

18.40 In this problem we are to estimate the electrical conductivity, at 135°C, of silicon that has been doped with  $10^{24} \text{ m}^{-3}$  of aluminum atoms. Inasmuch as Al is a group IIIA element in the periodic table (Figure 2.6) it acts as an acceptor in silicon. Thus, this material is *p*-type extrinsic, and it is necessary to use Equation 18.17; *p* in this expression is  $10^{24} \text{ m}^{-3}$  since at 135°C all of the Al acceptor impurities are ionized. The hole mobility is determined using Figure 18.19b. From the  $10^{24} \text{ m}^{-3}$  impurity concentration curve and at 135°C (408 K,)  $\mu_h = 0.007 \text{ m}^2/\text{V}\cdot\text{s}$ . Therefore, the conductivity is equal to

$$\sigma = p/e|\mu_h = (10^{24} \text{ m}^{-3})(1.602 \times 10^{-19} \text{ C})(0.007 \text{ m}^2/\text{V}\cdot\text{s}) = 1120 \text{ } (\Omega\text{-m})^{-1}$$