5 A circuit is set up as shown in Fig. 5.1. A cylindrical uniform resistance wire XY of length 1.20 m and resistivity 6.9 x 10^{-7} Ω m has resistance 7.5 Ω. Cell A has e.m.f. 2.0 V and internal resistance of 0.50 Ω. The current through cell A is *I*. Cell B has an e.m.f. *E* and internal resistance *r*.

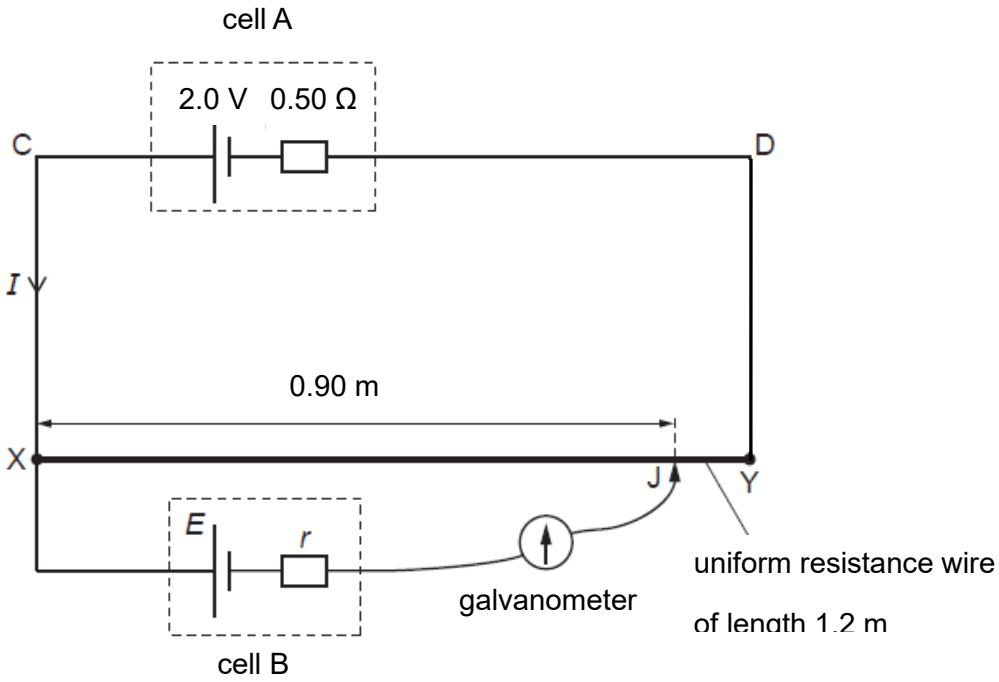

Fig. 5.1

The galvanometer shows no deflection when the movable connection J is adjusted so that the length XJ is 0.90 m.

(a) Show that, when the length XJ is 0.90 m, the current *I* is 0.25 A.

[1]

(b) **(i)** Determine the drift velocity of the electrons in the resistance wire XY given that the number density of the wire is 8.0×10^{28} m^{-3}.

drift velocity = …….. $m\ s^{-1}$ [3]

(ii) Explain the effect that stretching the wire will have on the drift velocity of electrons in the wire. Assume that the volume of the wire remains unchanged and that there is a constant potential difference across the wire.

…….....

…….....

……..... [2]

(c) **(i)** Calculate the value of *E*.

E = ……. V [2]

(ii) State and explain what happens to the balanced length XJ when the galvanometer used has resistance.

…….....

…….....

……..... [1]

(iii) On Fig. 5.1, add a resistor to the circuit such that the balance length is increased. [1]

[Total: 10]