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

**1)** For a moderately forward biased PN junction, we solve the minority carrier diffusion equation in the quasi-neutral N and P regions. We need 2 boundary conditions. If \( x = 0 \) is the boundary of the quasi-neutral P region adjacent to the depletion region, what is the boundary condition for the excess minority electron equation at \( x = 0 \) for an applied bias of \( V_A \)? (This result is known as the “Law of the Junction.”)

a) \( \Delta n(x = 0) = N_A e^{qV_A/k_BT} \)

b) \( \Delta n(x = 0) = \left( n_i^2/N_A \right) \ln \left( qV_A/k_BT \right) \)

c) \( \Delta n(x = 0) = \left( n_i^2/N_A \right) e^{q(V_A-V_B)/k_BT} \)

d) \( \Delta n(x = 0) = n_i^2 e^{qV_A/k_BT} \)

e) \( \Delta n(x = 0) = \left( n_i^2/N_A \right) e^{qV_A/k_BT} \)

**2)** For very large forward bias, the current “rolls off” (i.e. the current is not as large at a given voltage as the ideal diode equation would predict). The reason for this is:

a) For high currents, there are voltage drops across the N and P regions, so only a portion of the applied voltage actually gets to the PN junction and forward biases it.

b) The applied bias exceeds the bandgap of the semiconductor.

c) The diode enters breakdown.

d) The depletion approximation begins to fail.

e) The diode begins to overheat.

**3)** If you observe a \( n = 2 \) slope to the high forward bias IV current of a PN junction, what physical explanation would you give?

a) Diode is in low level injection.

b) Zener tunneling.

c) Diode is in high level injection with ambipolar transport

d) Recombination is controlled by radiative recombination

e) Recombination is controlled by Auger recombination
4) What region of the IV characteristic of a PN junction does tunneling affect?

a) Low forward bias (if the junction is heavily doped on both sides) and moderate to high reverse bias.
b) Low forward bias (if the junction is heavily doped on one side) and moderate to high reverse bias.
c) High forward bias (if the junction is heavily doped on both sides) and moderate to high reverse bias.
d) High forward bias (if the junction is heavily doped on one side) and moderate to high reverse bias.
e) Only high reverse bias.

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

Turn in to Ms. Wanda Dallinger, EE-326 before 4:30 PM Friday, March 1