

Homework #2

Solution Set

1.  $N_d = 10^{18} \text{ cm}^{-3}$   
 $N_a = 0 \text{ cm}^{-3}$   
 $L = 10 \text{ cm}$   
 $D = 1 \text{ mm}$

10 pts 5 pts

$n = N_D = 10^{18} \text{ cm}^{-3}$

10 pts 5 pts

$p = \frac{n_i^2}{N_D}$

$p = \frac{(10^{10} \text{ cm}^{-3})^2}{10^{18} \text{ cm}^{-3}}$

$p = 10^2 \text{ cm}^{-3}$

$\mu_n = 250 \text{ cm}^2/\text{v-sec}$  → from graph p. 80

5 pts

$R = \rho \frac{L}{A} = \frac{1}{q \mu_n N_D} \cdot \frac{L}{A}$

$R = \frac{1}{(1.6 \times 10^{-19})(250)(10^{18}) \pi [(1/10)/2]^2}$

5 pts

$R = 31.8 \Omega$

2.  $N_a = 10^{16} \text{ cm}^{-3}$   
 $N_d = 0 \text{ cm}^{-3}$   
 $L = 1 \text{ cm}$   
 $d = 10 \mu\text{m}$

5

$p = N_a = 10^{16} \text{ cm}^{-3}$

$n = \frac{n_i^2}{N_a}$

$n = \frac{(10^{10} \text{ cm}^{-3})^2}{10^{16} \text{ cm}^{-3}}$

5

$n = 10^4 \text{ cm}^{-3}$

$\mu_p = 437 \text{ cm}^2/\text{v-sec}$  → from graph p. 80

5

$$R = \frac{\rho \cdot L}{A} = \frac{1}{q \mu_p N_A} \cdot \frac{L}{A}$$

$$R = \frac{1}{(1.6 \times 10^{-16})(437)(10^{16})} \cdot \frac{1}{\pi [(10/10000)/2]^2}$$

$$R = 1820000 \Omega$$

5

3. a)  $N_A = 1.5 \times 10^{16} \text{ cm}^{-3}$   $\rightarrow$  from graph p. 86  $\leftarrow$  10 pts  
 $N_D = 0 \text{ cm}^{-3}$
- b)  $N_D = 5 \times 10^{15} \text{ cm}^{-3}$   $\rightarrow$  from graph p. 86  $\leftarrow$  10 pts  
 $N_A = 0 \text{ cm}^{-3}$

4. a)  $R = \rho \frac{L}{A}$   $\rho \rightarrow$  from graph p. 86

$$R = (6.5 \times 10^{-4}) \cdot \frac{1}{\pi [(1/10)/2]^2}$$

$$R = .0828 \Omega$$

10 pts

- b)  $R = \rho \cdot \frac{L}{A}$   $\rho \rightarrow$  from graph p. 86

$$R = (2 \times 10^{-6}) \cdot \frac{1}{\pi [(1/10)/2]^2}$$

$$R = 2.55 \times 10^{-4} \Omega$$

10 pts

5.  $N_A = N_D = 10^{16} \text{ cm}^{-3}$ , Si

$$N_D \ll n_i \Rightarrow n = n_i = 10^{10} \text{ cm}^{-3}$$

$$N_A \ll n_i \Rightarrow p = n_i = 10^{10} \text{ cm}^{-3}$$

$\leftarrow$  10

$\leftarrow$  10