6 **(a)** A network of three resistors of resistances R_1, R_2 and R_3 is shown in Fig. 6.1.

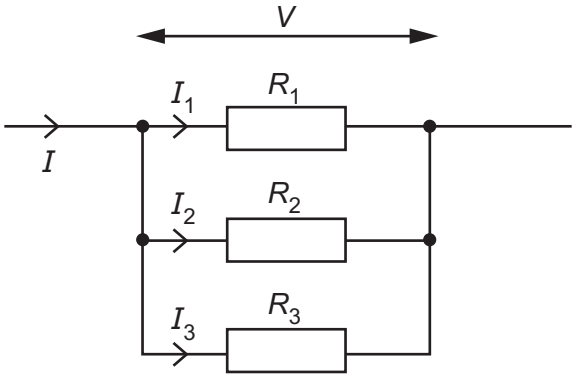

Fig. 6.1

The individual currents in the resistors are I_1, I_2 and I_3. The total current in the combination of resistors is I and the potential difference across the combination is V.

Show that the combined resistance R of the network is given by

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}.$$

[2]

(b) A battery of electromotive force (e.m.f.) 8.0 V and internal resistance r is connected to three resistors X, Y and Z, as shown in Fig. 6.2.

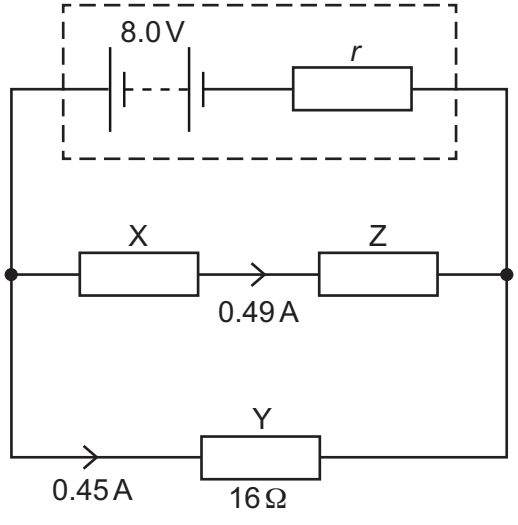

Fig. 6.2

Resistor Y has a resistance of 16 Ω. The current in resistor X is 0.49A and the current in resistor Y is 0.45A.

Calculate:

(i) the current in the battery

current = ... A [1]

(ii) the internal resistance *r* of the battery.

r = ... Ω [2]

(c) Resistors X and Y in Fig. 6.2 are made from wires of the same material and cross-sectional area. The average drift speed of the free electrons in X is $2.1 \times 10^{-4}\,m\,s^{-1}$.

Calculate the average drift speed *v* of the free electrons in Y.

v = ... $m\,s^{-1}$ [2]

(d) Resistor Z in Fig. 6.2 is replaced by a new resistor of smaller resistance.

State and explain the effect, if any, on the terminal potential difference of the battery.

.....

.....

..... [2]

[Total: 9]