Cambridge International AS & A Level

Cambridge Assessment International Education
Cambridge International Advanced Subsidiary and Advanced Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

3854102650

PHYSICS **9702/36**

Paper 3 Advanced Practical Skills 2 **October/November 2019**

2 hours

Candidates answer on the Question Paper.

Additional Materials: As listed in the Confidential Instructions.

READ THESE INSTRUCTIONS FIRST

Write your centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **both** questions.
You will be allowed to work with the apparatus for a maximum of one hour for each question.
You are expected to record all your observations as soon as these observations are made, and to plan the presentation of the records so that it is not necessary to make a fair copy of them.
You are reminded of the need for good English and clear presentation in your answers.

Electronic calculators may be used.
You may lose marks if you do not show your working or if you do not use appropriate units.

Additional answer paper and graph paper should be used only if it becomes necessary to do so.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

For Examiner's Use	
1	
2	
Total	

This document consists of **11** printed pages and **1** blank page.

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

1 In this experiment, you will investigate the equilibrium of a loaded wooden strip.

(a) (i) • Balance the wooden strip on the prism.

• Use the pencil to make a small line on the side of the wooden strip where it touches the prism, as shown in Fig. 1.1.

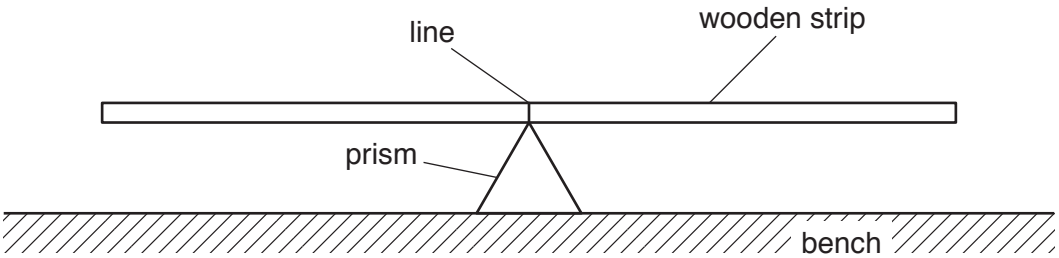


Fig. 1.1

• Roll the piece of modelling clay into a uniform cylinder of approximate length 20cm and place it on the wooden strip with one end above the line, as shown in Fig. 1.2.

• Place the mass on the wooden strip and adjust the position of the mass until the strip balances, as shown in Fig. 1.2.

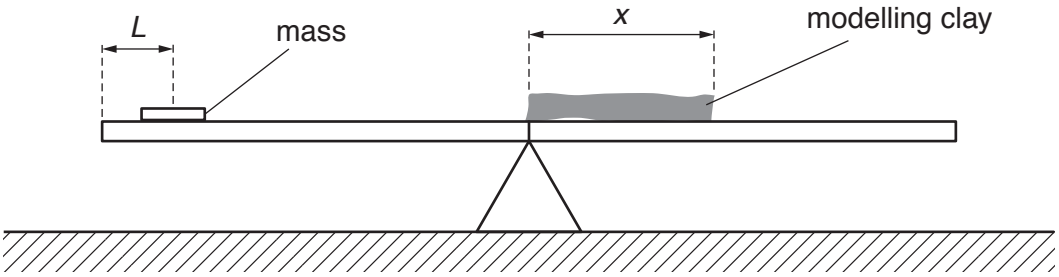


Fig. 1.2 (not to scale)

• The length of the cylinder of modelling clay is *x*, as shown in Fig. 1.2.

Measure and record *x*.

x = ... cm [1]

(ii) The distance between the centre of the mass and the end of the wooden strip is *L*, as shown in Fig. 1.2.

Measure and record *L*.

L = ... cm [1]

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(b) • Reduce x by cutting off and removing approximately 1 cm of the cylinder of modelling clay at the end furthest from the line, as shown in Fig. 1.3. Adjust the position of the mass until the wooden strip is balanced.

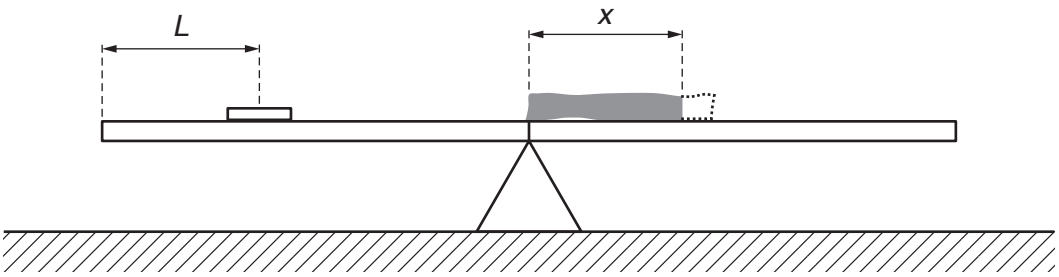


Fig. 1.3 (not to scale)

• Measure and record the new values of x and L.

x = ... cm

L = ... cm
[1]

(c) Continue to reduce x until you have six sets of values of x and L. You may include your previous results.

Record your results in a table. Include values of x^2 in the table.

[9]

(d) **(i)** Plot a graph of L on the y-axis against x^2 on the x-axis. [3]

(ii) Draw the straight line of best fit. [1]

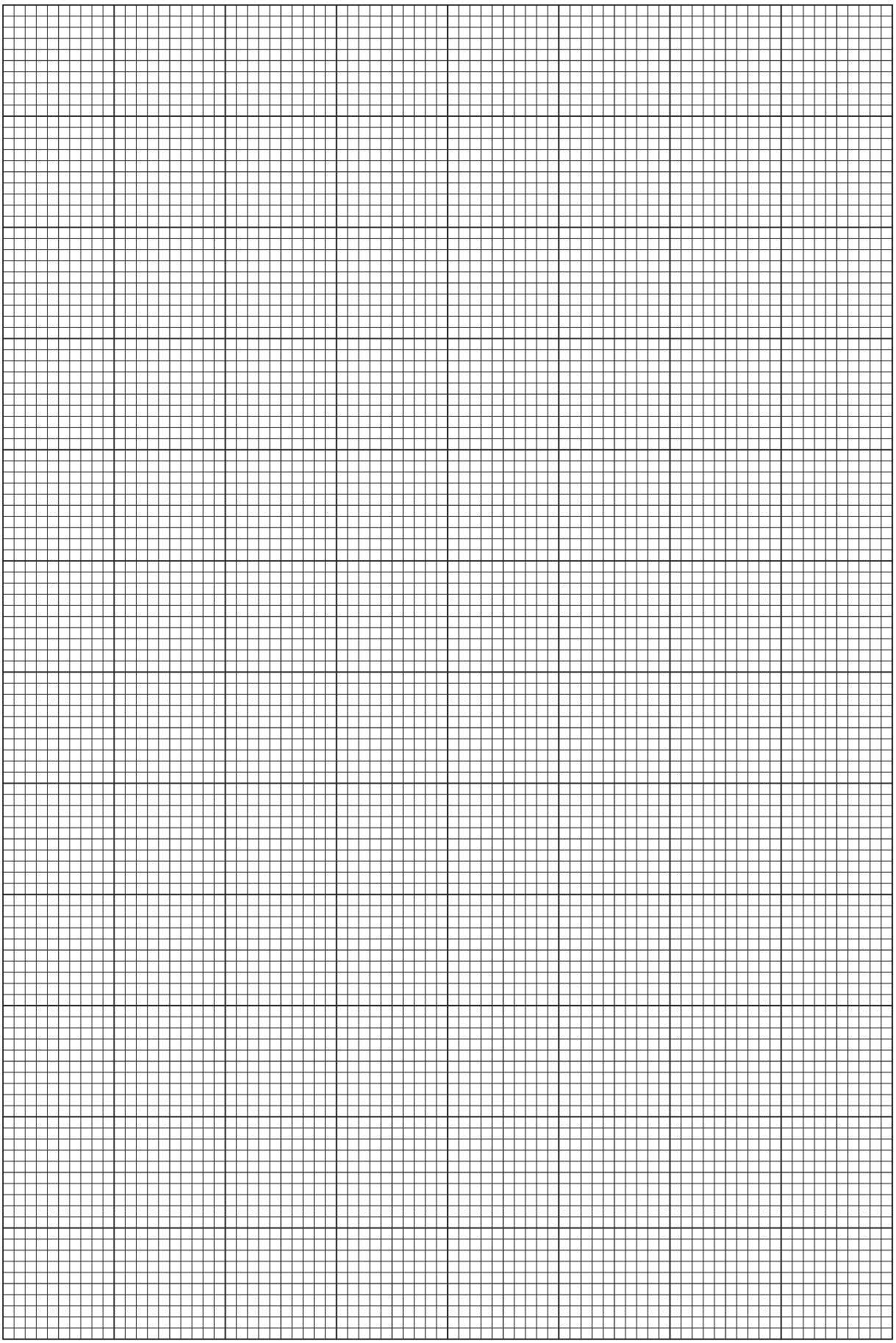
(iii) Determine the gradient and y-intercept of this line.

gradient = ...

y-intercept = ...

[2]

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[Turn over

(e) It is suggested that the quantities L and x are related by the equation

$$L = ax^2 + b$$

where a and b are constants.

Use your answers in **(d)(iii)** to 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 expansion of a wire heated by an electric current.

(a) • The apparatus is partly assembled as shown in Fig. 2.1.

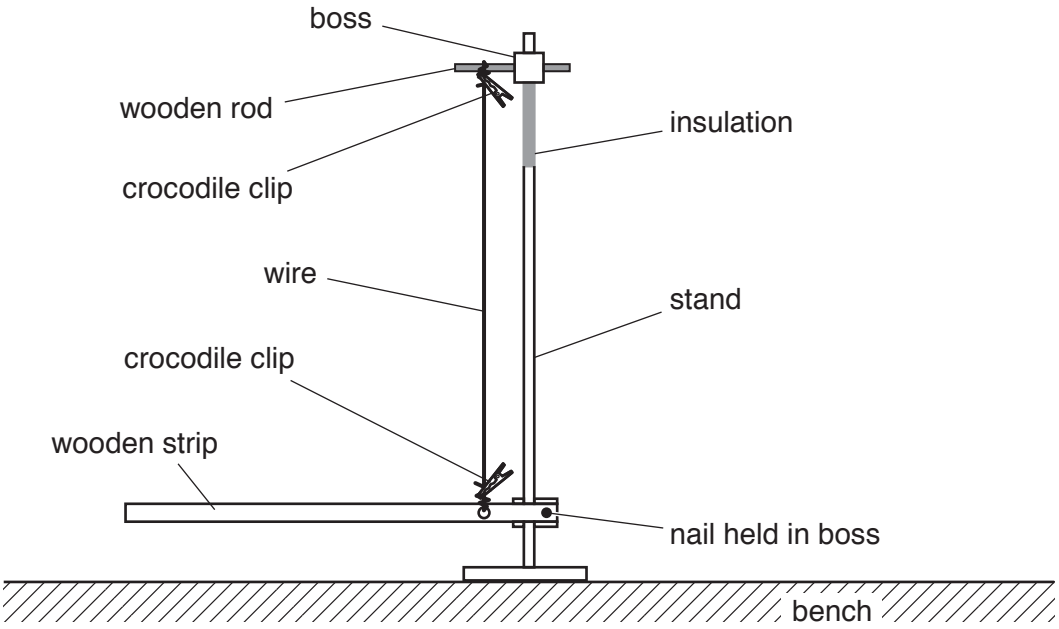


Fig. 2.1

Assemble the circuit shown in Fig. 2.2 **with the switch open** and the power supply set to its minimum voltage.

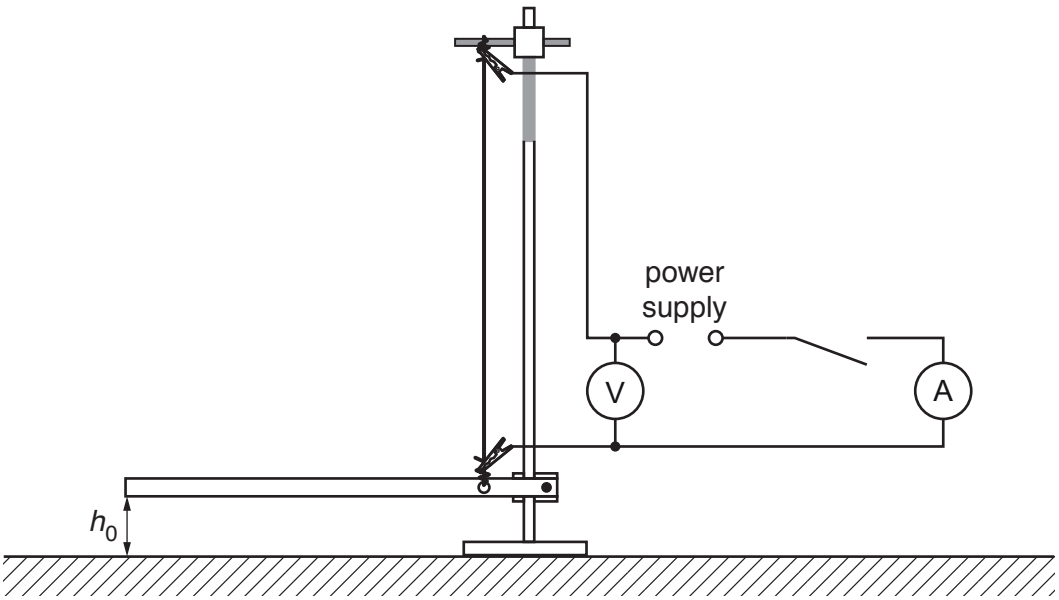


Fig. 2.2

• The height of the end of the wooden strip above the bench is h_0, as shown in Fig. 2.2.

Measure and record h_0.

h_0 = ... mm [1]

(b) (i) • When the switch is closed, the wire will get hot. **Do not touch the wire.**

• Close the switch and adjust the power supply until the ammeter reading I is between 0.40A and 0.50A.

• Measure and record I and the voltmeter reading V.

I = ... A

V = ... V
[2]

(ii) The wire expands and this causes the wooden strip to move.

• The height of the end of the wooden strip above the bench is now h.

Measure and record h.

h = ...mm

• Open the switch.
[1]

(iii) Calculate the change in height Δh, where $\Delta h = h_0 - h$.

Δh = ...mm [1]

(c) Estimate the percentage uncertainty in your value of Δh.

percentage uncertainty = ... [1]

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(d) • Write down the value, in kelvin, of the room temperature T_0 given on the card.

T_0 = ... K

• Calculate the temperature T of the wire using the relationship

$$T = T_0 + \alpha\Delta h$$

where $\alpha = 11.8\,\text{K}\,\text{mm}^{-1}$.

T = ... K [1]

(e) Repeat **(b)** and **(d)** with the ammeter reading between 0.90 A and 1.00 A.

I = ... A

V = ... V

h = ... mm

Δh = ... mm

T = ... K
[2]

(f) It is suggested that the relationship between I, V, T and T_0 is

$$IV\beta = (T^4 - T_0^4)$$

where β is a constant.

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

first value of β = ...

second value of β = ...
[1]

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

.....

.....

..... [1]

(iii) Explain whether your results in **(f)(i)** support the suggested relationship.

.....

.....

..... [1]

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(g) (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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