

# Cambridge International AS & A Level

CANDIDATE NAME				
CENTRE NUMBER		CANDIDATE NUMBER		

977982246

PHYSICS 9702/31

Paper 3 Advanced Practical Skills 1

May/June 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 Exam	iner's Use
1	
2	
Total	

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

- 1 In this experiment, you will investigate an electrical circuit.
  - (a) Place the  $18\Omega$  resistor in component holder R.
    - Set up the circuit shown in Fig. 1.1.

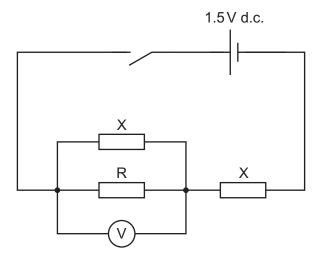


Fig. 1.1

• The resistor in R has resistance R. Record R.

R = .....Ω

- Close the switch.
- Record the voltmeter reading V.

V = .....

• Open the switch.

[1]

(b)	Change the resistor in R and repeat (a) until you have six sets of readings of R and V. Include
	your values from (a).

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

[9]

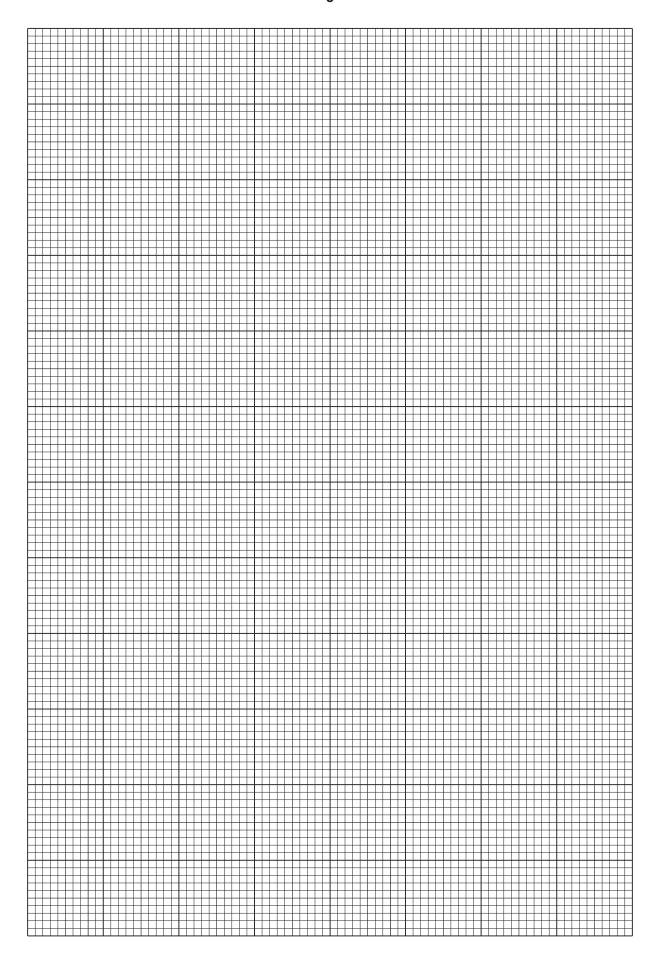
(c) (i) Plot a graph of 
$$\frac{1}{V}$$
 on the *y*-axis against  $\frac{1}{R}$  on the *x*-axis. [3]

(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	V and R are	related by the	e equation
14	, it is suggested	mat the quantities	v and / t arc	i ciatea by tile	, cquation

$$\frac{1}{V} = \frac{A}{R} + B$$

where A and B are constants.

Using your answers in **(c)(iii)**, determine values for *A* and *B*. Give appropriate units.

A =	 	 
B =	 	
		[2

(e) (i) Theory suggests that

$$B = \frac{2}{E}$$

where *E* is the electromotive force (e.m.f.) of the cell.

Determine E.

(ii) The two other resistors in the circuit each have resistance X.

When R = X, theory suggests that

$$\frac{1}{V} = \frac{3}{E}$$
.

Determine X.

$$X = \dots \Omega$$
 [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 equilibrium of a metre rule.
  - (a) (i) You have been provided with a metre rule with two springs attached.

The distance between one end of the metre rule and the string is *L*, as shown in Fig. 2.1.

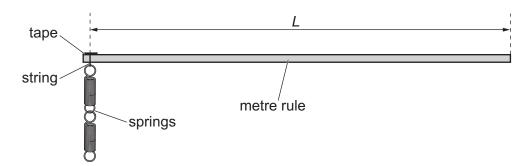


Fig. 2.1

Measure and record *L*.

L =	 [1	1
	ъ.	

(ii) Calculate  $\frac{L}{n}$  where n = 3.

$$\frac{L}{n}$$
 = ......[1]

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

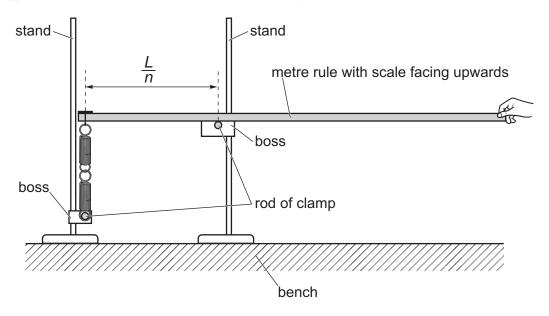


Fig. 2.2

- Adjust the apparatus until the horizontal distance between the centres of the rods of the clamps is equal to your value of  $\frac{L}{n}$ .
- Adjust the heights of the bosses so that the rule is horizontal and the springs are vertical and **unstretched** when the rule is held in position.
- Gradually release the rule by lowering your hand. The rule will tilt.
- The angle between the rule and the horizontal is  $\theta$ , as shown in Fig. 2.3.

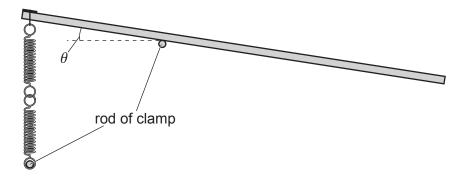


Fig. 2.3

Measure and record  $\theta$ .

*θ* = .....° [2]

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(ii)	Estimate the percentage uncertainty in your value of $\theta$ . Show your working.
(:::\	percentage uncertainty =[1]
(iii)	Calculate $\sin \theta$ .
	$\sin \theta = \dots$ [1]
(iv)	Justify the number of significant figures that you have given for your value of $\sin \theta$ .
(c) •	Calculate $\frac{L}{n}$ where $n = 4$ .
	$\frac{L}{n} = \dots$
•	Repeat <b>(b)(i)</b> and <b>(b)(iii)</b> using this value of $\frac{L}{n}$ .
	heta=°
	$\sin \theta = \dots$

1	d)	It is suggested	that the	relationship	hetween	$\theta$ and	n is
١	u	it is suggested	ulat ule	Telationship	DEIMEEII	U anu	11 13

$$\sin \theta = C\left(\frac{n^2}{2} - n\right)$$

where C is a constant.

	/:\	المال ا		4-4-	calculate	4		~ £	
1		USING	VOUL	ดลเล	caiculate	IWO	values	OI	(,
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first value of C =	
second value of C =	[1]
sults support the suggested relationship.	

Explain whether your re-

© UCLES 2020 9702/31/M/J/20 (e) Theory suggests that

$$C = \frac{Mg}{kL}$$

where

- *M* is the mass of the metre rule given on the card
- k is the spring constant of the spring system  $g = 9.81 \,\mathrm{m \, s^{-2}}$ .

Use your second value of *C* to determine a value for *k*. Give appropriate units.

k	=	[1	1

(f)	(i)	Describe four sources of uncertainty or limitations of the procedure for this experiment.
		1
		2
		3
		4
		[4]
		נדו
	(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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