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Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

* 3 2 6 0 1 0 9 4 9 2 *

PHYSICS **9702/52**

Paper 5 Planning, Analysis and Evaluation **February/March 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.

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[Turn over

1 Fig. 1.1 shows two identical cylindrical metal conductors P and Q, each of length L and cross-sectional area A.

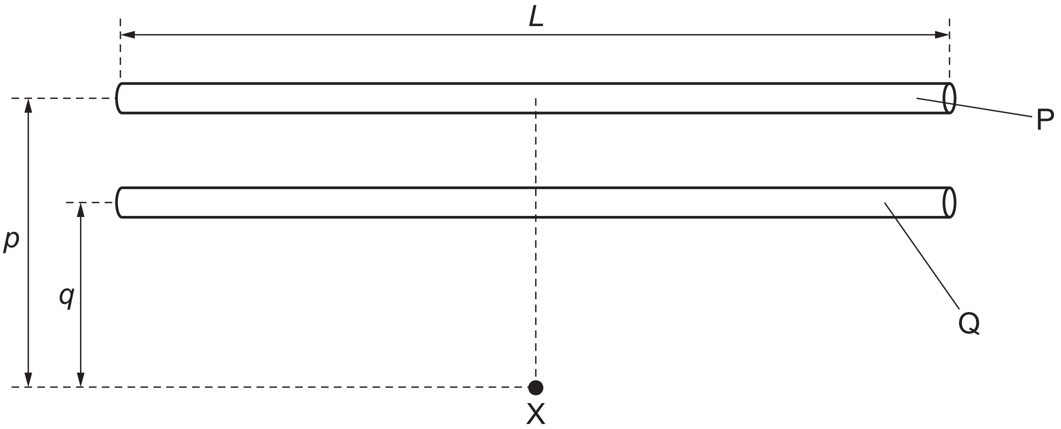


Fig. 1.1

The conductors are placed parallel to each other. The perpendicular distance from the midpoint of P to point X is p. The perpendicular distance from the midpoint of Q to point X is q.

The two conductors are electrically connected in parallel. This parallel combination is connected in series to a power supply and a resistor. The potential difference V between the ends of P is the same as the potential difference between the ends of Q.

The magnetic flux density at X due to the currents in the conductors is B.

It is suggested that B is related to p by the relationship

$$B = \frac{YAV}{Lp} + \frac{YZAV}{Lq}$$

where Y and Z are constants.

Plan a laboratory experiment to test the relationship between B and p.

Draw a diagram showing the arrangement of your equipment.

Explain how the results could be used to determine values for Y 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 cooling of a liquid in a beaker.

The temperature θ_R of the laboratory is measured using a thermometer.

Hot water is added to an insulated beaker, as shown in Fig. 2.1.

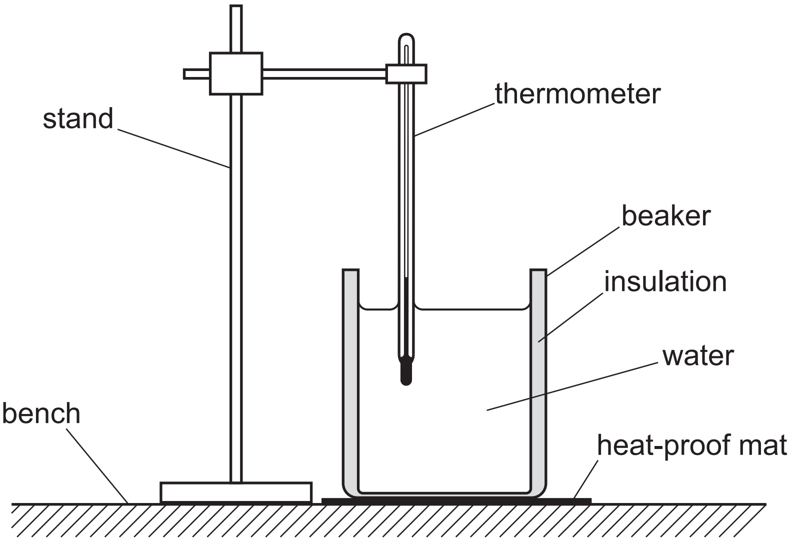


Fig. 2.1

The thermometer measures the temperature of the water. At time t the temperature of the water is θ.

A series of readings of t and θ are taken.

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

$$\theta = \theta_R + (\theta_0 - \theta_R)e^{-\left(\frac{t}{K}\right)}$$

where θ_0 is the temperature at $t = 0$ and K is a constant.

(a) A graph is plotted of $\ln(\theta - \theta_R)$ on the y-axis against t on the x-axis.

Determine expressions for the gradient and y-intercept.

gradient = ...

y-intercept = ...

[1]

(b) Values of t and θ are given in Table 2.1.

Table 2.1

t / min	θ / °C	$(\theta - \theta_R)$ / °C	$\ln((\theta - \theta_R)$ / °C)
6.0	75.0 ± 0.5		
12.0	64.5 ± 0.5		
18.0	57.0 ± 0.5		
24.0	50.0 ± 0.5		
30.0	44.5 ± 0.5		
36.0	41.0 ± 0.5		

The value of θ_R is (18.5 ± 0.5) °C.

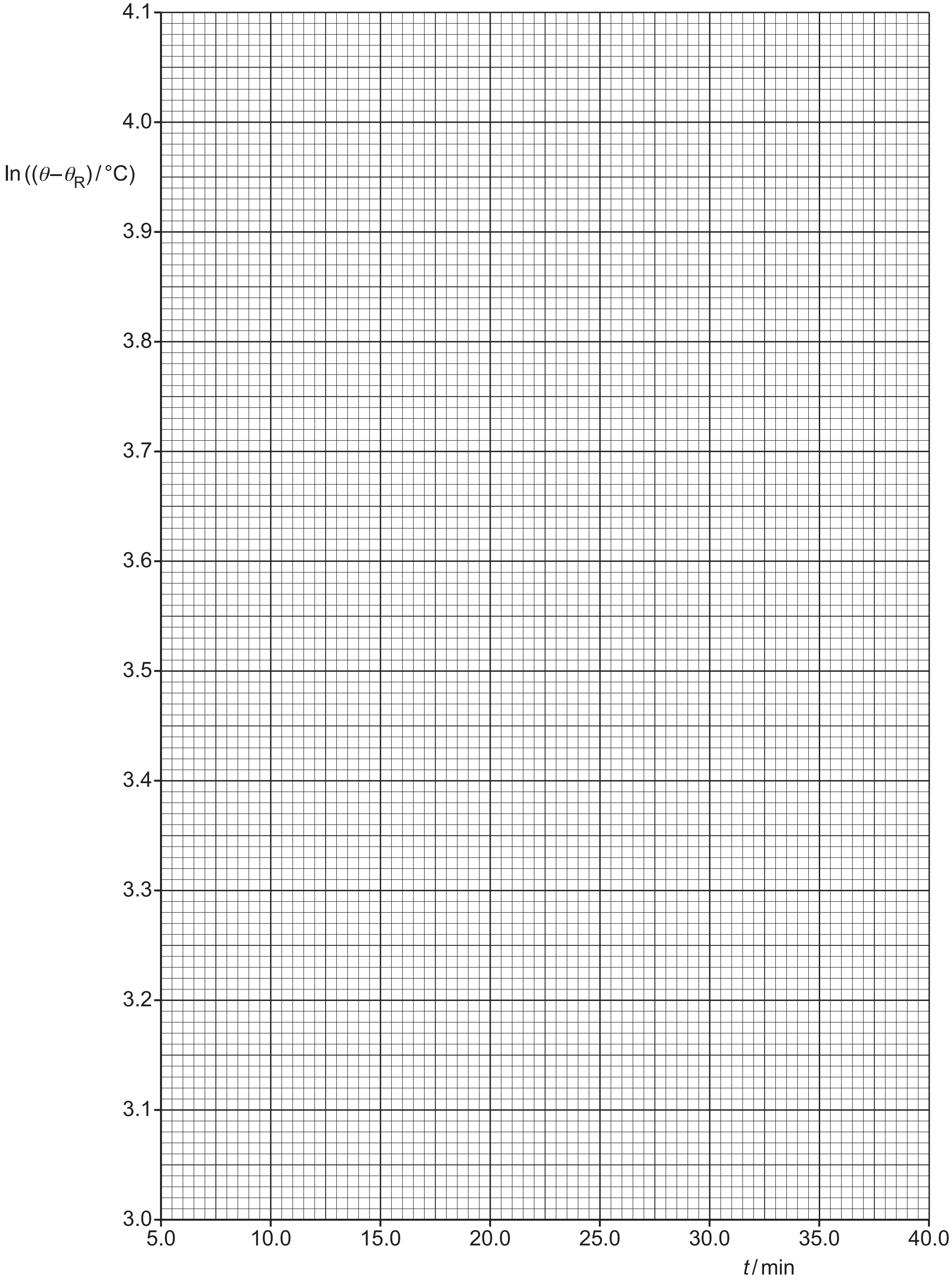
Calculate and record values of $(\theta - \theta_R)$ / °C and $\ln((\theta - \theta_R)$ / °C) in Table 2.1.
Include the absolute uncertainties in $(\theta - \theta_R)$ and $\ln((\theta - \theta_R)$ / °C). [2]

(c) (i) Plot a graph of $\ln((\theta - \theta_R)$ / °C) against t / min. Include error bars for $\ln((\theta - \theta_R)$ / °C). [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]


ln ((θ–θR) / °C)
4.1
4.0
3.9
3.8
3.7
3.6
3.5
3.4
3.3
3.2
3.1
3.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
t / min

(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 K and θ_0. Include appropriate units.

K = ...

θ_0 = ...
[2]

(ii) Determine the absolute uncertainty in your value of θ_0.

absolute uncertainty = ... [1]

(e) Determine the time t for the temperature to reach 25.0 °C.

t = ... min [1]

[Total: 15]