6 A resistance wire of uniform cross-sectional area 3.3×10^{-7} m^2 and length 2.0 m is made of metal of resistivity 5.0×10^{-7} Ω m.

(a) Show that the resistance of the wire is 3.0 Ω.

[2]

(b) The ends of the resistance wire in **(a)** are connected to the terminals S and T in the circuit shown in Fig. 6.1.

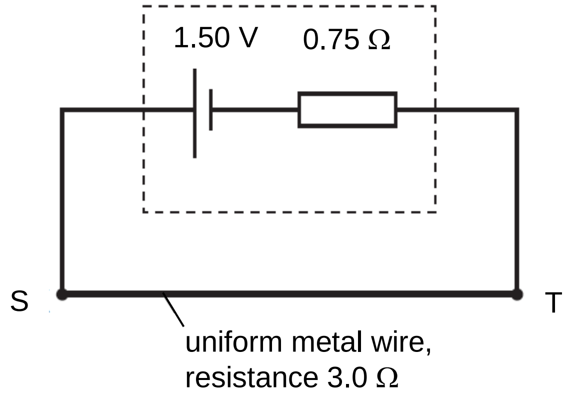

Fig. 6.1

The cell has an e.m.f. of 1.50 V and internal resistance 0.75 Ω.

The resistance wire has 8.5×10^{28} free electrons per m^3.

Calculate the average drift speed of the electrons.

speed = ………………………..m s^{-1} [2]

(c) A galvanometer and a cell of e.m.f. *E* with negligible internal resistance are connected to the circuit in **(b)**, as shown in Fig. 6.2.

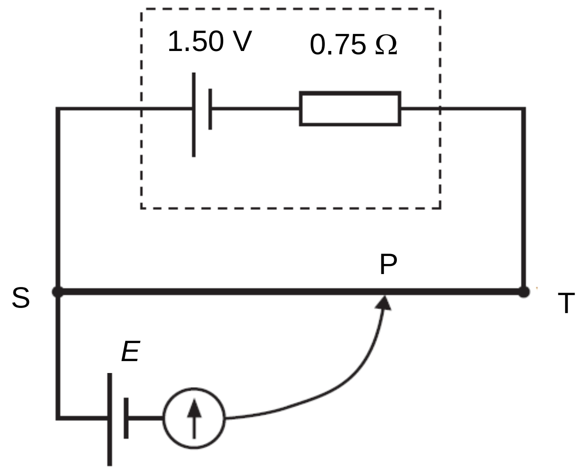

Fig. 6.2

The galvanometer has a reading of zero when the connection P is adjusted so that the length SP is 1.4 m.

(i) Determine the e.m.f. *E* of the cell.

e.m.f = …………………………….V [2]

(ii) The circuit in Fig. 6.2 is modified by replacing the original resistance wire with a second resistance wire. The second wire has the same length as the original wire and is made of the same metal.

The second wire has a smaller cross-sectional area than the original wire. Connection P is adjusted on the second wire so that the galvanometer has a reading of zero.

State and explain whether length SP for the second wire is shorter than, longer than or the same as length SP for the original wire when the galvanometer reading is zero.

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