Physics 116A Fall 2004: Diode Problem

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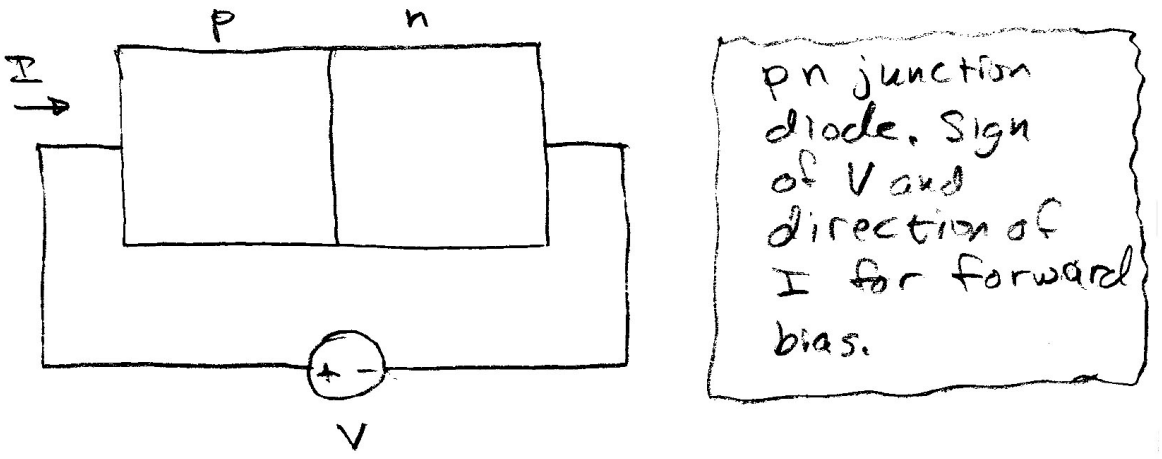

The figure above is a diagram of a silicon junction diode connected to a source of bias voltage, V, at $T = 300$ K. The sign of V and the current direction shown are for *forward bias*.

1. Let $V = 0$. On the sketch *(remember to turn it in)*, show the locations of the depletion region, uncovered positive ions ($\oplus$), uncovered negative ions ($\ominus$), free electrons ($\bullet$) and holes ($\circ$). Also show the direction of the electric field, $\vec{\mathcal{E}}$, in the depletion region.

2. Find I if $V = 0.6$ V and $I_s = 10$ nA ($T = 300$ K and assume $\eta = 2$).

3. The current is due to movement of holes and electrons across the junction and through the semiconductor material. In the case of forward bias with $V = 0.6$ V,

   (a) show the direction of the electric field, $\vec{\mathcal{E}}$, in the depletion region. Is the field greater or less than in part 1, above?

   (b) Consider the electrons. Do they come mainly from the p material or the n material in this case?

   (c) Is their flow due primarily to drift or to diffusion? Explain briefly.

4. Now consider the case of reverse bias (e.g., for $V = -1.0$ V).

   (a) Show the direction of the electric field, $\vec{\mathcal{E}}$, in the depletion region. Is the field greater or less than in part 1, above?

   (b) Consider the electrons. Do they come mainly from the p material or the n material in this case?

   (c) Is their flow due primarily to drift or to diffusion? Explain briefly.