6 A battery of electromotive force (e.m.f.) E and internal resistance r is connected to a variable resistor of resistance R, as shown in Fig. 6.1.

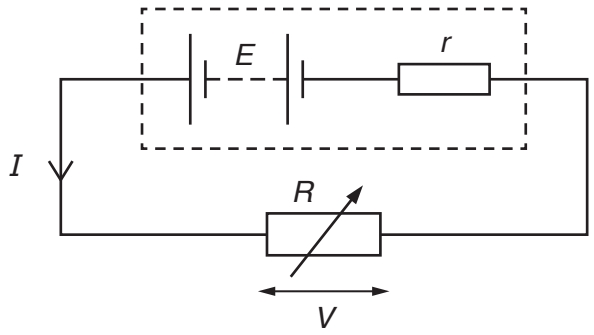

Fig. 6.1

The current in the circuit is I and the potential difference across the variable resistor is V.

(a) Explain, in terms of energy, why V is less than E.

.....

.....[1]

(b) State an equation relating E, I, r and V.

.....[1]

(c) The resistance R of the variable resistor is varied. The variation with I of V is shown in Fig. 6.2.

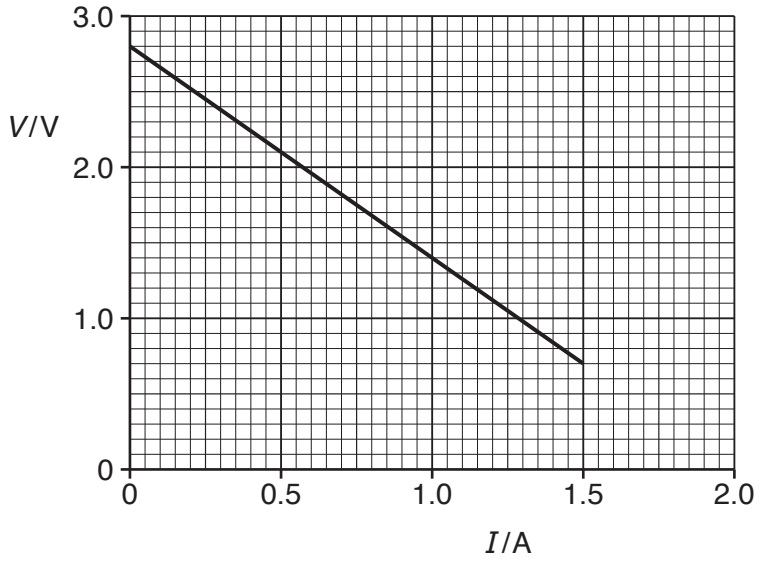

Fig. 6.2

Fig. 6.2 to:

(i) explain how it may be deduced that the e.m.f. of the battery is 2.8 V

.....

.....[1]

(ii) calculate the internal resistance *r*.

r = ... Ω [2]

(d) The battery stores 9.2 kJ of energy. The variable resistor is adjusted so that *V* = 2.1 V. Fig. 6.2 to:

(i) calculate resistance *R*

R = ... Ω [1]

(ii) calculate the number of conduction electrons moving through the battery in a time of 1.0 s

number = ... [1]

(iii) determine the time taken for the energy in the battery to become equal to 1.6 kJ. (Assume that the e.m.f. of the battery and the current in the battery remain constant.)

time taken = ... s [3]

[Total: 10]