6 **(a)** Define electromotive force (e.m.f.) for a battery.

.....

..... [1]

(b) A battery of e.m.f. 6.0 V and internal resistance 0.50 Ω is connected in series with two resistors X and Y, as shown in Fig. 6.1.

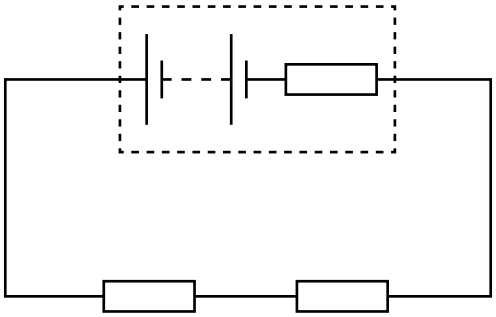

Fig. 6.1

The resistance of X is 4.0 Ω and the resistance of Y is 12 Ω.

Calculate

(i) the current in the circuit,

current = ... A [2]

(ii) the terminal potential difference (p.d.) across the battery.

p.d. = ... V [1]

(c) A resistor Z is now connected in parallel with resistor Y in the circuit in **(b)**. The new arrangement is shown in Fig. 6.2.

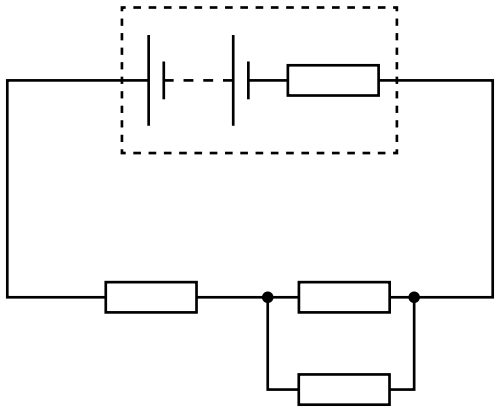

Fig. 6.2

Resistor Y is made from a wire of length l and diameter d. Resistor Z is a wire made from the same material as Y. The length of the wire for Z is $l/2$ and the diameter is $d/2$.

(i) Calculate the resistance R of the combination of resistors Y and Z.

R = ... Ω [3]

(ii) State and explain the effect on the terminal p.d. across the battery.

A numerical value is not required.

.....

.....

.....

..... [2]

(d) the circuits given in **(b)** and **(c)**, show that the ratio

$$\frac{\text{power developed in the external circuit in Fig. 6.1}}{\text{power developed in the external circuit in Fig. 6.2}}$$

is approximately 0.8.

[3]

7 Two parallel, vertical metal plates in a vacuum are connected to a power supply and a switch, as shown in Fig. 7.1.

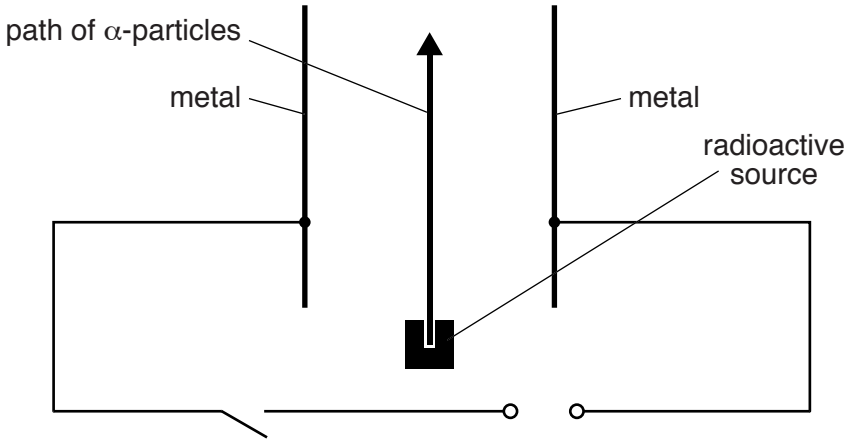

Fig. 7.1

A radioactive source emitting α-particles is placed below the plates. The path of the α-particles is shown on Fig. 7.1. The switch is closed producing a potential difference (p.d.) across the plates. This gives rise to a uniform electric field between the plates.

The separation of the plates is 12 mm.

(a) (i) On Fig. 7.1, draw the path of the α-particles. [1]

(ii) Explain why the metal plates are placed in a vacuum.

.....

..... [1]

(iii) Calculate the p.d. required to produce an electric field of 140 MV m^{-1}.

p.d. = ... MV [2]

(b) The α-particle source is replaced by a β-particle source. By reference to the properties of α-radiation and β-radiation, suggest three possible differences in the deflection observed with β-particles.

1. .....

.....

2. .....

.....

3. .....

.....

[3]

(c) Complete Fig. 7.2 to show the changes in the proton number *Z* and the nucleon number *A* of different radioactive nuclei when either an α-particle or a β-particle is emitted.

emitted particle	change in *Z*	change in *A*
α-particle		
β-particle		

Fig. 7.2

[1]