4 **(a)** Define resistance.

……

…… [1]

(b) The resistivity of copper is 1.7×10^{-8} Ω m. Calculate the resistance of a copper wire of length 1.5 m and cross-sectional area of 3.2×10^{-9} m^2.

resistance = …… Ω [2]

(c) The copper wire in **(b)** is used to connect a circuit as shown in Fig. 4.1. Cell A has an e.m.f of 12.0 V and internal resistance 1.0 Ω. A 2.0 Ω resistance is also connected in series with cell A.

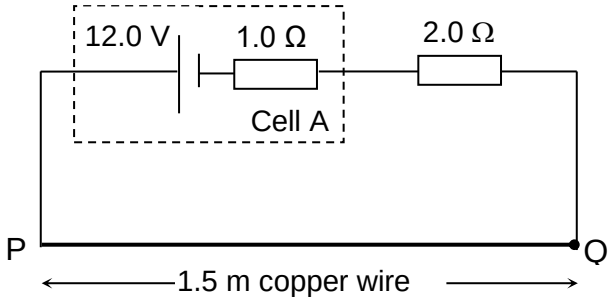

Fig. 4.1

Determine the drift velocity of the electrons flowing in the copper if the number of electrons per unit volume is 8.5×10^{28} m^{-3}.

drift velocity = ... m s^{-1} [2]

(d) **(i)** Cell B, a galvanometer and resistor of 4.0 Ω are now placed in parallel together with the circuit as shown in Fig. 4.2. The movable contact J can be connected to any point along the wire PQ.

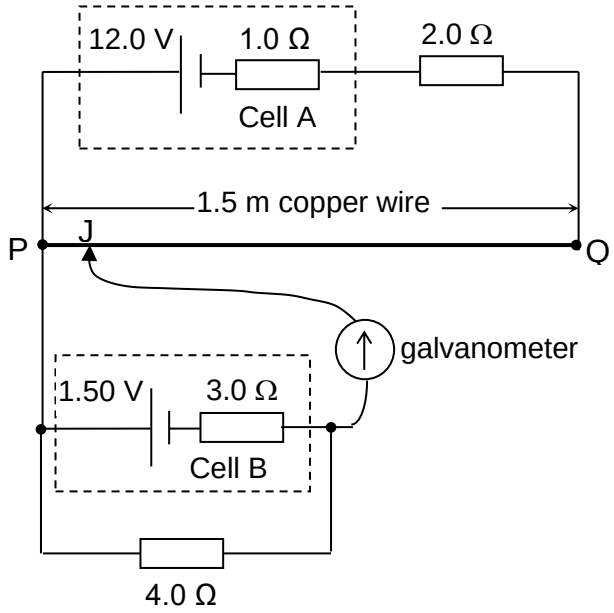

Fig. 4.2

Show that the potential difference across the copper wire PQ is 8.7 V when there is zero current in the galvanometer.

[1]

(ii) Calculate the balance length PJ.

PJ = ... m [3]

(iii) The balance point is found to be too near P.

Suggest and explain how the circuit can be modified, without changing Cell B, to improve the accuracy of the balanced length PJ.

.....

.....

.....

..... [2]

[Total: 11]