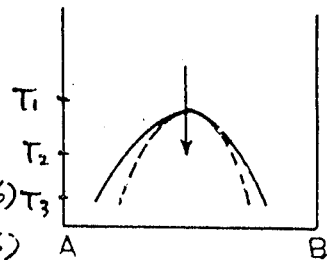


(Please answer in order.)

1. Please describe the apparatus arrangement of the Debye-Scherrer or powder method briefly and discuss the procedure for determining an unknown structure of a material in detail. (10%)
2. Please discuss the interactions of dislocations and solute atoms. (10%)
3. Would a high-angle boundary or a coherent boundary be more effective at stopping dislocation motion? Please explain in terms of the energy of interface. (10%)
4. 請以簡單示意圖分別描述，未經高溫長時間固溶均質化熱處理之亞共晶、共晶以及過共晶組成合金之組織特徵及差異。(10%)
5. 在液相中生成固相之過程，考量全体自由能變化以及核生成的關係試以簡圖進行說明。(相關條件效應說明愈詳細者得分愈高) (10%)
6. 常溫環境下有些固體金屬有相變態發生的現象，請舉例並說明發生條件，導致何種效應以及起因。(10%)
7. (a) 請列出四種強化材料之方法，簡單敘述其強化之原因。(5%)
 (b) 下列工業材料之強化機制為(a)中之何項，簡單敘述之。(5%)
 (b.1) 淬火之碳鋼
 (b.2) 碳纖維球桿
 (b.3) Yttrium Stabilized Zirconium
 (b.4) Ni based Superalloy
8. (a) 右圖之相圖代表何種相變態，簡述其特性(5%)
 (b) 簡述此類相變常在何製程中出現，為何?(5%)
 (c) 當溫度由 $T_1 \rightarrow T_2 \rightarrow T_3$ ，請問可觀察到何種現象(可以圖示輔助說明) (5%)



(背面仍有題目,請繼續作答)

9. A Cu crucible was filled with pure Zn as shown in the figure. It was heated to 500 °C, held for 15 hours, and then furnace cooled; it was sectioned in half longitudinally and the surface was polished and etched. The interface region between the Cu and Zn was examined in an optical microscope at 50 x as shown in the micrograph. Four distinct interfaces were observed. All of the regions are single phase except that to the left of interface 4. The Cu-Zn phase diagram is also attached.

- (a) Identify the phases present in the 5 regions in the micrograph. Explain your reasoning. (4%)
- (b) Make a plot of the variation of the zinc concentrations along the interface in the micrograph. (4%)
- (c) Estimate the inter-diffusion rate D at 500 °C. (4%)
- (d) Estimate either $D(\text{Zn})$ in Cu or $D(\text{Cu})$ in Zn is larger?, Why? (3%)

