

6 A cylindrical copper wire P of length 0.24 m is shown in Fig. 6.1.

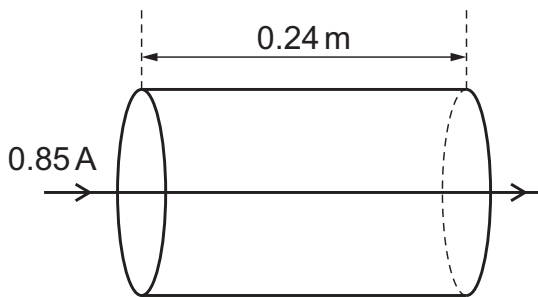


Fig. 6.1 (not to scale)

The current in the wire is 0.85 A.  
 The resistance of the wire is 3.3 mΩ.  
 The **total** number of charge carriers  $N$  in the wire is  $2.6 \times 10^{22}$ .  
 The resistivity of copper is  $1.8 \times 10^{-8} \Omega \text{ m}$ .

(a) Calculate the potential difference between the two ends of the wire.

potential difference = ..... V [2]

(b) (i) Show that the cross-sectional area of the wire is  $1.3 \times 10^{-6} \text{ m}^2$ .

[2]

(ii) Show that the number density of charge carriers in the wire is  $8.3 \times 10^{28} \text{ m}^{-3}$ .

[1]

(iii) Calculate the average drift speed of the charge carriers (electrons) in the wire.

average drift speed = .....  $\text{ms}^{-1}$  [2]

(c) A different copper wire Q has the same volume as wire P, but non-uniform radius, as shown in Fig. 6.2.

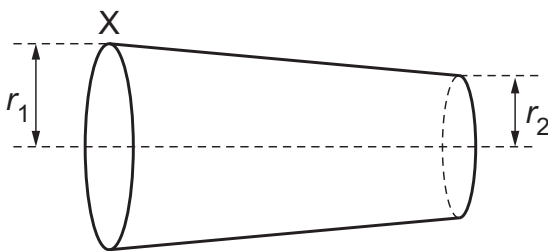


Fig. 6.2 (not to scale)

The radius  $r_1$  at end X of wire Q is the same as the radius of wire P. Radius  $r_2$  is less than  $r_1$ .

(i) State and explain how the resistance of wire Q compares with the resistance of wire P.

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[4]