5 **(a)** A cell of e.m.f. 2.50 V and internal resistance r is connected to two resistive wires in series

as shown in Fig. 5.1.

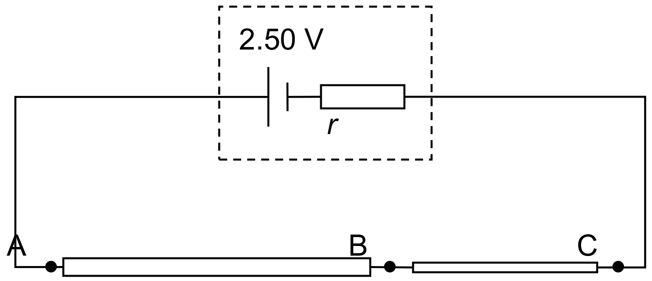

Fig. 5.1

The wires are made of the same material but have different lengths and diameters. Wire AB is 50.0 cm long and has a diameter d, whereas wire BC is 30.0 cm long and has a diameter 0.30 d. The connecting wires are assumed to have no resistance.

Show that $\frac{R_{AB}}{R_{BC}} = 0.15$.

[2]

(b) An ammeter is added to the circuit in **(a)**, along with a voltmeter connected across wire BC as shown in Fig. 5.2.

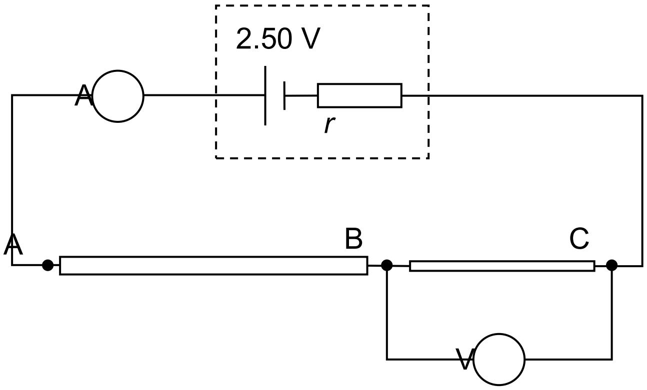

Fig. 5.2

If the ammeter shows a reading of 0.400 A and the voltmeter gives a reading of 2.00 V,

(i) show that the terminal potential difference of the cell is 2.30 V, terminal potential difference = ……………………V [2]

(ii) determine the internal resistance *r* of the 2.50 V cell,

r = ……………………Ω [2]

(iii) calculate the efficiency of the circuit.

efficiency = ……………………% [2]

(c) Suggest and explain whether your answer in **(b)(ii)** is an overestimate or underestimate if the ammeter is not ideal.

……………………………………………………………………………………..……………
…...

……………………………………………………………………………………..……………
…...

……………………………………………………………..……………………………………………
[2]