$$= 5.72 \text{ x } 10^{22} \text{ atoms/cm}^3$$

Now, from Equation 4.1, the total number of vacancies, N_v, is computed as

$$N_v = N_{\text{Au}} \exp\left(-\frac{Q_v}{kT}\right)$$

$$= (5.72 \times 10^{22} \text{ atoms/cm}^3) \exp\left[-\frac{0.98 \text{ eV/atom}}{(8.62 \times 10^{-5} \text{ eV/K})(800 + 273 \text{ K})}\right]$$

$$= 1.432 \times 10^{18} \text{ vacancies/cm}^3$$

We now want to determine the number of vacancies per unit cell, which is possible if the unit cell volume is multiplied by N_v. The unit cell volume (V_C) may be calculated using Equation 3.5 taking n = 4 inasmuch as Au has the FCC crystal structure. Thus, from a rearranged form of Equation 3.5

$$V_C = \frac{nA_{\text{Au}}}{\rho_{\text{Au}} N_{\text{A}}}$$

$$= \frac{(4 \text{ atoms/unit cell})(196.97 \text{ g/mol})}{(18.699 \text{ g/cm}^3)(6.023 \times 10^{23} \text{ atoms/mol})}$$

$$= 6.996 \times 10^{-23} \text{ cm}^3\text{/unit cell}$$

Now, the number of vacancies per unit cell, n_v, is just

$$n_v = N_v V_C$$

$$= (1.432 \times 10^{18} \text{ vacancies/cm}^3)(6.996 \times 10^{-23} \text{ cm}^3\text{/unit cell})$$

$$= 0.0001002 \text{ vacancies/unit cell}$$

What this means is that instead of there being 4.0000 atoms per unit cell, there are only 4.0000 – 0.0001002 = 3.9998998 atoms per unit cell. And, finally, the density may be computed using Equation 3.5 taking n = 3.9998998; thus