Homework # 2

EE 3161 - Spring 2008

Due Wednesday, February 27 in class

1) Problem 2.16 in Pierret.

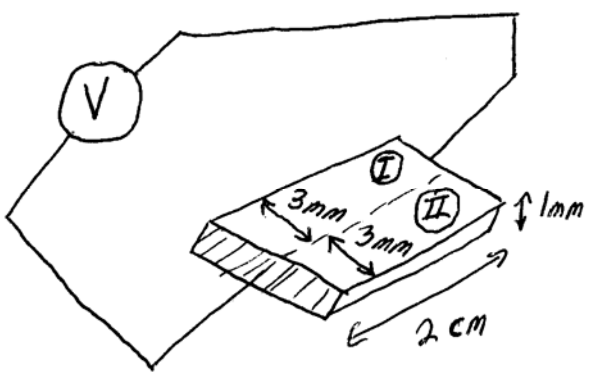
2) Assume we are using silicon at room temperature.

a) If $N_d = 5\times10^{15}$ cm^{-3} and $N_a = 2\times10^{15}$ cm^{-3}, find the number of free holes for the crystal.

b) Now double the bandgap, keeping the dopants *m*, N_c*, and N_v constant. What is the number of free holes? Did the Fermi level move with respect to E_c ? What about E_i ?

3) Assume we are using GaAs at room temperature. If $N_d = 6\times10^{17}$ cm^{-3} and $N_a = 5\times10^{17}$ cm^{-3}, draw the band diagram for the system, labeling E_f, E_c, E_v, E_i, and the energy differences between them. For E_i you can use the position found in problem 2b.

4) If we have a block of silicon doped as shown in the figure below, what is the resistance of the block?



I $N_a = 7\times10^{16}$ Boron
$N_d = 6\times10^{16}$ Arsenic

II $N_d = 1\times10^{17}$ Arsenic
$N_a = 3\times10^{16}$ Boron

5) Problem 3.12 in Pierret. Use Figures P3.12a and P3.12d.

6) [*Problem 2, final exam, spring 2007*]
An intrinsic piece of silicon of length 200μm and width and thickness of 20μm is used as a resistor. Let the base temperature be 300K.

a) Calculate its resistance.

b) If the temperature is increased, will the resistance go up or down? Why? Is this different from a metal resistor or the same? Explain.

c) Calculate numerically by what percentage per degree the resistance will change. (A perfect number is not needed here; I'm just interested in whether you understand the primary dependency.)