* 0000800000001 *

Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

* 5 8 1 7 0 0 8 4 1 6 *

PHYSICS **9702/52**

Paper 5 Planning, Analysis and Evaluation **October/November 2024**

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.

DC (DE/FC) 336258/2

1 Fig. 1.1 shows a coil made from resistance wire.

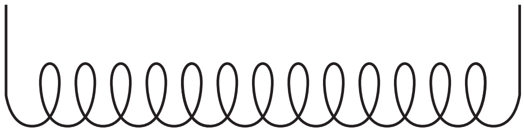


Fig. 1.1

The coil is placed in cooking oil of mass m. The total length of the resistance wire in the oil is L.

A potential difference V is applied to the coil. The temperature of the oil increases by $\Delta\theta$ in time t.

It is suggested that $\Delta\theta$ is related to L by the relationship

$$\frac{AtV^2}{L} = mK\Delta\theta + Z$$

where A is the cross-sectional area of the wire, and K and Z are constants.

Plan a laboratory experiment to test the relationship between $\Delta\theta$ and L.

Draw a diagram showing the arrangement of your equipment.

Explain how the results could be used to determine values for K and Z.

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 refraction of white light entering a transparent rectangular block. A narrow beam of light enters the block at the midpoint of one of the shorter sides. The angle of incidence θ is measured, as shown in Fig. 2.1.

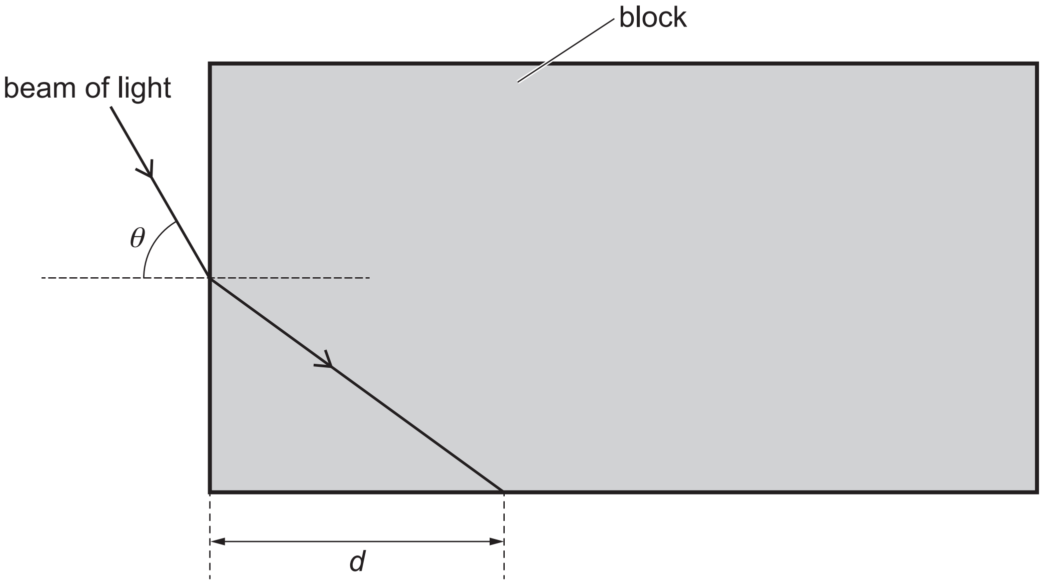


Fig. 2.1 (not to scale)

The distance d between the corner of the block and the point where the beam of light touches the boundary of the block is measured.

The experiment is repeated for different values of θ.

It is suggested that d and θ are related by the equation

$$\frac{B}{B + d^2} = \frac{\sin^2\theta}{n^2}$$

where B and n are constants.

(a) A graph is plotted of d^2 on the y-axis against $\frac{1}{\sin^2\theta}$ on the x-axis.

Determine expressions for the gradient and y-intercept.

gradient = ...

y-intercept = ...

[1]

(b) Values of θ, $\frac{1}{\sin^2\theta}$ and d are given in Table 2.1.

Table 2.1

θ / °	$\frac{1}{\sin^2\theta}$	d / cm	d^2 / cm^2
28.5	4.39	24.8 ± 0.2	
33.5	3.28	21.4 ± 0.2	
42.5	2.19	17.1 ± 0.2	
50.0	1.70	14.7 ± 0.2	
57.5	1.41	12.9 ± 0.2	
63.5	1.25	11.8 ± 0.2	

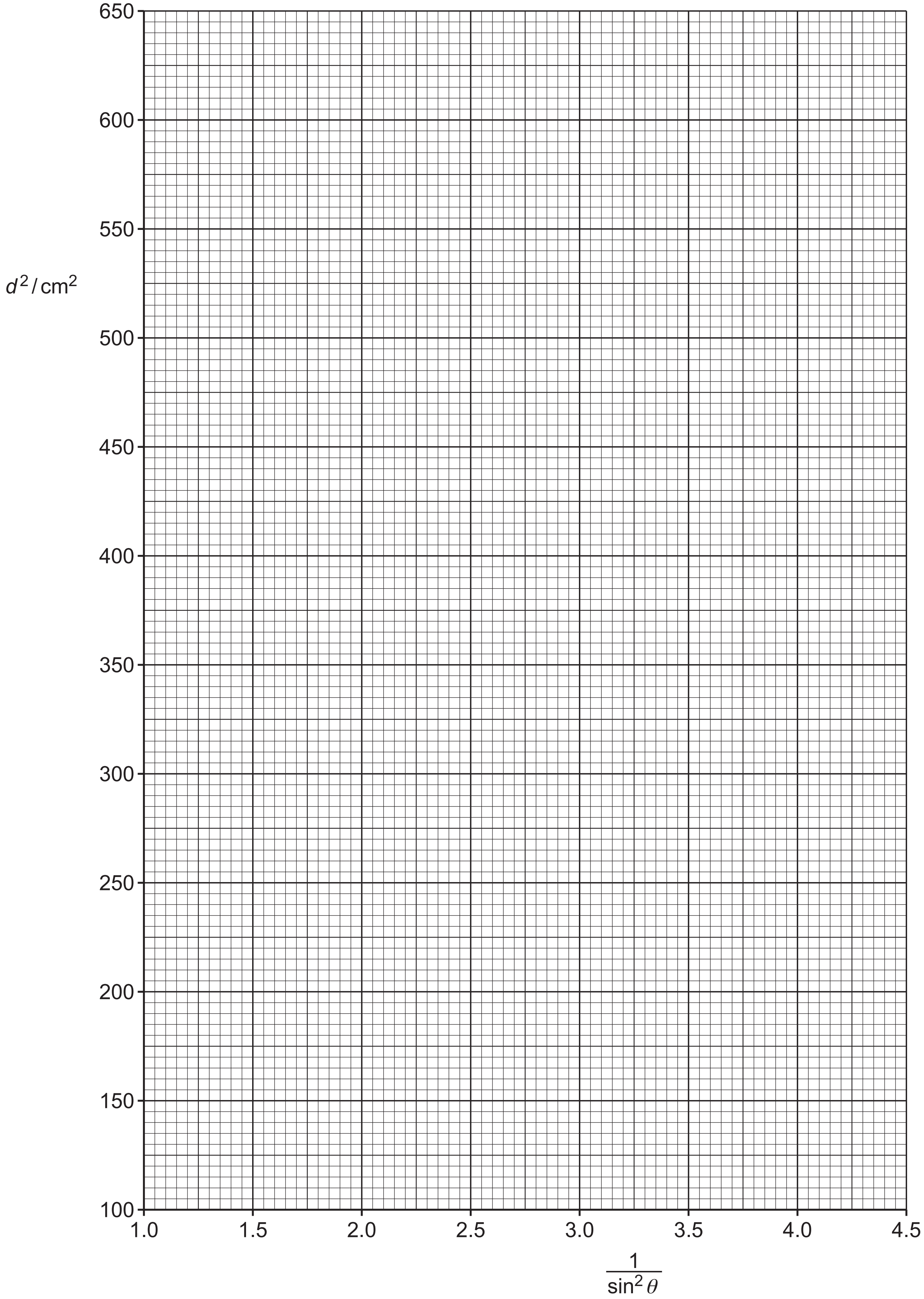
Calculate and record values of d^2 / cm^2 in Table 2.1.
Include the absolute uncertainties in d^2. [2]

(c) (i) Plot a graph of d^2 / cm^2 against $\frac{1}{\sin^2\theta}$. Include error bars for d^2. [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]


d^2 / cm^2
650
600
550
500
450
400
350
300
250
200
150
100
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
$\frac{1}{\sin^2\theta}$

(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 B and n. Include appropriate units.

B = ...

n = ...
[2]

(ii) Determine the percentage uncertainty in n.

percentage uncertainty in n = ... % [1]

(e) The experiment is repeated. Determine the angle θ that gives a value of d of 30.0 cm.

θ = ... ° [1]

[Total: 15]