18-44

18.40 In this problem we are to estimate the electrical conductivity, at 135°C, of silicon that has been doped with  $10^{24}$  m<sup>-3</sup> 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  $10^{24}$  m<sup>-3</sup> since at 135°C all of the Al acceptor impurities are ionized. The hole mobility is determined using Figure 18.19b. From the  $10^{24}$  m<sup>-3</sup> impurity concentration curve and at 135°C (408 K<sub>2</sub>)  $\mu_h = 0.007$  m<sup>2</sup>/V-s. Therefore, the conductivity is equal to

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

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