Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME	

CENTRE NUMBER						CANDIDATE NUMBER					

9149537647

PHYSICS **9702/36**

Paper 3 Advanced Practical Skills 2 **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	

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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) • Connect the circuit shown in Fig. 1.1.

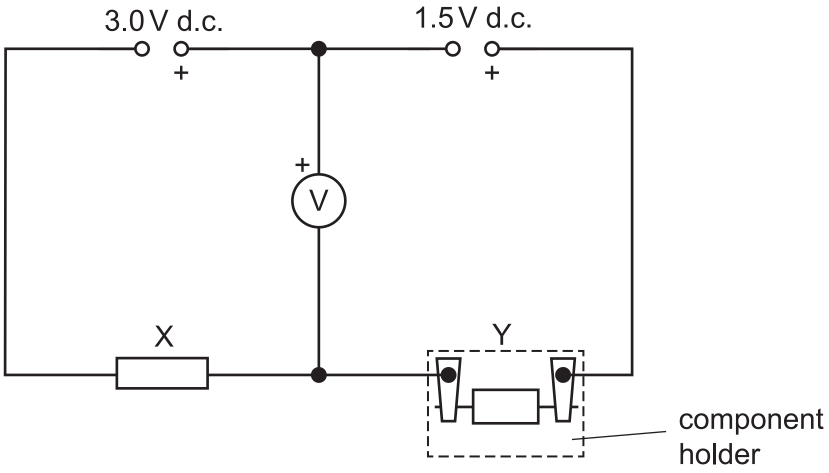

Fig. 1.1

- Ensure that the polarities of the two power supplies and the voltmeter are as shown in Fig. 1.1.

- Connect one of the labelled resistors into the component holder as resistor Y, as shown in Fig. 1.1. Record the resistance *R* of resistor Y.

R = ...

- The voltmeter reading should be approximately 3 V.

  Record the voltmeter reading *V*.

V = ...
[2]

(b) Change Y and record R and V. Repeat until you have six sets of values of R and V.

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

[10]

(c) **(i)** Plot a graph of 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

$$V = \frac{a}{R} + b$$

where a and b are constants.

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

a = ...

b = ...
[2]

[Total: 20]

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

2 In this experiment, you will investigate the properties of linked rubber bands.

You are provided with two elastic strings made from linked rubber bands. The longer one is made from three rubber bands and the shorter one is made from two rubber bands. Each string has a 50 g mass attached to one end.

(a) Measure and record the unstretched length l_0 of the **longer** elastic string, as shown in Fig. 2.1.

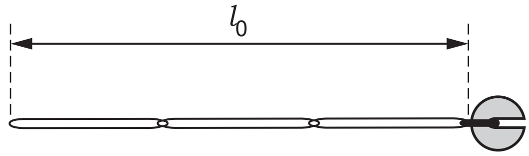

Fig. 2.1

l_0 = ... cm [1]

(b) • Assemble the apparatus as shown in Fig. 2.2 using the **longer** elastic string and with the clip approximately 40 cm above the pad of paper.

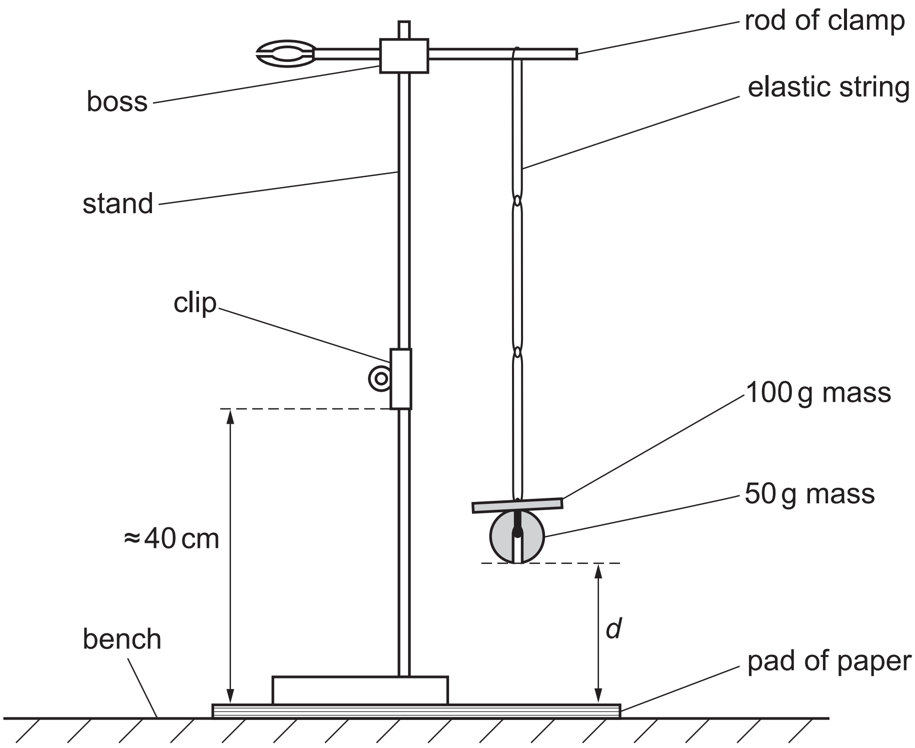

Fig. 2.2

• The distance between the bottom of the 50 g mass and the pad is d. Adjust the boss until d is approximately 2 cm.

• Measure and record d.

d = ... cm

- Remove the 100 g mass from the elastic string, as shown in Fig. 2.3.

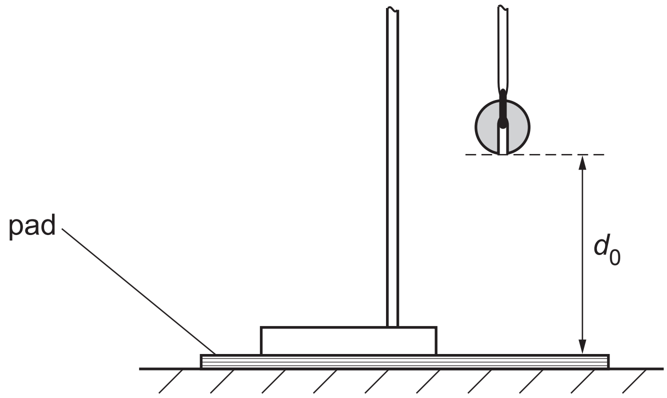

Fig. 2.3

- Measure and record the distance d_0 between the bottom of the 50 g mass and the pad.

d_0 = ... cm [2]

(c) **(i)** • Using your hand, raise the 50 g mass until the bottom of the mass is level with the bottom of the clip, as shown in Fig. 2.4.

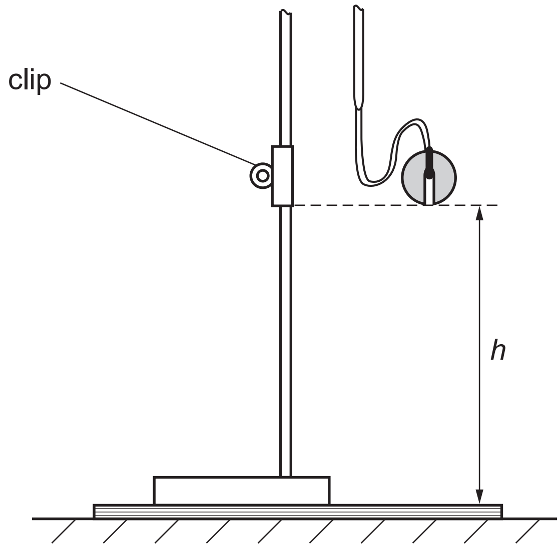

Fig. 2.4

- Release the mass and watch (and listen) to see if it **just** touches the pad.
  If it doesn't **just** touch the pad, change the position of the clip and repeat the process.
  Continue until the mass **just** touches the pad.

- Measure and record the vertical height h of the bottom of the clip above the pad, as shown in Fig. 2.4.

h = ... cm [1]

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

percentage uncertainty = ... % [1]

(iii) • Using your hand, pull the 50 g mass down until it is just touching the pad, as shown in Fig. 2.5.

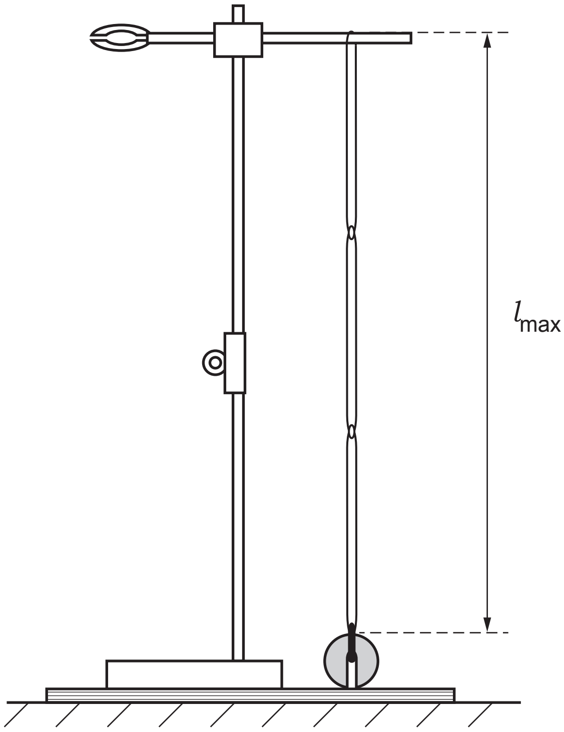

Fig. 2.5

• Measure and record the length l_{max} of the elastic string, as shown in Fig. 2.5.

l_{max} = ... cm [1]

(d) Repeat **(a)**, **(b)**, **(c)(i)** and **(c)(iii)** using the **shorter** elastic string.

l_0 = ... cm

d = ... cm

d_0 = ... cm

h = ... cm

l_{max} = ... cm
[3]

(e) It is suggested that the relationship between l_{max}, l_0, h, d_0 and d is

$$(l_{max} - l_0)^2 = Ch(d_0 - d)$$

where C is a constant.

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

first value of C = ...

second value of C = ...
[1]

(ii) Justify the number of significant figures that you have given for your values of C.

....

....

.... [1]

(f) It is suggested that the percentage uncertainty in the values of C is 15%.

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

....

....

....

.... [1]

(g) (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]