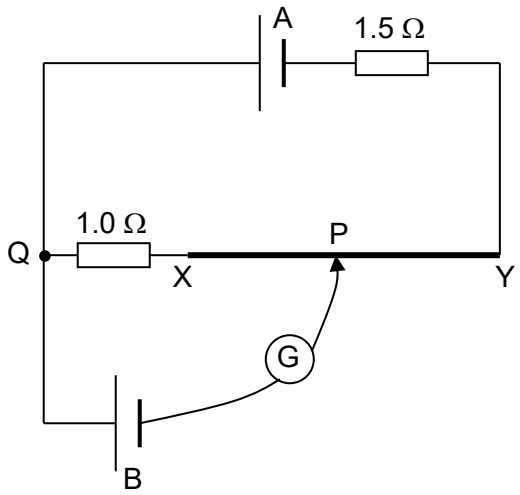
6 **(a)** A length of copper wire of cross-sectional area 1.2×10^{-6} m^2 carries a steady current of 2.5 A. The wire has a density of 8.9×10^3 kg m^{-3}. Assume the wire is made entirely of copper atoms, each contributing one free electron to conduction. The molar mass of copper is 63.5 g mol^{-1}.

Calculate the average drift velocity of the electrons in the wire.

average drift velocity = ... m s^{-1} [3]

(b) In the circuit below, cell A has an e.m.f. 2.0 V and negligible internal resistance. Wire XY is 100.0 cm long with a resistance of 5.0 Ω.



(i) Distinguish between *electromotive force e.m.f.* and *potential difference p.d.* using energy considerations.

.....

.....

.....[1]

(ii) Calculate the current flowing from Q to Y when the galvanometer registers a null deflection.

current = ... A [2]

(iii) Cell B has an e.m.f. of 1.5 V. At balance point P,

1. show that resistance across X and P is 4.6 Ω,

[2]

2. calculate the balance length XP.

length XP = ... m [2]

(iv) State and explain how the length XP in **(b)(iii)2.** will change if the internal resistance of cell A is not negligible.

.....

.....[2]

[Total: 12]