18.35 This problem asks that we estimate the temperature at which GaAs has an electrical conductivity of $1.6 \times 10^{-3} (\Omega-m)^{-1}$ assuming that the conductivity has a temperature dependence as shown in Equation 18.36. From the room temperature (298 K) conductivity $[10^{-6} (\Omega-m)^{-1}]$ and band gap energy (1.42 eV) of Table 18.3 we determine the value of *C* (Equation 18.36) by taking natural logarithms of both sides of the equation, and after rearrangement as follows:

$$\ln C = \ln \sigma + \frac{3}{2} \ln T + \frac{E_g}{2kT}$$
$$= \ln \left[10^{-6} (\Omega - m)^{-1} \right] + \frac{3}{2} \ln (298 \text{ K}) + \frac{1.42 \text{ eV}}{(2)(8.62 \text{ x } 10^{-5} \text{ eV/K})(298 \text{ K})}$$
$$= 22.37$$

Now we substitute this value into Equation 18.36 in order to determine the value of T for which $\sigma = 1.6 \times 10^{-3} (\Omega - m)^{-1}$, thus

$$\ln \sigma = \ln C - \frac{3}{2} \ln T - \frac{E_g}{2kT}$$
$$\ln \left[1.6 \times 10^{-3} (\Omega - m)^{-1} \right] = 22.37 - \frac{3}{2} \ln T - \frac{1.42 \text{ eV}}{(2)(8.62 \times 10^{-5} \text{ eV/K})(T)}$$

This equation may be solved for T using an equation solver. For some solvers, the following set of instructions may be used:

$$\ln(1.6*10^{-3}) = 22.37 - 1.5*\ln(T) - 1.42/(2*8.62*10^{-5}T)$$

The resulting solution is T = 417; this value is the temperature in K which corresponds to $T(^{\circ}C) = 417 \text{ K} - 273 = 144^{\circ}C$.

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