※ 考生請注意：本試題不可使用計算機。 請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

1. Explain or distinguish the following terms: (12%)

   (a) Coarse pearlite vs fine pearlite (b) Schottky vs. Frenkel defects

   (c) Mechanical and annealing twins

2. (a) Briefly explain why BCC metal alloys may experience a ductile-to-brittle transition with decreasing temperature, whereas FCC alloys do not experience such a transition? (6%)

   (b) Cite three metallurgical/processing techniques that are employed to enhance the creep resistance of metal alloys. (6%)

3. (a) A cylindrical metal specimen having an original diameter of 12.0 mm and guage length of 50.0 mm is pulled in tension until fracture occurs. The diameter at the point of fracture is 6.0 mm, and the fractured guage length is 72.0 mm. Calculate the ductility in terms of percent reduction in area and percent elongation. (8%)

   (b) An undeformed alloy specimen has an average grain diameter of 0.030 mm. You are asked to reduce its average grain diameter to 0.008 mm. Is this possible? If so, explain the procedures you would use and name the processes involved. If it is not possible, explain why? (6%)

4. (a) What is the precipitation hardening? (3%)

   (b) Please explain the three steps of precipitation hardening treatment. (9%)

5. An aluminum alloy is under tensile test. a. What are the engineering elastic strain and plastic strain for material at point A in the stress-strain diagram shown in Fig. 1? b. After the specimen is unloaded, what are its the elastic and plastic strains? c. Use this diagram to explain the strain hardening effect. (10%) (E = 70 GPa)

(背面仍有題目,請繼續作答)

系所組別：機械工程學系丁組
考試科目：機械製造及材料　　考試日期：0222，節次：2

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6. A cable is made of two parallel strands of different materials, all behaving according to the equation $\sigma=K\varepsilon^n$. Their properties and cross-sections are:
   Material A: K=600 MPa, n_A=0.5, A_0=5 mm^2 .
   Material B: K=300 MPa, n_B=0.5, A_0=4 mm^2.
   (a) What are the physical significances of K and n? (5%)
   (b) Calculate the maximum tensile force that this cable can withstand prior to necking. (5%)

7. Temperature rise in a cutting process largely depends on the following parameters: (1) flow stress of workpiece material, Y_f, (2) cutting speed, V, (3) density of workpiece material, ρ, (4) specific heat of the workpiece material, c, (5) thermal diffusivity of the workpiece material, K, and (6) depth of cut, t_0. The temperature distribution of an orthogonal cutting is shown in Fig. 2. It mean temperature along the tool/chip interface can be approximated as: $T = \frac{1.2\times(a)}{(b)(c)}\sqrt[3]{\frac{(d)(e)}{(f)}}$

   A. Please rewrite the equation by inserting the six parameters in their appropriate spaces. (5%)

   B. Offer an explanation as to why the maximum temperature is located at about the middle of the tool-chip interface? Also use this figure to explain the causes and locations of tool flank wear and crater wear. (5%)

8. (a) Why are steels more difficult to cast than cast irons? (b) How does the shape of graphite in cast iron affect its properties? (c) Explain why cast iron expands after solidification. (10%)

9. Find the maximum force required in open-die forging of a solid cylindrical, annealed copper specimen 5.08 cm high and 2.54 cm in diameter, up to a reduction of 70%, for the case of μ=0 between the flat dies and the specimen. Material properties: K=315 MPa; n=0. (5%)

10. A perfectly plastic material with Y= 300 MPa is being drawn into a wire. If the original diameter of the wire is 8 mm, what is the minimum possible diameter at the exit of deformation? Assume that there is no redundant and friction work. (5%)

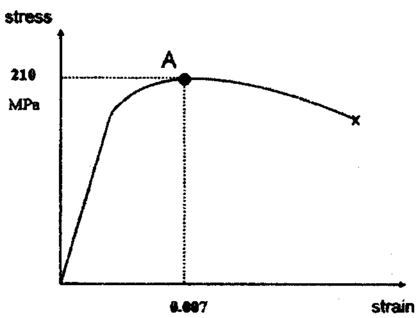

Fig. 1

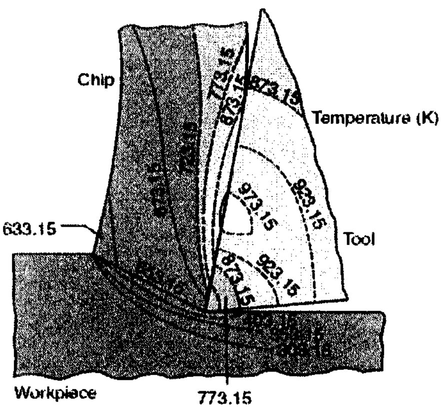

Fig. 2