3 **(a)** Fig. 3.1 shows two identical resistors connected in series with a cell with unknown electromotive force (e.m.f.) and unknown internal resistance.

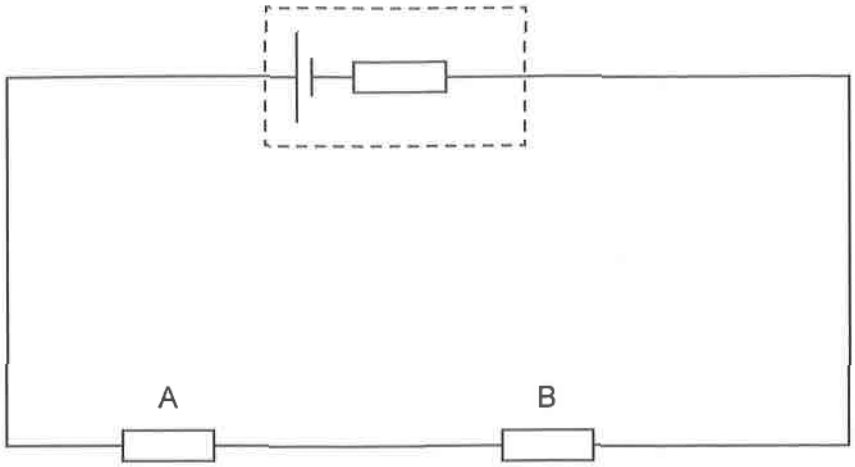

Fig. 3.1

The potential difference (p.d.) across resistor A is 2.90 V and the current in resistor A is 0.968 A.

A third identical resistor is now connected in parallel with resistor B. The p.d. across resistor A is now 3.83 V and the current in resistor A is 1.277 A.

(i) Calculate the resistance of one of the three identical resistors.

resistance = ... Ω [2]

(ii) Calculate the internal resistance of the cell.

internal resistance = ... Ω [3]

(iii) Calculate the e.m.f. of the cell.

e.m.f. = ... V [2]

(b) (i) Sketch the I–V characteristic for a filament lamp on Fig. 3.2.

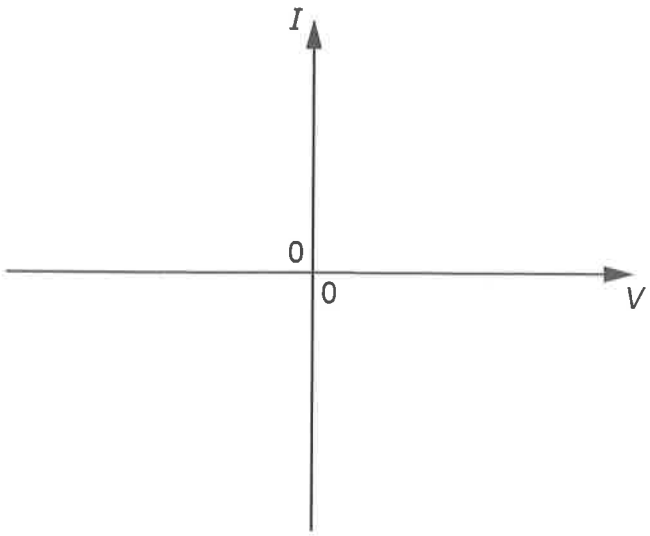

Fig. 3.2

[2]

(ii) Explain, in terms of particles, why the I–V characteristic for a filament lamp has this shape.

.....

.....

.....

..... [4]

(iii) Discuss whether the resistance of the lamp can be deduced from:

$$\frac{1}{\text{gradient of } I\text{–}V \text{ characteristic}}.$$

.....

.....

..... [2]

(c) Draw the diagram of a circuit used to obtain data for an I–V characteristic for a 12 V filament lamp using a fixed 12 V D.C. power supply with no internal resistance.

It must be possible to vary the p.d. continuously from 0 to 12 V.

[3]

[Total: 18]