1. The extra energy required to move an interstitial atom between two other atoms is found to be 1.0ev,. If one atom out of 10^{20} atoms in a metal has this much additional energy at 20℃, what fraction of the atoms will have 1.0ev additional energy at 1000℃. (20%)

[Hint: 1ev=1.6 × 10^{-12} erg, Boltzmann's constant K=1.38 × 10^{-16} erg/atom ^{o}k]

2. An intrinsic Semiconductor has a resistivity of 1.20 ohm.cm at 20℃ and 1.08 ohm.cm at 50℃, Estimate the value of the energy gap. (Assume negligible change in mobility over this small temperature range)(20%).
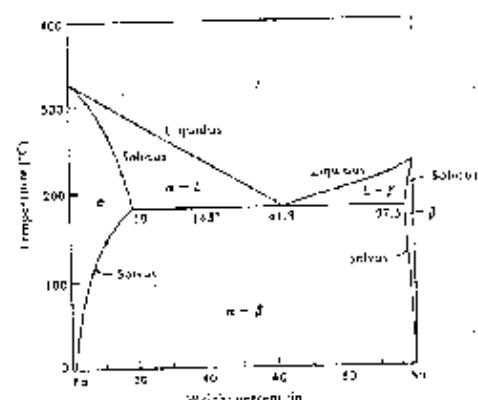
3. Consider the polymorphic transformation A ⇌ B. The interface energy between A and B is 500 ergs/cm^2, and the values of the change in free energy Per unit volume $\triangle Fv$ for A → B are -100 cal/cm^3 at 1000℃ and -500 Cal/cm^3 at 900℃ (1cal/cm^3= 4.185 × 10^7 ergs/cm^3). (20%)

(a) Determine the critical nucleus radius for the nucleation of B within A at each temperature

(b) Calculate the energy that must be supplied for reaction to proceed in each case.
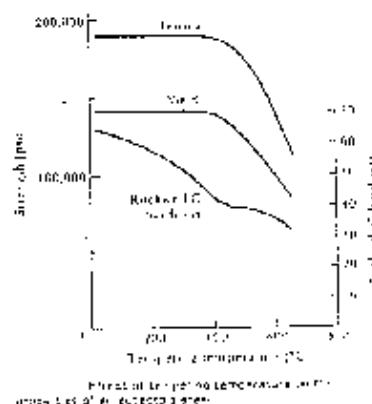
4. For a pb-30% Sn alloy, determine the phase present, their amounts and compositions at 300℃, 200℃, 184℃, 182℃ and 0℃.

(20%)

5. We would like to produce an eutectoid steel that has a maximum yield strength of 100,000 psi with a maximum hardness of Rc40. What tempering temperature would you recommend?

(20%)