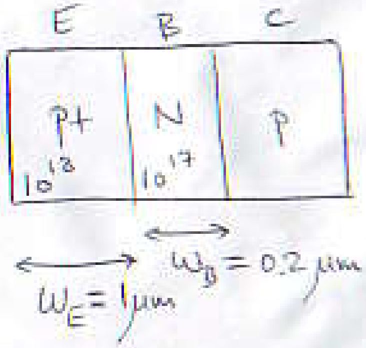
Ex



$\tau_n = \tau_p = 10$ ns

$\mu_n = 1000$ cm²/Vs $\rightarrow$ $D_n^E = \frac{kT}{q}\mu_n = 26$ cm²/s

$\mu_p = 300$ cm²/V.s $\rightarrow$ $D_p = \frac{kT}{q}\mu_p = 7.8$ cm²/s

$$\begin{cases} L_n = \sqrt{D_n \tau_n} = \sqrt{26 \text{ cm}^2/\text{s} \times 10^{-8} \text{ sec}} = 5.1\times10^{-4} \text{ cm} = 5.1\,\mu m > W_E\ ! \\ L_p = \sqrt{D_p \tau_p} = \sqrt{7.8 \text{ cm}^2/\text{s} \times 10^{-8}\text{ s}} = 2.8\,\mu m \gg W_B \end{cases}$$

Base & Emitter are both "narrow!" $\rightarrow$ use $W_{B,E}$ instead of $L_{B,E}$ in I-equations

1) $$\gamma = \frac{I_{E_p}}{\underbrace{I_{E_p} + I_{E_n}}_{I_E}} = \frac{1}{1 + I_{E_n}/I_{E_p}} = \frac{1}{1 + \frac{D_n^E W_B N_B}{D_p W_E N_E}} = \frac{1}{1 + \frac{26 \times 0.2\times10^{-4} \times 10^{17}}{7.8 \times 10^{-4} \times 10^{18}}} = 0.9375$$

2) $$B = \frac{I_C}{I_{E_p}} = \frac{I_{E_p} - I_{B,rec}}{I_{E_p}} = 1 - \frac{I_{B,rec}}{I_{E_p}} = 1 - \frac{W_B^2}{2\tau_p D_p} = 1 - \frac{(0.2\times10^{-4})^2 \text{ cm}^2}{2\times10^{-8}\text{ s} \times 7.8 \text{ cm}^2/\text{s}} = 0.9974$$

3) $$\beta = \frac{I_C}{I_B} = \frac{B\, I_{E_p}}{I_{B,rec} + I_{E_n}} = \frac{B}{\left(\frac{I_{B,rec}}{I_{E_p}}\right) + \left(\frac{I_{E_n}}{I_{E_p}}\right)} = \frac{B}{(1 - B) + \left(\frac{1}{\gamma} - 1\right)} = \frac{B}{\frac{1}{\gamma} - B} = \frac{0.9974}{1.0667 - 0.9974} = \underline{\underline{14.4}}$$

$$\left(= \frac{I_{E_p} - I_{B,rec}}{I_{B,rec} + I_{E_n}} = \text{big plug'n'chug} \right)$$

not good!

why?