18.35 This problem asks that we estimate the temperature at which GaAs has an electrical conductivity of 1.6 x 10^{-3} (Ω-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} (Ω-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:

$$\ln C = \ln \sigma + \frac{3}{2}\ln T + \frac{E_g}{2kT}$$

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

$$= 22.37$$

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

$$\ln \sigma = \ln C - \frac{3}{2}\ln T - \frac{E_g}{2kT}$$

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

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*(ºC) = 417 K – 273 = 144°C.