1. **This diagram shows the Gibbs free energy of liquid and solid state. Derive an equation for a driving force at temperature T. (When T and Tm is close each other.)**
2. **In the nature, it is hard to find a material without any kind of impurities. It is also true in laboratory. Please explain the reason for hardly finding a pure material based on your Phase transform knowledge. (Including equations)**
3. **There is a solution mixed with A and B.**
4. **How can you derive an equation for ε, the average difference between bonding energy of A-B, A-A, and B-B?**
5. **How can ΔGmix be expressed for each IDEAL SOLUTION and REGULAR SOLUTION? And, what should be assumed for expressing that equation? (explain relating to ε**)
6. **Explain the difference between the cases for ε<0 and ε>0 at both relatively low temperature. And, what would be different when the temperature is elevated? What is the reason?**

**4. The diagram on the right is Ag-Sn phase diagram. Answer the questions based on the diagram. (20pt)**

1. **Label each region in the diagram.**
2. **Draw composition-Gibbs energy diagrams for each given 4 temperature.**
3. **Assume that at each component a and b, temperature is lowered to 200℃. Explain what phenomena occur passing through each region.**
4. **There is a thin film that Si and Ge are deposited without any dislocation or grain boundary at the same lattice. Assume that the intrinsic diffusivity is DGe>DSi and the substitutional diffusion occurs for each other. Then, answer the below questions with appropriate diagrams. (Complicated derive is unnecessary.) (20pt)**

1. **The atomic flux of each Si and Ge**
2. **Flux of vacancies**
3. **Interface motion**
4. **Vacancy creation/annihilation**
5. **The diagram below shows when component A and B are mixed at arbitrary temperature, T1. The phase α with composition ① welds to phase β with composition ②, and they are tempered at temperature T1. (20pt)**
6. **Considering chemical potential of A and B in the phase α and β, show where each atom is diffused into and what composition is reached at the equilibrium. (Show every composition and chemical potential for before and after equilibrium.)**
7. **Explain briefly why the state you explained above is equilibrium.**
8. **Show this motion reduces total molar free energy.**