

- 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.

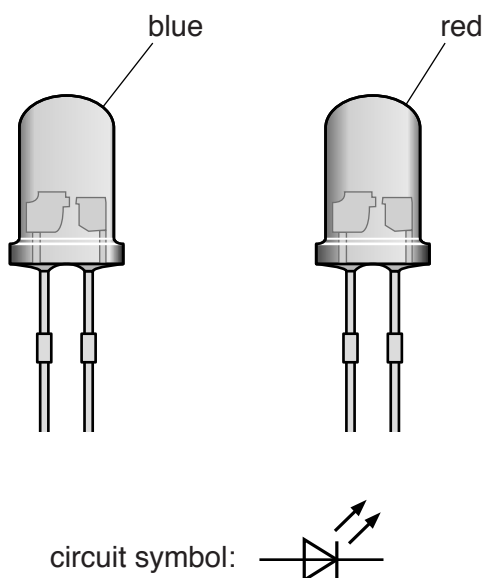


Fig 1.1

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]

- 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.

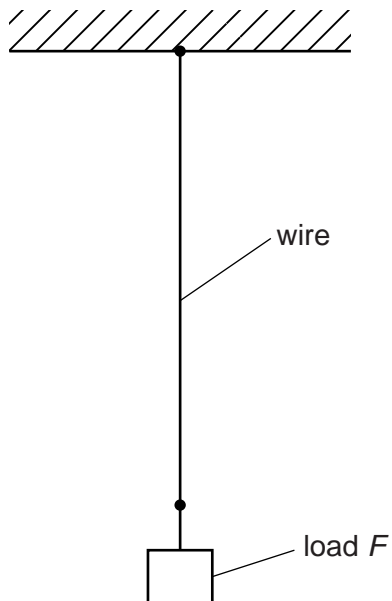


Fig. 2.1

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.

$d / 10^{-3} \text{ m}$	$e / 10^{-3} \text{ m}$	
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]

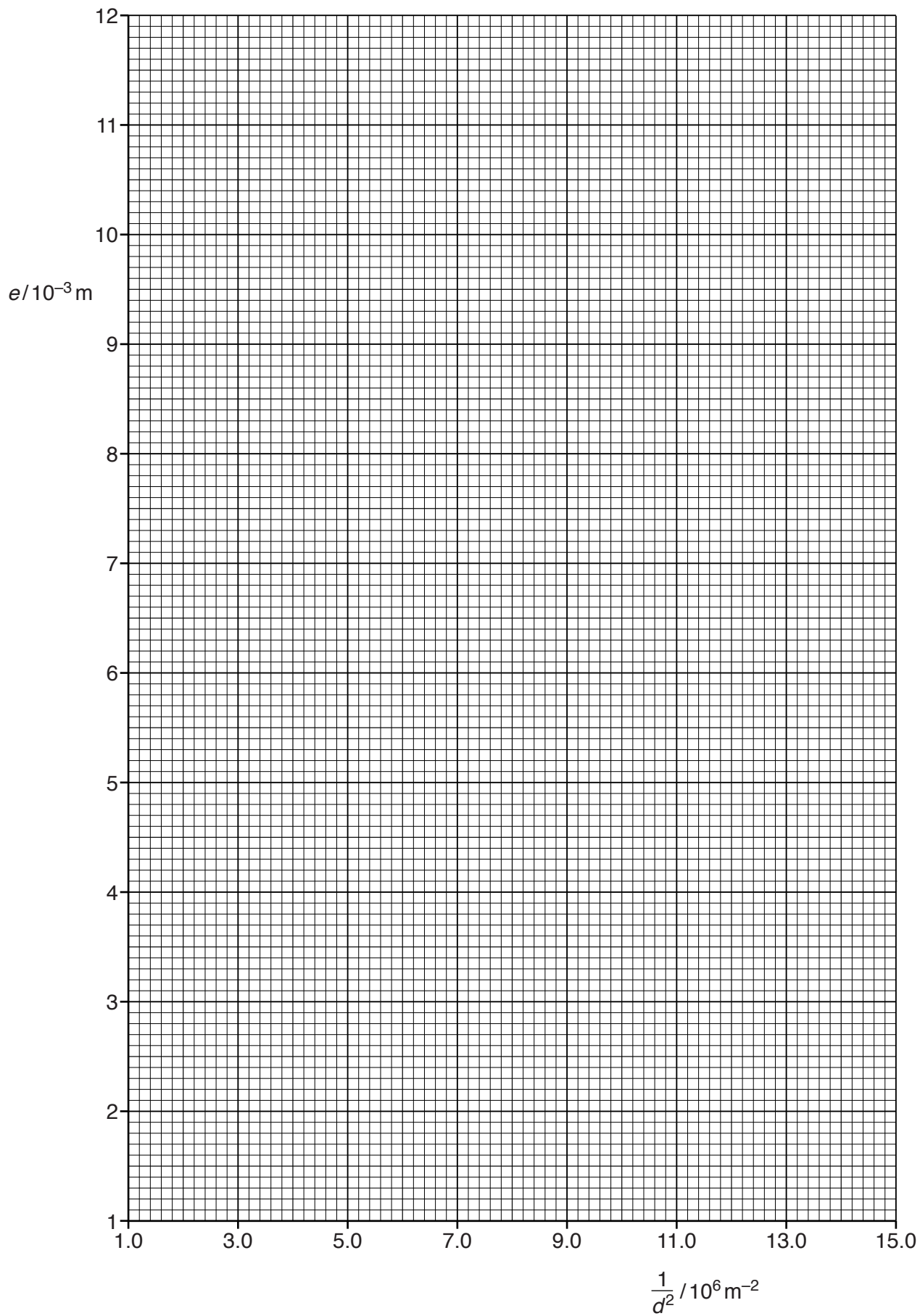
(c) (i) Plot a graph of $e / 10^{-3} \text{ m}$ against $\frac{1}{d^2} / 10^6 \text{ m}^{-2}$.

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]



8

- (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.

$E = \dots\dots\dots$ [2]

- (ii) Determine the percentage uncertainty in E .

percentage uncertainty in $E = \dots\dots\dots$ % [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.

$e = \dots\dots\dots$ m [2]

[Total: 15]