18.39 In this problem we are to estimate the electrical conductivity, at 75°C, of silicon that has been doped with 10^{22} m^{-3} of phosphorous atoms. Inasmuch as P is a group VA element in the periodic table (Figure 2.6) it acts as a donor in silicon. Thus, this material is n-type extrinsic, and it is necessary to use Equation 18.16; n in this expression is 10^{22} m^{-3} since at 75°C all of the P donor impurities are ionized. The electron mobility is determined using Figure 18.19a. From the 10^{22} m^{-3} impurity concentration curve and at 75°C (348 K), $\mu_e = 0.08$ m^2/V-s.

Therefore, the conductivity is equal to

$$\sigma = n/e \,| \mu_e = \left(10^{22} \text{ m}^{-3}\right)\left(1.602 \text{ x } 10^{-19} \text{ C}\right)\left(0.08 \text{ m}^2/\text{V}-\text{s}\right) = 128 \ (\Omega - \text{m})^{-1}$$