5 **(a)** Two identical filament lamps are connected in series and then in parallel to a battery of electromotive force (e.m.f.) 12 V and negligible internal resistance, as shown in Fig. 5.1a and Fig. 5.1b respectively.

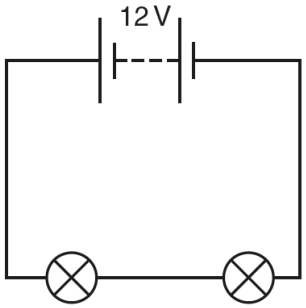

Fig. 5.1a

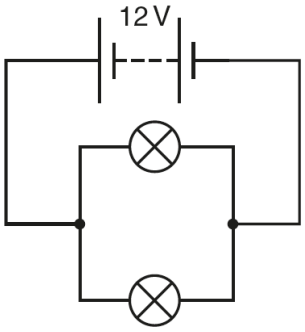

Fig. 5.1b

The I-V characteristic of each lamp is shown in Fig. 5.2.

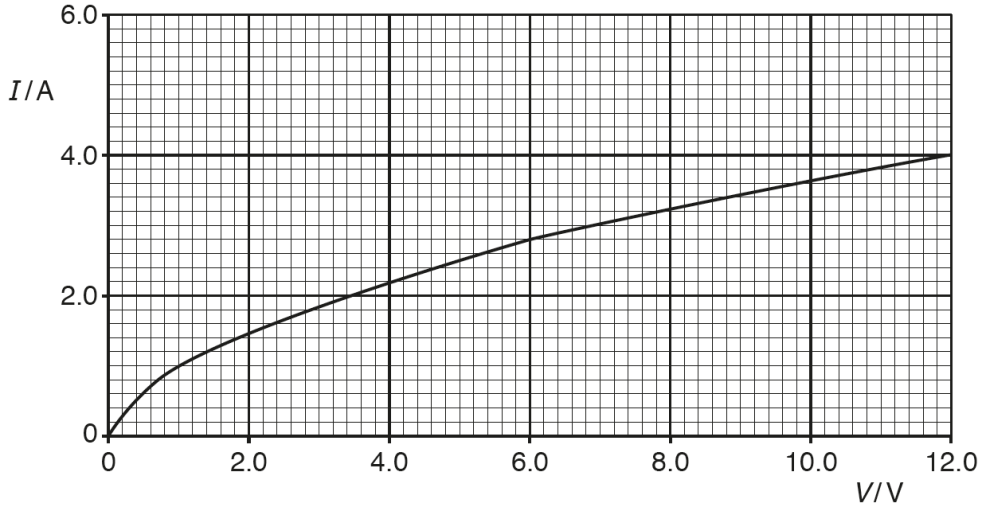

Fig. 5.2

(i) Use Fig. 5.2 to determine the current through the battery in the

1. circuit of Fig. 5.1a,

current = ... A

2. circuit of Fig. 5.1b.

current = ... A [2]

(ii) Calculate the total resistance in the

1. circuit of Fig. 5.1a,

resistance = ...
Ω

2. circuit of Fig. 5.1b.

resistance = ... Ω [2]

(iii) Calculate the ratio

$$\frac{\text{power dissipated in a lamp in the circuit of Fig. 5.1a}}{\text{power dissipated in a lamp in the circuit of Fig. 5.1b}}$$

ratio = ... [2]

(b) A metal wire BD has a length of 100 cm and resistance of 4.0 Ω. The ends B and D of the wire are connected to a cell X as shown in Fig. 5.3.

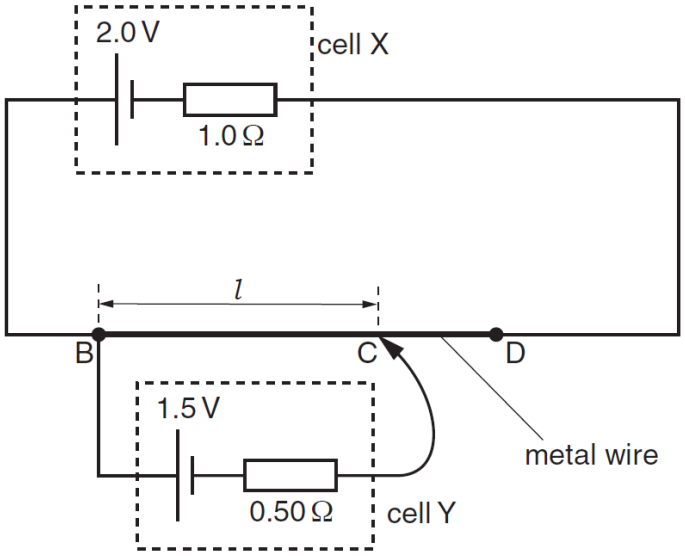

Fig. 5.3

The cell X has an e.m.f. of 2.0 V and internal resistance of 1.0 Ω.

A cell Y of e.m.f. 1.5 V and internal resistance 0.50 Ω is connected to the wire at points B and C, as shown in Fig. 5.3.

The point C is at a distance l from point B. The current in cell Y is zero.

Calculate

(i) the current in cell X,

current = ……. A [1]

(ii) the distance l.

l = ……. m [3]

(c) The connection at C in **(b)** is moved so that l is increased. Explain why the e.m.f. of cell Y is less than its terminal p.d.

…...……..……...

…...……..……....

...……..[2]