26.1. Here,

$i = 10^{-8} A$

Reverse voltage, $V_0 = -10$ V.

$T = 300K$

(i) $V_0 = 0.1V$, $i = ?$

(ii) $V_0 = 0.3V$, $i = ?$

(iii) $V_0 = 0.5V$, $i = ?$

We have, $i = i_0 \left(e^{eV_0/k_BT} - 1 \right)$

or, $10^{-8} = i_0 \left(e^{1.6 \times 10^{-19} \times (-10) / 1.38 \times 10^{-23} \times 300} - 1 \right)$

Find i_0.

Now,

(i) $V_0 = 0.1V$, $i = ?$

We have, $i = i_0 \left(e^{eV_0/k_BT} - 1 \right) = ?$

Do others in the same way.

26.2

Reverse saturation current i_0 is the current due to minority charge carrier (say electron) from p to n region that overcomes the ~~barrier~~ energy gap, E_g.

Since Si has more value of energy gap E_g, less current $i(p \to n)$

flows and hence the reverse saturation current becomes small. Hence one selects Si for the PN fabrication.

26-3,

Here, $i_0 = 5\times10^{-9}$ A

$V_0 = 0.45V$

$T = 27^\circ c = 300k.$

(a) $i = ?$

We have $i = i_0\left(e^{eV_0/k_BT} - 1\right) = ?$

(b) $i = ?$ for $T = 47^\circ c = 273+47$

$= 320k.$

Use $i = i_0\left(e^{eV_0/k_BT} - 1\right)$

26-4, Here,

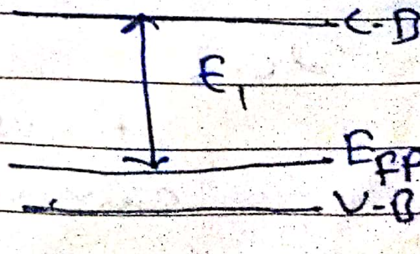
$T_1 = 27^\circ c \cancel{47^\circ c} = \cancel{320k}.\ 300k.$

$i_0 = 5\times10^{-9}$ A $(27^\circ c)$

$E_1 = 1eV = 1\times1.6\times10^{-19}$ J.

$T_2 = 47^\circ c = 320k.$

$\cancel{i_0}\ i_0(47^\circ c) = ?$



We have, $i_0 = A e^{-E_1/k_BT}$

At $T_1 = 27^\circ c$,

$$i_0(27^\circ c) = A e^{-\frac{E_1}{k_B T_1}} \quad \text{--- (i)}$$

At $T_2 = 47^\circ c$,

$$i_0(47^\circ c) = A e^{-\frac{E_1}{k_B T_2}} \quad \text{--- (ii)}$$

Now (ii) $\div$ (i)

$$\Rightarrow \frac{i_0(47^\circ c)}{i_0(27^\circ c)} = e^{-\frac{E_1}{k_B}\left(\frac{1}{T_2} - \frac{1}{T_1}\right)}$$

$$\therefore i_0(47^\circ c) = i_0(27^\circ c) \times e^{-\frac{E_1}{k_B}\left(\frac{T_1 - T_2}{T_1 T_2}\right)}$$

$$= ?$$

(b) $V = 0.45 V$.

$T = 47^\circ c = 320 K$.

$$\therefore i = i_0(47^\circ)\left(e^{eV_0/k_B T} - 1\right) = ?$$

5, At $T_1 = 27^\circ c = 300 k$, $i_0 = i_0$ (say)

At $T_2 = 33^\circ c = 306 K$, $i_0 = \alpha i_0$

From $i = i$ $\quad i_0 = A e^{-E_1/k_B T}$,

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$$\rho_0 = A e^{-E/k_B T_1} \quad \text{— (i)}$$

$$\alpha \rho_0 = A e^{-E_1/k_B T_2} \quad \text{— (ii)}$$

$$\text{(ii)} \div \text{(i)} \Rightarrow \frac{\alpha \rho_0}{\rho_0} = \frac{A e^{-E_1/k_B T_2}}{A e^{-E_1/k_B T_1}}$$

$$\text{or,} \quad \alpha = e^{-E_1/k_B \left(\frac{1}{T_2} - \frac{1}{T_1}\right)}$$

$$\text{or,} \quad \alpha = e^{-E_1/k_B \left(\frac{T_1 - T_2}{T_1 T_2}\right)}$$

$$\text{or,} \quad \ln \alpha = -\frac{E_1}{k_B}\left(\frac{T_1 - T_2}{T_1 T_2}\right)$$

$$\therefore \quad E_1 = \frac{0.693 \times k_B \times T_1 T_2}{T_2 - T_1} \text{ J.}$$

$$= \frac{0.693 \times 1.38 \times 10^{-23} \times 300 \times 306}{(306 - 300) \times 1.6 \times 10^{-19}} \text{ e}$$

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