ECSE-2210 Microelectronics Technology
Fall 2005
Class Activity 13

1. Answer the following questions. Give reasons.

   a. In a p^+-n junction, most of the depletion layer will be in the **(choose one: n-side or p-side)** of the junction.

   b. The depletion layer will **(choose one: increase or decrease)** with the applied reverse voltage.

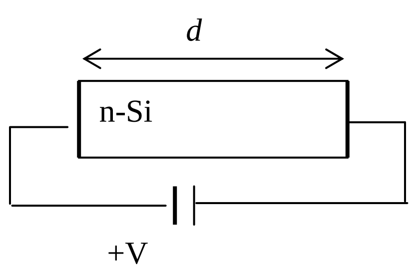
   c. The forward bias current is associated with what type of carrier activity? **(choose one; diffusion, drift or generation-recombination)**

   d. The reverse-bias current is associated with what type of carrier activity**? (choose one; diffusion, drift or generation-recombination)**

   e. Why is the reverse-bias current expected to be small in magnitude and to saturate at a small reverse voltage?

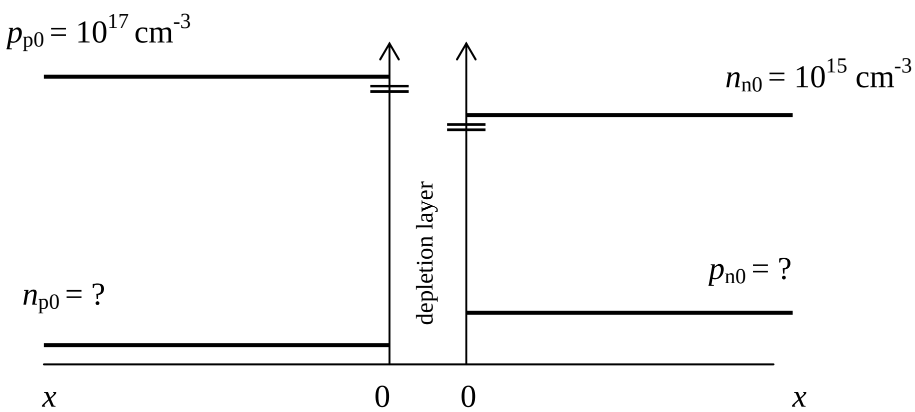
   f. Why can't the minority carrier diffusion equation be used to determine the minority carrier concentrations and currents in the depletion layer of a diode?

2. Sketch the energy band diagram for an n-type Si piece shown below. (Note that the slope of the band gives the $\mathcal{E}$-field and the Fermi-level difference gives the applied voltage).



3. Sketch the energy band diagram for an ideal p^+-n step junction diode. Assume that the Fermi-level is at the valence band in the p^+-side, and the n-side doping is 10^{16} cm^{-3}. Draw the diagrams for the following conditions: (a) V_A = 0 V (b) V_A = 0.5 V (c) V_A = -5 V (These diagrams should illustrate why the forward current is large, whereas the reverse current is negligibly small).

4. The following diagram shows the equilibrium carrier concentration on either side of a p-n junction.



a. Calculate the minority carrier concentration on each side and mark them in the figure below.

b. A forward voltage of 0.3V is applied to this diode. Plot the minority carrier concentration profile on either side of the diode. Assume electron diffusion length is twice that of hole diffusion length.