5 A cell is labelled “9.0 V, 0.450 A h”. This may be assumed to mean that the cell has an e.m.f. of 9.0 V, and will supply a current of 0.450 A for one hour before running out of energy.

It is found that a steady current of 0.450 A flows when a 18 Ω resistor is connected across the cell terminals as shown in Fig. 5.1. You can assume that the ammeter in the circuit is ideal.

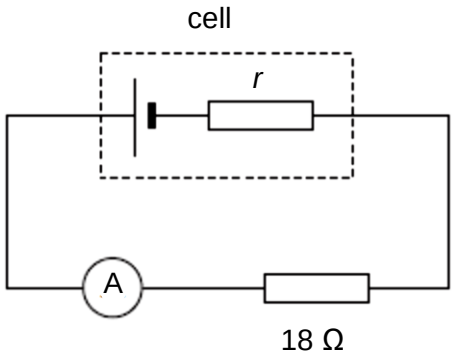

Fig. 5.1

(a) Calculate the cell’s internal resistance, *r*.

r = …… Ω [2]

(b) Calculate the total charge, *Q* that will flow if the resistor is left connected until the cell has run out of energy.

Q = …… C [2]

(c) Calculate the total energy generated by the cell before it runs out.

total energy = …… J [2]

(d) Calculate the rate of heat generated in the 18 Ω resistor.

rate of heat generated = …… W [2]

(e) Suppose that a resistor of higher resistance had been used instead of the 18 Ω resistor, so that the current was 0.225 A, calculate the resistance of this new resistor.

resistance of new resistor = …… Ω [2]