1. Calculate the Atomic Packing Factor (APF) for the diamond cubic structure (10%)

2. Calculate the minimum radius ratio for a coordination number of 8 (10%)

3. List the members of the <110> family of directions in the cubic system. (10%)

4. For low concentration of Zn in Cu, the diffusion coefficient of Zn has been measured to be 3.67×10^{-11} cm^2/s at 1000K and 8.32×10^{-18} cm^2/s at 600K. Determine the activation energy for this process and then determine the value of the diffusion coefficient at 450K. (10%)

5. Fig.(1) shows a hypothetical binary eutectic phase diagram on which we indicate an alloy of composition 0.27B. Calculate the following quantities (20%)
   a. The fraction of primary solid that forms under equilibrium cooling at the eutectic temperature .
   b. The fraction of liquid with the eutectic composition that will transform to two solid phases below the eutectic isotherm
   c. The amount of α and β that will form from the liquid just below the eutectic isotherm.
   d. The total amount of phase in the alloy at a temperature just below the eutectic temperature.

6. Calculate the electrical resistivity of intrinsic silicon at 300K. For Si at 300K $n_i=1.5 \times 10^{16}$ carries/m^3, $q=1.6 \times 10^{-19}$C, $\mu_n=0.135 m^2(V.s)$, and $\mu_p=0.048 m^2(V.s)$ (10%)

7. A n-type Si wafer has been doped uniformly with 10^{16} antimony (Sb) atom/cm^3. Calculate the position of the Fermi energy with respect to the Fermi energy E_{Fi} in intrinsic Si. The above n-type Si sample is further doped with 2×10^{17} boron atom/cm^3. Calculate the position of the Fermi energy with respect to the Fermi energy E_{Fi} in intrinsic Si. (Assume that T=300K, and kT=0.0259eV) (10%)

8. Please explain or define following noun: (20%)
   a). Frenkel defect
   b). Schottky defect
   c). Dislocation
   d). Gibbs phase rule
   e). Eutectic reaction
   f). Index of refraction
   g). Fluorescence
   h). Phosphorescence

(背面仍有題目,請繼續作答)

i). Ferromagnetism

j). Anti-ferromagnetism

Fig.(1)