Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME	

CENTRE NUMBER						CANDIDATE NUMBER				

7131671623

PHYSICS **9702/35**

Paper 3 Advanced Practical Skills 1 **October/November 2023**

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. Any blank pages are indicated.

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

1 In this experiment, you will determine the resistivity of a metal.

(a) • Set up the circuit shown in Fig. 1.1.

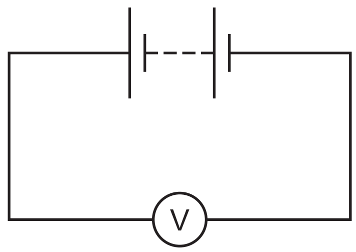

Fig. 1.1

• The voltmeter reading is E.

Record E.

E = ... V

• Set up the circuit shown in Fig. 1.2.

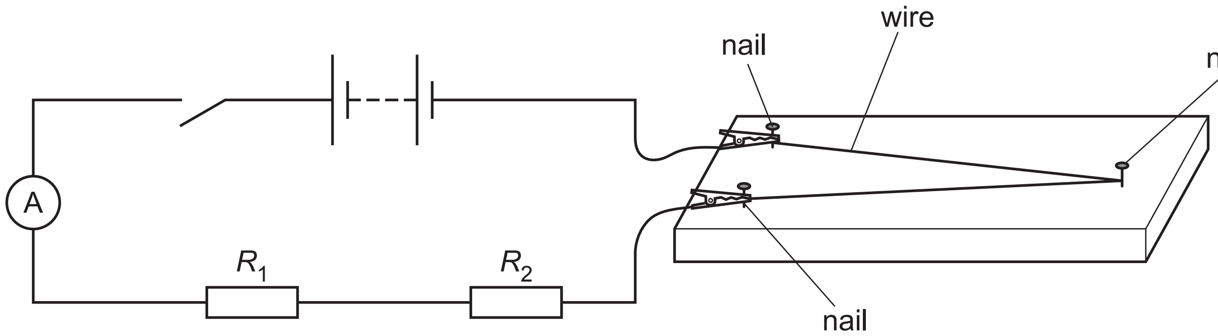

Fig. 1.2 (not to scale)

• You have been provided with several resistors, each with a different value of resistance.

Select resistors and connect them so that $R_1 = 33\,\Omega$ and $R_2 = 56\,\Omega$.

• Record R_1 and R_2.

R_1 = ...

R_2 = ...

• Calculate $(R_1 + R_2)$.

$(R_1 + R_2)$ = ...

- Close the switch.
- The ammeter reading is I.

  Record I.

I = ... mA

- Open the switch.

[1]

(b) Change the values of R_1 and R_2 to provide six different values of $(R_1 + R_2)$.

For each arrangement, record values of R_1, R_2 and I in a table. Include values of $(R_1 + R_2)$ and $\frac{1}{I}$ in your table.

[8]

(c) **(i)** Plot a graph of $\frac{1}{I}$ on the y-axis against $(R_1 + R_2)$ 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 I, R_1 and R_2 are related by the equation

$$\frac{1}{I} = F(R_1 + R_2) + G$$

where F and G are constants.

Using your answers in **(c)(iii)**, determine the values of F and G.
Give appropriate units.

F = ...

G = ...
[2]

(e) **(i)** Use the micrometer to measure the diameter d of the wire.

d = ... [2]

(ii) It is suggested that G is given by the equation

$$G = \frac{4\rho L}{\pi d^2 E}$$

where L is 0.560 m and ρ is the resistivity of the metal of the wire.

Using your answers in **(a)**, **(d)** and **(e)(i)**, determine a value for ρ.

ρ = ... Ωm [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 movement of a mass hanger.

(a) You are provided with a number of paper clips.

Use the top-pan balance to determine the mass *m* of **one** paper clip.

m = ... g [1]

(b) **(i)** • Set up the apparatus as shown in Fig. 2.1.

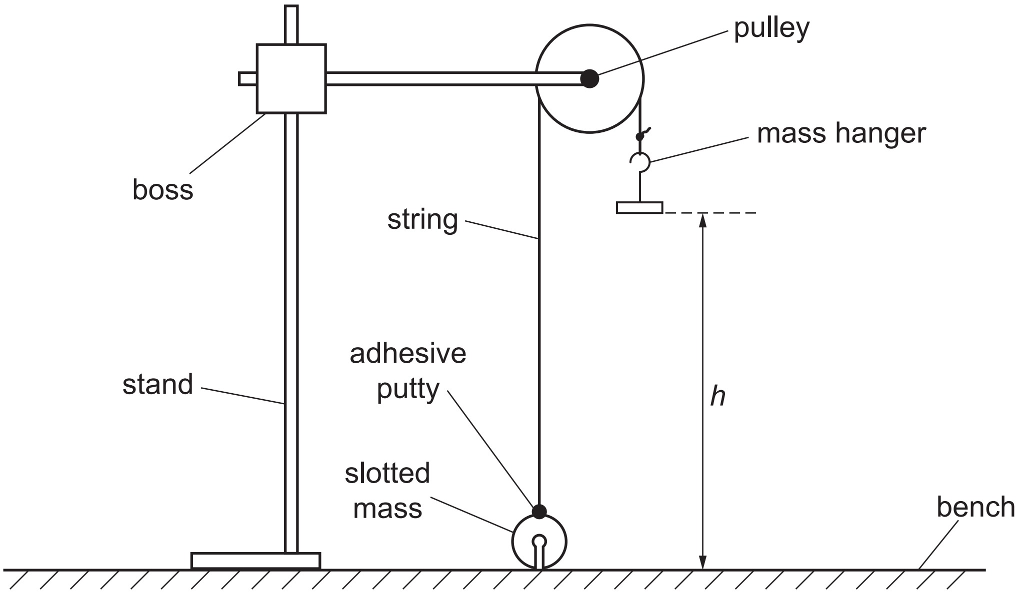

Fig. 2.1 (not to scale)

- Lower the slotted mass until it just touches the bench.
- The distance between the bottom of the mass hanger and the bench is *h*, as shown in Fig. 2.1.

  Measure and record *h*.

h = ... cm [1]

(ii) ● Add just enough paper clips to the mass hanger so that it falls smoothly to the bench without stopping.

● Record the total number N of paper clips on the mass hanger.

N = ... [1]

(iii) ● Adjust the position of the slotted mass so that it is just touching the bench again.

● Release the slotted mass and measure the time t for the mass hanger and N paper clips to fall to the bench.

t = ... [2]

(iv) Estimate the percentage uncertainty in your value of t. Show your working.

percentage uncertainty = ... % [1]

(v) The acceleration a of the mass hanger is given by the relationship

$$a = \frac{2h}{t^2}.$$

Calculate a.

a = ... $\mathrm{cm\,s^{-2}}$ [1]

(vi) Justify the number of significant figures that you have given for your value of a.

....

....

.... [1]

(c) • Add two more paper clips to the mass hanger.

• Record the total number N of paper clips on the mass hanger.

N = ...

• Repeat **(b)(iii)** and **(b)(v)**.

t = ...

a = ... cm s^{-2}
[2]

(d) It is suggested that the relationship between a, m and N is

$$\frac{k}{a} = 1 + \frac{2Z}{Nm}$$

where Z is the mass of the slotted mass and has the value 10.0 g, and k is a constant.

Using your data, calculate two values of k.

first value of k = ...

second value of k = ...
[1]

(e) It is suggested that the percentage uncertainty in the values of k is 25%.

Using this uncertainty, explain whether your results support the relationship in **(d)**.

....

....

....

.... [1]

(f) **(i)** Describe **four** sources of uncertainty or limitations of the procedure for this experiment.

For any uncertainties in measurement that you describe, you should state the quantity being measured and a reason for the uncertainty.

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]