3.26 (*a*) Determine the total number (#/cm^3) of energy states in silicon between E_c and $E_c + 2kT$ at (*i*) T = 300 K and (*ii*) T = 400 K.

- Repeat part a) for Germanium.

c) Per (3.72), $g_c(E) = \dfrac{4\pi(2m_n^*)^{3/2}}{h^3}\sqrt{E - E_c}$. Then following Example 3.4, the number of conduction energy states in Germanium between E_c and $E_c + 2k_BT$ is

$$N_c = \int_{E_c}^{E_c+2k_BT} g_c(E)\,dE = \int_{E_c}^{E_c+2k_BT} \frac{4\pi(2m_n^*)^{3/2}}{h^3}\sqrt{E - E_c}\,dE$$

$$= \left[\frac{4\pi(2m_n^*)^{3/2}}{h^3}\frac{2}{3}(E - E_c)^{3/2}\right]_{E_c}^{E_c+2k_BT} = \frac{8\pi(2m_n^*)^{3/2}}{3h^3}\left[(E_c + 2k_BT - E_c)^{3/2} - (E_c - E_c)^{3/2}\right].$$

$$= \frac{8\pi(2m_n^*)^{3/2}}{3h^3}(2k_BT)^{3/2}$$

Per Table B.4, the density of states effective electron mass for Germanium is $m_n^* = 0.55m_0$. Using this value and other constants, we get

$$N_c = \frac{8\pi\left(2(0.55)9.1093837\times10^{-31}\right)^{3/2}}{3\left(6.62607015\times10^{-34}\right)^3}\left[2(1.380649\times10^{-23})\right]^{3/2} T^{3/2}.$$

$$= 1.667643\times10^{20}\,T^{3/2}$$

(*i*) At T = 300 K, $N_c = 1.667643\times10^{20}(300)^{3/2}$

$\Rightarrow$ **N_c = 8.66533 × 10^{23} #/m^3 = 8.66533 × 10^{17} #/cm^3.**

(*ii*) At T = 400 K, $N_c = 1.667643\times10^{20}(400)^{3/2}$

$\Rightarrow$ **N_c = 1.33411 × 10^{24} #/m^3 = 1.33411 × 10^{18} #/cm^3.**