Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

PHYSICS **9702/33**

Paper 3 Advanced Practical Skills 1 **May/June 2022**

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.

[Turn over

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

1 In this experiment, you will investigate an electrical circuit.

You have been provided with a wooden strip with a wire attached.

(a) Measure and record the length *L* of the wire between the nails on the wooden strip, as shown in Fig. 1.1.

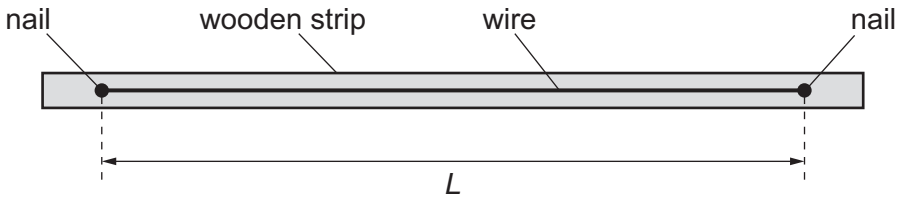


Fig. 1.1

L = ... [1]

(b) You have also been provided with a wire labelled A with crocodile clips at its ends.

- Set up the circuit shown in Fig. 1.2.

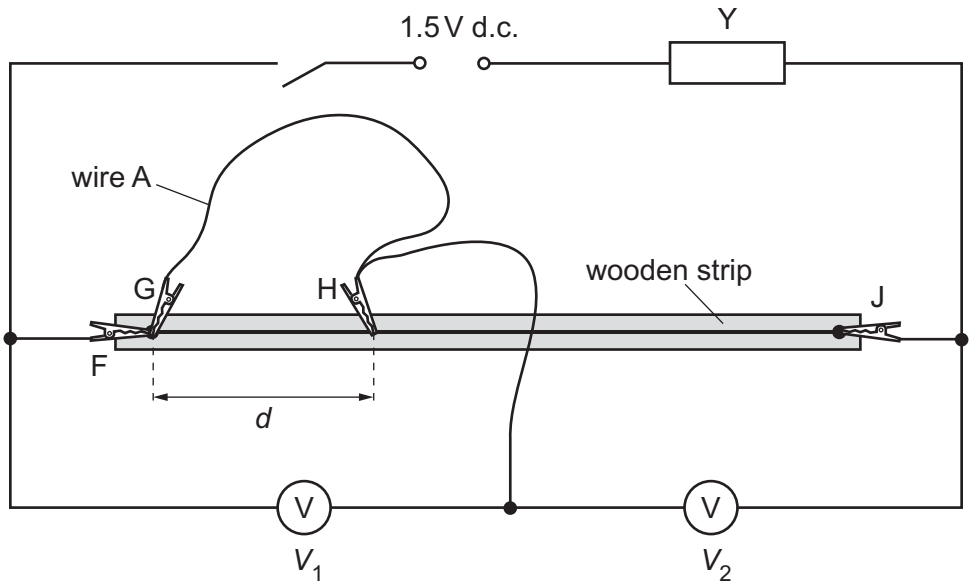


Fig. 1.2

- F, G, H and J are crocodile clips.

  The distance between one of the nails and H is *d*, as shown in Fig. 1.2. Attach H to the wire on the wooden strip so that *d* is approximately 20 cm.

- Close the switch.

- Record the value of *d* and the voltmeter readings V_1 and V_2.

d = ...

V_1 = ...

V_2 = ...

- Open the switch.

[2]

(c) Increase d by placing H at different positions on the wire and record V_1 and V_2.
Repeat until you have six sets of readings of d, V_1 and V_2. Include your values from **(b)**.

Record your results in a table. Include values of $\left(\frac{V_2}{V_1}\right)d$ and d^2 in your table.

[8]

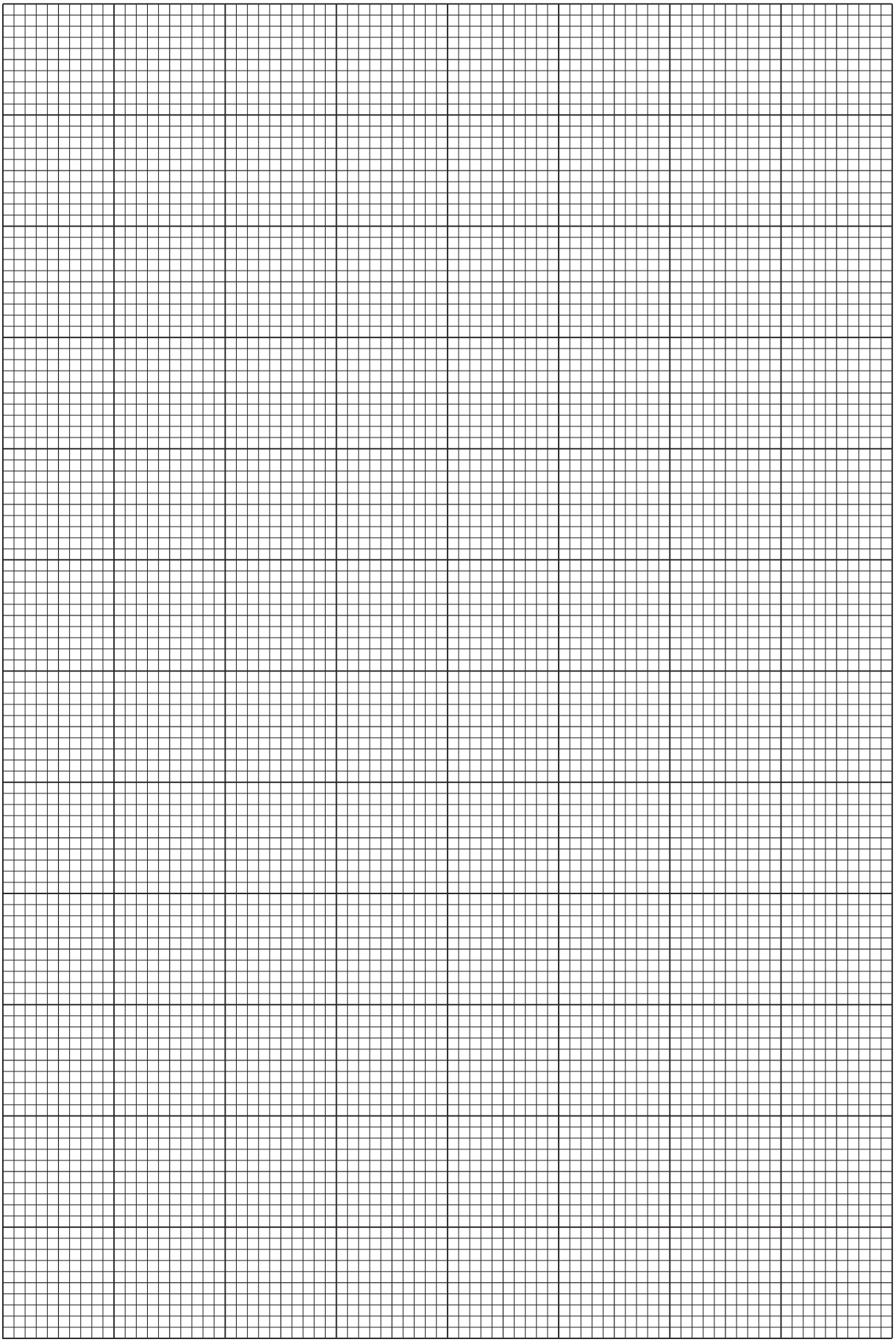
(d) (i) Plot a graph of $\left(\frac{V_2}{V_1}\right)d$ on the y-axis against d^2 on the x-axis. [3]

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

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

gradient = ...

y-intercept = ...
[2]



(e) It is suggested that the quantities V_1, V_2 and d are related by the equation

$$\left(\frac{V_2}{V_1}\right)d = Pd^2 + Q$$

where P and Q are constants.

Using your answers in **(d)(iii)**, determine values for P and Q.
Give appropriate units.

P = ...

Q = ...
[2]

(f) Wire A has the same length L as the wire between the nails.

Theory suggests that

$$P = -\frac{1}{L} \quad \text{and} \quad Q = L.$$

A student repeats the experiment using two shorter wires of equal length.

Sketch a second line on the graph to show the expected results.
Label this line W. [1]

[Total: 20]

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

2 In this experiment, you will investigate the motion of two connected masses.

You have been provided with two masses connected by a string.
The larger mass is 100 g and the smaller mass is 10 g.

(a) (i) ● Set up the apparatus as shown in Fig. 2.1.

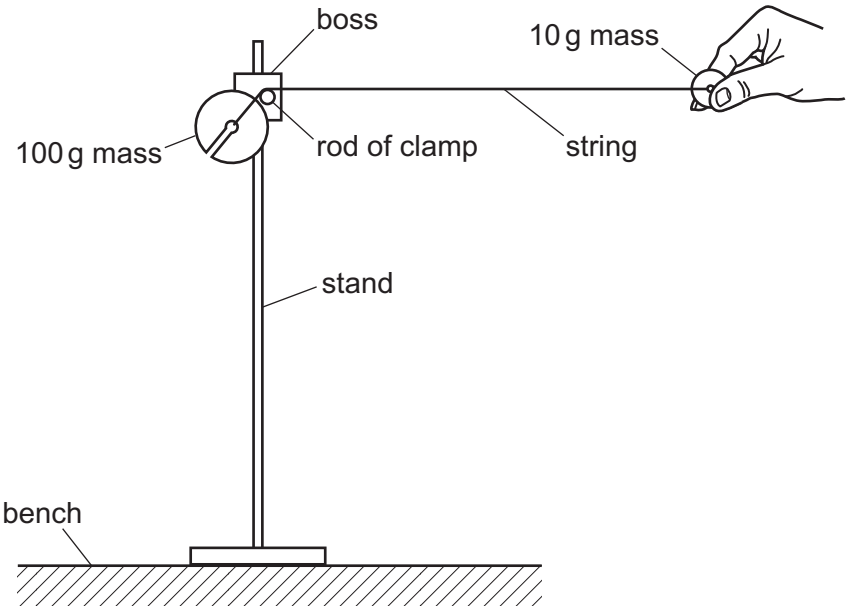


Fig. 2.1

● Hold the 10 g mass so that the string is horizontal and as straight as possible and the 100 g mass is as close to the rod of the clamp as possible. The string should be resting on the rod of the clamp.

When the 10 g mass is released, the 100 g mass will fall downwards.
The 10 g mass will fall and move towards the stand.
The string will wrap itself several times around the rod of the clamp.

You may need to repeat the procedure several times before you see this result.

- Release the 10 g mass.
- The distance fallen by the 100 g mass is *A*, as shown in Fig. 2.2.

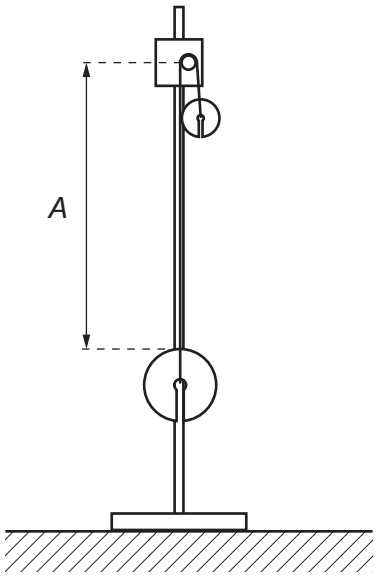


Fig. 2.2

Measure and record *A*.

A = ... [2]

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

percentage uncertainty = ...% [1]

(b) Fig. 2.3 shows the 10 g mass held so that the angle between the string and the vertical is θ.

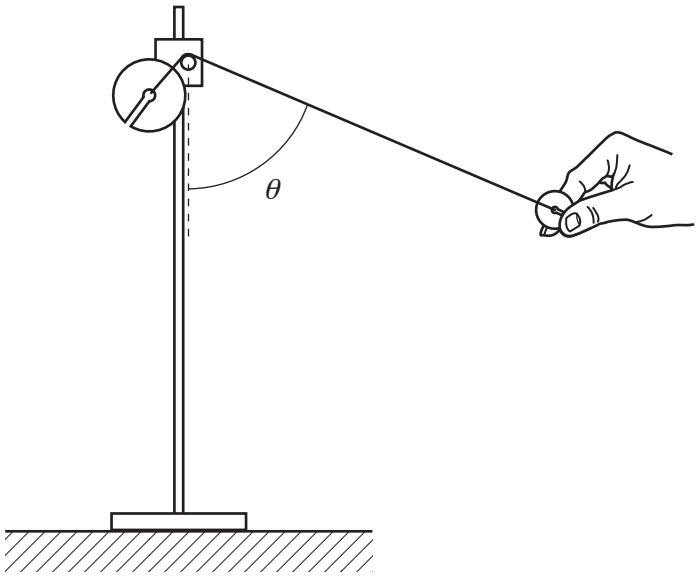


Fig. 2.3

(i)
- Hold the string so that θ is approximately 65°.
- Release the 10 g mass.
- The distance fallen by the 100 g mass is H, as shown in Fig. 2.4.

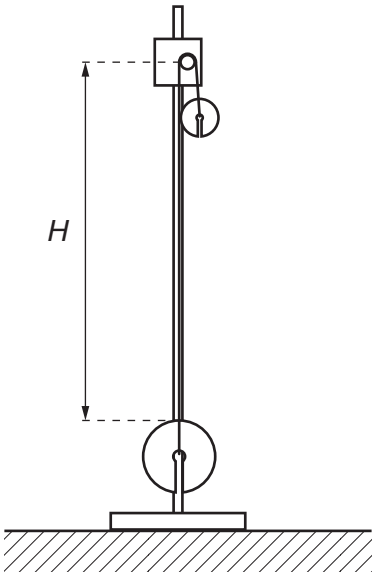


Fig. 2.4

Measure and record θ and H.

θ = ... °

H = ...

[2]

(ii) Calculate $\cos^2\theta$ and $\frac{H}{A}$.

$\cos^2\theta$ = ...

$\frac{H}{A}$ = ...
[1]

(c) Repeat **(b)(i)** and **(b)(ii)** with a value of θ of approximately 45°.

θ = ... °

H = ...

$\cos^2\theta$ = ...

$\frac{H}{A}$ = ...
[3]

(d) It is suggested that the relationship between H, A and θ is

$$\frac{H}{A} = k\cos^2\theta + 1$$

where k is a constant.

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

first value of k = ...

second value of k = ...
[1]

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

.....

.....

..... [1]

(e) It is suggested that the percentage uncertainty in the values of k is 20%.

Using this uncertainty, explain whether your results support the suggested 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]

Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

1319707073

PHYSICS **9702/34**

Paper 3 Advanced Practical Skills 2 **May/June 2022**

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 investigate an electrical circuit.

(a) You have been provided with the circuit shown in Fig. 1.1.

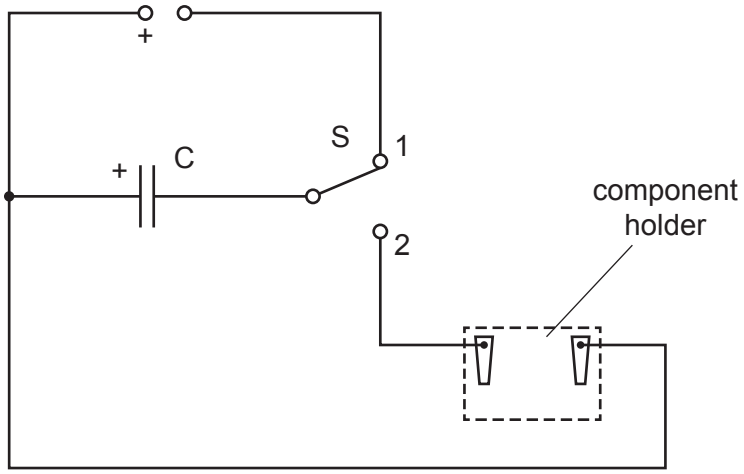


Fig. 1.1

- Connect the voltmeter in parallel with component C, as shown in Fig. 1.2.

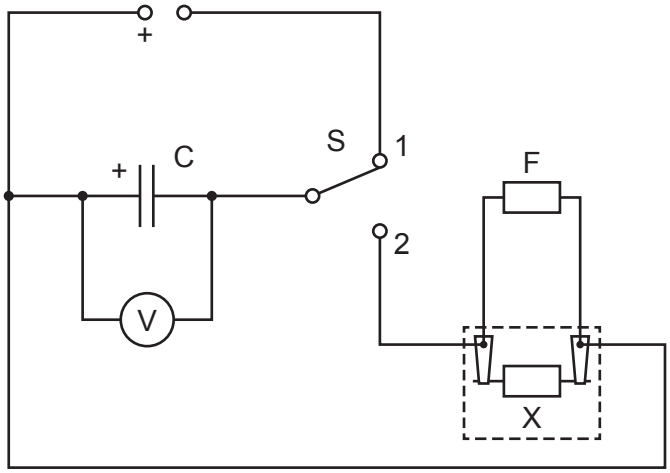


Fig. 1.2

- Connect the resistor labelled F in parallel with the component holder, as shown in Fig. 1.2.

- Connect one of the labelled resistors into the component holder as resistor X, as shown in Fig. 1.2. Record the resistance *R* of resistor X.

R = ...

- Switch on the power supply.
- Move S to position 1.
- Record the voltmeter reading V.

V = ... [1]

(b)
- Ensure S is at position 1.
- Move S to position 2 and start the stop-watch. The voltmeter reading will gradually decrease.
- Stop the stop-watch when the voltmeter reading passes 0.8 V.
- Record the time t shown by the stop-watch.

t = ...

- Move S to position 1.

[2]

(c) Change X and repeat **(b)** until you have six sets of values of R and t.

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

[9]

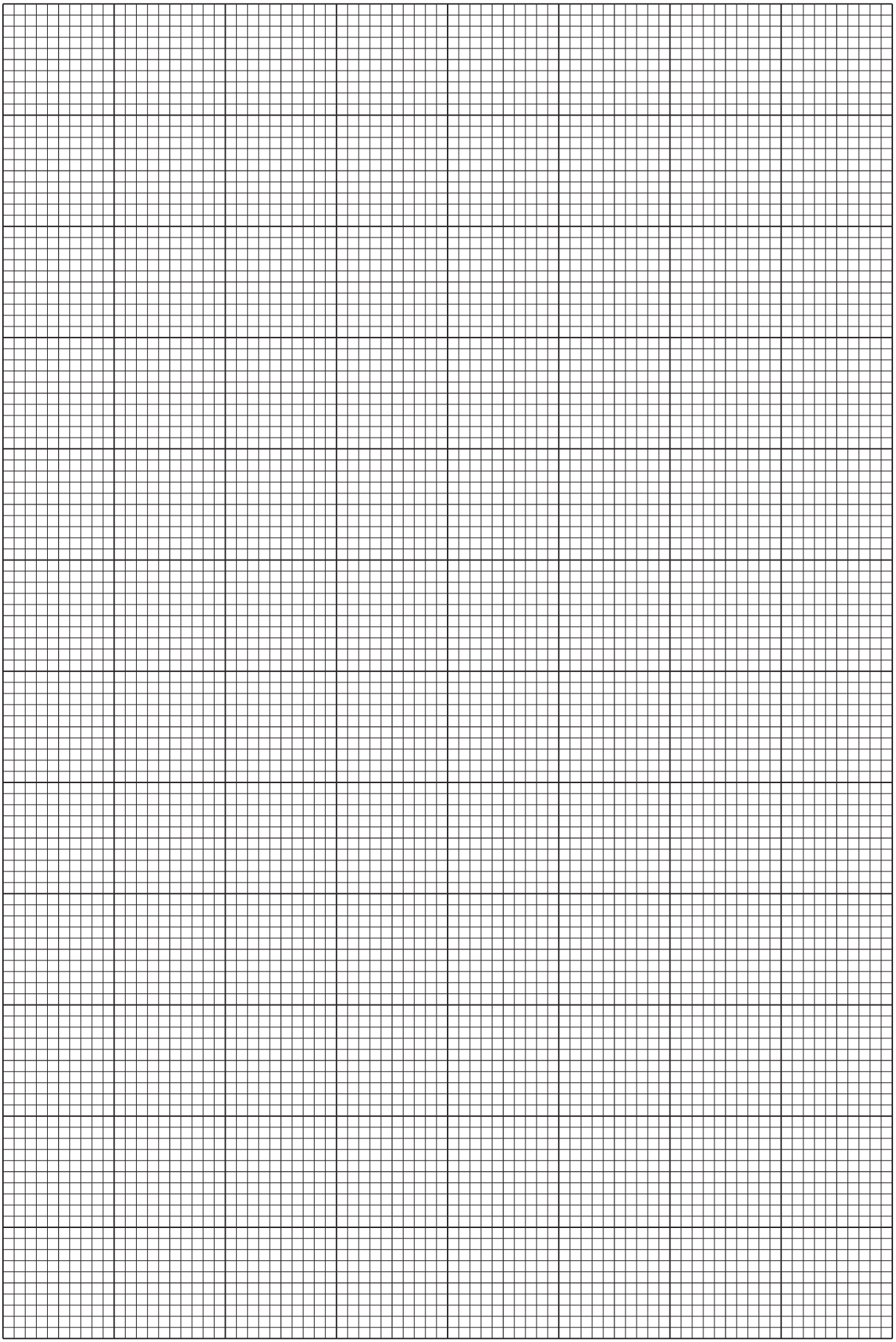
(d) **(i)** Plot a graph of $\frac{1}{t}$ on the y-axis against $\frac{1}{R}$ on the x-axis. [3]

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

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

gradient = ...

y-intercept = ...
[2]



(e) It is suggested that the quantities t and R are related by the equation

$$\frac{1}{t} = \frac{a}{R} + b$$

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 compare some of the properties of two liquids.

(a) You are provided with a block of transparent material with a string loop attached to its rear face, as shown in Fig. 2.1.

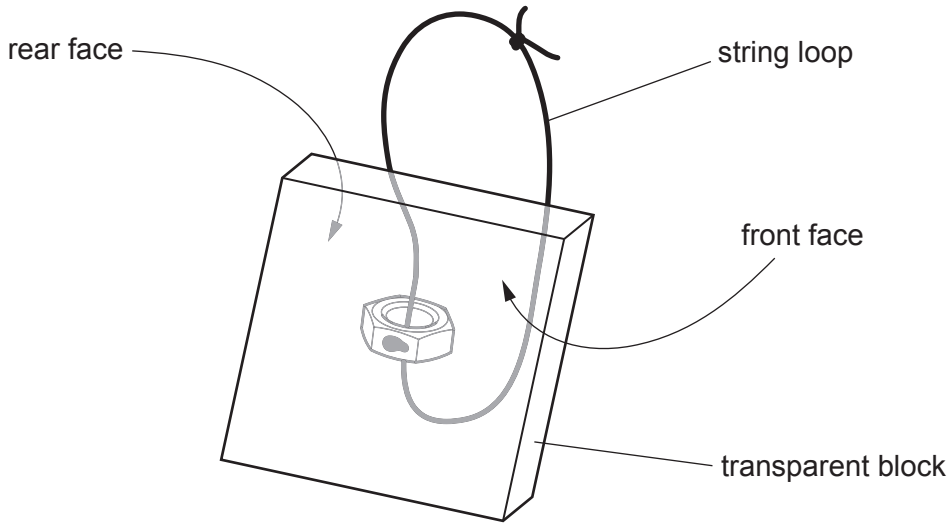


Fig. 2.1

- Hook the newton meter through the string loop.
- Record the weight *W* of the block shown by the newton meter.

W = ... N [1]

(b) (i)

- Place the large transparent plate flat on the bench.
- Use the beaker labelled WATER and its pipette to make a pool of water of approximate diameter 5 cm near the centre of the large plate.
- Place the front face of the transparent block on the pool of water. There should be a film of water over the whole of the front face of the block, as shown in Fig. 2.2.
- Hold the large plate down on the bench.
- Hook the newton meter through the string loop and slowly pull up vertically on the block.

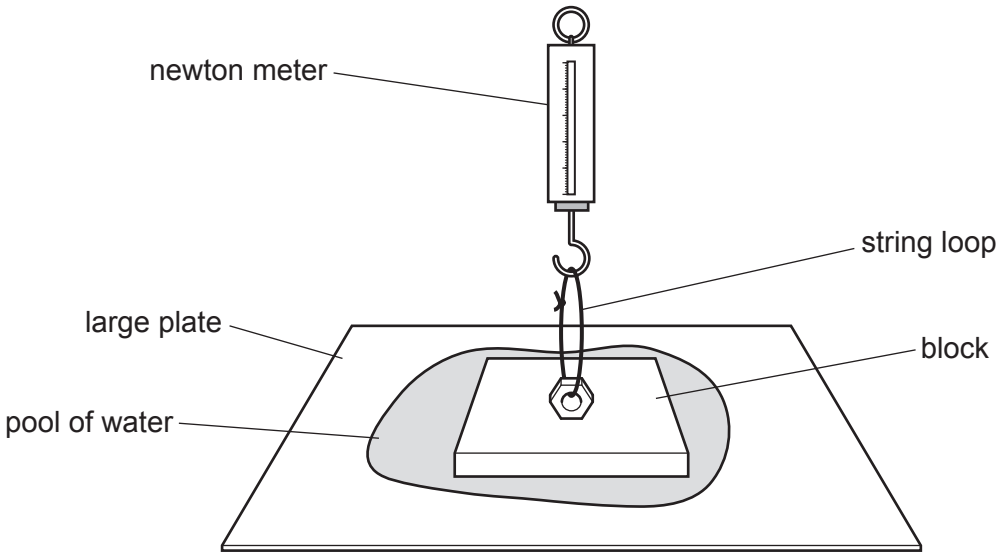


Fig. 2.2

- Record the newton meter reading *F* at the moment the block is detached from the plate.

F = ... N [2]

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

percentage uncertainty = ...% [1]

(iii) Calculate *E* using $E = F - W$.

E = ... N [1]

(c) • Use the stand, boss and clamp to position the syringe body above the beaker of water, as shown in Fig. 2.3.

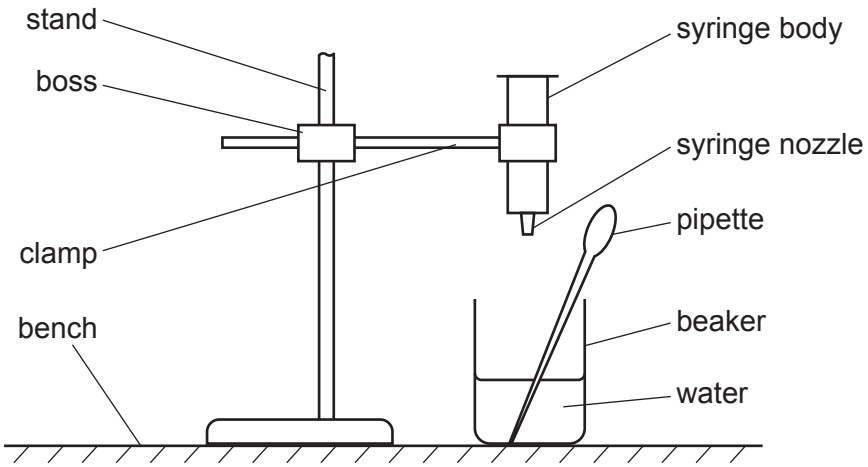


Fig. 2.3

- Cover the nozzle with a finger.
- Use the pipette to fill the syringe with water until the level is above the 10 cm^3 mark.
- Uncover the nozzle and start the stop-watch when the level passes the 10 cm^3 mark.
- Stop the stop-watch when the level passes the 1 cm^3 mark.
- Record the stop-watch reading *T*.

T = ... s [2]

(d) • Use paper towels to dry the water from the large plate, the block and the syringe body.

- Repeat **(b)(i)**, **(b)(iii)** and **(c)** with oil, using the beaker labelled OIL and its pipette.

F = ... N

E = ... N

T = ... s
[2]

(e) It is suggested that the relationship between E and T is

$$kE^2 = T$$

where k is a constant.

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

first value of k = ...

second value of k = ...
[1]

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

.....

.....

..... [1]

(f) It is suggested that the percentage uncertainty in the values of k is 40%.

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]

BLANK PAGE

Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME	
CENTRE NUMBER	
CANDIDATE NUMBER	

PHYSICS **9702/35**

Paper 3 Advanced Practical Skills 1 **May/June 2022**

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.

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

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

You have been provided with a wooden strip with two string loops attached.

(a) ● Set up the apparatus as shown in Fig. 1.1.

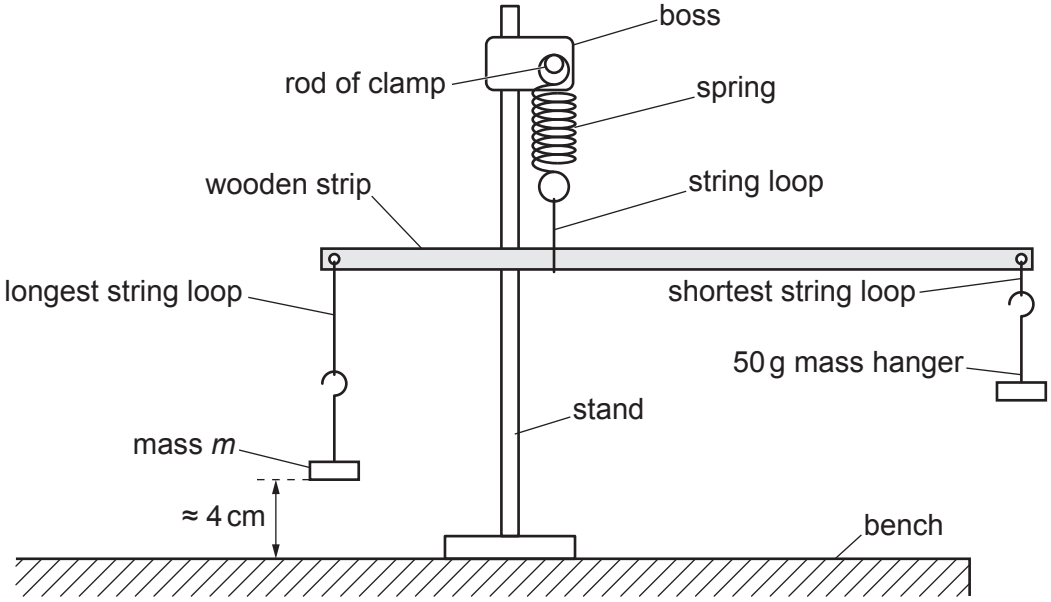


Fig. 1.1

- Add a 100 g mass to the 100 g mass hanger to make a total mass *m* of 200 g.
- Suspend mass *m* from the longest string loop.
- Record *m*.

m = ... g

- Suspend the 50 g mass hanger from the shortest string loop.
- Adjust the position of the wooden strip in the string loop attached to the spring until the strip balances. Use some of the adhesive putty to fix this string loop to the strip.
- Pull mass *m* down to the bench and secure it to the bench using adhesive putty.
- With mass *m* stuck to the bench, adjust the height of the boss until the wooden strip is parallel to the bench, as shown in Fig. 1.2.

3

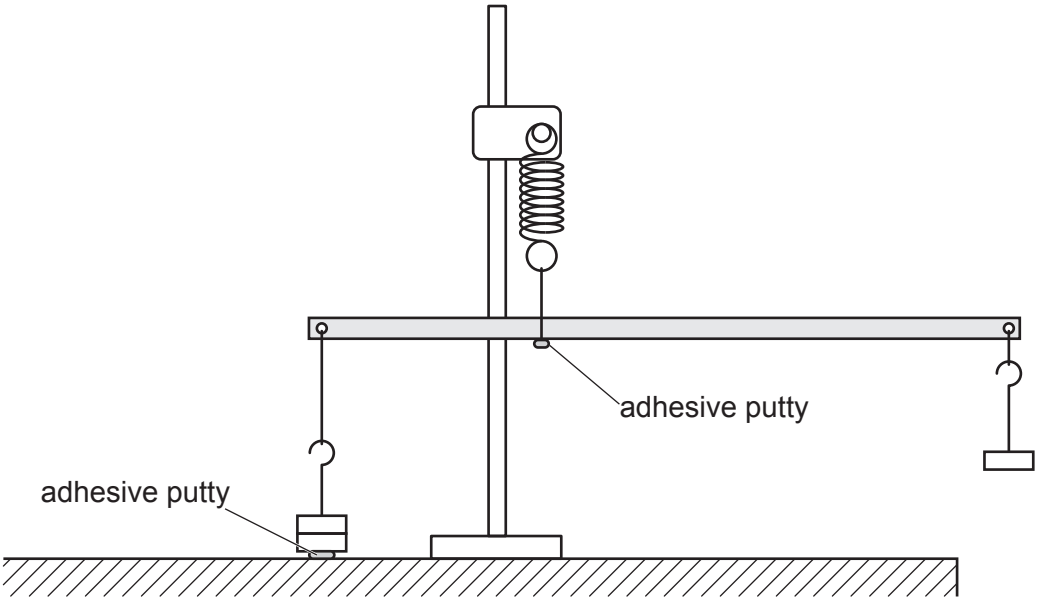


Fig. 1.2

- Pull the 50 g mass hanger down through a short distance.
- Release the 50 g mass hanger. The hanger will oscillate.
- Determine the period T of these oscillations.

T = ...

- Carefully remove all the adhesive putty from mass m and the strip.

[2]

(b) Vary m and repeat **(a)** with different values of m until you have six sets of readings of m and T.

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

[10]

(c) **(i)** Plot a graph of $\frac{T}{m}$ on the y-axis against $\frac{1}{m}$ on the x-axis. [3]

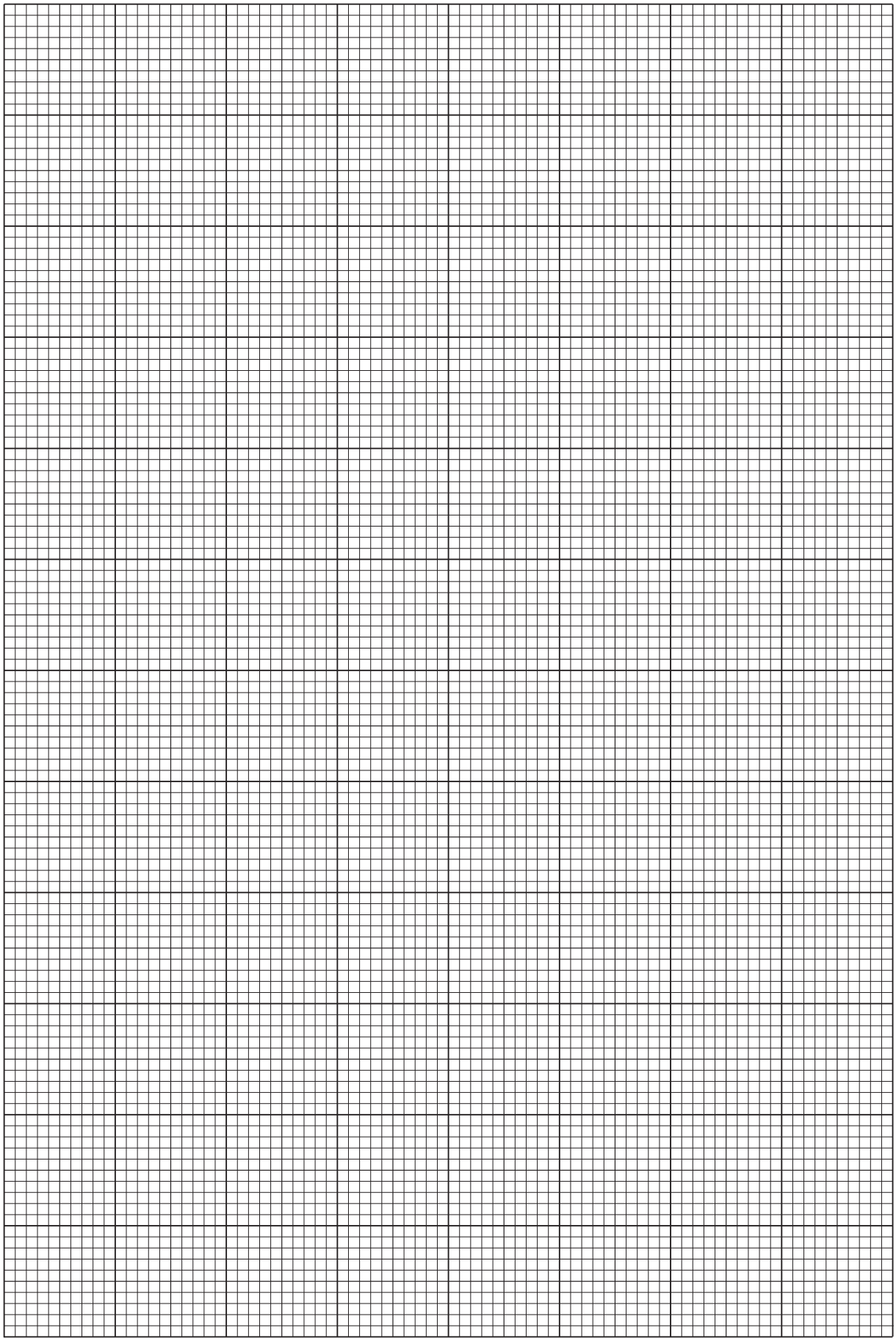
(ii) Draw the straight line of best fit. [1]

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

gradient = ...

y-intercept = ...

[2]



(d) It is suggested that the quantities T and m are related by the equation

$$\frac{T}{m} = \frac{P}{m} + Q$$

where P and Q are constants.

Using your answers in **(c)(iii)**, determine values for P and Q.
Give appropriate units.

P = ...

Q = ...
[2]

[Total: 20]

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

2 In this experiment, you will investigate the effect of temperature on an electric circuit.

You have been provided with two copper wires of the same length. You have also been provided with two constantan wires of different lengths.

(a) (i) Measure and record the diameter *d* of the **longer** constantan wire.

d = ... [1]

(ii) ● Using the two copper wires and the longer constantan wire, twist the ends together to form junctions as shown in Fig. 2.1.

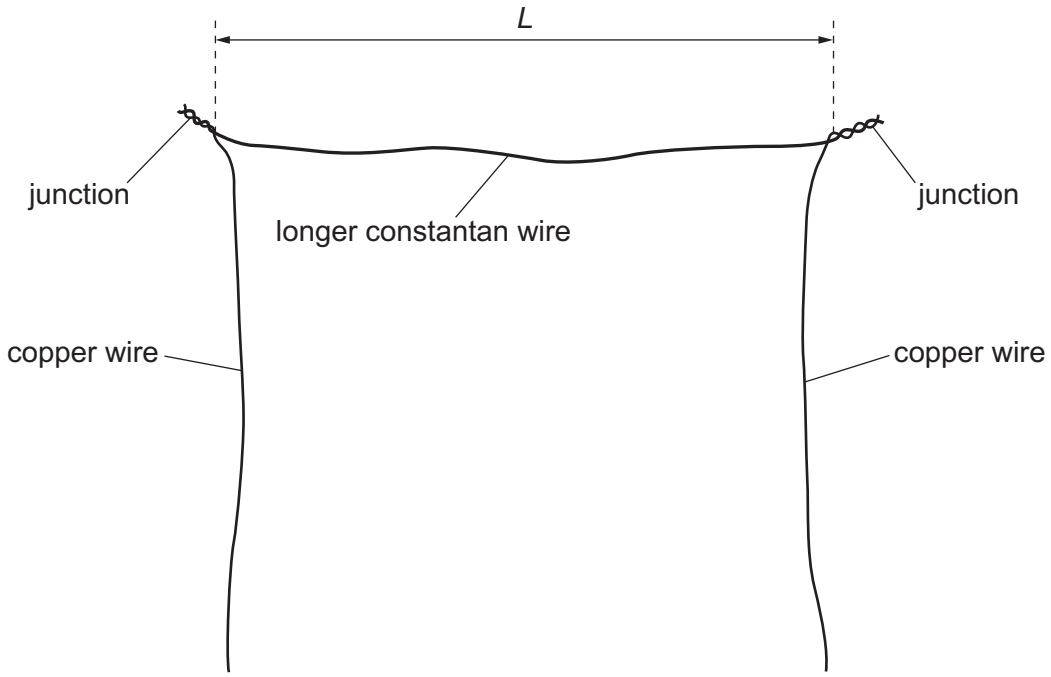


Fig. 2.1

- Ensure the junctions are tight so that the wires cannot be separated by pulling.
- The distance between the junctions along the constantan wire is *L*, as shown in Fig. 2.1.

  Measure and record *L*.

L = ... cm [1]

(iii) Estimate the percentage uncertainty in your value of L. Show your working.

percentage uncertainty = ... % [1]

(iv) Calculate C where

$$C = \frac{d^2}{L}.$$

C = ... [1]

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

.....

.....

..... [1]

(b) ● Measure and record the temperature θ_R of the room.

θ_R = ... °C

● Connect the copper wires to the ammeter as shown in Fig. 2.2.

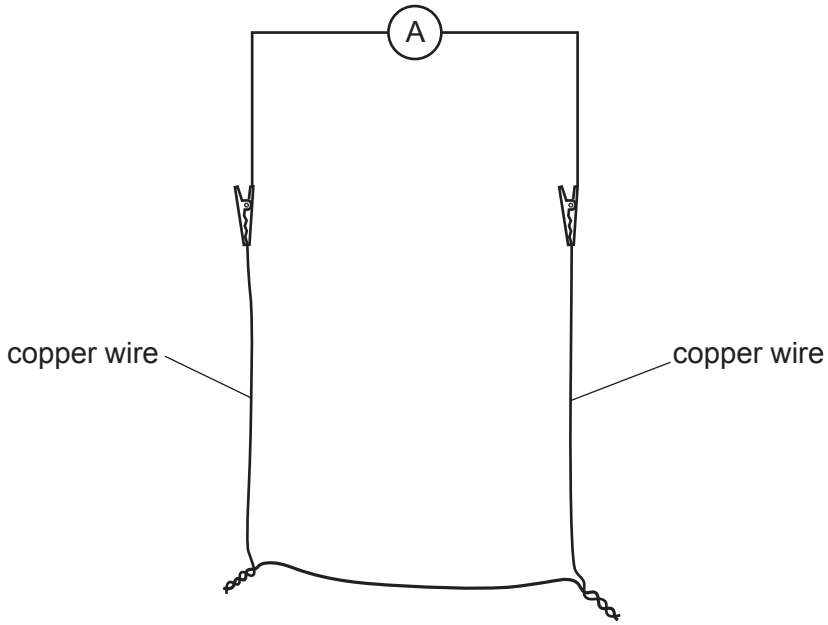


Fig. 2.2

● Pour boiling water into the beaker so that the beaker is half-full.

● Place **one** of the junctions deep in the water. The other junction should be at room temperature.

● Record the ammeter reading I when the temperature θ of the water passes 75 °C.

I = ...

● Record θ.

θ = ... °C

● Calculate $\Delta\theta$ where

$$\Delta\theta = (\theta - \theta_R).$$

$\Delta\theta$ = ... °C

● Pour the hot water into the sink.

[2]

(c) (i) ● Untwist the wires at the junctions.

● Using the **shorter** constantan wire and the two copper wires, repeat **(a)(i)**, **(a)(ii)** and **(a)(iv)**.

d = ...

L = ... cm

C = ...
[2]

(ii) ● Connect the copper wires to the ammeter as shown in Fig. 2.2.

● Pour boiling water into the beaker so that the beaker is half-full.

● Place **one** of the junctions deep in the water. The other junction should be at room temperature.

● Record the ammeter reading I when the temperature θ of the water passes 65 °C.

I = ...

● Record θ.

θ = ... °C

● Calculate $\Delta\theta$ where

$$\Delta\theta = (\theta - \theta_R).$$

$\Delta\theta$ = ... °C

● Pour the hot water into the sink.
[1]

(d) It is suggested that the relationship between I, C and $\Delta\theta$ is

$$I = kC\Delta\theta$$

where 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 30%.

Using this uncertainty, explain whether your results support the suggested 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]