Massachusetts Institute of Technology
Department of Electrical Engineering and Computer Science

6.012
Microelectronic Devices and Circuits
Fall 1999

September 17, 1999- Homework #2
Due – September 24, 1999

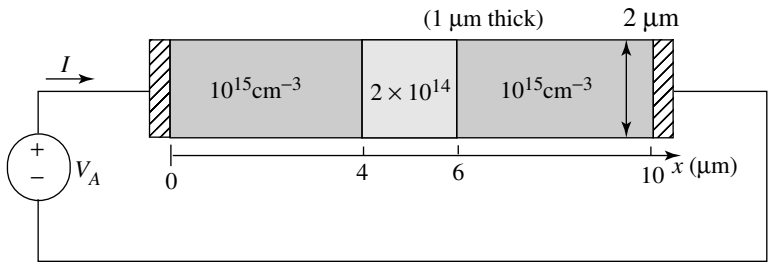
Reading: Chapter 3.1 - 3.3

For this problem set use Figure 2.8 to find the hole and electron mobility for the given doping concentration.

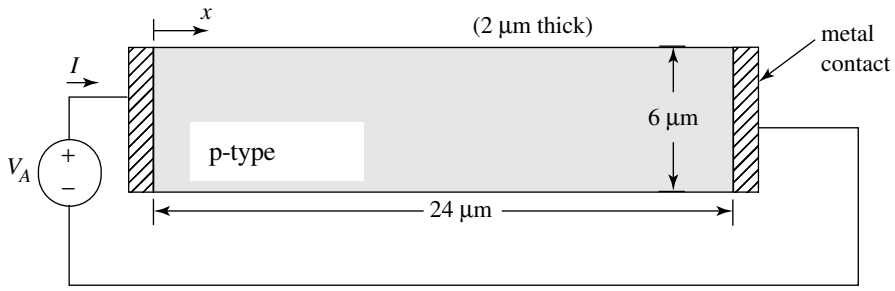
Problem 1 The structure below is a top view of a 1μm-thick silicon region with different donor concentrations, across which a voltage source V_A is applied through metal electrical contacts.

a) What is the voltage V_A necessary to have 1 μA flowing through the device?

b) What is the voltage drop across each region?



Problem 2 Given the p-type silicon structure below



a) Plot the I – V characteristic given $N_a = 10^{16}$ cm^{-3}.

b) Plot the I – V characteristic given $N_a = 10^{18}$ cm^{-3}.

Be sure to take into account the fact that $v_{sat} = 10^7$ cm/s.

Problem 3 In a silicon sample, we establish a minority electron concentration gradient over the region $x \geq 0$ that is given by

$$n(x) = (10^{14}\ \text{cm}^{-3}) \exp(-x/5\mu\text{m})$$

The acceptor concentration is $N_a = 10^{17}$ cm^{-3}.

a) Find the magnitude and sign of the electron diffusion current density at x = 0.

b) Plot the electron diffusion current density over the interval $0 < x < 25$ μm

Problem 4 Howe and Sodini P2.14

Problem 5 Howe and Sodini P2.26