6 **(a)** Define the *coulomb*.

....[1]

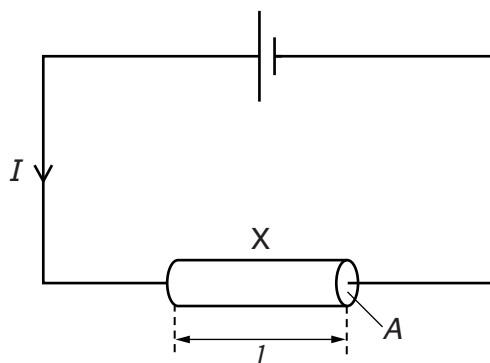**(b)** A resistor X is connected to a cell as shown in Fig. 6.1.

Fig. 6.1

The resistor is a wire of cross-sectional area A and length l. The current in the wire is I.

Show that the average drift speed v of the charge carriers in X is given by the equation

$$v = \frac{I}{nAe}$$

where e is the charge on a charge carrier and n is the number of charge carriers per unit volume in X.

[3]

(c) A 12V battery with negligible internal resistance is connected to two resistors Y and Z, as shown in Fig. 6.2.
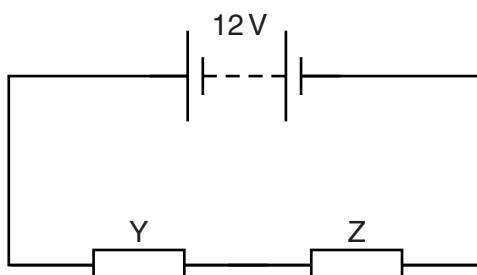

Fig. 6.2

The resistors are made from wires of the same material. The wire of Y has a diameter d and length l. The wire of Z has a diameter $2d$ and length $2l$.

(i) Determine the ratio

$$\frac{\text{average drift speed of the charge carriers in Y}}{\text{average drift speed of the charge carriers in Z}}.$$

ratio = ... [3]

(ii) Show that

$$\frac{\text{resistance of Y}}{\text{resistance of Z}} = 2.$$

[2]

(iii) Determine the potential difference across Y.

potential difference = ... V [2]

(iv) Determine the ratio

$$\frac{\text{power dissipated in Y}}{\text{power dissipated in Z}}.$$

ratio = ... [1]

[Total: 12]