

- 4.23 (a) The Fermi energy level in silicon at $T = 300$ K is 0.22 eV above the intrinsic Fermi level. Determine n_0 and p_0 .

$$k_B T = (8.617333 \times 10^{-5} \frac{\text{eV}}{\text{K}}) 300 \text{ K} = 0.025852 \text{ eV}$$

Per Table B.4, $n_i = 1.5 \times 10^{10} \text{ \#}/\text{cm}^3$ for Si

$$\begin{aligned} \text{Per (4.39), } n_0 &= n_i e^{(E_F - E_{Fi})/k_B T} \\ &= 1.5 \times 10^{10} e^{0.22/0.025852} \end{aligned}$$

$$\underline{n_0 = 7.4461 \times 10^{13} \text{ \#}/\text{cm}^3 = 7.4461 \times 10^{19} \text{ \#}/\text{m}^3}$$

$$\begin{aligned} \text{Per (4.40), } p_0 &= n_i e^{-(E_F - E_{Fi})/k_B T} \\ &= 1.5 \times 10^{10} e^{-0.22/0.025852} \end{aligned}$$

$$\underline{p_0 = 3.0217 \times 10^6 \text{ \#}/\text{cm}^3 = 3.0217 \times 10^{12} \text{ \#}/\text{m}^3}$$