1. Explain why the theoretical shear strength of a single crystal is 1000 times higher than the experimental shear strength of a single crystal? **(5%)**

2. Explain the main reason why polymer materials present much lower melting temperature in comparison with metallic and ceramics materials? **(5%)**

3. Calculate the atomic packing factor (or so called packing density) of FCC (face centered cubic) crystal. **(5%)**

4. Why the hardness of a 1040 carbon steel bar can be increased 15% after cold worked 50%? Explain in detail. **(5%)**

5. Consider the A-B hypothetical binary phase diagram in Fig.1 and alloy of composition C_0 at temperature of T_1, Please derive the lever rule:$(W_\alpha / W_\beta)=(C_\beta- C_0)/(C_0 -C_\alpha)$. Where C_α and C_β represent the compositions of α-phase and β-phase, respectively, W_α and W_β represent the mass of α-phase and β-phase, respectively. **(4%)**

Fig.1
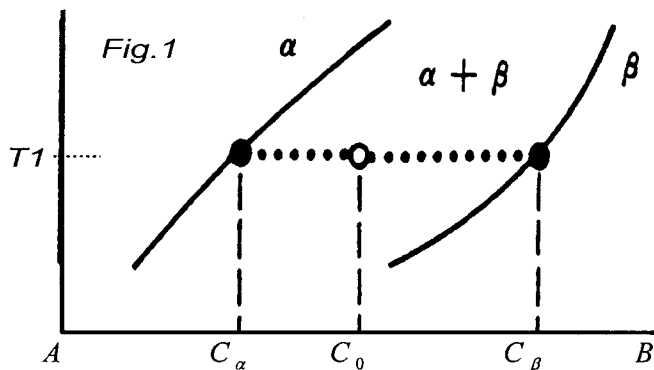
6. Consider 2.0 kg of a 99.5 wt% Fe−0.5 wt% C alloy that is cooled to a temperature just below the eutectoid temperature. Where C_{Fe3C} = 6.70 wt% C, and $C\alpha$ = 0.022 wt% C. **(6%)**
   (a) How many kilograms of proeutectoid ferrite form?
   (b) How many kilograms of eutectoid ferrite form?
   (c) How many kilograms of cementite form?

注意：背面有試題

7. The following figure show a isothermal transformation diagram of Fe-C alloy with hypo-eutectoid composition. Please answer the following questions based on the information provided in this figure.

(1) What is the micro-structure for the time-temperature path (a). **(2%),**
(2) What is the micro-structure for the time-temperature path (b). **(2%)**
(3) What is the micro-structure for the time-temperature path (c). **(2%)**
(4) What is the micro-structure for the time-temperature path (d). **(2%)**
(5) What is the micro-structure for the time-temperature path (e). **(2%)**
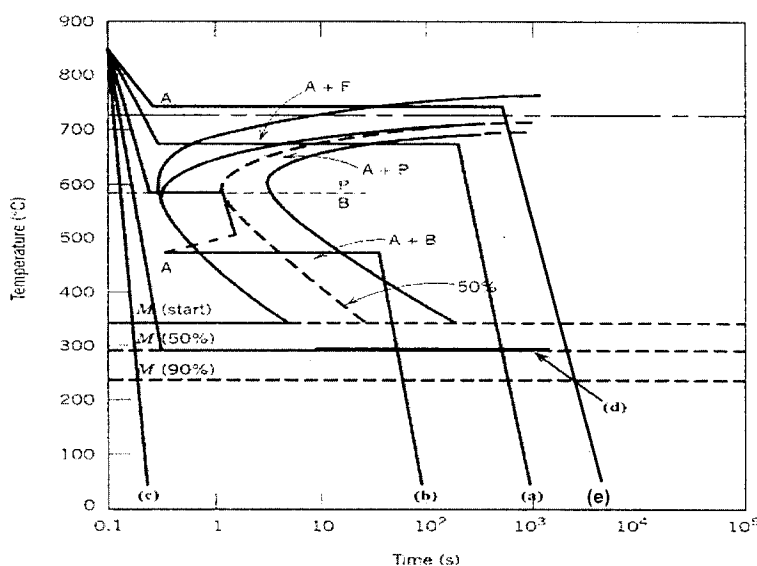
8. Please describe the difference in electrical behavior between intrinsic semiconductor and extrinsic semiconductor. **(4%)** Can compound semiconductor exhibit intrinsic behavior? Explain why can or cannot. **(3%)** No free electron is generated by the electron excitation involving an acceptor impurity atom? Why **(3%)**

注意：背面有試題

9. 試說明切削加工時產生高溫的幾個熱源及其對切削加工的重要影響。 (10%)

10. 試說明切削加工刀具的硬度及熱硬度的差別及其意義。 (10%)

11. 試說明刀具傾斜角(rake angle) 大小對切削加工有何影響。 (5%)

12. Assume your future research requires making 1 mm-width long slots on an alumina sheet.
    (a) Please name three different manufacturing processes to produce the structures. (5%)
    (b) If you are worry about the stresses built in the alumina sheet during the process, what manufacturing process should be use? (5%)
    (c) Please briefly describe the process you choose in (b). (5%)

13. (a) Briefly describe the sputtering process? (5%)
    (b) List two applications of physical vapor deposition? (5%)

注意：背面有試題