ECSE-2210 Microelectronics Technology
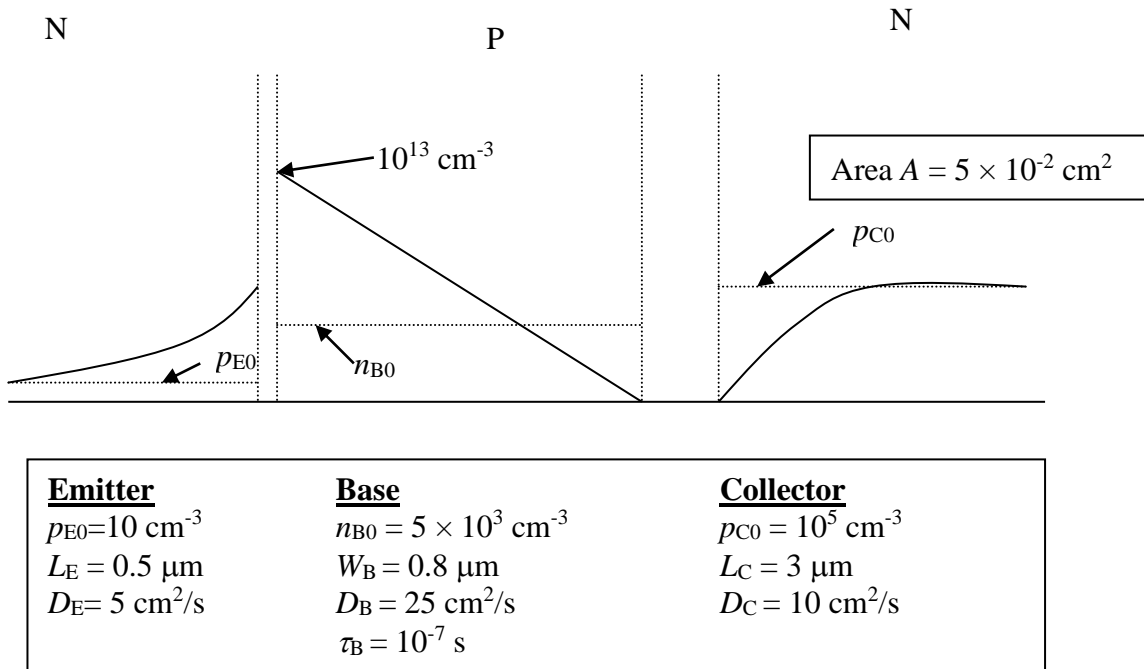## Class Activity 20

1. The figure below shows the minority carrier concentrations in the emitter, base and the collector region of an npn transistor. Answer the following questions. Most questions do not need any extensive calculations.

N   P   N

10^{13} cm^{-3}

Area $A = 5 \times 10^{-2}$ cm^2

p_{C0}

p_{E0} n_{B0}

Emitter	Base	Collector
$p_{E0}=10$ cm^{-3}	$n_{B0} = 5 \times 10^3$ cm^{-3}	$p_{C0} = 10^5$ cm^{-3}
$L_E = 0.5$ μm	$W_B = 0.8$ μm	$L_C = 3$ μm
$D_E = 5$ cm^2/s	$D_B = 25$ cm^2/s	$D_C = 10$ cm^2/s
	$\tau_B = 10^{-7}$ s	

a. Is the base-emitter junction forward-biased or reverse-biased? What is the voltage applied to the E-B junction?

b. Is the collector-base junction forward-biased or reverse-biased? Can we calculate the voltage applied to the C-B junction with the available data?

c. What is the value of the collector current?

d. What is the value of the base current due to recombination in base? Call it I_{BR}.

e. What is the value of the base current due to the injection of holes into the emitter? Call it I_{BE}.

f. What is the value of the total base current?

g. What is the value of β_{dc} for this transistor?

h. What is the value of the electron component of the emitter current?

i. What is the value of the base transport factor?

j. What is the value of the hole component of the emitter current?

k. What is the value of the emitter injection efficiency?

l. Suppose the lifetime of minority carriers in the base is increased to 2×10^{-7} s. What will be the value of β_{dc} now?