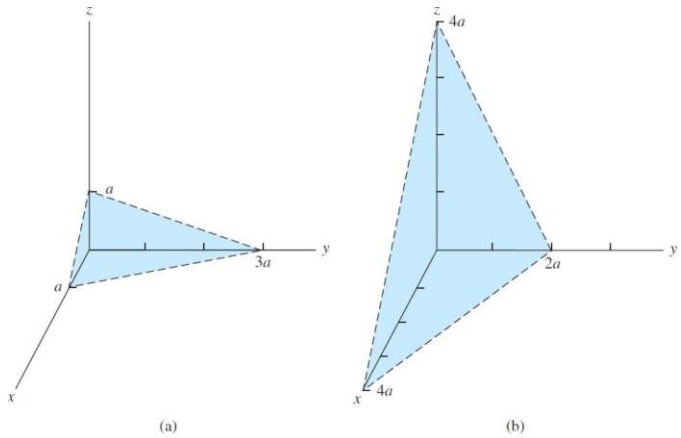
ECE 3030 Spring 2025 HOMEWORK ASSIGNMENT NO. 1

Due: Wednesday, January 15th 11:59 pm upload to Carmen 3030 SpeedGrader

Please complete the following exercises (10 pts each)



1. For a simple cubic lattice with lattice constant *a*, describe the planes in the figures at right in terms of their Miller indices. Draw the [112] vector in (a) and show its intercepts. Draw the [021] vector in (b) and show its intercepts.

2. Compute the linear densities of the [110] and [111] directions for BCC.

3. Calculate the planar densities of the (100) and (110) planes for BCC.

4. Find the number of atoms/unit cell and the nearest neighbor distance for sc, bcc, and fcc lattices

5. Assume the radius of an atom, which can be represented as a hard sphere, is r = 1.95 Å. Atoms with this radius are placed in a (*a*) simple cubic, (*b*) fcc, (*c*) bcc, and (*d*) diamond lattice. Assuming that nearest atoms are touching each other, what is the lattice constant of each lattice?

6. The lattice constant of germanium is 5.65 Å, calculate (*a*) the distance from the center of one Ge atom to the center of its nearest neighbor, (*b*) the number density of Ge atoms (#/cm^3), and (*c*) the mass density (g/cm^3) of Ge.[Hint: atoms are spaced apart 1/4 of the unit cell body diagonal.]

7. (*a*) The lattice constant of GaAs is 5.65 Å. Determine the number of Ga atoms and As atoms per cm^3. (*b*) Determine the volume density of germanium atoms in a germanium semiconductor.

8. Calculate the density of valence electrons in silicon.

9. (a) Find the composition of $AlSb_xAs_{1-x}$ to lattice match InP and give band gap. (b) Repeat for $In_xGa_{1-x}P$ to lattice match to GaAs and give band gap. Hint: Use Vegard's Law: $a_{A(1-x)Bx} = (1-x)\cdot a_A + x\cdot a_B$.

10. Here is a crystalline substance with the unit cell structure shown, an atomic weight of 35.2g/mol, and a density of 3.65 g/cm^3. Solve for the atomic radius.