



Cambridge International AS & A Level

CANDIDATE
NAME

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CENTRE
NUMBER

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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 Examiner's Use

1	
2	
Total	

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)
- Place the $18\ \Omega$ resistor in component holder R.
 - Set up the circuit shown in Fig. 1.1.

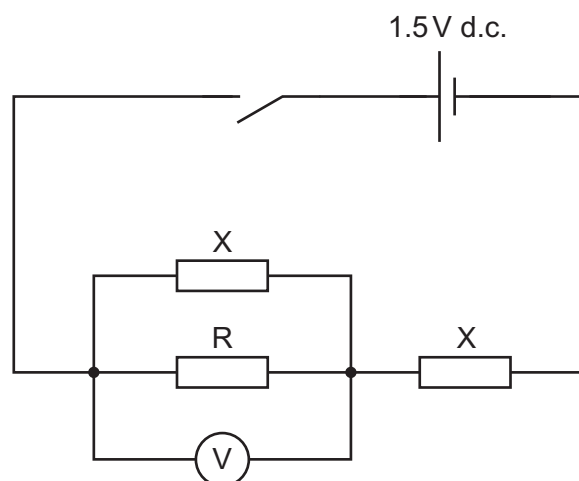


Fig. 1.1

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

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

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

$V = \dots\dots\dots$

- 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.

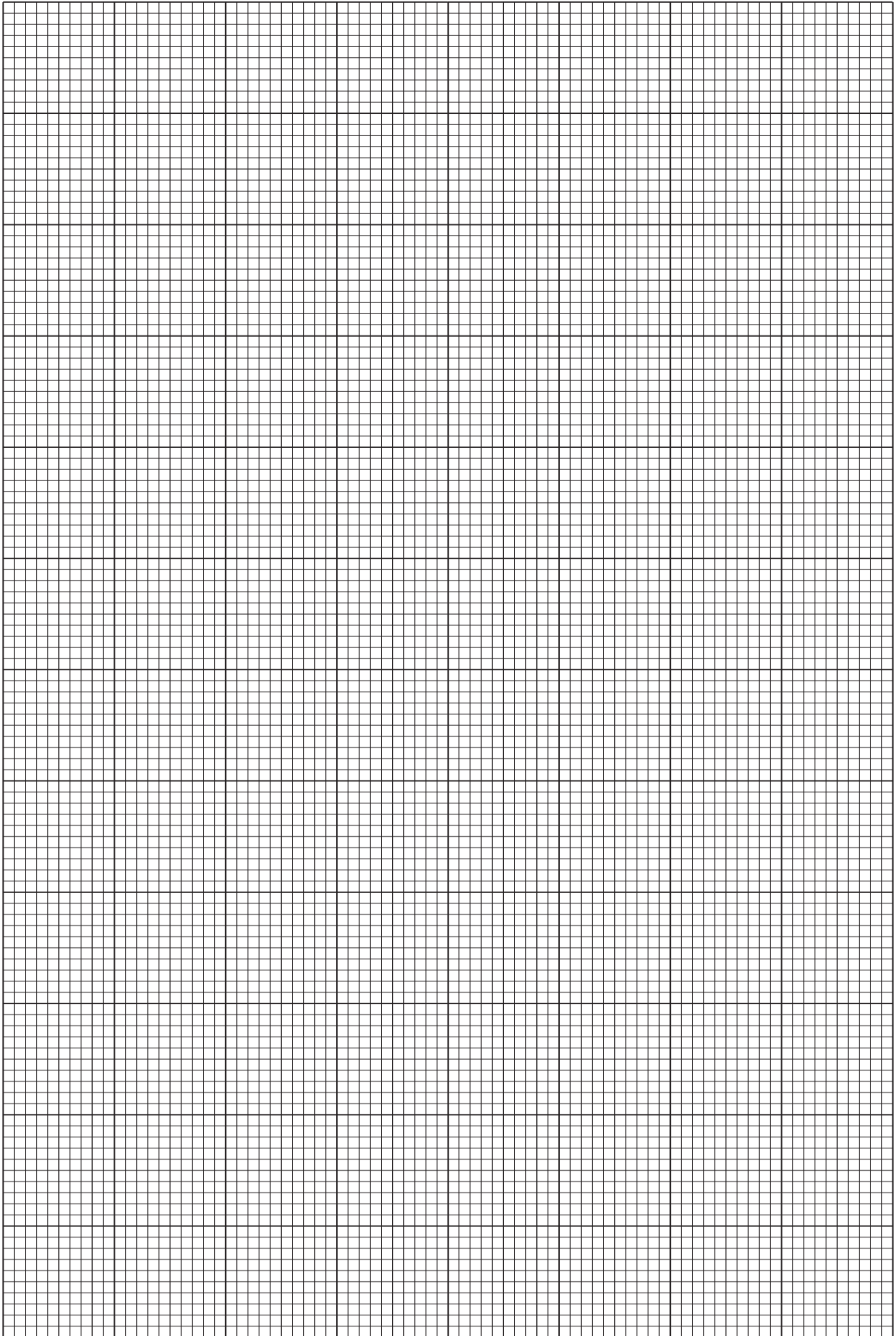
[1]

- (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 equation

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

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 .

$E =$ V [1]

- (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 .

$X =$ Ω [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.

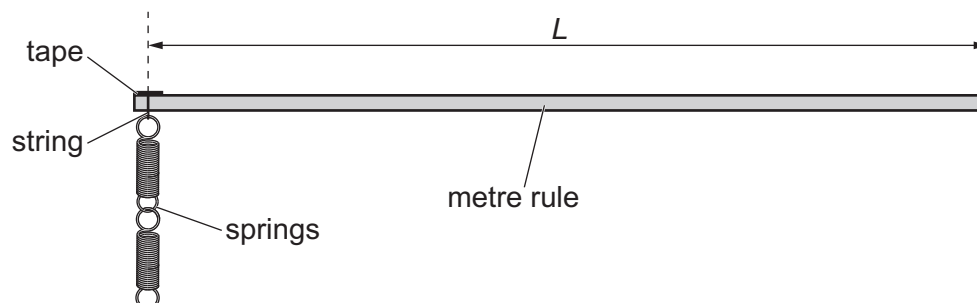


Fig. 2.1

Measure and record L .

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

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

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

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

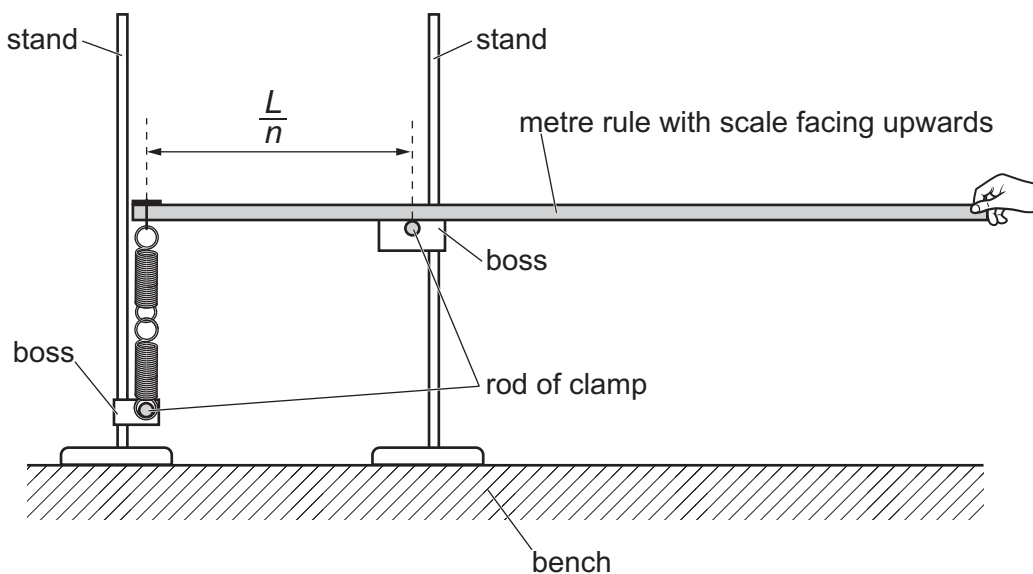


Fig. 2.2

- 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 θ , as shown in Fig. 2.3.

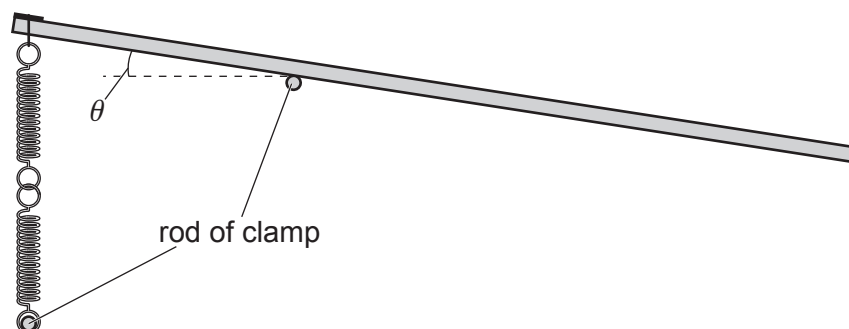


Fig. 2.3

Measure and record θ .

$\theta = \dots\dots\dots^\circ$ [2]

- (ii) Estimate the percentage uncertainty in your value of θ . Show your working.

percentage uncertainty = [1]

- (iii) Calculate $\sin \theta$.

$\sin \theta =$ [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 $n = 4$.

$\frac{L}{n} =$

- Repeat (b)(i) and (b)(iii) using this value of $\frac{L}{n}$.

$\theta =$ °

$\sin \theta =$ [2]

- (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.

.....

 [1]

(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
- $g = 9.81 \text{ m s}^{-2}$.

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

$k = \dots\dots\dots$ [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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