

編號: F109 系所: 機械工程學系丁組

科目: 機械材料

- Explain or distinguish the following terms: (24%)
 - Yield strength vs tensile strength
 - Fatigue vs creep
 - Isotropic vs anisotropic
 - Ionic bonding vs covalent bonding
 - Frenkel defect vs Schottky defect
 - Polymorphism vs isomerism
- (a) Briefly explain the difference between self-diffusion and inter-diffusion. (4%)
 (b) For a steel alloy it has been determined that a carburizing heat treatment of 10 h duration will raise the carbon concentration to 0.45 wt% at a point 2.5 mm from the surface. Estimate the time necessary to achieve the same concentration at a 5.0 mm position for an identical steel and at the same carburizing temperature. (6%)
- (a) Cite the primary differences between elastic, anelastic, and plastic deformation behaviors. (6%)
 (b) Would you expect a crystalline ceramic to strain harden at room temperature? Why? (4%)
 (c) A cylindrical specimen of a hypothetical metal alloy is stressed in compression. If its original and final diameters are 30.00 and 30.04 mm, respectively, and its final length is 105.20 mm, compute its original length if the deformation is totally elastic. The elastic and shear moduli for this alloy are 65.5 and 25.4 GPa, respectively ($E=2G(1+\nu)$). (8%)
- An undeformed specimen of some alloy has an average grain diameter of 0.040 mm. You are asked to reduce its average grain diameter to 0.010 mm. Is this possible or not? If yes, explain the procedures you would use and name the processes involved. If not, explain why? (6%)
- (a) What are the slip system and its conditions? (4%)
 (b) Which of the following is the slip system for the simple cubic crystal structure? $\{100\}\langle 110\rangle$, $\{110\}\langle 110\rangle$, $\{100\}\langle 010\rangle$, $\{110\}\langle 111\rangle$. Why? (4%)
 (c) Which is more ductile between Al and Mg? Why? (2%)
- For a tensile test, it can be demonstrated that necking begins when $(d\sigma_T/d\varepsilon_T) = \sigma_T$, here σ_T is true stress, ε_T is true strain. Using Equation ($\sigma_T = K\varepsilon_T^n$) determine the value of the true strain at this onset of necking where K and n are constants. (8%)
- The phase diagram of Fe-Fe₃C binary system is shown in the following.
 - What is the eutectic reaction in the Fe-Fe₃C binary system? Explain it. (4%)
 - What is the eutectoid reaction in the Fe-Fe₃C binary system? Explain it. (4%)
 - Which diffusion is faster for C interstitial diffusion in α -Fe (bcc) and γ -Fe (fcc)? Why? (4%)
 - What is the proeutectoid phase for an iron-carbon alloy in which the mass fractions of total ferrite and total cementite are 0.92 and 0.08, respectively? Why? (6%)
 - The mass fractions of total ferrite and total cementite in an iron-carbon alloy are 0.88 and 0.12, respectively. Is this a hypoeutectoid or hypereutectoid alloy? (6%)

