Answer the **four multiple choice questions** below by choosing the **one, best answer.** Then **ask a question** about the lecture.

1) The Gummel plot is a common way to plot the IV characteristics of a bipolar transistor. What is a Gummel plot for an NPN bipolar transistor?

   a) A plot of $I_C$ and $I_B$ vs. $V_{BE}$ for $V_{CB} >> k_B T / q$
   b) A plot of log $I_C$ and log $I_B$ vs. $V_{BE}$ for $V_{CB} >> k_B T / q$
   c) A plot of log $I_C$ and log $I_E$ vs. $V_{BE}$ for $V_{CB} >> k_B T / q$
   d) A plot of log $I_C$ and log $I_E$ vs. $V_{CE}$ for $V_{BE} >> k_B T / q$
   e) A plot of log $I_C$ and log $I_B$ vs. $V_{CE}$ for $V_{CB} >> k_B T / q$

2) There are two kinds of current gain that we speak of for BJTs, $\alpha_{DC}$ and $\beta_{DC}$. How are these two related and what is a typical value for $\alpha_{DC}$?

   a) $\beta_{DC} = \frac{\alpha_{DC}}{1 - \alpha_{DC}}$, $\alpha_{DC} = 1$
   b) $\beta_{DC} = \frac{\alpha_{DC}}{1 - \alpha_{DC}}$, $\alpha_{DC} = 100$
   c) $\beta_{DC} = \frac{\alpha_{DC}}{1 + \alpha_{DC}}$, $\alpha_{DC} = 1$
   d) $\beta_{DC} = \frac{\alpha_{DC}}{1 + \alpha_{DC}}$, $\alpha_{DC} = 100$
   e) $\beta_{DC} = \frac{\alpha_{DC} - 1}{\alpha_{DC}}$, $\alpha_{DC} = 1$

3) To achieve a high common emitter current gain, $\beta_{DC}$, the base of an NPN silicon BJT **must** be doped much less heavily than the emitter. Why?

   a) To minimize recombination in the emitter-base junction.
   b) The minimize recombination in the base.
   c) To minimize current crowding in the base.
   d) To put the base in high-level injection.
   e) To increase the ratio of the electron current injected into the base and the hole current injected into the emitter.
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4) Doping the base lightly to improve the current gain leads to two problems. What are these two problems?

   a) Strong base pushout effect and strong emitter current crowding.
   b) Strong Kirk effect effect and strong emitter current crowding.
   c) Strong Early effect and strong emitter-base current crowding.
   d) Strong Early effect and strong Kirk effect.
   e) Increase recombination in the quasi-neutral base and decreased emitter injection efficiency.

5) What question(s) do you have about this lecture?

Turn in to Ms. Wanda Dallinger, EE-326 by Friday, March 22