

1 The power of a 230V mains filament lamp is 40W.

(a) Define *power*.

.....  
..... [1]

(b) The lamp is connected to the 230V supply. Calculate

(i) the current  $I$  in the filament

$I =$  ..... A [2]

(ii) the resistance  $R$  of the filament.

$R =$  .....  $\Omega$  [1]

(c) The cross-sectional area of the wire of the filament is  $3.0 \times 10^{-8} \text{m}^2$ . The resistivity of the filament when the lamp is lit is  $7.0 \times 10^{-5} \Omega \text{m}$ . Use your answer to (b)(ii) to calculate the length  $L$  of the filament wire.

$L =$  ..... m [3]

(d) Explain whether the filament of a 60W, 230V lamp is thicker or thinner than that of the 40W, 230V lamp. The length and material of the filament are the same in both lamps.

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..... [3]

(e) The 40W filament lamp is left on for 8 hours.

(i) Calculate the charge  $Q$  passing through the lamp in this time.

$Q = \dots\dots\dots C$  [2]

(ii) 1 Define the *kilowatt-hour*.

.....  
..... [1]

2 Calculate the cost of leaving the lamp switched on. The cost of 1 kWh is 22 p.

cost =  $\dots\dots\dots p$  [2]

[Total: 15]

2 Fig. 2.1 shows the  $I$ - $V$  characteristic of a light-emitting diode (LED).

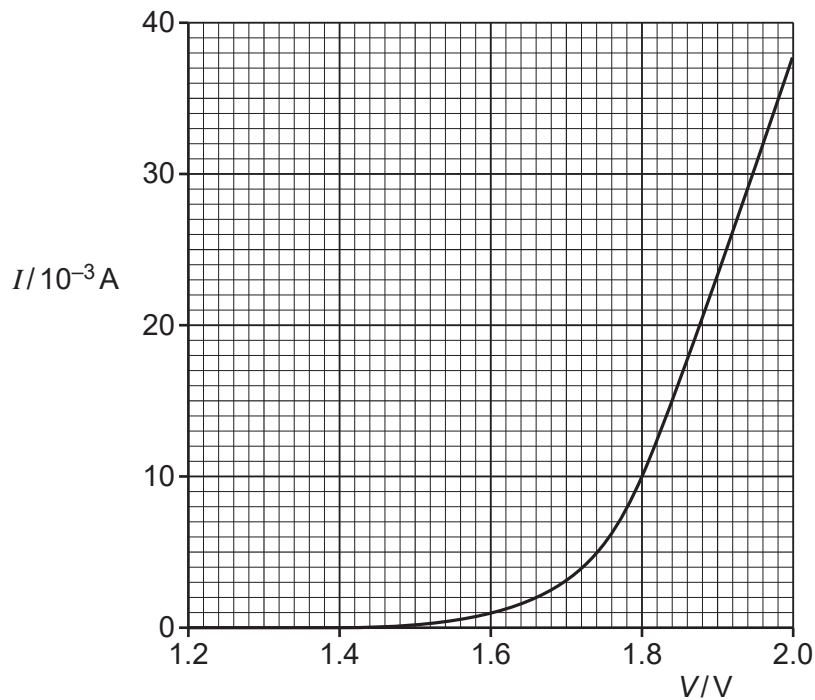


Fig. 2.1

(a) (i) Use Fig. 2.1 to

1 state the value of the resistance  $R$  below 1.4V.

$R = \dots\dots\dots \Omega$  [1]

2 determine the resistance  $R$  of the LED at  $V = 1.8V$ .

$R = \dots\dots\dots \Omega$  [2]

(ii) At voltages  $V$  above 1.8V, state whether the resistance of the LED increases, remains the same or decreases as  $V$  increases. Justify your answer.



*In your answer you should link features of the graph into your justification.*

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- (b) A circuit is set up to obtain the  $I-V$  characteristic shown in Fig. 2.1. It consists of a variable 0–6.0V d.c. power supply connected in **series** to a  $100\Omega$  resistor and the LED. Fig. 2.2 shows the variable supply. Draw the resistor, LED and suitable meters on the diagram between terminals **X** and **Y** to complete the circuit required for the experiment. [4]

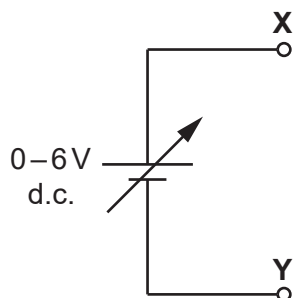


Fig. 2.2

- (c) One or more LEDs are often used in places where, in the past, a filament lamp would have been used.  
 Give **one** example of such a situation.  
 Explain **one** advantage of using LEDs in place of a filament lamp in the situation you have chosen.

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[2]

[Total: 12]

- 3 Two 6.0V torches produce similar light intensities. The light source of one is a single filament lamp and of the other is a combination of four light-emitting diodes (LEDs). Fig. 1.1 shows the  $I$ - $V$  characteristics of the filament lamp and **one** LED.

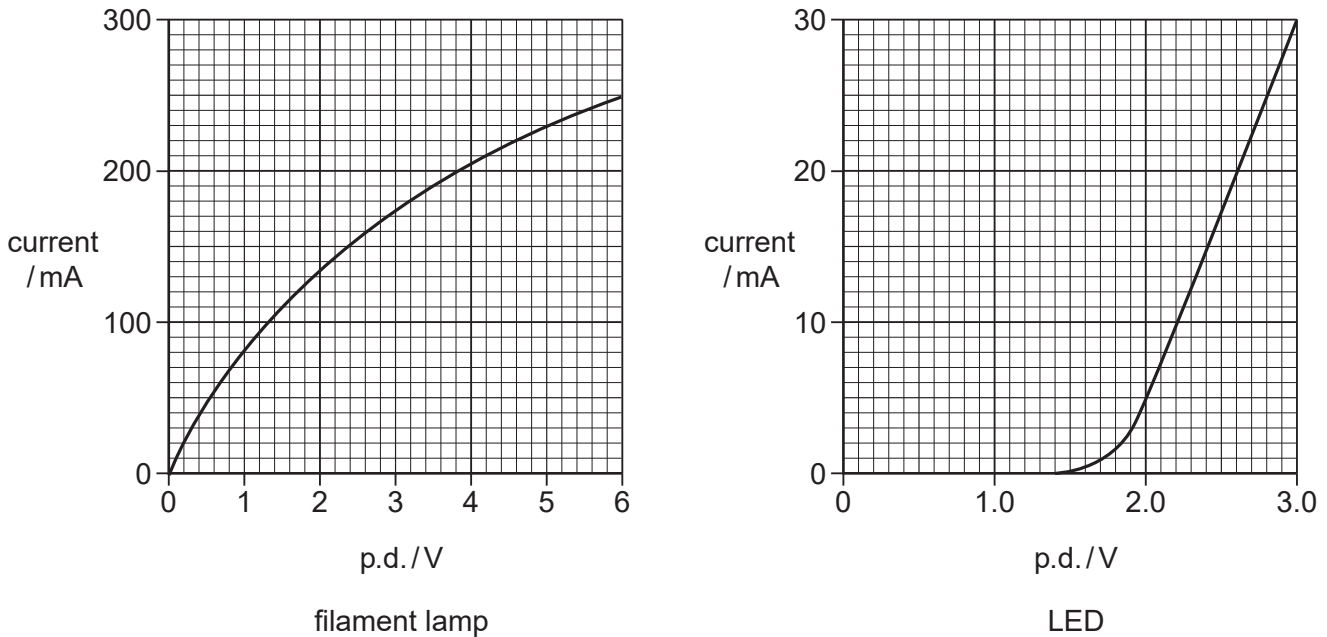


Fig. 1.1

- (a) (i) Describe how the resistance of the filament lamp at 6.0V can be determined from its  $I$ - $V$  characteristic.

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

- (ii) State how the  $I$ - $V$  characteristics show that the filament lamp and the LED do not obey Ohm's law.

.....  
 ..... [1]

- (b) When at normal brightness the current in the filament lamp is 0.25A at a p.d. of 6.0V.

- (i) Calculate the charge  $Q$  passing through the filament each second.

$Q = \dots\dots\dots$  C [1]

- (ii) Calculate the energy drawn from the battery each second.

energy =  $\dots\dots\dots$  J [1]

(iii) The battery is able to keep the lamp lit for 4 hours. Estimate the energy stored in the battery.

energy stored = ..... J [2]

(c) The LEDs in the LED torch are connected in pairs across the 6.0V battery and switch so that the potential difference across each of the four LEDs is 3.0V.

(i) Define the term *potential difference*.

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

(ii) Use Fig. 1.1 to determine the current through each LED.

current = ..... mA [1]

(iii) Show that the power drawn from the battery in the LED torch is 0.36W.

[2]

(iv) Sketch a circuit diagram showing how the battery, the four LEDs and the switch are connected in the torch.

[3]

(d) Suggest one advantage of using LEDs rather than a filament lamp in a torch.

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..... [1]

[Total: 16]