

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

.....
..... [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.

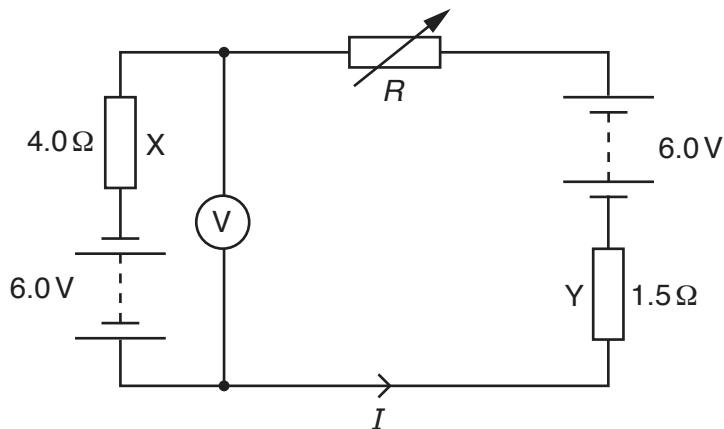


Fig. 5.1

Resistor X has resistance 4.0Ω and resistor Y has resistance 1.5Ω .

- (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,

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

2. the resistance R .

$$R = \dots \Omega [2]$$

- (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.

.....
.....
.....
..... [3]

[Total: 10]