Assignment 6.3

Question 1:

Sketch the energy diagrams of a *pn* junction, indicating the Fermi energy (E_F), the bottom of the conduction band (E_C), the top of the valence band (E_V), built-in potential (V_o), and the direction of the internal field.

Question 2:

In the lecture, we used Boltzmann statistics to derive the built-in potential, V_o, of a *pn* junction. The energy band treatment allows a simple way to calculate V_o. When the junction is formed, E_{Fp} and E_{Fn} must shift and line up. The shift in E_{Fp} and E_{Fn} to line up is clearly $\Phi_p - \Phi_n$, the work function difference.

Using the energy band diagrams and semiconductor equations, derive an expression for the built-in potential V_o in terms of N_d, N_a, and n_i.

Question 3:

Consider a p^+n junction, which has a heavily doped p-side relative to the n-side, that is, $N_a \gg N_d$. What is your comment on the depletion width on the n-side and the p-side? What is the total depletion width (W_0) for the p^+n junction Si diode that has been doped with 10^{18} acceptor atoms cm^{-3} on the p-side and 10^{16} donor atoms cm^{-3} on the n-side?