6 **(a)** A resistance wire of uniform cross-sectional area $3.3 \times 10^{-7}\,m^2$ and length 2.0 m is made of metal of resistivity $5.0 \times 10^{-7}\,\Omega\,m$.

Show that the resistance of the wire is $3.0\,\Omega$.

[2]

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

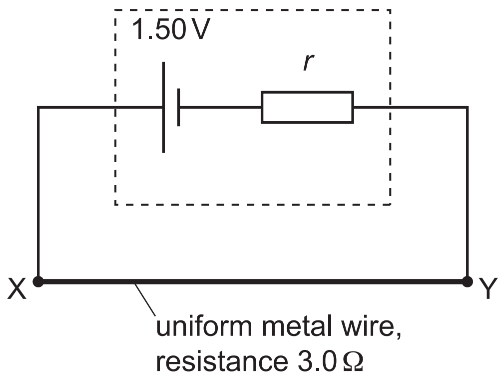

Fig. 6.1

The cell has an electromotive force (e.m.f.) of 1.50 V and internal resistance *r*. The potential difference between X and Y is 1.20 V.

Calculate:

(i) the current in the circuit

current = ... A [1]

(ii) the internal resistance *r*.

r = ... Ω [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.

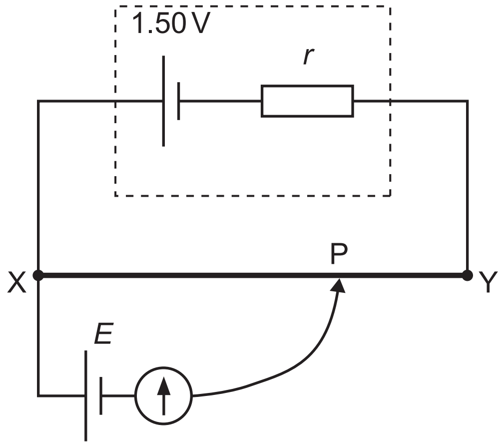

Fig. 6.2

The resistance wire between X and Y has a length of 2.0 m. The galvanometer has a reading of zero when the connection P is adjusted so that the length XP is 1.4 m.

Determine the e.m.f. E of the cell.

E = ... V [2]

(d) 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 XP for the second wire is shorter than, longer than or the same as length XP for the original wire when the galvanometer reading is zero.

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