

Cambridge International AS & A Level

CANDIDATE NAME					
CENTRE NUMBER			CANDIDATE NUMBER		

9779822461

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 [].

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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 18Ω resistor in component holder R.
 - Set up the circuit shown in Fig. 1.1.

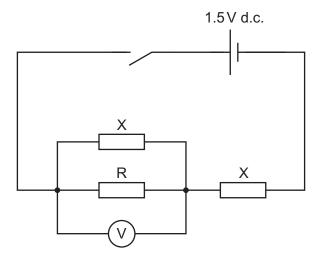


Fig. 1.1

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

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- 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).

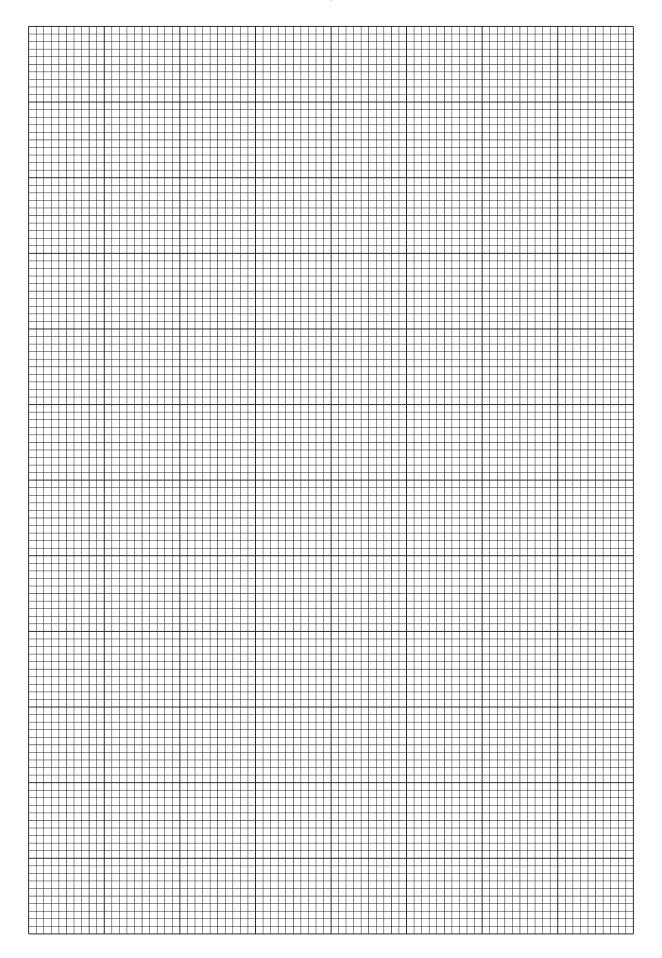
Record your results in a table. Include values of $\frac{1}{R}$ and $\frac{1}{V}$ in your table.

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

gradient =

y-intercept =



(0	(k	It is suggested	that the q	uantities \	V and R are	related b	v the ed	uation
1,	4)	it is suggested	mat mic q	dantitios	v and n are	i ciatoa b	y 1110 00	laation

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

where A and B are constants.

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

4 =	 	
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]

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.

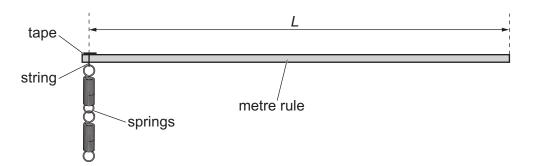


Fig. 2.1

Measure and record *L*.

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

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

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

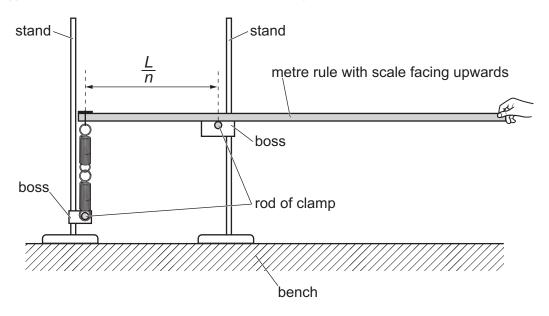


Fig. 2.2

- 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 θ , as shown in Fig. 2.3.

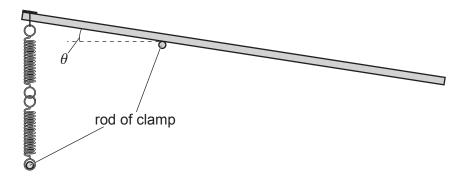


Fig. 2.3

Measure and record θ .

α		0	$\Gamma \cap I$
н	=	-	171

(ii)	Estimate the percentage uncertainty in your value of θ . 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 $\sin \theta$.
	[1]
(c) •	Calculate $\frac{L}{n}$ where $n = 4$.
	$\frac{L}{R} = \dots$
•	Repeat (b)(i) and (b)(iii) using this value of $\frac{L}{n}$.
·	n
	heta =°
	$\sin \theta = \dots$

(d)	It is suggested that the relationship between θ and n is
	$\sin \theta = C\left(\frac{n^2}{2} - n\right)$

where C is a constant.

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

	first value of C =	
	second value of C =	[1]
(ii)	Explain whether your results support the suggested relationship.	

(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]
-----	--	-----

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

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[Total: 20]

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