ECSE-2210 Microelectronics Technology
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.

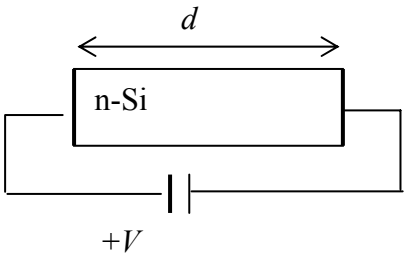
   c. The forward bias current is associated with what type of carrier activity? **(choose one; diffusion, drift or generation-recombination)**

   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?

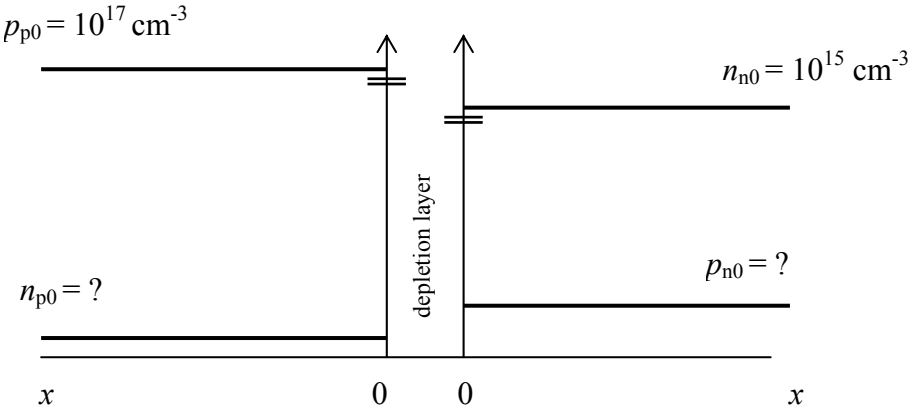
   f. Why can't the minority carrier diffusion equation be used to determine the minority carrier concentrations and currents in the depletion layer of a diode?

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 Si p-n junction.



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

b. A forward voltage of 0.3 V 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.