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

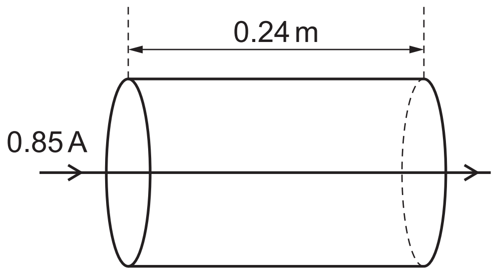

Fig. 6.1 (not to scale)

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 2.6×10^{22}.
The resistivity of copper is $1.8 \times 10^{-8}\,\Omega\,m$.

(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 $1.3 \times 10^{-6}\,m^2$.

[2]

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

[1]

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

average drift speed = ... $m\,s^{-1}$ [2]

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

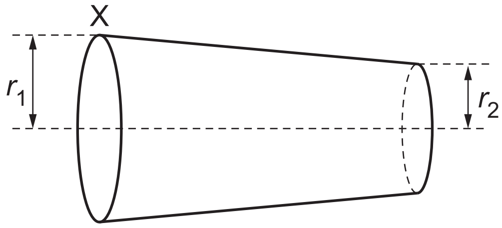

Fig. 6.2 (not to scale)

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.

....

....

....

....

....

....

.... [4]

(ii) On Fig. 6.3, sketch a graph of the variation of the average drift speed of the charge carriers with distance from end X of wire Q.

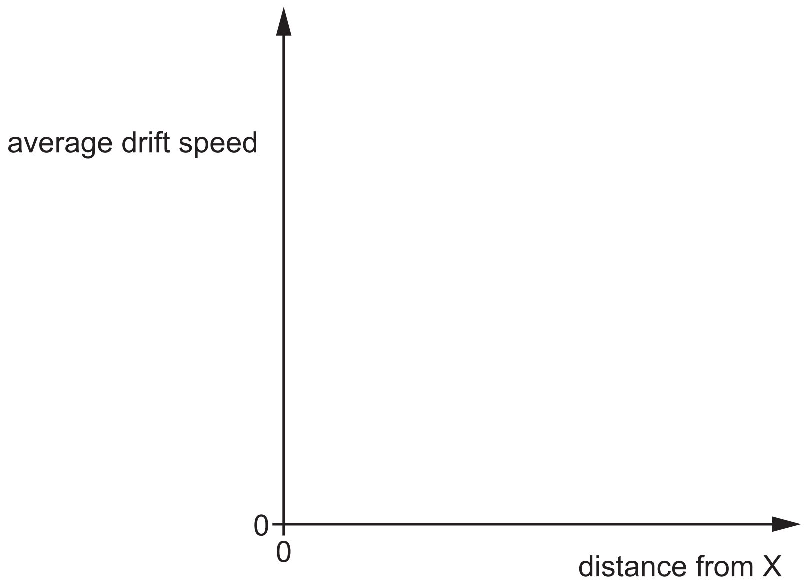

Fig. 6.3

[2]

[Total: 13]