4.3 This problem calls for the computation of the activation energy for vacancy formation in silver. Upon examination of Equation 4.1, all parameters besides Q_v are given except N, the total number of atomic sites. However, N is related to the density, (ρ), Avogadro's number (N_A), and the atomic weight (A) according to Equation 4.2 as

$$N = \frac{N_A \rho_{Pb}}{A_{Pb}}$$

$$= \frac{(6.023 \times 10^{23} \text{ atoms/mol})(9.5 \text{ g/cm}^3)}{107.9 \text{ g/mol}}$$

$$= 5.30 \text{ x } 10^{22} \text{ atoms/cm}^3 = 5.30 \text{ x } 10^{28} \text{ atoms/m}^3$$

Now, taking natural logarithms of both sides of Equation 4.1,

$$\ln N_v = \ln N - \frac{Q_v}{kT}$$

and, after some algebraic manipulation

$$Q_v = -kT \ln\left(\frac{N_v}{N}\right)$$

$$= -(8.62 \times 10^{-5} \text{ eV/atom-K})(800°\text{C} + 273 \text{ K}) \ln\left[\frac{3.60 \times 10^{23} \text{ m}^{-3}}{5.30 \times 10^{28} \text{ m}^{-3}}\right]$$

$$= 1.10 \text{ eV/atom}$$