Cambridge International AS & A Level

Cambridge International Examinations
Cambridge International Advanced Subsidiary and Advanced Level

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER			

3400660356

PHYSICS **9702/51**

Paper 5 Planning, Analysis and Evaluation **May/June 2016**

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.

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1 A student is investigating the characteristics of different light-emitting diodes (LEDs). Fig. 1.1 shows examples of LEDs and the circuit symbol for an LED.

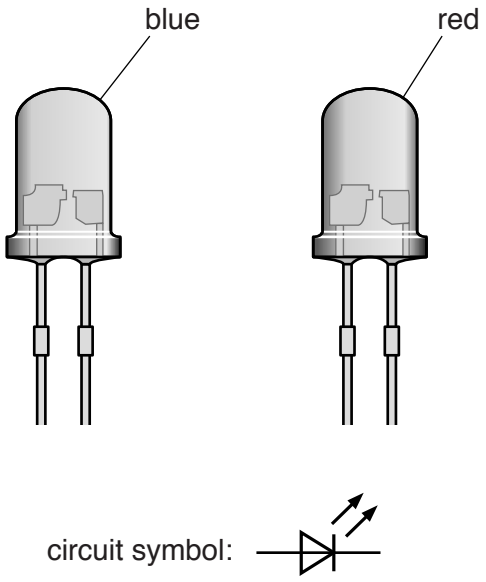

Fig 1.1

Each LED needs a minimum potential difference V across it to emit light. The student is investigating the relationship between V and the wavelength λ of the light emitted by the LED for several different LEDs.

It is suggested that the relationship is

$$V = k\lambda^n$$

where k and n are constants.

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

- 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.

[15]

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Diagram

[Total: 15]

2 A student is investigating how the extension of a loaded wire depends on the diameter of the wire.

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

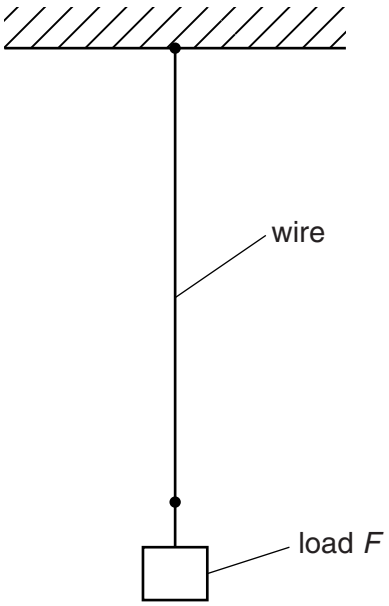

Fig. 2.1

A load F is applied to the wire and the extension e is measured.

The experiment is repeated for wires of the same material and same initial length L but different diameter d.

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

$$e = \frac{4LF}{\pi E d^2}$$

where E is a constant.

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

Determine an expression for the gradient.

gradient = ...[1]

(b) Values of d and e are given in Fig. 2.2.

$d / 10^{-3}$ m	$e / 10^{-3}$ m	
0.28 ± 0.02	11.3	
0.32 ± 0.02	8.6	
0.38 ± 0.02	6.0	
0.46 ± 0.02	4.1	
0.56 ± 0.02	2.7	
0.72 ± 0.02	1.7	

Fig. 2.2

Calculate and record values of $\frac{1}{d^2} / 10^6\,\text{m}^{-2}$ in Fig. 2.2.

Include the absolute uncertainties in $\frac{1}{d^2}$. [3]

(c) (i) Plot a graph of $e / 10^{-3}$ m against $\frac{1}{d^2} / 10^6\,\text{m}^{-2}$.

Include error bars for $\frac{1}{d^2}$. [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]

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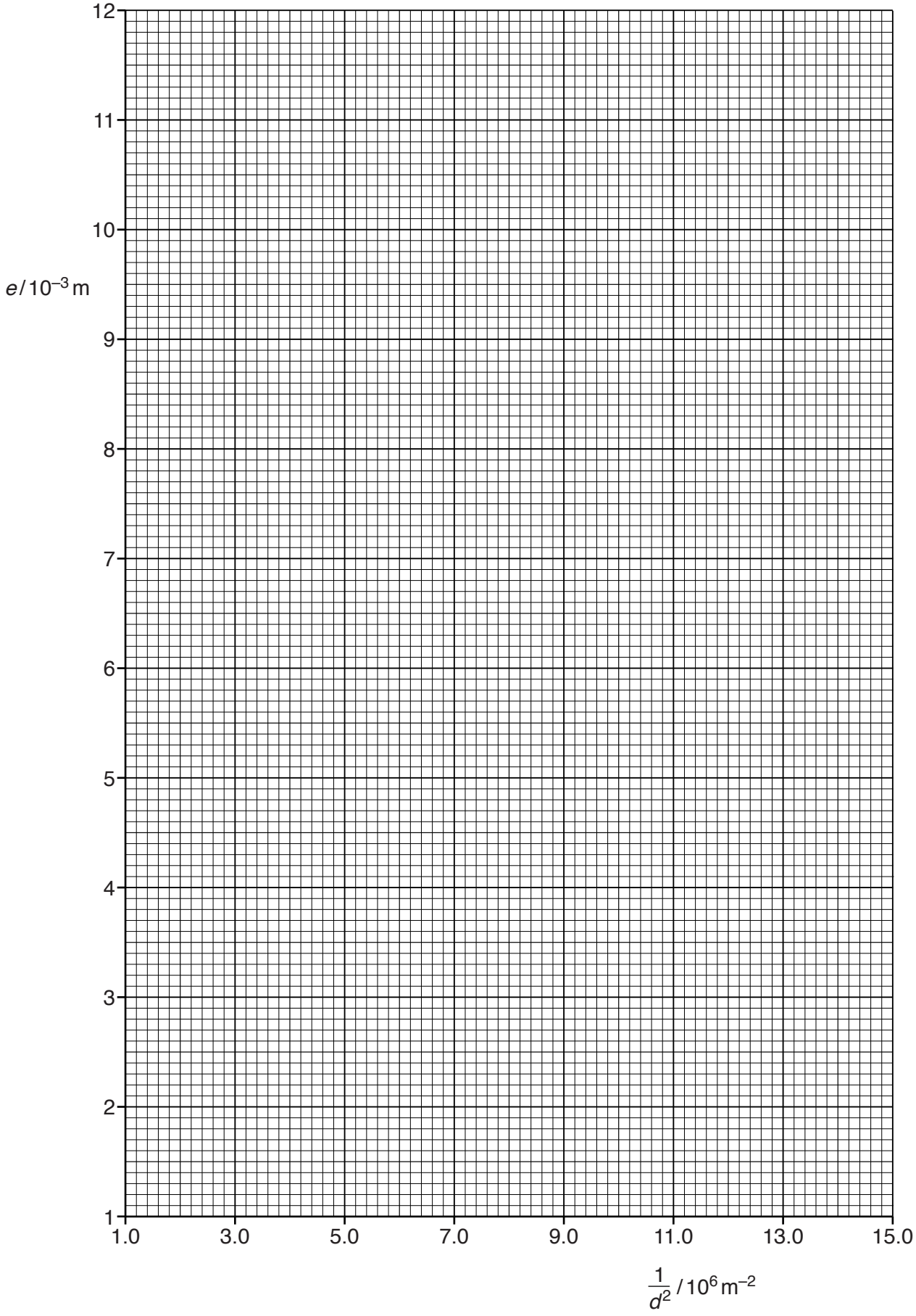
12
11
10
9
8
7
6
5
4
3
2
1
e / 10–3 m
1.0
3.0
5.0
7.0
9.0
11.0
13.0
15.0
1/d2 / 10^6 m–2

(d) **(i)** Using your answers to **(a)** and **(c)(iii)**, determine the value of E. Include an appropriate unit.

Data: $L = 2.50 \pm 0.01$ m and $F = 19.0 \pm 0.5$ N.

$E =$ .....[2]

(ii) Determine the percentage uncertainty in E.

percentage uncertainty in $E =$ ..... % [1]

(e) The experiment is repeated with a thinner wire of diameter 0.23 ± 0.02 mm. The wire is of the same material and initial length.

Determine the extension e of the wire when the same load is added to it. Include the absolute uncertainty in your answer.

$e =$ .....m [2]

[Total: 15]

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