8.11 Consider an ideal silicon pn junction diode. (*a*) What must be the ratio of N_d/N_a so that 90 percent of the current in the depletion region is due to the flow of electrons?

From (8.26), $J_s = \frac{eD_p p_{no}}{L_p} + \frac{eD_n n_{po}}{L_n} = J_p + J_n$

Set $\frac{J_n}{J_p + J_n} = \frac{\frac{eD_n n_{po}}{L_n}}{\frac{eD_p p_{no}}{L_p} + \frac{eD_n n_{po}}{L_n}} = 0.9$

$$\frac{D_n n_{po}}{D_p p_{no}\frac{L_n}{L_p} + D_n n_{po}} = 0.9$$

Now, $p_{po} \simeq N_a$ and (4.43) $n_{po} = \frac{n_i^2}{p_{po}} = \frac{n_i^2}{N_a}$

$n_{no} \simeq N_d$ and (4.43) $p_{no} = \frac{n_i^2}{n_{no}} = \frac{n_i^2}{N_d}$

(6.63) $L_n = \sqrt{D_n \tau_{no}}$ and (8.26) $L_p = \sqrt{D_p \tau_{po}}$

w/ these substitutions:

$$\frac{D_n \frac{n_i^2}{N_a}}{D_p \frac{n_i^2}{N_d}\frac{\sqrt{D_n\tau_{no}}}{\sqrt{D_p\tau_{po}}} + D_n \frac{n_i^2}{N_a}} = \frac{D_n}{D_p \frac{N_a}{N_d}\frac{\sqrt{D_n\tau_{no}}}{\sqrt{D_p\tau_{po}}} + D_n} = 0.9$$

$$\hookrightarrow 0.9\frac{\sqrt{D_n\tau_{no}}}{\sqrt{D_p\tau_{po}}} D_p \frac{N_a}{N_d} + 0.9 D_n = D_n$$ use p. 323 values

$$\frac{N_a}{N_d} = \frac{0.1 D_n}{0.9\frac{\sqrt{D_n\tau_{no}}}{\sqrt{D_p\tau_{po}}} D_p} = \frac{0.1(25)}{0.9\frac{\sqrt{25(5\times10^{-7})}}{\sqrt{10(10^{-7})}}(10)}$$

$$\frac{N_a}{N_d} = 0.0785674 \Longrightarrow \underline{\underline{\frac{N_a}{N_d} = 12.728}}$$