1. Explain or distinguish the following terms: (15%)
(a) Young's modulus vs Shear modulus (b) Fatigue vs Creep
(c) Coarse pearlite vs fine pearlite

2. Of those metals listed in Table below,
(a) Which will experience the greatest percent reduction in area? Why? (4%)
(b) Which is the stiffest? Why? (4%)
(c) Which is the strongest? Why? (4%)

Table Tensile stress-strain data for several hypothetical metals

Materials	Yield Strength (MPa)	Tensile Strength (MPa)	Strain at Fracture	Fracture Strength (MPa)	Elastic Modulus (GPa)
A	310	340	0.23	265	210
B	100	120	0.40	105	150
C	415	550	0.15	500	310
D	700	850	0.14	720	210
E	Fractures before yielding			650	350

3. An undeformed specimen of some alloy has an average grain diameter of 0.050 mm. You are asked to reduce its average grain diameter to 0.020 mm. Is this possible? If so, explain the procedures you would use and name the processes involved. If it is not possible, explain why? (5%)

4. 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 ($E=2G(1+\nu)$). (10%)

5. (a) Name the two stages involved in the formation of particles of a new phase. Briefly describe each. (4%)
(b) Briefly describe the phenomena of supercooling. Why does it occur? (4%)

(背面仍有題目,請繼續作答)

6. A sheet metal forming is shown in figure 1 with a biaxial stress state $|\sigma_1|=0.5Y$, $|\sigma_2|=0.5Y$, and $\sigma_3=0$ which normal to the plate. The yielding strength of the steel is Y. Please show the magnitude (in Y) and the plane of the maximum shear stress in your answer sheet (5%). Show your reasons about the steel plate in the plastic deformation or not. (5%)

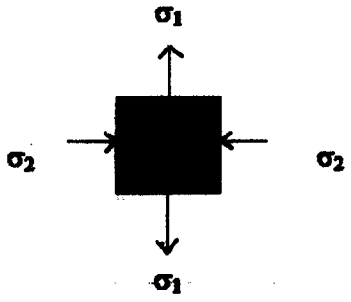

Figure 1

7. In a steel rod drawing process, the stress-strain relationship is $\sigma = k\varepsilon^{2n}$. Please derive the maximum reduction per pass of the steel rod for an ideal drawing process? (10%) What is the deformation work per unit volume in the ideal drawing process for a drawing strain of ε_1? (5%)

8. Please answer the possible casting conditions and materials (pure metals, alloys, and etc) according to the following microstructures (a), (b) and (c) in the metal casting as shown in figure 2. (5%) How to judge them and why? (5%)

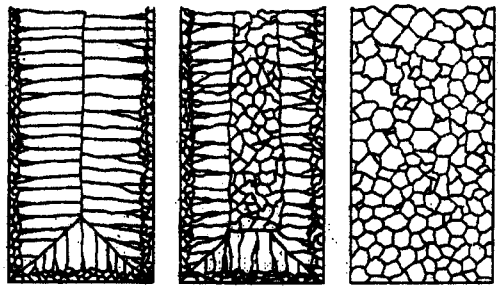

Figure 2

9. Please draw a figure of the pressure distributions (friction hills) on the forging die at constant friction coefficient and sticking conditions respectively. (8%) How to prevent the wear of the forging die due to the die pressure? (2%) You may show the equation of the die-pressure distribution for your answers.

10. Please explain (or translate) the following statements in Chinese. Are they all correct? If not, please correct them. (5%)
(I) The material removal rate is the mass of material removed per unit time, such as mm^3/min. (II) The various angles on a tool have important functions in cutting operation. (III) The factors that influence surface integrity are (a) temperatures generated during processing, (b) residual stresses, (c) metallurgical transformations, and (d) plastic deformation of the surface.