



Cambridge International AS & A Level

CANDIDATE
NAMECENTRE
NUMBER

--	--	--	--	--

CANDIDATE
NUMBER

--	--	--	--

PHYSICS

9702/51

Paper 5 Planning, Analysis and Evaluation

May/June 2025

1 hour 15 minutes

You must answer on the question paper.

No additional materials are needed.

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 may use a calculator.
- You should show all your working and use appropriate units.

INFORMATION

- The total mark for this paper is 30.
- The number of marks for each question or part question is shown in brackets [].

This document has 8 pages.

- 1 Fig. 1.1 shows a thin coil of cross-sectional area A and length l connected to a resistor of resistance S and two terminals.

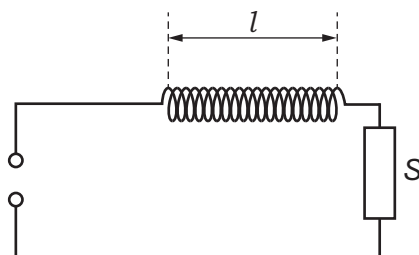


Fig. 1.1

An alternating voltage is applied to the terminals. The peak value of the alternating voltage is E and the frequency is f . The peak value of the potential difference V across the resistor is determined using an oscilloscope.

It is suggested that V is related to f by the relationship

$$\frac{ES}{V} = \frac{KAN^2f}{l}$$

where N is the number of turns on the coil and K is a constant.

Plan a laboratory experiment to test the relationship between V and f .

Draw a diagram showing the arrangement of your equipment.

Explain how the results could be used to determine a value for K .

In your plan you should include:

- the procedure to be followed
- the measurements to be taken
- the control of variables
- the analysis of the data
- any safety precautions to be taken.



This image shows a full page of white paper with horizontal dashed lines, typical of primary school writing paper. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

..... [15]

- 2 A student investigates an electrical circuit.

The circuit is set up as shown in Fig. 2.1.

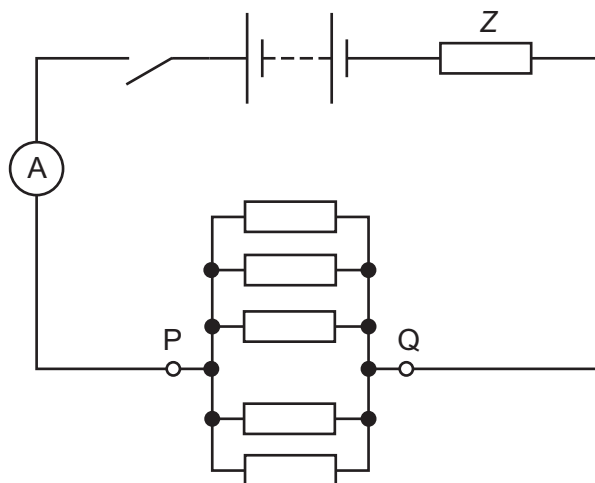


Fig. 2.1

A battery of negligible internal resistance is connected to a resistor of resistance Z . Five resistors, each of resistance R , are connected in parallel between P and Q.

The switch is closed. The total current I in the circuit is measured using the ammeter.

The experiment is then repeated by changing the number n of resistors, each of resistance R , connected in parallel between P and Q.

It is suggested that I and n are related by the equation

$$E = I \left(\frac{R}{n} + Z \right)$$

where E is the electromotive force (e.m.f.) of the battery.

- (a) A graph is plotted of $\frac{1}{I}$ on the y-axis against $\frac{1}{n}$ on the x-axis.

Determine expressions for the gradient and y-intercept.

gradient = ...

y-intercept = ...

[1]





(b) Values of n , $\frac{1}{n}$ and I are given in Table 2.1.

Table 2.1

n	$\frac{1}{n}$	$I/\mu\text{A}$	$\frac{1}{I}/10^3\text{A}^{-1}$
5	0.200	455 ± 5	
6	0.167	525 ± 5	
7	0.143	580 ± 5	
8	0.125	635 ± 5	
9	0.111	685 ± 5	
11	0.0909	765 ± 5	

Calculate and record values of $\frac{1}{I}/10^3\text{A}^{-1}$ in Table 2.1. Include the absolute uncertainties in $\frac{1}{I}$. [2]

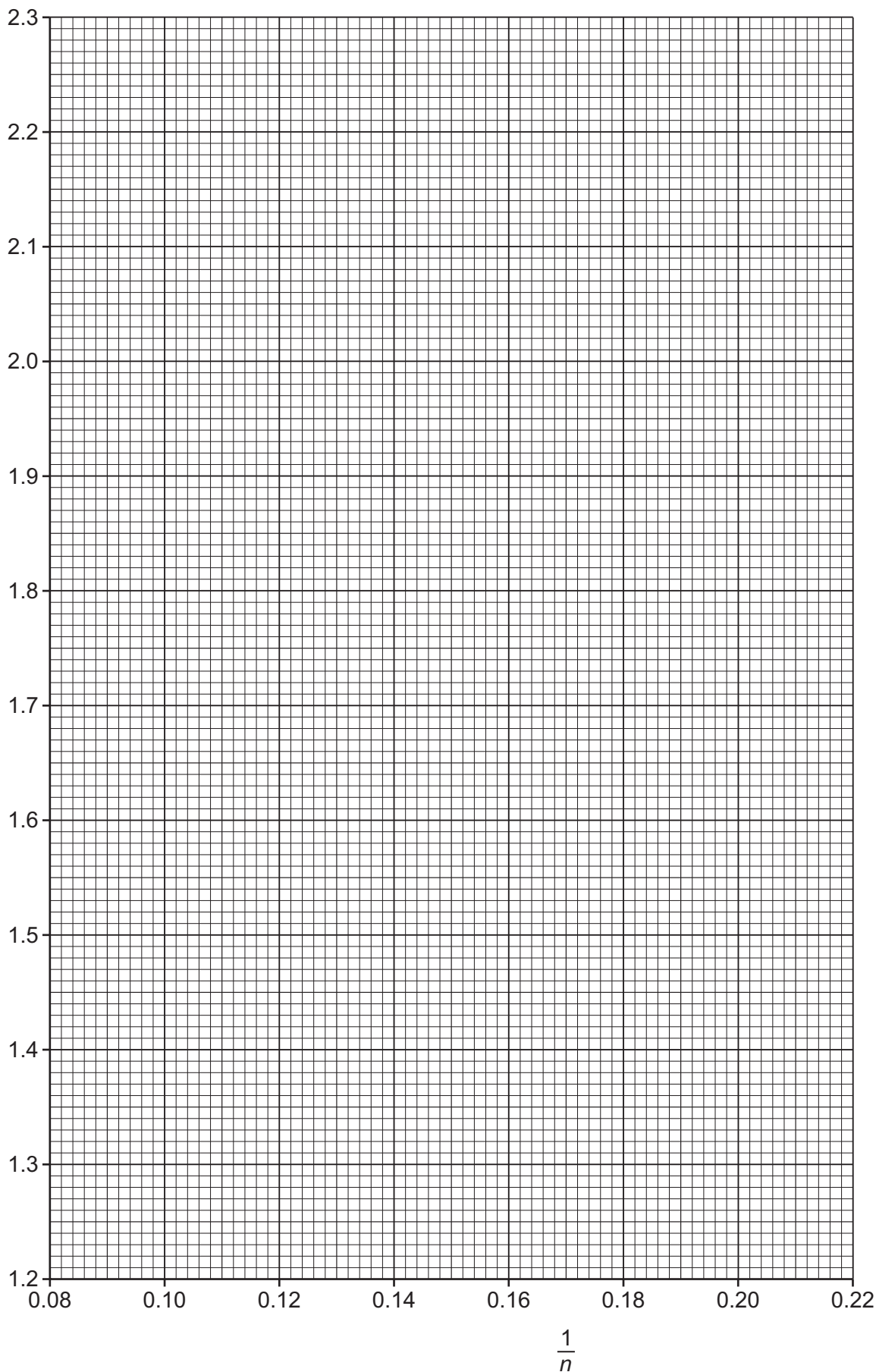
- (c) (i) Plot a graph of $\frac{1}{I}/10^3\text{A}^{-1}$ against $\frac{1}{n}$. Include error bars for $\frac{1}{I}$. [2]
- (ii) Draw the straight line of best fit and a worst acceptable straight line on your graph. Label both lines. [2]
- (iii) Determine the gradient of the line of best fit. Include the absolute uncertainty in your answer.

gradient = ... [2]





$\frac{1}{I} / 10^3 \text{A}^{-1}$





- (iv) Determine the y -intercept of the line of best fit. Include the absolute uncertainty in your answer.

y -intercept = ... [2]

- (d) The e.m.f. E of the battery is determined twice during the experiment. The values obtained are 5.6 V and 6.0 V.

- (i) Using your answers to (a), (c)(iii) and (c)(iv), determine the values of R and Z . Include appropriate units.

R = ...

Z = ... [2]

- (ii) Determine the percentage uncertainty in your value of R .

percentage uncertainty = ... % [1]

- (e) The experiment is repeated with 20 resistors, each of resistance R , connected in parallel between P and Q. Determine the total current I in the circuit.

I = ... A [1]

[Total: 15]





Cambridge International AS & A Level

CANDIDATE
NAMECENTRE
NUMBER

--	--	--	--	--

CANDIDATE
NUMBER

--	--	--	--

PHYSICS

9702/52

Paper 5 Planning, Analysis and Evaluation

May/June 2025

1 hour 15 minutes

You must answer on the question paper.

No additional materials are needed.

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 may use a calculator.
- You should show all your working and use appropriate units.

INFORMATION

- The total mark for this paper is 30.
- The number of marks for each question or part question is shown in brackets [].

This document has 8 pages.



- 1 A thin solid disc of radius r and thickness z is attached to a thin axle. String is wrapped around the axle, as shown in Fig. 1.1.

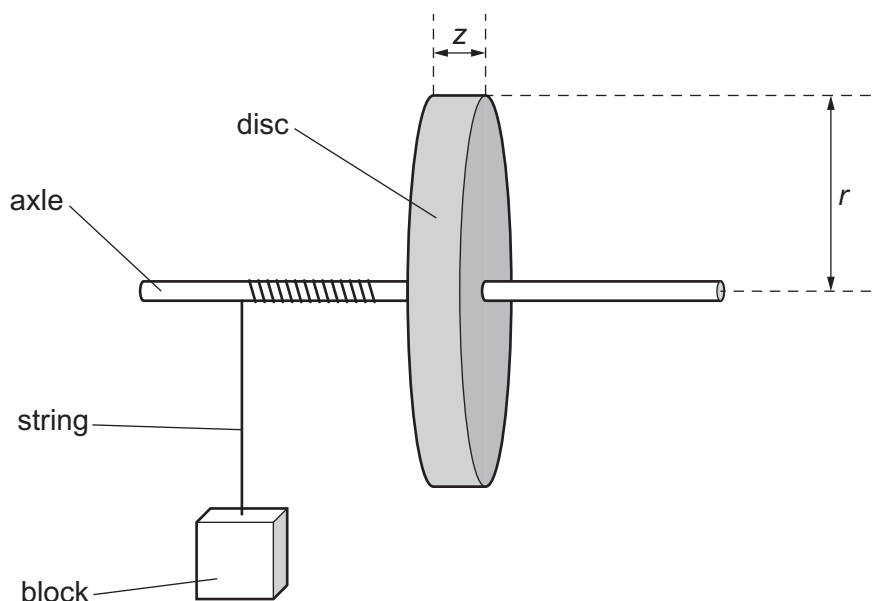


Fig. 1.1

A block of mass m is attached to the string.

The block is released from rest and falls downwards. The block has speed v when it has fallen through a distance h from the point of release. The value of v is determined using **one** light gate connected to a timer.

It is suggested that v is related to m by the relationship

$$\frac{h}{v^2} = \frac{\pi r^2 z}{2PQm} + \frac{1}{P}$$

where P and Q are constants.

Plan a laboratory experiment to test the relationship between v and m .

Draw a diagram showing the arrangement of your equipment.

Explain how the results could be used to determine values for P and Q .

In your plan you should include:

- the procedure to be followed
- the measurements to be taken
- the control of variables
- the analysis of the data
- any safety precautions to be taken.





Diagram

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....



..... [15]

- 2 A student investigates a circuit containing capacitors. The circuit is connected with a capacitor of capacitance A , as shown in Fig. 2.1.

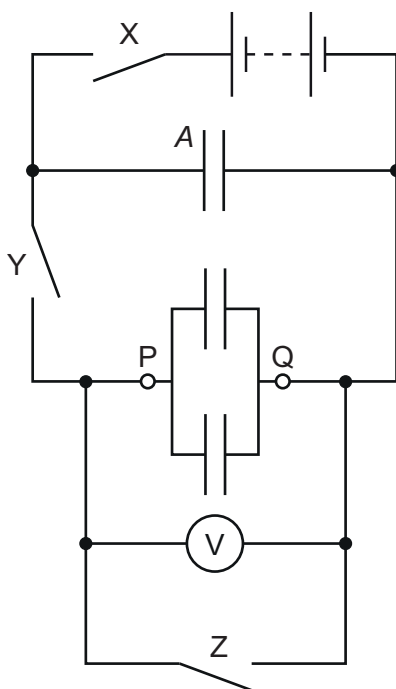


Fig. 2.1

Two capacitors, each of capacitance C , are connected in parallel between P and Q.

Initially, switch X and switch Z are closed and switch Y is open.

Switches X and Z are opened. Switch Y is then closed. The maximum potential difference between P and Q is measured using the voltmeter. This procedure is repeated and the mean maximum potential difference V between P and Q is determined.

The experiment is then repeated by changing the number n of capacitors, each of capacitance C , connected in parallel between P and Q.

It is suggested that V and n are related by the equation

$$EA = V(nC + A)$$

where E is the electromotive force (e.m.f.) of the battery.

- (a) A graph is plotted of $\frac{1}{V}$ on the y -axis against n on the x -axis.

Determine expressions for the gradient and y -intercept.

gradient = ...

y -intercept = ...

[1]





- (b) Values of n and the two measured values of the maximum potential difference V_1 and V_2 are given in Table 2.1.

Table 2.1

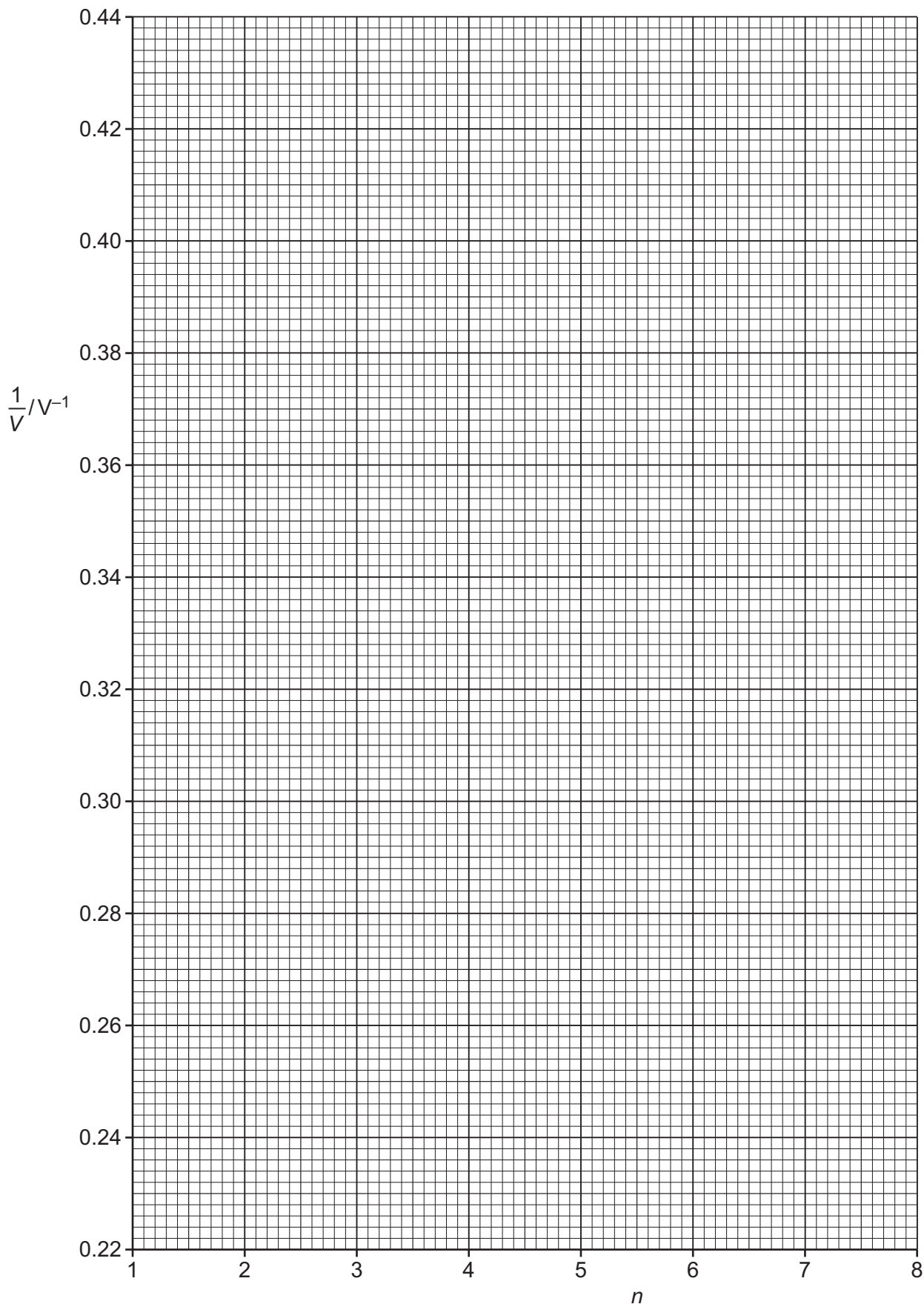
n	V_1/V	V_2/V	V/V	$\frac{1}{V}/V^{-1}$
2	4.30	4.20		
3	3.65	3.75		
4	3.30	3.20		
5	2.85	2.95		
6	2.65	2.55		
7	2.30	2.40		

Calculate and record values of V/V and $\frac{1}{V}/V^{-1}$ in Table 2.1. Include the absolute uncertainties in V and $\frac{1}{V}$. [2]

- (c) (i) Plot a graph of $\frac{1}{V}/V^{-1}$ against n . Include error bars for $\frac{1}{V}$. [2]
- (ii) Draw the straight line of best fit and a worst acceptable straight line on your graph. Label both lines. [2]
- (iii) Determine the gradient of the line of best fit. Include the absolute uncertainty in your answer.

gradient = ... [2]







- (iv) Determine the y -intercept of the line of best fit. Include the absolute uncertainty in your answer.

y -intercept = ... [2]

- (d) (i) Using your answers to (a), (c)(iii) and (c)(iv), determine the values of E and C . Include appropriate units.

Data: $A = (2.2 \pm 0.2) \text{ mF}$

$E = \dots\dots\dots$

$C = \dots\dots\dots$

[2]

- (ii) Determine the percentage uncertainty in your value of C .

percentage uncertainty = ...% [1]

- (e) The experiment is repeated with 10 capacitors, each of capacitance C , connected in parallel between P and Q. Determine the maximum potential difference V between P and Q.

$V = \dots\dots\dots V$ [1]

[Total: 15]





Cambridge International AS & A Level

CANDIDATE
NAMECENTRE
NUMBER

--	--	--	--	--

CANDIDATE
NUMBER

--	--	--	--

PHYSICS

9702/53

Paper 5 Planning, Analysis and Evaluation

May/June 2025

1 hour 15 minutes

You must answer on the question paper.

No additional materials are needed.

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 may use a calculator.
- You should show all your working and use appropriate units.

INFORMATION

- The total mark for this paper is 30.
- The number of marks for each question or part question is shown in brackets [].

This document has 8 pages.

- 1 Fig. 1.1 shows a thin coil of cross-sectional area A and length l connected to a resistor of resistance S and two terminals.

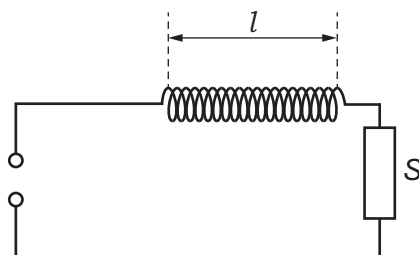


Fig. 1.1

An alternating voltage is applied to the terminals. The peak value of the alternating voltage is E and the frequency is f . The peak value of the potential difference V across the resistor is determined using an oscilloscope.

It is suggested that V is related to f by the relationship

$$\frac{ES}{V} = \frac{KAN^2f}{l}$$

where N is the number of turns on the coil and K is a constant.

Plan a laboratory experiment to test the relationship between V and f .

Draw a diagram showing the arrangement of your equipment.

Explain how the results could be used to determine a value for K .

In your plan you should include:

- the procedure to be followed
- the measurements to be taken
- the control of variables
- the analysis of the data
- any safety precautions to be taken.



This image shows a full page of white paper with horizontal dashed lines, typical of primary school writing paper. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

..... [15]

- 2 A student investigates an electrical circuit.

The circuit is set up as shown in Fig. 2.1.

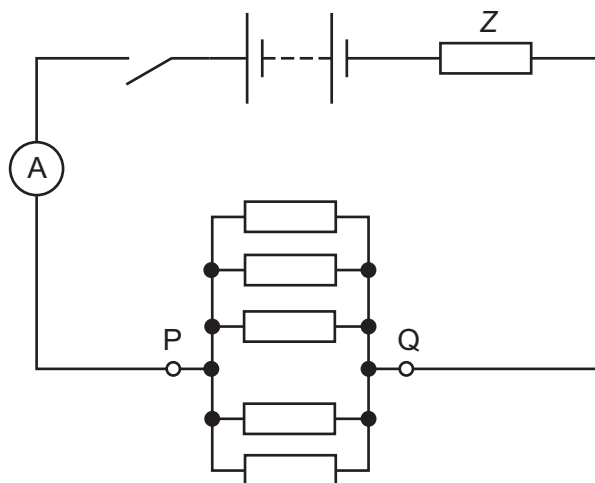


Fig. 2.1

A battery of negligible internal resistance is connected to a resistor of resistance Z . Five resistors, each of resistance R , are connected in parallel between P and Q.

The switch is closed. The total current I in the circuit is measured using the ammeter.

The experiment is then repeated by changing the number n of resistors, each of resistance R , connected in parallel between P and Q.

It is suggested that I and n are related by the equation

$$E = I \left(\frac{R}{n} + Z \right)$$

where E is the electromotive force (e.m.f.) of the battery.

- (a) A graph is plotted of $\frac{1}{I}$ on the y-axis against $\frac{1}{n}$ on the x-axis.

Determine expressions for the gradient and y-intercept.

gradient = ...

y-intercept = ...

[1]





(b) Values of n , $\frac{1}{n}$ and I are given in Table 2.1.

Table 2.1

n	$\frac{1}{n}$	$I/\mu\text{A}$	$\frac{1}{I}/10^3\text{A}^{-1}$
5	0.200	455 ± 5	
6	0.167	525 ± 5	
7	0.143	580 ± 5	
8	0.125	635 ± 5	
9	0.111	685 ± 5	
11	0.0909	765 ± 5	

Calculate and record values of $\frac{1}{I}/10^3\text{A}^{-1}$ in Table 2.1. Include the absolute uncertainties in $\frac{1}{I}$. [2]

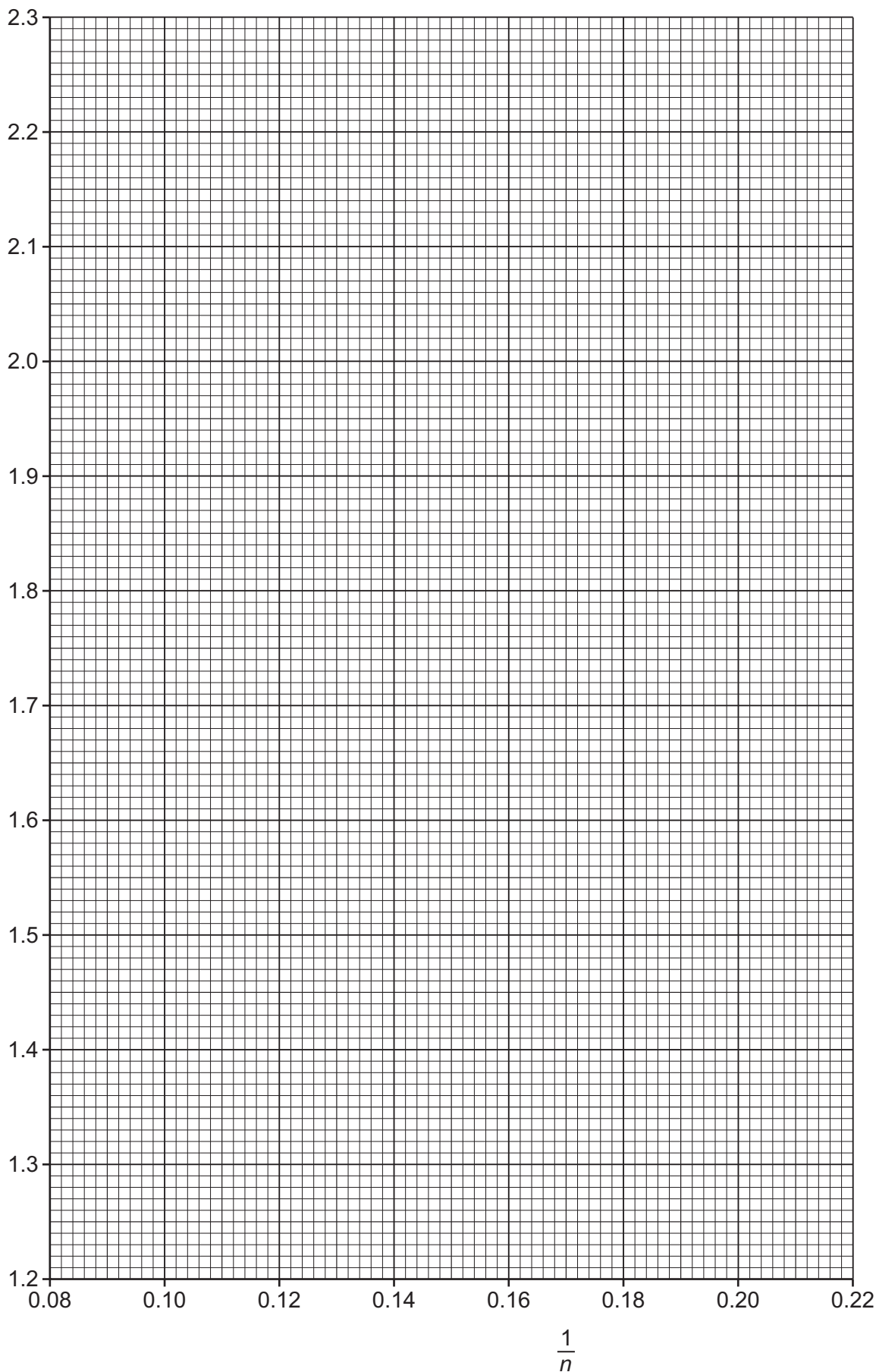
- (c) (i) Plot a graph of $\frac{1}{I}/10^3\text{A}^{-1}$ against $\frac{1}{n}$. Include error bars for $\frac{1}{I}$. [2]
- (ii) Draw the straight line of best fit and a worst acceptable straight line on your graph. Label both lines. [2]
- (iii) Determine the gradient of the line of best fit. Include the absolute uncertainty in your answer.

gradient = ... [2]





$\frac{1}{I} / 10^3 \text{A}^{-1}$





- (iv) Determine the y -intercept of the line of best fit. Include the absolute uncertainty in your answer.

y -intercept = ... [2]

- (d) The e.m.f. E of the battery is determined twice during the experiment. The values obtained are 5.6 V and 6.0 V.

- (i) Using your answers to (a), (c)(iii) and (c)(iv), determine the values of R and Z . Include appropriate units.

R = ...

Z = ...

[2]

- (ii) Determine the percentage uncertainty in your value of R .

percentage uncertainty = ... % [1]

- (e) The experiment is repeated with 20 resistors, each of resistance R , connected in parallel between P and Q. Determine the total current I in the circuit.

I = ... A [1]

[Total: 15]





Cambridge International AS & A Level

CANDIDATE
NAME



CENTRE
NUMBER

--	--	--	--	--

CANDIDATE
NUMBER

--	--	--	--

PHYSICS

9702/54

Paper 5 Planning, Analysis and Evaluation

May/June 2025

1 hour 15 minutes

You must answer on the question paper.

No additional materials are needed.

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 may use a calculator.
- You should show all your working and use appropriate units.

INFORMATION

- The total mark for this paper is 30.
- The number of marks for each question or part question is shown in brackets [].

This document has 8 pages.



- 1 A ball is dropped on to an inclined thin metal sheet, as shown in Fig. 1.1.

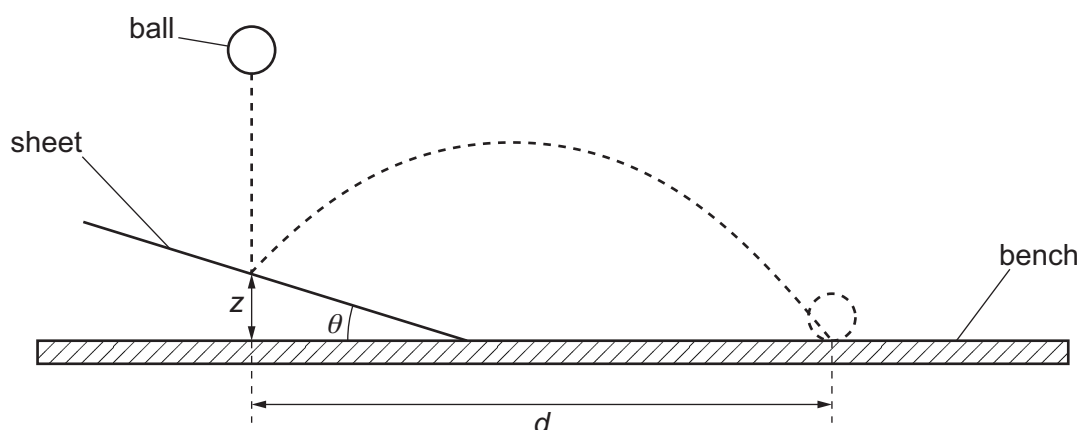


Fig. 1.1 (not to scale)

The angle between the sheet and the horizontal bench is θ . The height of the point of contact of the ball and the sheet is z . The horizontal distance travelled by the ball between its points of contact with the sheet and the bench is d , as shown in Fig. 1.1.

It is suggested that d is related to θ by the relationship

$$d = \frac{Pv^2 \sin 4\theta}{g} + Q\sqrt{z}$$

where v is the speed of the ball as it makes contact with the sheet, g is the acceleration of free fall, and P and Q are constants.

Plan a laboratory experiment to test the relationship between d and θ .

Draw a diagram showing the arrangement of your equipment.

Explain how the results could be used to determine values for P and Q .

In your plan you should include:

- the procedure to be followed
- the measurements to be taken
- the control of variables
- the analysis of the data
- any safety precautions to be taken.





Diagram

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....



..... [15]

- 2 A student investigates the relationship between the luminosity of a star and its mass.

The student obtains data of relative luminosity λ and relative mass μ for six stars, where

$$\lambda = \frac{\text{luminosity of star}}{\text{luminosity of Sun}}$$

and

$$\mu = \frac{\text{mass of star}}{\text{mass of Sun}}.$$

It is suggested that λ and μ are related by the equation

$$\lambda = k\mu^n$$

where k and n are constants.

- (a) A graph is plotted of $\lg \lambda$ on the y -axis against $\lg \mu$ on the x -axis.

Determine expressions for the gradient and y -intercept.

gradient = ...

y -intercept = ...

[1]





(b) Values of μ and λ are given in Table 2.1.

Table 2.1

μ	λ	$\lg \mu$	$\lg \lambda$
4.6 ± 0.4	500		
5.4 ± 0.4	800		
8.4 ± 0.4	3200		
11 ± 1	7000		
16 ± 1	25 000		
18 ± 1	38 000		

Calculate and record values of $\lg \mu$ and $\lg \lambda$ in Table 2.1.

Include the absolute uncertainties in $\lg \mu$.

[2]

- (c) (i) Plot a graph of $\lg \lambda$ against $\lg \mu$.
Include error bars for $\lg \mu$.

[2]

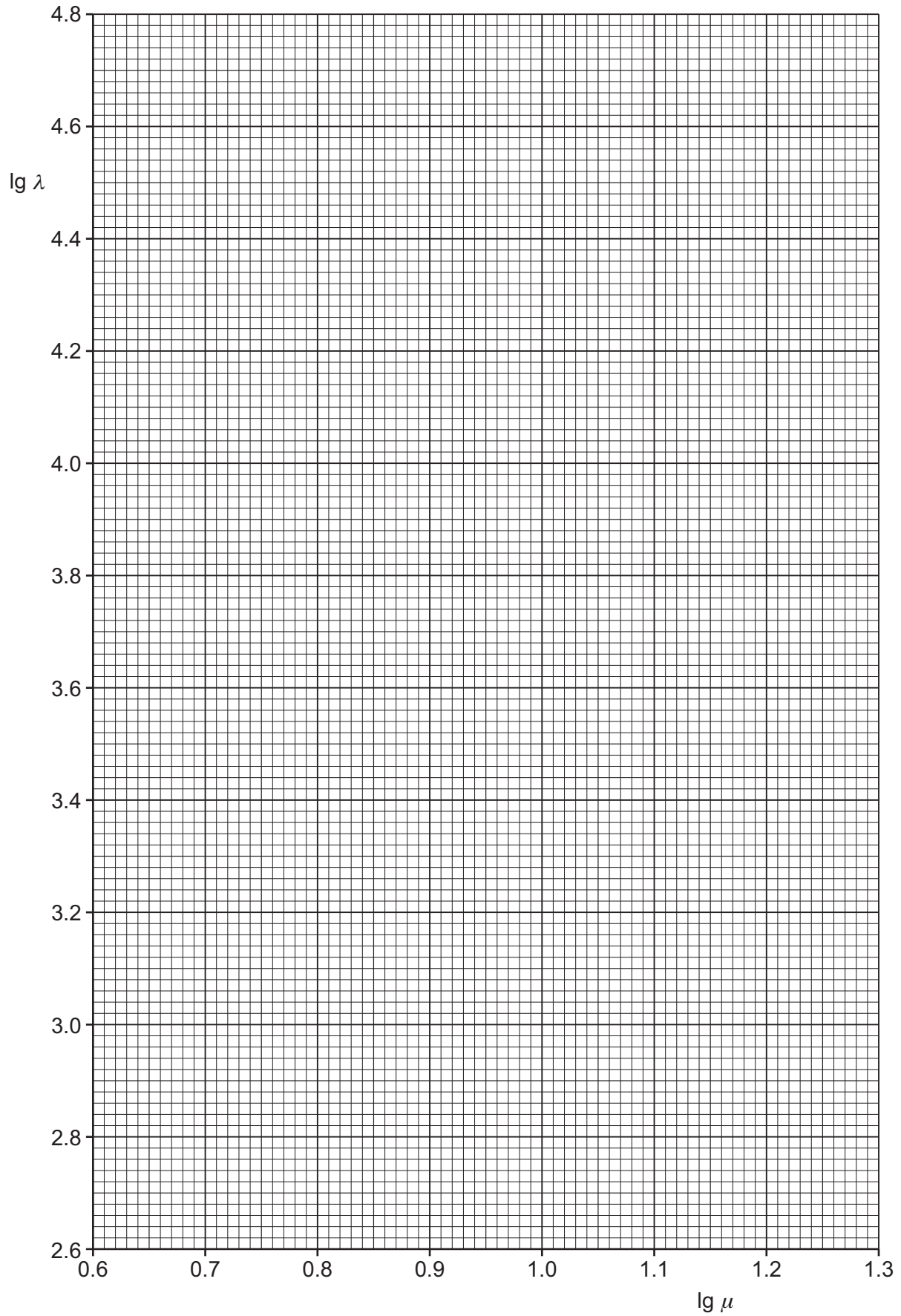
- (ii) Draw the straight line of best fit and a worst acceptable straight line on your graph. Label both lines.

[2]

- (iii) Determine the gradient of the line of best fit. Include the absolute uncertainty in your answer.

gradient = ... [2]







- (iv) Determine the y -intercept of the line of best fit. Include the absolute uncertainty in your answer.

y -intercept = ... [2]

- (d) Using your answers to (a), (c)(iii) and (c)(iv), determine the values of k and n . Include the absolute uncertainties in your values. You need not be concerned with units.

k = ...

n = ... [3]

- (e) The mass of the Sun is 2.0×10^{30} kg. The star Alpha Centauri B has a value of λ of 0.46.

Determine the mass M of Alpha Centauri B.

M = ... kg [1]

[Total: 15]

