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), $\mu_e = 0.08$ m²/V-s.

Therefore, the conductivity is equal to

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

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