and solving for Q_s leads to the expression

$$Q_s = \frac{-2k\left[\ln\left(\frac{N_{s1}}{N_{s2}}\right) - \ln\left(\frac{\rho_1}{\rho_2}\right)\right]}{\frac{1}{T_1} - \frac{1}{T_2}}$$

Let us take T_1 = 750°C and T_2 = 1500°C, and we may compute the value of Q_s as

$$Q_s = \frac{-(2)(8.62 \times 10^{-5}\ \text{eV/K})\left[\ln\left(\frac{5.7 \times 10^{9}\ \text{m}^{-3}}{5.8 \times 10^{17}\ \text{m}^{-3}}\right) - \ln\left(\frac{3.50\ \text{g/cm}^3}{3.40\ \text{g/cm}^3}\right)\right]}{\frac{1}{750 + 273\ \text{K}} - \frac{1}{1500 + 273\ \text{K}}}$$

$$= 7.70\ \text{eV}$$

(b) It is now possible to solve for N_s at 1000°C using Equation 12.S2 above. This time let's take T_1 = 1000°C and T_2 = 750°C. Thus, solving for N_{s1}, substituting values provided in the problem statement and Q_s determined above yields

$$N_{s1} = \frac{N_{s2}\,\rho_1}{\rho_2}\exp\left[-\frac{Q_s}{2k}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)\right]$$

$$= \frac{(5.7 \times 10^{9}\ \text{m}^{-3})(3.45\ \text{g/cm}^3)}{3.50\ \text{g/cm}^3}\exp\left[-\frac{7.70\ \text{eV}}{(2)(8.62 \times 10^{-5}\ \text{eV/K})}\left(\frac{1}{1000 + 273\ \text{K}} - \frac{1}{750 + 273\ \text{K}}\right)\right]$$

$$= 3.0 \times 10^{13}\ \text{m}^{-3}$$

(c) And, finally, we want to determine the identity of metal M. This is possible by computing the atomic weight of M (A_M) from Equation 12.S1a. Rearrangement of this expression leads to

$$\left(\frac{N_A\rho_1}{A_M + A_O}\right) = N_{s1}\exp\left(\frac{Q_s}{2kT_1}\right)$$

And, after further algebraic manipulation