3.091 Fall Term 2004

Homework #6

October 12 (to be tested Tuesday, October 19)

From the text, Chapter 9, problems 50, 51, and 59 (31, 27, and 35 1st edition).

Additional questions:

0. Iron (ρ= 7.86 g/cm^3) crystallizes in a BCC unit cell at room temperature. Calculate the radius of an iron atom in this crystal. At temperatures above 910ºC iron prefers to be FCC. If we neglect the temperature dependence of the radius of the iron atom on the grounds that it is negligible, we can calculate the density of FCC iron. Use this to determine whether iron expands or contracts when it undergoes transformation from the BCC to the FCC structure.

1. Determine the total void volume (cm^3/mole) for Au (at 27°C); make the hard-sphere approximation in your calculation; use data provided in the periodic table.

2. For the element copper (Cu) determine:

(a) the distance of second nearest neighbors;

(b) the interplanar spacing of {110} planes.

3. Consider a (111) plane in an FCC structure. How many different [110]-type directions lie in this (111) plane? Write out the indices for ***each*** such direction.

4. Determine for barium (Ba) the linear density of atoms along the <110> directions.

5. For aluminum at 300K, calculate the planar packing fraction (fractional area occupied by atoms) of the (110) plane and the linear packing density (atoms/cm) of the [100] direction.

6. Sketch a cubic unit cell and in it show the following planes: (111), (210) and (003).

7. Braquium, chemical symbol Bq, is simple cubic. Calculate the atomic density (atoms/cm^2) in the (011) plane of Bq. The molar volume of Bq is 22.22 cm^3.

8. You are operating an x-ray tube with a Cr target by applying an acceleration potential (V) of 60 kV. Draw a schematic of the x-ray spectrum emitted by this tube; label on it three characteristic λs and give the numerical value of two of these.

9. (a) You operate the x-ray tube of part (a) at a plate voltage of 66 kV. Calculate the value of λ_{SWL}, the shortest wavelength.

(b) Sketch the emission spectrum (intensity *vs* wavelength) of the Ag target in part (b). On your sketch, indicate the *relative* positions of the K_α, K_β, L_α, and L_β lines and λ_{SWL}. It is not necessary to calculate the λ values of the K_β, L_α, and L_β lines.

(c) In one or two sentences explain the origin of the continuous spectrum.