

- 5 (a) State Kirchhoff's second law.

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[2]

- (b) Two batteries, each of electromotive force (e.m.f.) 6.0 V and negligible internal resistance, are connected in series with three resistors, as shown in Fig. 5.1.

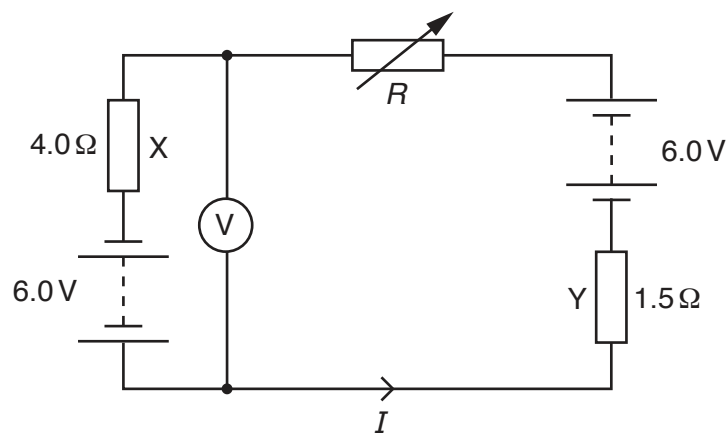


Fig. 5.1

Resistor X has resistance $4.0\ \Omega$ and resistor Y has resistance $1.5\ \Omega$.

- (i) The resistance R of the variable resistor is changed until the voltmeter in the circuit reads zero.

Calculate

1. the current I in the circuit,

$$I = \dots\dots\dots \text{ A [1]}$$

2. the resistance R .

$$R = \dots\dots\dots \ \Omega \text{ [2]}$$

- (ii) Resistors X and Y are wires made from the same material. The diameter of the wire of X is twice the diameter of the wire of Y.

Determine the ratio

$$\frac{\text{average drift speed of free electrons in X}}{\text{average drift speed of free electrons in Y}}$$

ratio = [2]

- (iii) The resistance R of the variable resistor is now increased.

State and explain the effect of the increase in R on the power transformed by each of the batteries.

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[3]

[Total: 10]