1) 12.3

2) 12.5ab

3) 12.9ab

4) At 300 K, a silicon npn bipolar junction transistor (BJT), with each region uniformly doped, has the following parameters:

$N_E = 1.6 \times 10^{18}$ cm^{-3}	$N_B = 3 \times 10^{16}$ cm^{-3}	$N_C = 2 \times 10^{15}$ cm^{-3}
$D_E = 7.5$ cm^2/sec	$D_B = 14$ cm^2/sec	$D_C = 11$ cm^2/sec
$\tau_{E0} = 10$ ns	$\tau_{B0} = 44$ ns	$\tau_{C0} = 90$ ns
$x_E = 0.9$ μm	$x_B = 0.7$ μm	$x_C = $ large

Also, $A_{BE} = 3 \times 10^{-3}$ cm^2, $x_{BE} = 7.6$ nm, $V_{BE} = 0.62$ V and $V_{CE} = 4.8$ V. Then:

a) Determine the thermal equilibrium minority carrier concentrations p_{E0}, n_{B0}, and p_{C0}.

b) Find the current densities J_{nE} and J_{pE} as well as the emitter current I_E. What fraction of I_E is due to electrons?

c) Find the current density constants J_{s0} and J_{r0}. **[Hint: see (8.39) for τ_0]**

d) Find the approximate base transport factor α_T and emitter injection efficiency γ as well as the recombination factor δ.

e) Find the approximate common-base α and common-emitter β current gains.

f) Find the collector I_C and base I_B currents.

Due Wednesday, May 1, 2024 at my office or mail box by 2 pm.

Notes:

➤ If completed, this extra credit opportunity will replace your *lowest* HW or quiz grade (as best advantages your overall grade).

➤ There will be at least one question dealing with this material on the final.

➤ Read *Note* on page 560.

➤ Carry *at least* 6 significant figures on constants/parameters in calculations. Give answers with 4-5 significant figures.

➤ If a solution requires the use of a graph, include the graph with work shown.