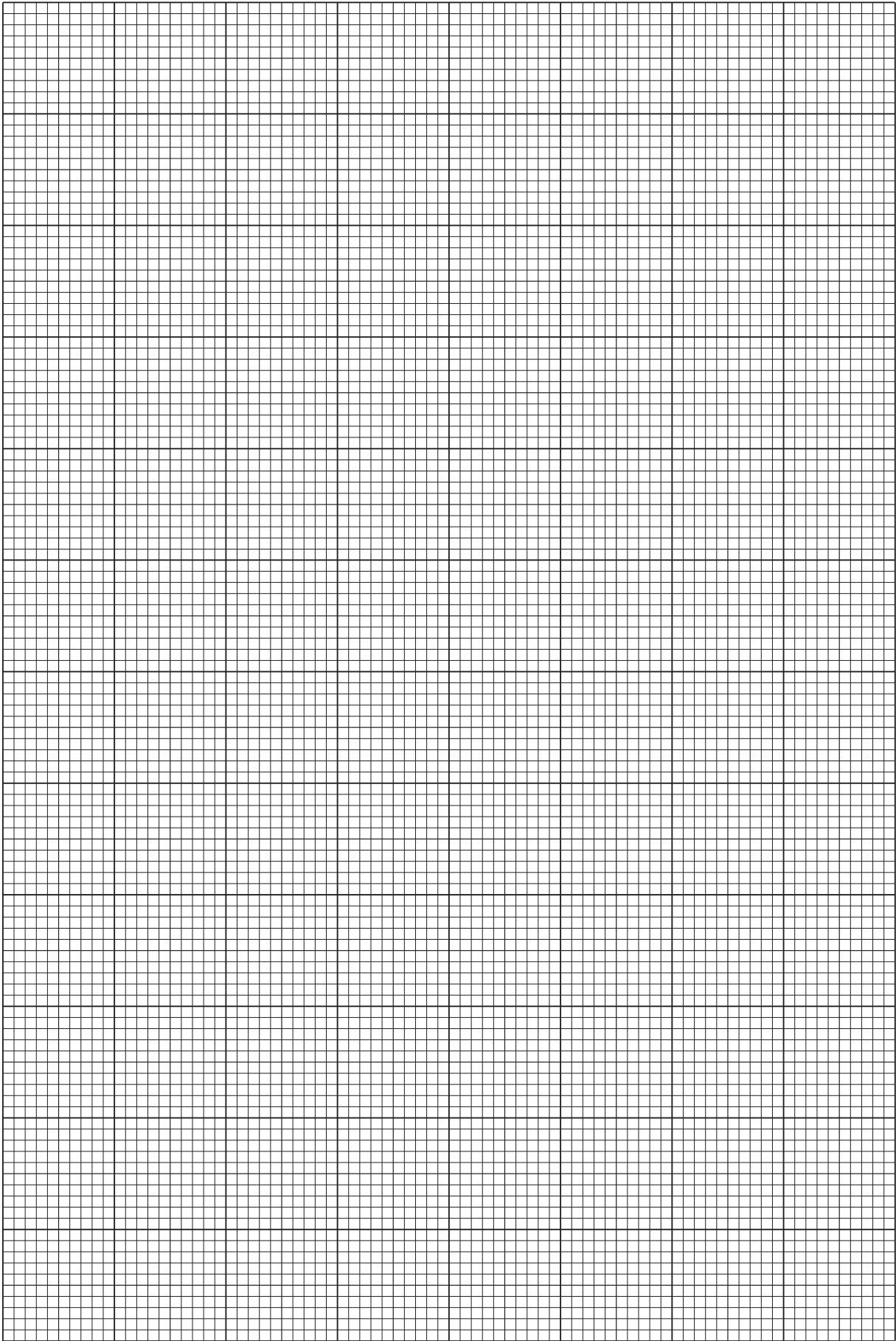
Record your results in a table. Include values of  $\frac{1}{y}$  in your table.

- (c) (i) Plot a graph of  $\frac{1}{y}$  on the  $y$ -axis against  $R$  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]



(d) It is suggested that the quantities  $y$  and  $R$  are related by the equation

$$\frac{1}{y} = aR + b$$

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) (i) Measure and record the length  $W$  of the wire between the crocodile clips A and C.

$$W = \dots\dots\dots \text{ cm } [1]$$

(ii) The resistor P has resistance  $P$ .

Calculate the value of  $P$  using the relationship

$$a = \frac{1}{PW}.$$

$$P = \dots\dots\dots \Omega [1]$$

[Total: 20]

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

- 2 In this experiment, you will investigate an oscillating system.

You have access to a roll of strong adhesive tape. Cut off a piece of tape of approximate length 40 cm. The exact length is not important.

- (a) • You have been provided with two plastic rulers. Bend one of the rulers so that the distance  $L$  between its ends is approximately 29 cm. Use the adhesive tape to fix it in this shape, as shown in Fig. 2.1.

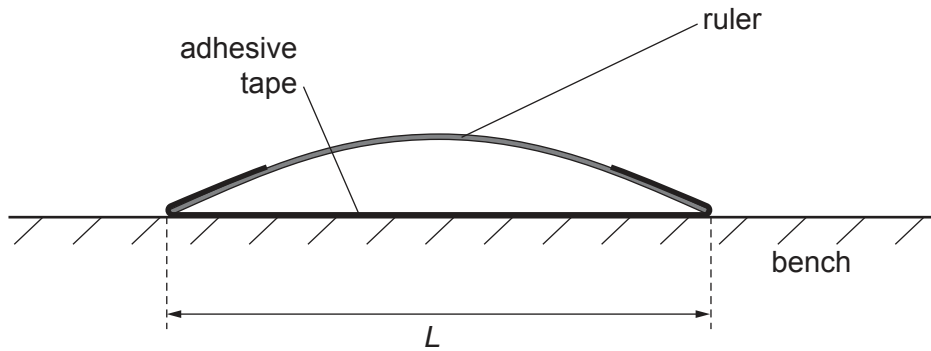


Fig. 2.1

- Measure and record the length  $L$  and the height  $H$  of the bent ruler, as shown in Fig. 2.2.

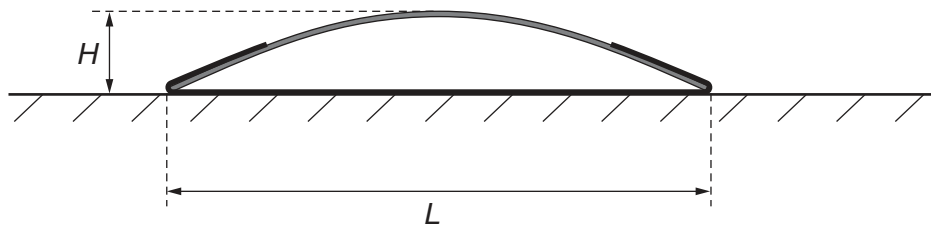


Fig. 2.2

$L =$  ..... cm

$H =$  ..... cm  
[2]

- (b) Estimate the percentage uncertainty in your value of  $H$ . Show your working.

percentage uncertainty = ..... [1]

- (c) • Balance the wooden strip on top of the ruler, as shown in Fig. 2.3.

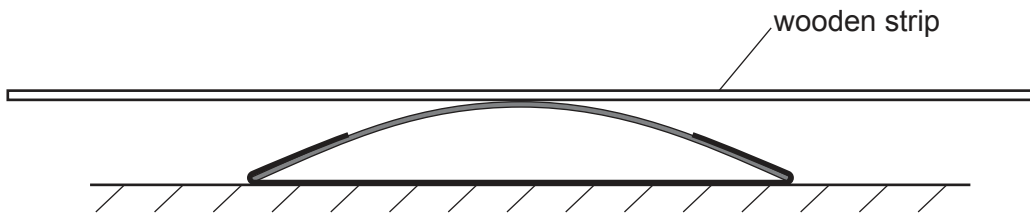


Fig. 2.3

- Push one end of the strip down a short distance and release it so that it oscillates.
- Determine the period  $T$  of the oscillations.

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

- (d) (i) Repeat (a) using a length  $L$  of approximately 27 cm.

$L = \dots\dots\dots$  cm

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

- (ii) Repeat (c).

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



- (e) It is suggested that the relationship between  $T$ ,  $L$  and  $H$  is

$$T^2L^2 = kH$$

where  $k$  is a constant.

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

first value of  $k = \dots\dots\dots$

second value of  $k = \dots\dots\dots$

[1]

- (ii) Justify the number of significant figures you have given for your values of  $k$ .

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

- (iii) Explain whether your results in (e)(i) support the suggested relationship.

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

(f) The length  $S$  of the wooden strip is 91 cm.

An approximate value for the acceleration of free fall  $g$  is given by

$$3gk = \pi^4 S^2.$$

Use your second value of  $k$  to calculate  $g$ .

Give an appropriate unit.

$g = \dots\dots\dots$  [1]

(g) (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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