Homework #1

1. For dopant atoms uniformly distributed in a silicon crystal, how far apart are these dopant atoms when the doping concentration is a) $2 \times 10^{15}$ cm$^{-3}$, b) $10^{18}$ cm$^{-3}$, c) $7 \times 10^{20}$ cm$^{-3}$.

2. What is the resistivity of pure silicon at room temperature?

3. a) Show that the minimum conductivity of a semiconductor occurs when $n = n_i \sqrt{\mu_p/\mu_n}$.
   
   b) How does the minimum conductivity for silicon compare to the intrinsic conductivity of silicon at room temperature?

4. Consider a resistor made of pure silicon with a cross-sectional area of 0.5 $\mu$m$^2$, and a length of 50 $\mu$m. What is the resistance of this silicon piece? For an applied voltage of 5 V, how much current would flow through it?

5. Suppose the resistor of problem 4 were made of p-type silicon. What doping level would be required to make the resistance equal to 25 k$\Omega$? 25 $\Omega$?