

HW 6

8.1
A

$$E_{IMP} = \frac{m^*}{\epsilon^2} \underbrace{(13.6)}_{Ry} \text{ eV}$$
$$= \frac{0.015}{(18)^2} (13.6) \text{ eV}$$

$$E_{IMP} = 0.62 \text{ meV}$$

B

$$a = \frac{\epsilon}{m^*} \underbrace{(0.529 \text{ \AA})}_{a_0}$$

$$a = 635 \text{ \AA}$$

C IMPURITIES WILL OVERLAP WHEN THERE IS MORE THAN 1 PER VOLUME

$$\frac{4}{3} \pi (635 \text{ \AA})^3 \Rightarrow$$

$$n \approx \frac{1}{\frac{4}{3} \pi (635 \times 10^{-8} \text{ cm})^3} = 9.3 \times 10^{14} \frac{1}{\text{cm}^3}$$

CHAP 8

②

WE USE EQ. 53

(NOTE THOUGH THAT $kT \approx 0.35 \text{ meV}$
SO THAT $kT \lesssim E_d = 1 \text{ meV}$
NOT $kT \ll E_d$)

THEN

$$n \approx (n_0 N_d)^{1/2} \text{EXP}(-E_d/2k_B T)$$

WITH

$$N_d = 1 \times 10^{13} / \text{cm}^3$$

$$n_0 = 2 \left(\frac{m_e k_B T}{2 \pi \hbar^2} \right)^{3/2} \approx 3.9 \times 10^{13} \frac{1}{\text{cm}^3}$$

$$\text{FOR } m_e = 0.51 m_0$$

SO THAT

$$n \approx \left((\sqrt{3.9}) \times 10^{13} \frac{1}{\text{cm}^3} \right) \left(\text{EXP} \left(-\frac{1 \text{ meV}}{2(0.345 \text{ meV})} \right) \right)$$

$$n \approx 0.46 \times 10^{13} \frac{1}{\text{cm}^3}$$

③

$$R_H = -\frac{1}{n e c}$$

=

$$-1.5 \times 10^{-14} \text{ (CGS UNITS)}$$

~~APPROXIMATELY~~

$$= -1.35 \frac{\text{MKS}}{\text{UNITS}}$$

NOTE:

$$e = 1.6 \times 10^{-19} \text{ C (MKS)}$$

$$R_H = -\frac{1}{n e} \text{ (MKS)}$$

$$e = 4.8 \times 10^{10} \text{ STAT COULOMB (CGS)}$$