8 **(a)** **(i)** Define *electromotive force*.

....

.... [1]

(ii) State how electromotive force differs from potential difference.

....

.... [1]

(b) A cell of negligible internal resistance and electromotive force (e.m.f.) 1.5 V is used to power a small filament lamp. The current in the filament lamp is 0.12 A.

(i) Calculate the number of electrons which pass through the filament lamp in 10 s.

number of electrons = ... [2]

(ii) Sketch, on Fig. 8.1, the I–V characteristic graph for a filament lamp. [2]
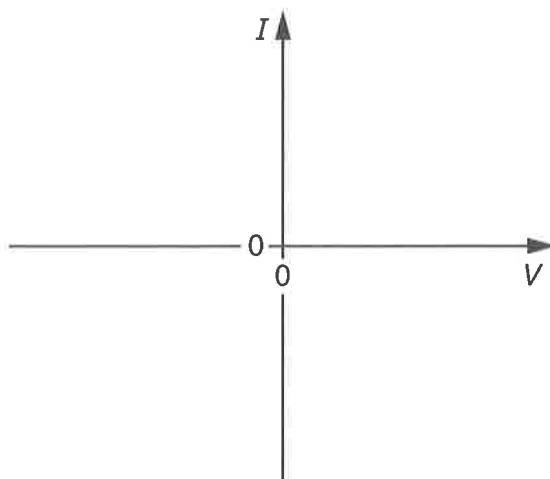
Fig. 8.1

(iii) Explain the shape of the I–V characteristic graph of a filament lamp.

....

....

.... [2]

(c) The filament in the lamp is a tungsten wire of length 17 mm. Tungsten has a resistivity of $5.0 \times 10^{-8}\,\Omega\,m$.

Calculate the diameter of the wire.

diameter = ... m [4]

(d) Light-emitting diodes (LEDs) are often used instead of filament lamps because they need less power for the same brightness of light.

When the p.d. across the LED is less than 2.0 V, the LED is off and when the p.d. across the LED is more than 2.0 V, the LED is at full brightness.

(i) Design a potential divider circuit using a battery, a fixed resistance resistor, an LED and a light-dependent resistor (LDR).

The LED in the circuit must switch on when the intensity of the light falling on the LDR decreases below a certain level.

[3]

(ii) Explain how the circuit you have drawn in **(i)** functions.

....

....

....

....

.... [3]

(iii) Suggest a modification to your circuit in **(i)** that results in the same LED switching on at a lower light intensity. The LDR cannot be changed.

Explain the reasoning behind your suggestion.

....

....

....

....

.... [2]

[Total: 20]