ECE 305 – Spring 2018

Homework 12 solution

1.

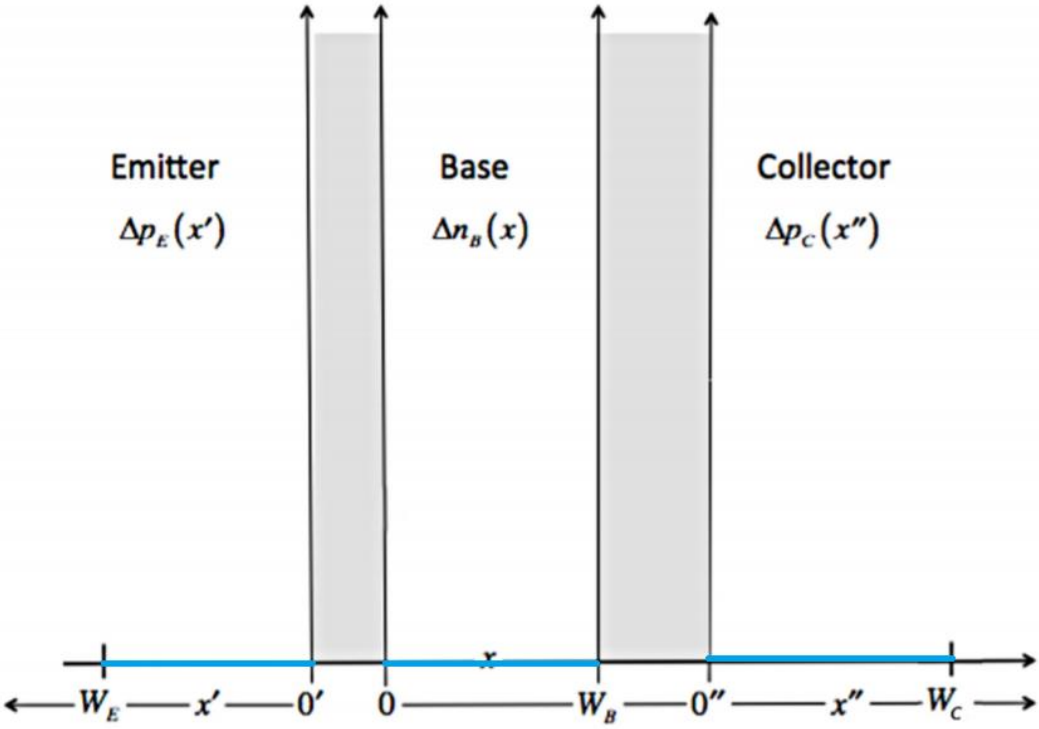
a. Excess minority carrier concentration at the depletion edges is governed by the equations:

$$\Delta n(0) = \frac{n_i^2}{N_A}\left(e^{qV_A/kT} - 1\right) \qquad \Delta p(0) = \frac{n_i^2}{N_D}\left(e^{qV_A/kT} - 1\right)$$

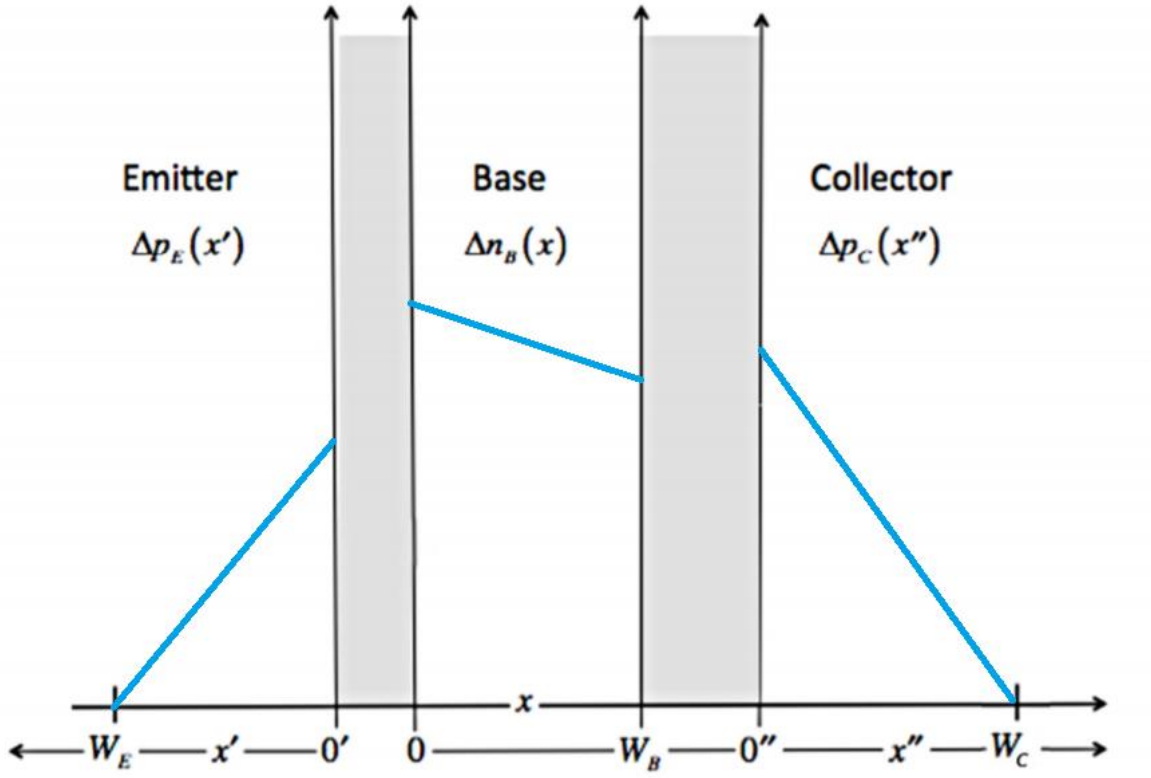
$V_A = 0$ in equilibrium.

Therefore excess minority carrier concentration is zero everywhere.

b.



c. Both the emitter-base junction and the collector-base junction are forward biased, so there will be significant positive excess carrier minority concentrations at the edges of depletion region. The concentration will go to zero at the contacts if they are assumed to be ohmic. The concentration will vary linearly if no recombination is assumed as the regions are short. This mode of BJT operation is known as saturation.



2.

a. $\gamma=\frac{I_{EP}}{I_E}=\frac{1}{1+0.001}=0.999$

b. $\alpha_T=I_{c,p}/I_{E,p}=(0.999-10^{-6})/(0.999)= 0.99999899899$

c. $\alpha_{DC}= \gamma\alpha_T=0.998999$

$\beta_{DC}=\alpha_{DC}/(1-\alpha_{DC})=998$

d. $I_B=I_E-I_C=1-0.999=0.001\ I_1$

e. Yes, it is negligible as all the individual currents stay constant throughout the depletion region.