IMPERFECTIONS IN SOLIDS

1) Calculate the activation energy for vacancy formation in aluminum, given that the equilibrium number of vacancies at 500°C (773°K) is 7.57×10^{23} m^{-3}. The atomic weight and density (at 500°C) for aluminum are, respectively, 26.98 g/mol and 2.62 g/cm^3.

2) For the BCC and FCC crystal structures, interstitial sites may be occupied by impurity atoms are located at the center of each of the unit cell edges. Compute *the radius r of an impurity atom* that will just fit into one of these sites, in terms of *the atomic radius R* of the host atom.

3) Which one of the following elements would you expect to form the following with copper:
   a. A substitutional solid solution having complete solubility?
   b. A substitutional solid solution having incomplete solubility?
   c. An interstitial solid solution?

Element	Atomic radius	Crystal Structure	Electronegativity	Valence
Ni	0.1246	FCC	1.8	2+
C	0.071			
H	0.046			
Ag	0.1445	FCC	1.9	1+
Al	0.1431	FCC	1.5	3+
Fe	0.1241	BCC	1.8	2+
Zn	0.1332	HCP	1.6	2+
Cu	0.128	FCC	1.9	1+, 2+

4) What is the composition, in atom percent, of an alloy that contains 98 gr tin (Sn) and 65 gr of lead(Pb)? (A_{sn}=118,49 gr/mole , A_{Pb}= 207,2 g/mol)

5) Nickel forms a substitutional solid solution with copper. Compute the number of nickel atoms per cubic centimeter for a copper-nickel alloy that contains 1.0 wt.% Ni and 99.0 wt.% Cu. The densities of pure nickel and copper are 8.90 and 8.93 g/cm^3, respectively. (A_{Ni}= 58.69 gr/mole , A_{Cu}= 63.55 gr/mole)

6) (a) The surface energy of a single crystal depends on the crystallographic orientation with respect to the surface. Explain why this is so.
   (b) For an FCC crystal, such as aluminum, would you expect the surface energy for a (100) plane to be greater or less than that for a (111) plane? Why?