Cambridge International A Level

**Cambridge International Examinations**
Cambridge International Advanced Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

*9328967468*

**PHYSICS** **9702/51**

Paper 5 Planning, Analysis and Evaluation **October/November 2015**

**1 hour 15 minutes**

Candidates answer on the Question Paper.

No Additional Materials are required.

**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 **all** questions.

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

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.

This document consists of **8** printed pages.


© UCLES 2015

CAMBRIDGE International Examinations

**1** A student is investigating the angle at which a glass cylinder containing oil topples, as shown in Fig. 1.1.

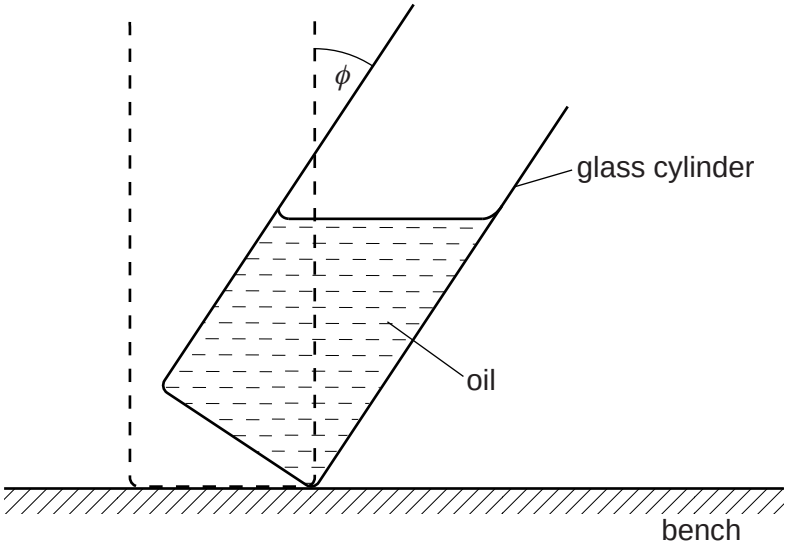



**Fig. 1.1**

A cylinder containing a mass $m$ of oil can be tilted through a maximum angle $\phi$ from the vertical before it topples.

It is suggested that the relationship between $m$ and $\phi$ is

$$\frac{1}{\tan \phi} = \frac{am}{\rho d^3} + b$$

where $d$ is the diameter of the cylinder, $\rho$ is the density of the oil and $a$ and $b$ are constants.

Design a laboratory experiment to test the relationship between $\phi$ and $m$. Explain how your results could be used to determine values for $a$ and $b$. You should draw a diagram, on page 3, showing the arrangement of your equipment. In your account you should pay particular attention to

**(a)** the procedure to be followed,

**(b)** the measurements to be taken,

**(c)** the control of variables,

**(d)** the analysis of the data,

**(e)** the safety precautions to be taken.

[15]

© UCLES 2015

**Diagram**

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

| Defining the problem | Methods of data collection | Method of analysis | Safety considerations | Additional detail |
|---|---|---|---|---|
| | | | | |

**2** A student is investigating an electrical circuit containing a length of nichrome wire.

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

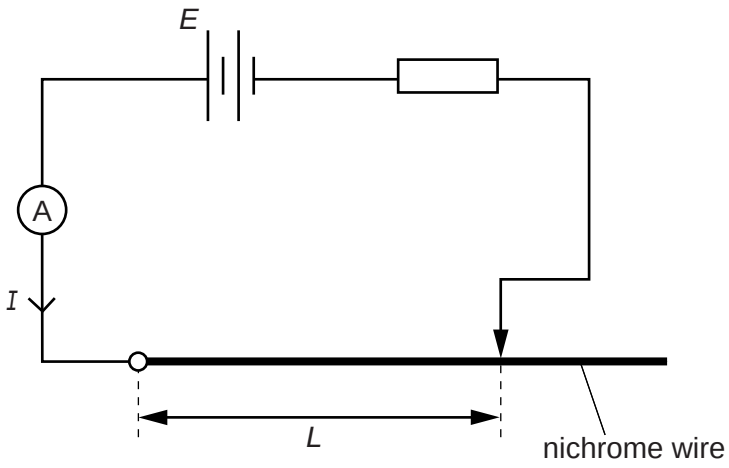



**Fig. 2.1**

The length $L$ of the wire in the circuit is varied and the current $I$ is measured.

It is suggested that $I$ and $L$ are related by the equation

$$\frac{1}{I} = \frac{4\rho L}{\pi E d^2} + \frac{r}{E}$$

where $E$ is the e.m.f. of the battery, $d$ is the diameter of the wire and $\rho$ and $r$ are constants.

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

Determine expressions for the gradient and $y$-intercept.

gradient = .....

$y$-intercept = .....

[1]

**(b)** Values of $L$ and $I$ are given in Fig. 2.2.

| $L$ / $10^{-2}$ m | $I$ / A | |
|---|---|---|
| 40.0 | 0.24 ± 0.01 | |
| 48.0 | 0.20 ± 0.01 | |
| 60.0 | 0.17 ± 0.01 | |
| 70.0 | 0.15 ± 0.01 | |
| 80.0 | 0.13 ± 0.01 | |
| 92.0 | 0.12 ± 0.01 | |

**Fig. 2.2**

Calculate and record values of $\frac{1}{I}$ / $A^{-1}$ in Fig. 2.2.

Include the absolute uncertainties in $\frac{1}{I}$ / $A^{-1}$. [3]

**(c)** **(i)** Plot a graph of $\frac{1}{I}$ / $A^{-1}$ against $L$ / $10^{-2}$ m.

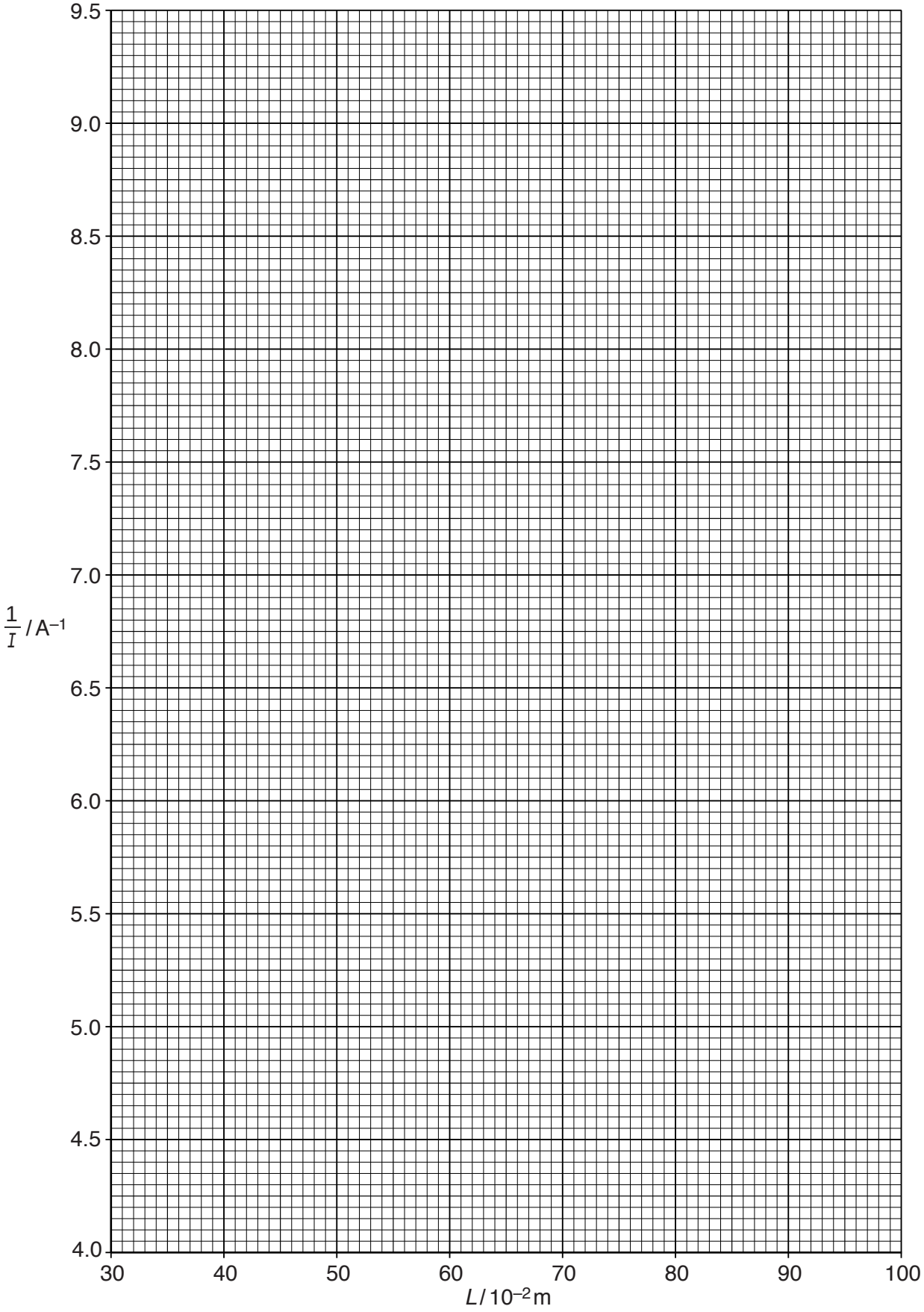
Include error bars for $\frac{1}{I}$ / $A^{-1}$. [2]

**(ii)** Draw the straight line of best fit and a worst acceptable straight line on your graph. Both lines should be clearly labelled. [2]

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

gradient = ..... [2]

© UCLES 2015


9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
1/I / A⁻¹
30
40
50
60
70
80
90
100
L / 10⁻² m

**(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 $\rho$ and $r$. Include appropriate units.

Data: $E = 3.2 \pm 0.1\,\text{V}$ and $d = 0.31 \pm 0.01\,\text{mm}$.

$\rho$ = .....

$r$ = .....

[2]

**(ii)** Determine the percentage uncertainty in $\rho$.

percentage uncertainty in $\rho$ = ..... % [1]

To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced online in the Cambridge International Examinations Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download at www.cie.org.uk after the live examination series.

© UCLES 2015