PHYS 565 Solid State Physics - Spring 2012
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Homework # 1 - Due 01ˢᵗ February 2012

1. Explain in words
   - Primitive Cell
   - Conventional Cell
   - Lattice and Basis
   - Primitive Translation Vectors

2. The packing fraction is an important quantity to identify the strength of different materials. Verify the packing fractions (the ratio of volume occupied by the atomic spheres to the total volume) tabulated in different crystal lattices as tabulated follows: (Show all the work)

Structure	Packing Fraction
FCC	0.74
BCC	0.68
SC	0.52
Diamond	0.34

3. Explain why the tetragonal base centered system does not come as one of the Bravais Lattices.

4. Gallium Aresenide crystallizes with a Zinc Blende structure. (Zinc Blende structure is similar to Diamond structure, with two different atoms in the basis) The Ga-As bond length is 2.45 A. (a) what is the length of a cube edge? (b) What is the shortest Ga-Ga separation? (c) What is the density of GaAs? The atomic weights of Ga and As are 69.7 and 75.0 respectively.

   Use the length of the cube and visualize the GaAs system XCRYSDEN. Measure Ga-As bond   length in XCRYSDEN and verify your result. (Get extra help for visualizing the atomic system in XCRYSDEN – If you know another graphics package for atomistic visualization, you may use that unless you really want to learn XCRYSDEN)

5. For each of the following sets of primitive lattice vectors, identify the Bravais Lattice type and give the dimensions of the conventional unit cell in terms of a, b, and c,
   - $(a/2) i + (a/2) j, a j, (a/\sqrt{2})k$
   - $(a/2)i + (a/2) j , a j, a k$
   - $a i + 2b j, b j, c k$
   - $(a/2)i + (b/2) j , b j, c k$