※ 考生請注意：本試題不可使用計算機

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

   (a) Young's vs Shear modulus (b) Fatigue vs Creep

   (c) Toughness vs Resilience

2. (a) What is the Schmid's law for plastic deformation in critical resolved shear stress (τ_{CRSS})? (4%)

   (b) Describe how temperature, purity, strain rate and dislocation density affect the τ_{CRSS} respectively. (4%)

   (c) Would you expect a crystalline ceramic material to strain harden at room temperature? Why or why not? (4%)

3. (a) What is the relationship between the unit cell length a and atomic radius R in BCC crystal structure? (3%)

   (b) Calculate the atomic packing factor of BCC crystal structure. (5%)

   (c) Molybdenum has a BCC crystal structure and an atomic radius of 0.1363 nm. Compute the interplanar spacing for the (111) set of planes. (6%)

4. For alloys of two hypothetical metals A and B, there exist an α, A-rich phase and a β, B-rich phase. From the mass fractions of both phases for two different alloys (given below), which are at the same temperature, determine the composition of the phase boundary (or solubility limit) for (a) α and (b) β phases at this temperature. (12%)

Alloy Composition	*Fraction α Phase*	*Fraction β Phase*
60 wt% A–40 wt% B	*0.56*	*0.44*
30 wt% A–70 wt% B	*0.12*	*0.88*

(背面仍有題目,請繼續作答)

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5. With a ductile metal ($\sigma=k\varepsilon^{2n}$) in the uni-axial tensile test, please derive the necking strain (in true strain) of it . (10%)

Express the maximum load in a form of the necking strain and the initial cross-sectional area A_o of the specimen. (5%)

6. Please explain the microstructure change at the locations of (a) to (d) as shown in the figure A of the metal in hot rolling. (5%)

How to prevent the defect of the sheet metal in rolling as shown in figure B and why? (5%)

How to obtain a metal casting with single crystal microstructure and why? (5%)

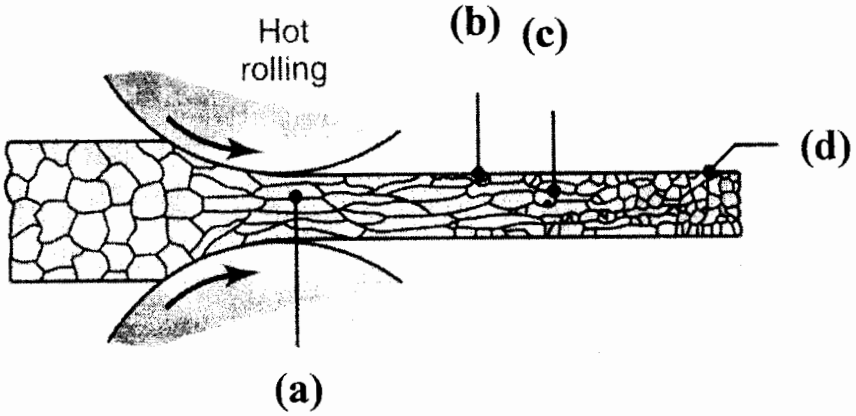

Figure A Microstructure change in hot rolling

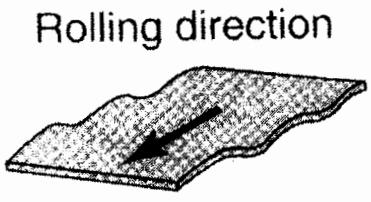

Figure B Defect in sheet metal rolling

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7. For a metal ($\sigma=k\varepsilon^n$) in the drawing process as shown in figure C, please derive the drawing force (F) by the ideal work method (no friction or redundant work).(5%)

Find the maximum reduction $\frac{A_o - A_f}{A_o}$ of the process in figure C. (5%)

With front and back tension on the ends of the drawing specimen, show the die pressure change in figure C and explain your answer. (5%)

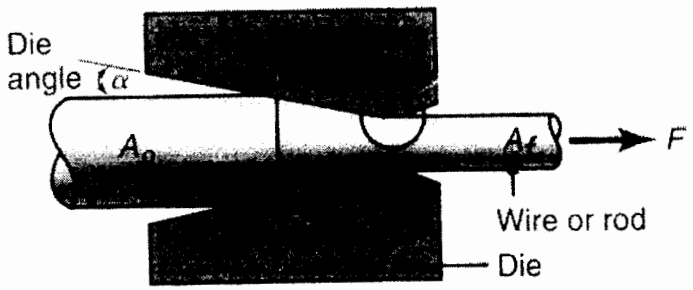

Figure C Drawing process for the specimen with inlet area of A_o and outlet area of A_f.

8. Please discuss the advantages and disadvantages of the laser machining and electrical discharge machining (EDM) in comparison with the conventional machining processes such as drilling for the modern industry. (5%)