

AS @j Y Physics B
H157/01 Foundations of physics

Question Set 5

1. Fig. 1 shows a model of current in a wire.

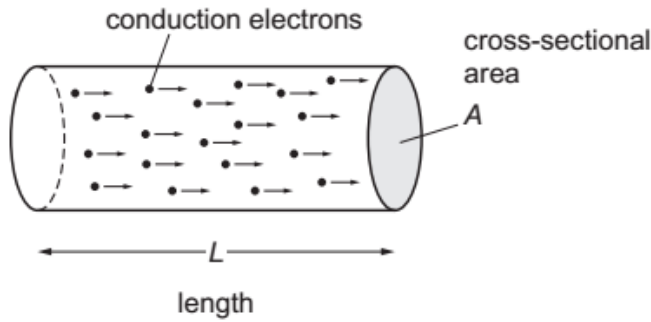


Fig. 1

n is the number density of charge carriers in the wire.

(a) What is the SI unit of charge?

[1]

(b) Show that the total charge, ΔQ , in the cylinder above is $nALe$, where e is the charge of an electron.

[2]

(c) The current in a cylindrical wire is related to the number density of charge carriers (electrons) by the equation

$$I = nAve$$

where I is the current and v is the drift velocity of the electrons.

The drift velocity is the average speed of the electrons in the wire in the direction of the current.

The wire carries a current of 3.2A.

Calculate the diameter of the wire.

Drift velocity of electrons in the wire is 0.50 mm s^{-1} .

Number density of electrons is $8.0 \times 10^{28} \text{ m}^{-3}$.

diameter =m

[3]

2.

A student is investigating the resistivity of a metal.

The student has a 1.0 m length of wire made from the metal.

Fig. 2.1 shows the circuit used by the student.

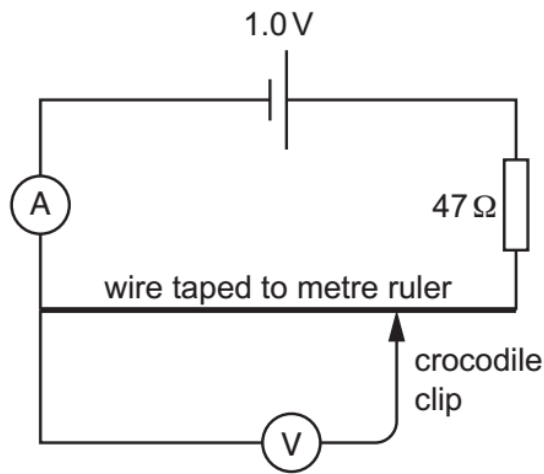


Fig. 2.1

(a)

Explain why the voltmeter should have a very high resistance.

[2]

The cell has an e.m.f. of 1.0 V and negligible internal resistance.

The wire has a resistance of $3.0\ \Omega$.

The crocodile clip is connected at the centre of the wire as shown in **Fig. 2.2**.

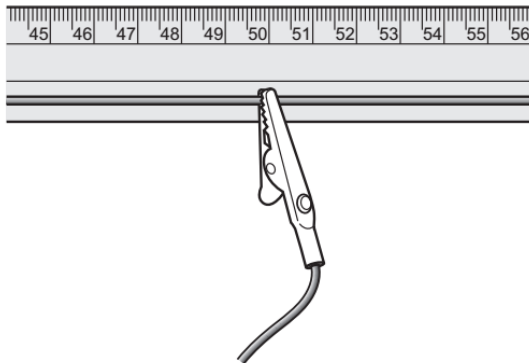


Fig. 2.2.

(b)

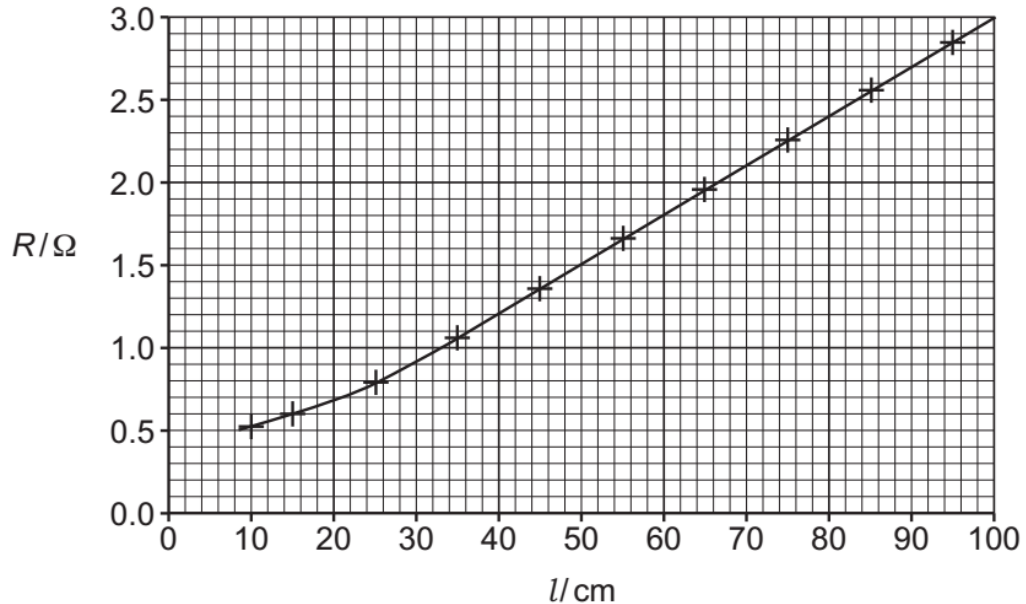
Calculate the voltmeter reading you expect the student to see.

Expected reading = V [2]

The student records the readings on the voltmeter and ammeter for a range of positions of the crocodile clip.

The student uses the results to calculate the resistance for each length l of wire under test.

The graph shows the results of the investigation.



The student expected the graph to show that R is directly proportional to l .

(c) (i) State the shape of graph expected if R were directly proportional to l . [1]

(ii) The graph is a curve for small lengths because the higher current heats the wire and its resistivity increases.

The resistivity of the metal increases by 0.4% for each $^{\circ}\text{C}$ temperature rise.

Calculate the temperature rise of the wire when $l = 20\text{ cm}$.

Temperature rise = $^{\circ}\text{C}$ [4]

(iii) State one other variable, apart from temperature, that should be controlled in this investigation. [1]

Another student repeats the experiment. The crocodile clip is replaced with a sliding contact which has a sharp edge and measurements are taken as shown in Fig. 2.3.

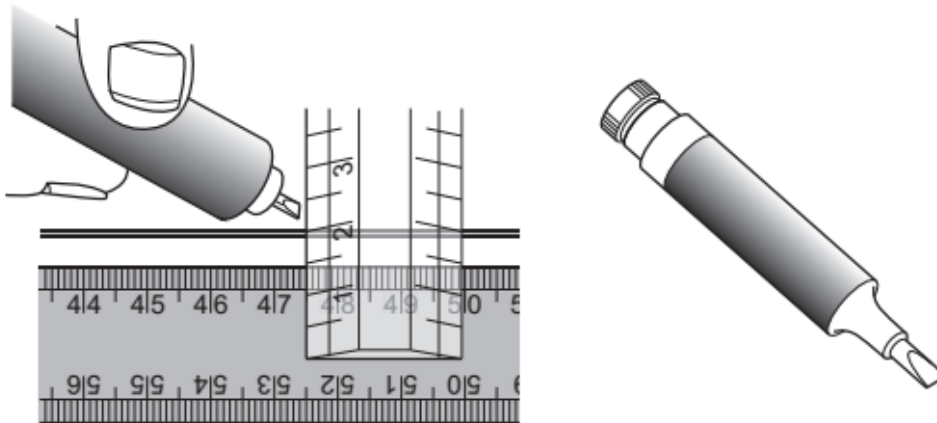


Fig. 2.3

(d) Explain how these changes will affect the quality of the measurements of length.

[2]

Total Marks for Question Set 5: 18

OCR

Oxford Cambridge and RSA

Copyright Information

OCR is committed to seeking permission to reproduce all third-party content that it uses in its assessment materials. OCR has attempted to identify and contact all copyright holders whose work is used in this paper. To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced in the OCR Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download from our public website (www.ocr.org.uk) after the live examination series.

If OCR has unwittingly failed to correctly acknowledge or clear any third-party content in this assessment material, OCR will be happy to correct its mistake at the earliest possible opportunity.

For queries or further information please contact The OCR Copyright Team, The Triangle Building, Shaftesbury Road, Cambridge CB2 8EA. OCR is part of the Cambridge Assessment Group; Cambridge