1 Review

1.1 Terms to understand

a. electron/hole
b. donor/acceptor atom
c. intrinsic/extrinsic silicon
d. n-type/p-type silicon
e. energy band diagram
f. valence and conduction energy levels
g. Fermi energy level
h. electron/hole mobility
i. thermal voltage

1.2 Semiconductor physics

a. Current (density) in semiconductor (e.g. P-type)
   (a) drift current
   (b) diffusion current
b. Energy band diagrams of unbiased NI, PI, PN junctions

c. Built-in voltage, junction capacitance, depletion width for unbiased PN junction
2 Exercises

1. Consider a sample of silicon doped with $3 \times 10^{15}$ atoms/cm$^3$ of antimony [Sb] and $2 \times 10^{16}$ atoms/cm$^3$ of indium [In]. Assume $T = 300$ K and intrinsic carrier density $n_i = 1.5 \times 10^{10}$ atoms/cm$^3$.

   a. What type of semiconductor is this sample?
   b. What are the majority and minority carrier concentrations?
   c. What is the sign and magnitude of the Fermi energy shift?
   d. What is the conductivity $\sigma$ if hole mobility $\mu_h = 250$ cm$^2$/V$\cdot$s and electron mobility $\mu_e = 600$ cm$^2$/V$\cdot$s?

2. a. Draw the energy band diagram for P-I-N.
   b. Draw the energy band diagram for P-N-P$^+$.
   c. Draw the energy band diagram for I-N-P-P$^+$-N$^{++}$.
   d. How does the depletion width for P-N change under forward bias? reverse bias?

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