

# 國立中山大學 104 學年度碩士暨碩士專班招生考試試題

科目名稱：材料科學【材光系碩士班丙組】

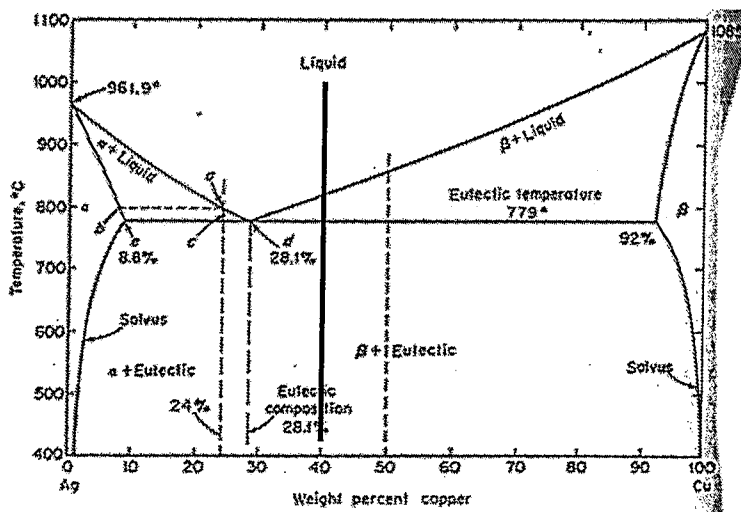
題號：439004

※本科目依簡章規定「可以」使用計算機（廠牌、功能不拘）

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**50 points (2 points each)**

1. Try to write out the electronic configuration for Mg \_\_\_\_\_
2. What is the Miller index for the  $a_2$  axis? \_\_\_\_\_  
What is the Miller index for the prism plane that is parallel to the  $a_2$  axis?  
\_\_\_\_\_
3. Write the simple equations for the relationships between the flow stress  $\sigma$  and
  - (a) grain size  $d$  \_\_\_\_\_
  - (b) dislocation density  $\rho$  \_\_\_\_\_
  - (c) shear strain  $\epsilon$  \_\_\_\_\_
  - (d) shear strain rate  $\dot{\epsilon}$  \_\_\_\_\_
 Also, write the relationship between the critical resolved shear stress (CRSS)  $\tau_c$  and the tensile yield stress  $\sigma_y$  for a single crystal specimen. \_\_\_\_\_  
What is the maximum ratio for CRSS/ $\sigma_y$ ? \_\_\_\_\_
4. For a phase diagram of the isomorphous type, its heat of mixing  $\Delta H_m$  will be \_\_\_\_\_ ( $<0$ ,  $=0$ , or  $>0$ ?)  
For a eutectic phase diagram, its  $\Delta H_m$  will be \_\_\_\_\_ ( $<0$ ,  $=0$ , or  $>0$ ?)  
For a phase diagram with an intermetallic compound (of high melting temperature), its  $\Delta H_m$  will be \_\_\_\_\_ ( $<0$ ,  $=0$ , or  $>0$ ?)
5. What is the phase rule for P, F, and C for an alloy. \_\_\_\_\_
6. If a metal possesses a very high stacking fault energy, then the dislocations in this metal would be mostly perfect dislocations or mostly partial dislocations: \_\_\_\_\_.
7. For an alloy with the composition of 60wt%Ag - 40wt%Cu, answer the following questions.  
What is the chemical composition for the  $\beta$  phase at  $800^\circ\text{C}$ ? \_\_\_\_\_  
What is the chemical composition for the  $\beta$  phase at  $600^\circ\text{C}$ ? \_\_\_\_\_  
What is the amount in weight for the  $\beta$  phase at  $800^\circ\text{C}$ ? \_\_\_\_\_  
What is the amount in weight for the  $\beta$  phase at  $500^\circ\text{C}$ ? \_\_\_\_\_



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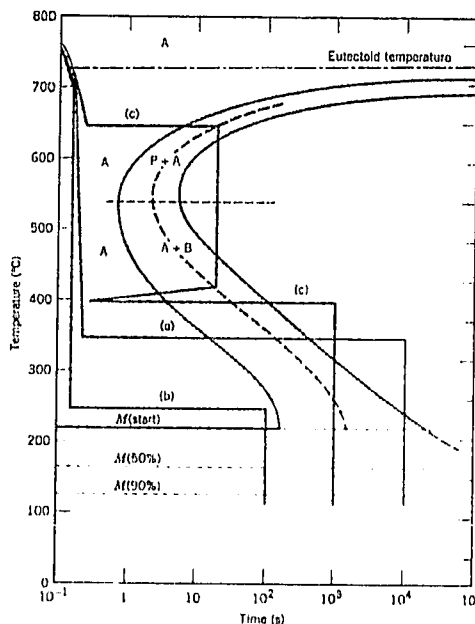
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8. According to the TTT diagram below, fill out the blank.



What is the phase(s) after cooling curve (a)? \_\_\_\_\_

What is the phase(s) after cooling curve (b)? \_\_\_\_\_

What is the phase(s) after cooling curve (c)? \_\_\_\_\_

9. Write the reaction for peritectoid \_\_\_\_\_  
Write the reaction for monotectic \_\_\_\_\_
10. If a metal has a high melting point, then its diffusivity would be \_\_\_\_\_  
How about its thermal expansion coefficient? \_\_\_\_\_ (high, average, low)

**50 points**

11. Describe in your own words the meaning and the different stages occurred during “annealing” for metallic materials? What are the material and processing factors that will affect the characteristics of annealing? What is the driving force for each stage of the annealing process? (15 points)
12. How do we calculate the  $c/a$  ratio for an ideal HCP crystal? You cannot just write out the  $c/a$  value, need to derive it. (10 points)
13. How do we transform an engineering strain into a true strain? You cannot just write out the equation, need to derive it. (10 points)
14. (a) The packing density is defined as the fraction of the total volume of the cell that is filled by atoms. Try to determine the maximum packing density for the diamond structure (shown below). This structure may be viewed as two interpenetrating FCC lattices, arranged such that each atom is surrounded by four other atoms, forming a regular tetrahedron. (10 points)
- (b) Calculate the shortest distance of two parallel planes in the diamond structure (assume the lattice constant  $c$  is  $5.64 \text{ \AA}$ ) (5 points)

