OCR
Oxford Cambridge and RSA

A Level Physics A

H556/02 Exploring physics

Question Set 26

1 Fig. 19.1 shows an electric circuit.

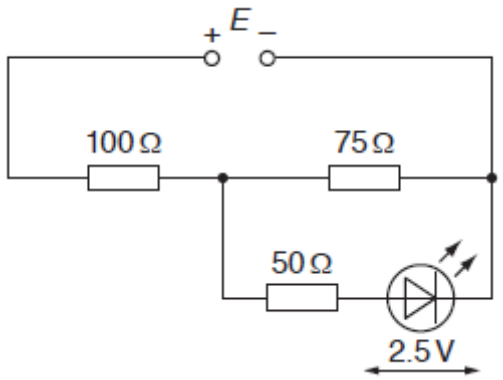


Fig. 19.1

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.

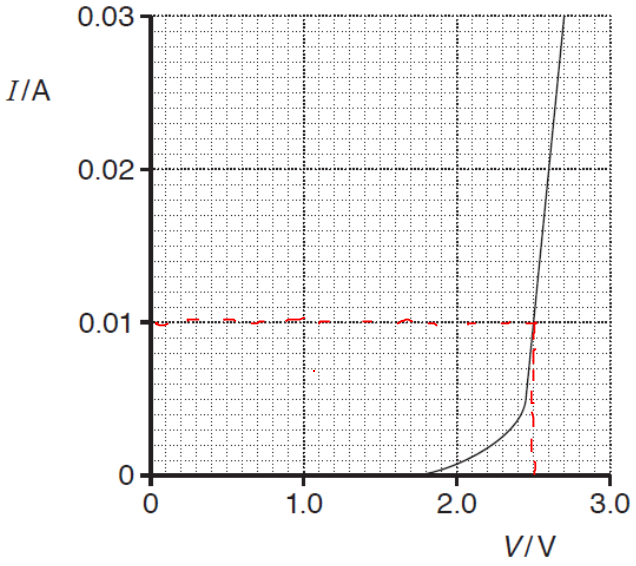


Fig. 19.2

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

(a) Use Fig. 19.2 to show that the p.d. across the 50 Ω resistor is 0.50 V. **[2]**

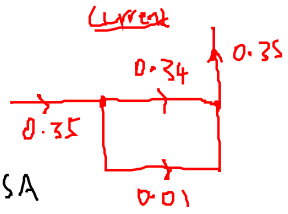
From 19.2 , I = 0.01 A

V = IR = 0.01 x 50 = 0.5 V

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

P.d. across 75 Ω = 25 + 0.5 = 25.5 V

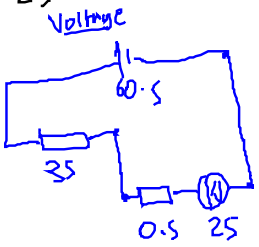
$I = \frac{V}{R} = \frac{25.5}{75} = 0.34$ A



From kirchoff's 1st law, I through 100 Ω = 0.35A

$V = IR = 0.35 \times 100 = 35$ V

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



E = 60.5 V **[3]**

(c) The LED emits blue light of wavelength 4.7×10^{-7} m.

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

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

Power = $V \times I = 0.25$ J/s

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

number of photons per second = 5.9×10^{17} s^{-1} **[3]**

(ii) The light from the LED is incident on a metal of work function 2.3 eV.

Explain, with the help of a calculation, whether or not photoelectrons will be emitted from the surface of the metal. **[2]**

2.3 eV = $2.3 \times 1.6 \times 10^{-19} = 3.7 \times 10^{-19}$ J

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

Total Marks for Question Set 26: 10