

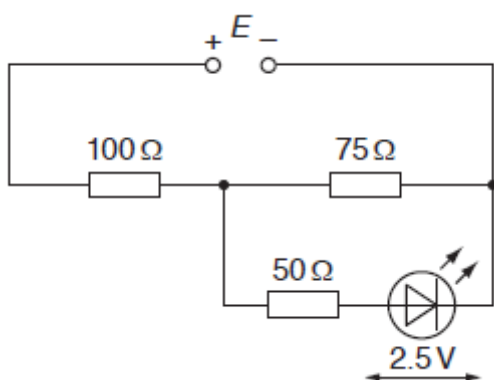


# **A Level Physics A**

**H556/02** Exploring physics

**Question Set 26**

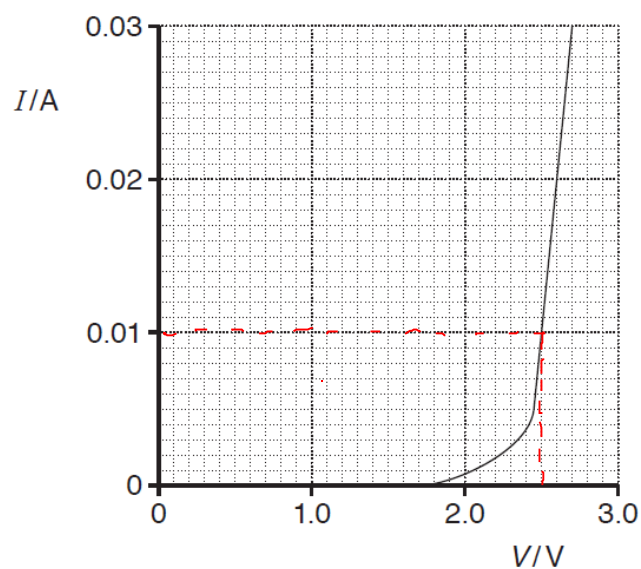
1 Fig. 19.1 shows an electric circuit.



**Fig. 19.1**

The power supply has electromotive force (e.m.f.)  $E$  and negligible internal resistance.

The resistance values of the resistors are shown in Fig. 19.1. The  $I$ - $V$  characteristic of the light-emitting diode (LED) is shown in Fig. 19.2.



**Fig. 19.2**

The potential difference (p.d.) across the LED is 2.5V.

(a) Use Fig. 19.2 to show that the p.d. across the  $50\ \Omega$  resistor is 0.50V.

From 19.2,  $I = 0.01\ \text{A}$

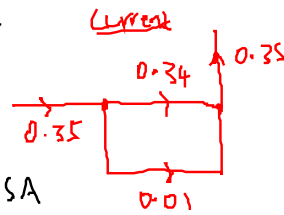
$$V = IR = 0.01 \times 50 = \underline{0.5\ \text{V}}$$

[2]

(b) Calculate the e.m.f.  $E$  of the power supply.

$$\text{P.d. across } 75 \Omega = 25 + 0.5 = 25.5 \text{ V}$$

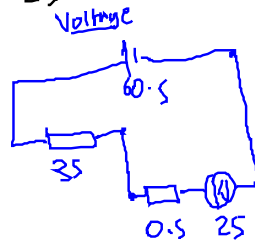
$$I = \frac{V}{R} = \frac{25.5}{75} = 0.34 \text{ A}$$



From Kirchhoff's 1st law,  $I$  through  $100 \Omega = 0.35 \text{ A}$

$$V = IR = 0.35 \times 100 = 35 \text{ V}$$

$$\text{From Kirchhoff's 2nd law, } \mathcal{E} = 35 + 25 + 0.5 = 60.5 \text{ V}$$



$$E = \dots 60.5 \dots \text{V [3]}$$

(c) The LED emits blue light of wavelength  $4.7 \times 10^{-7} \text{ m}$ .

(i) Estimate the number of blue light photons emitted from the LED per second.

$$E \text{ of 1 photon} = \frac{hc}{\lambda} = \frac{6.63 \times 10^{-34} \times 3 \times 10^8}{4.7 \times 10^{-7}} = 4.2 \times 10^{-19}$$

$$\text{Power} = V \times I = 0.25 \text{ J/s}$$

$$\text{Each second } 0.25 \text{ J} = \frac{0.25}{4.2 \times 10^{-19}} = 5.9 \times 10^{17} \text{ photons/s}$$

$$\text{number of photons per second} = \dots 5.9 \times 10^{17} \dots \text{s}^{-1} \text{ [3]}$$

(ii) The light from the LED is incident on a metal of work function  $2.3 \text{ eV}$ .

Explain, with the help of a calculation, whether or not photoelectrons will be emitted from the surface of the metal.

$$2.3 \text{ eV} = 2.3 \times 1.6 \times 10^{-19} = 3.7 \times 10^{-19} \text{ J} \quad [2]$$

$4.2 \times 10^{-19} > 3.7 \times 10^{-19}$  so photoelectrons will be emitted.

**Total Marks for Question Set 26: 10**

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