# Assignment 5

Ram Seshadri MRL 2031, x6129, seshadri@mrl.ucsb.edu

Submit to Paul by Thursday 11/18/2004.

1. Why is Si in the diamond structure an insulator ? Explain using molecular orbital and energy band diagrams. When Si melts, the density of the liquid is slightly larger than the density of the crystal. In other words, the density increases a little, and the volume decreases (like when ice melts). Liquid Si is a metal. Can you explain why ?

2. You have been taught how to form bonding and antibonding combinations for a chain of s orbitals. Can you do the same for a square lattice of s orbitals ?
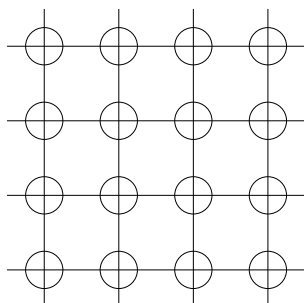
   The question is, how would you shade the orbitals (circles) to form (a) the most bonding case, (b) the most antibonding case, and (c) the intermediate case(s) which are non-bonding (bonds = antibonds).

3. Would the square lattice of s orbitals be a metal if: (a) there is 1 electron *per* orbital ? (b) there are 2 electrons *per* orbital ?

4. Which elements would you chose to n-dope Si, and which would you chose to p-dope Si.

5. A cylindrical piece of copper has a diameter of 1 cm and a length of 5 cm. Its resistivity is ρ. This piece of copper is now extended so that it is 10 cm long. How does the resistance change, assuming that ρ does not. Do you expect ρ to change ? Why ?

6. Indicate using an illustration, of how the valence and conduction bands bend at the point of contact of a p and an n type semiconductor.