9(a) A metal wire X of length 6.0 cm and diameter 0.30 mm is made of a material with resistivity 1.50 x 10^{-6} Ω m at room temperature.

(i) Show that the resistance of X at room temperature is 1.3 Ω. [2]

(ii) The metal wire X is placed in a circuit in series with an ideal cell of e.m.f. of 1.2 V and a variable resistor. An ideal voltmeter is connected across X to measure its p.d. *V*, and an ideal ammeter is connected in series with X to measure its current *I*, as shown in Fig. 9.1:

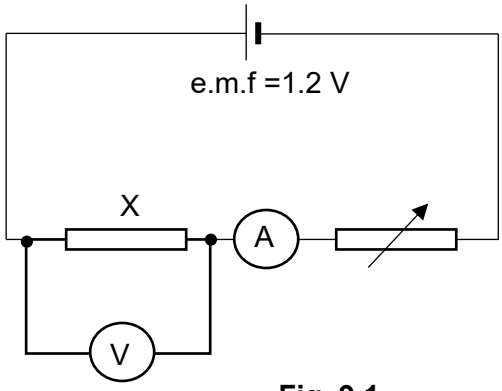

Fig. 9.1

1. Distinguish between e.m.f. and p.d. [2]

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2. As the current through X is increased, its temperature rises. Sketch an *I* – *V* characteristic graph for X. [1]

3. Explain how the graph in (ii)2. can be used to determine the resistance of X for a given value of *V*. [1]

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4. The variable resistor is set to 0.50 Ω. Using the value of the resistance of X that you found in (i), calculate the fraction of the power delivered by the cell that is dissipated through X. [2]

Fraction = ……..

(b) A light bulb is placed in a circuit with a rheostat and an ideal voltmeter connected across it. The resistance of the rheostat can be varied from 0 Ω to 10 Ω. The combination is placed in series with an ideal cell of e.m.f. 3.0 V and a resistor S of 0.60 Ω, as shown in Fig. 9.2:

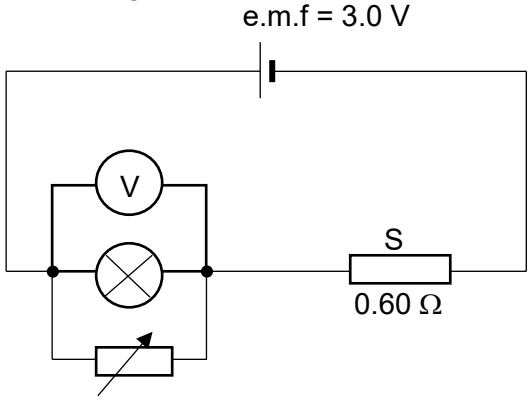

Fig. 9.2

(i) Explain how the reading on the voltmeter will change as resistance of the rheostat is varied from minimum to maximum value. [3]

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(ii) Explain the purpose of resistor S. [2]

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(iii) When the rheostat is set to the maximum setting of 10 Ω, the voltmeter reads 1.2 V.

1. Calculate the current delivered by the cell. [2]

Current = ……..

2. Calculate the current flowing through the light bulb. [3]

Current = …….

3. A student suggests that the rheostat can act as a switch for the light bulb, since setting the resistance of the rheostat to 0 Ω will cause the current in the light bulb to drop to 0 A. Explain why it is not practical to use the rheostat as a switch. [2]

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