Solutions
Chapter 8

2a. From Eq. (53), $n \simeq (n_0 N_d)^{1/2} e^{-E_d/2k_BT}$, in an approximation not too good for the present example.

$$n_0 \equiv 2\left(\frac{m^* k_B T}{2\pi\hbar^2}\right)^{3/2} \approx 4\times 10^{13}\ \mathrm{cm}^{-3};$$

$\frac{E_d}{2k_BT} \simeq 1.45$; $e^{-1.45} \simeq 0.23$.

$n \simeq 0.46\times 10^{13}$ electrons cm^{-3}.

b. $R_H = -\frac{1}{nec} \simeq -1.3\times 10^{-14}$ CGS units

Chapter 9

3a. In the hcp structure there is one atom whose z coordinate is 0 and one at $\frac{1}{2}c$. The structure factor of the basis for $\underset{\sim}{G}_c = \frac{2\pi}{c}\hat{\underset{\sim}{z}}$ is

$$S_{\underset{\sim}{G}_c}(\text{basis}) = 1 + e^{-i\pi} = 1 - 1 = 0,$$

the corresponding component $U_{\underset{\sim}{G}_c}$ of the crystal potential is zero.

b. But for $U_{2\underset{\sim}{G}_c}$ the structure factor is

$$S_{2\underset{\sim}{G}_c}(\text{basis}) = 1 + e^{-i2\pi} = 2.$$

c. The two valence electrons can just fill the first BZ. All we need is an adequate energy gap at the zone boundary and for simple hex. there is no reason against a gap.

d. In hcp there will be no gap (at least in lowest order) on the top and bottom faces of the BZ, by the argument of part a.