編號：F 98　系所：機械工程學系丁組　　科目：機械材料

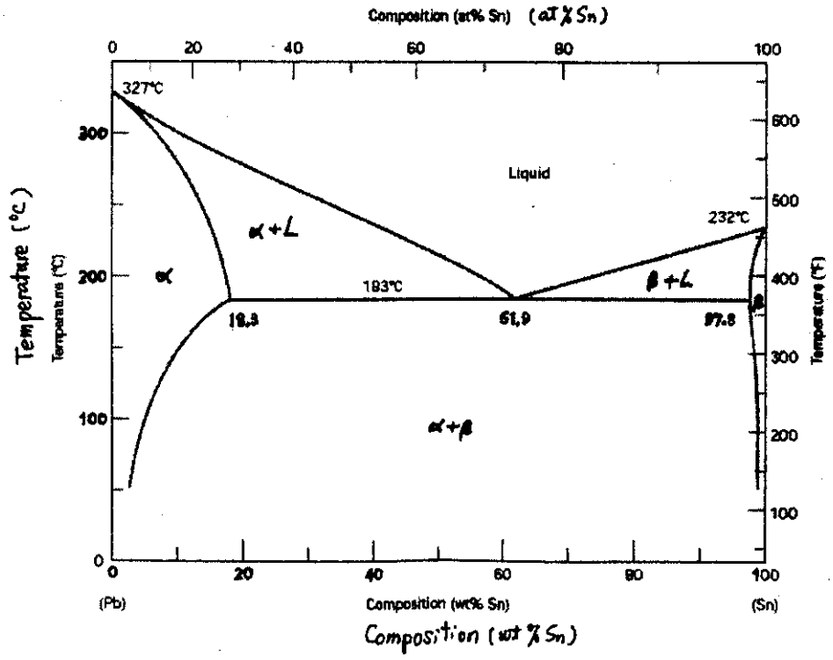
本試題是否可以使用計算機：☑可使用，□不可使用　（請命題老師勾選）

1. Please explain the following questions: (12%)
   (a) What is the difference between the amorphous vs crystalline material?
   (b) What is the difference between the atomic structure and crystal structure?
   (c) What is the difference between the grain boundary vs phase boundary?

2. Please explain the following questions: (16%)
   (a) Briefly describe the phenomena of superheating and supercooling. Why do they occur?
   (b) Name the two stages involved in the formation of particles of a new phase. Briefly describe each.
   (c) Would you expect a material in which the atomic bonding is predominantly ionic in nature to be more or less likely to form a noncrystalline solid upon solidification than a covalent material? Why?
   (d) Do noncrystalline materials display the phenomenon of allotropy (or polymorphism)? Why or why not?

3. Rank the magnitudes of the diffusion coefficients from greatest to least for the following systems: (1) N in Fe at 700 °C, (2) Cr in Fe at 700 °C, (3) N in Fe at 900 °C, and (4) Cr in Fe at 900 °C (Note: Both Fe and Cr have BCC crystal structures, and the atomic radii for Fe, Cr, and N are 0.124, 0.125, and 0.065 nm, respectively.) (8%)

4. A 1.5-kg specimen of a 90 wt% Pb–10 wt% Sn alloy is heated to 250 °C (480 °F), at which temperature it is entirely an α-phase solid solution (Figure below). The alloy is to be melted to the extent that 50% of the specimen is liquid, the remainder being the α-phase. This may be accomplished either by heating the alloy or changing its composition while holding the temperature constant.
   (a) To what temperature must the specimen be heated? Please explain. (6%)
   (b) How much tin must be added to the 1.5-kg specimen at 250 °C to achieve this state? (8%)



（背面仍有題目，請繼續作答）

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5. What is the purpose of the following heat treatment　(10%)
   1. Homogenization
   2. Quenching
   3. Tempering
   4. Spheroidizing
   5. Subzero heat treatment

6. (a). Plot the Fe-C equilibrium phase diagram and label the corresponding phases and transformation lines (Temp.) such as Ac1, Ac3 …etc.
   (b). Point out and explain the 3 reactions occurred in this diagram Eutectic, Eutectoidic, & Peritectic reaction　(10%)

7. What is recrystallization by metallic materials? How can it occur? Name some methods that can effectively decrease the recrystallization temperature?　(10%)

8. What is the concept of hardening or strengthening by metallic materials? Can you name some practical methods that usually employed in industries and explain how?　(10%)

9. Explanations and nomenclatures ：(10%)

   (a) Embryo
   (b) DBTT
   (c) Dendritic growth
   (d) Orowan theory
   (e) Aging