

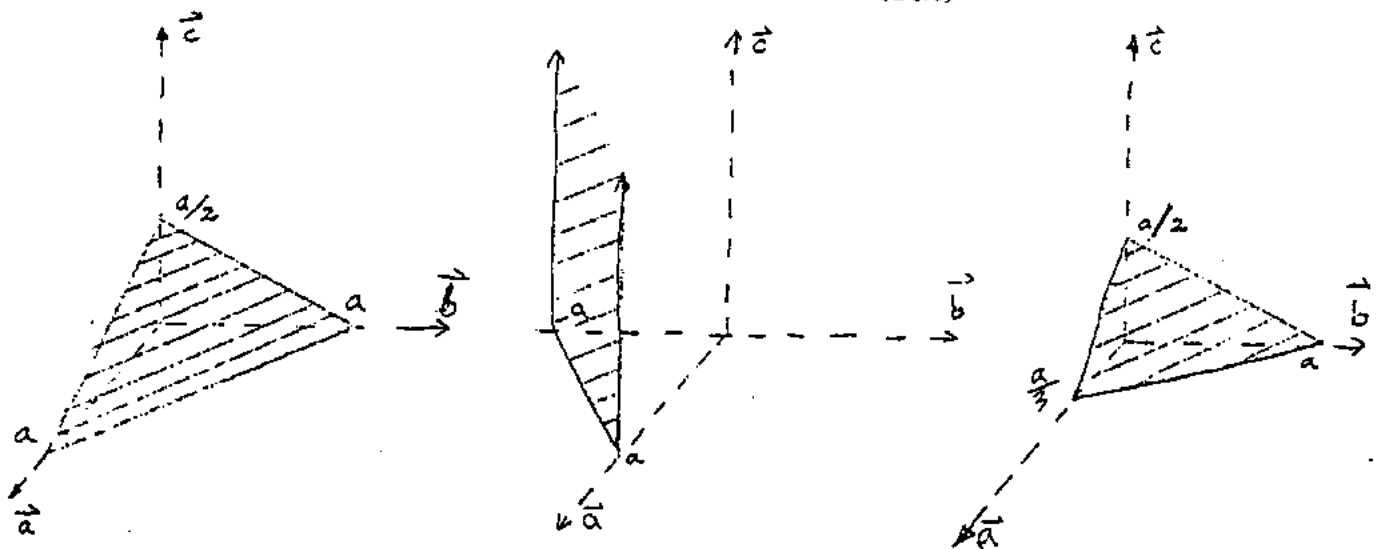
1.

(a) List at least two mechanisms of strengthening metals and alloys. For each mechanism describe processing methods or techniques which accomplish the desired strengthening. (10%)

(b) What is the fundamental action which all of the mechanisms listed in (a) have in common? That is, what is the common reason that these mechanisms are effective in strengthening? (5%)

2.

Three of the possible slip planes in a BCC crystal are shown below. What are the Miller indices for the specific plane shown in each case, and what type of slip direction in common to all three? (10%)



3.

右圖所示為一簡單之二相合金TTT曲線圖。你將利用此圖設計熱處理之程序，以製成不同之微組織。

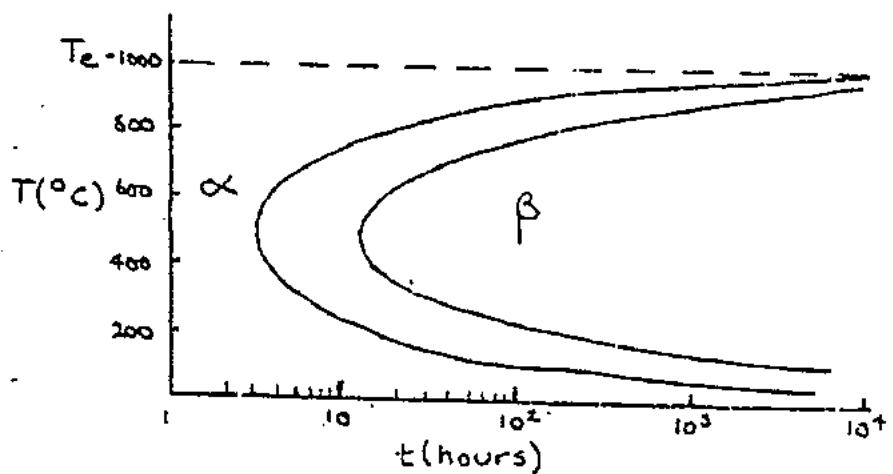
(a) 何謂TTT曲線圖 (3%)

(b) 如何在最短時間內，製成 100% β 相組織。其熱處理之溫度與時間之程序為何? (3%)

(c) 在以(a)熱處理程序中，請以圖示其 β 相之變態量與時間之關係曲線。(3%)

(d) 如何在 500 °C 製成 50% β , 50% α 之雙相組織，其溫度與時間之程序為何? (3%)

(e) 如何在 100 hours 製成 100% β 相組織，列出所有之可能程序。(3%)



4.

(a) 掃描式電子顯微鏡常被用於觀察材料之微組織及破斷面，敘述其成像原理 (5%)

(b) 掃描式電子顯微鏡附加一設備後，常被用於化學成份分析。附加設備為何? 敘述其化學元素分析原理。(5%)

5.

下圖所示為鐵-碳相圖。圖中標示著(1)至(8)八個相變化反應。

(a)請將(1)至(8)每一個相變化之反應式列出，並敘述其為何種相變化。(5%)

(b)選擇(1)至(8)每一個相變化屬於下列(甲、乙、丙、丁)何種反應?(5%)

(甲)結構改變

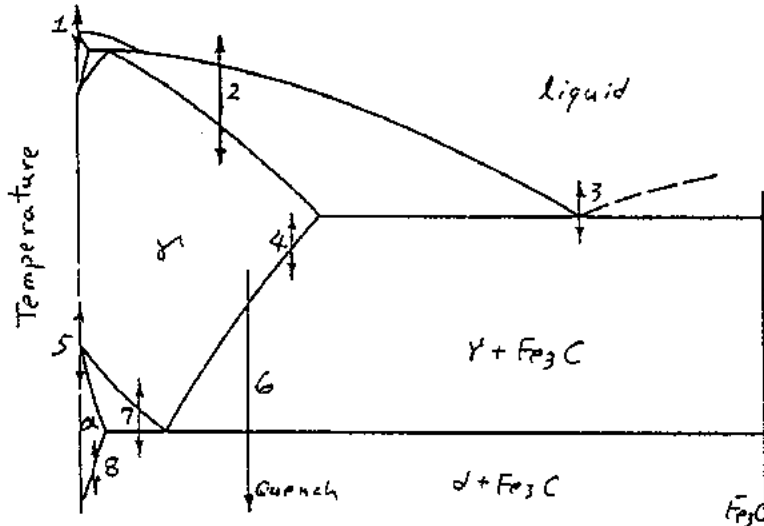
(乙)結構改變 + 化學成份改變

(丙)結構改變 + 體積改變

(丁)結構改變 + 化學成份改變 + 體積改變

(c)請問此一相圖，是否為鐵-碳平衡相圖? 為何此一相圖較平衡相圖常用?(5%)

(d)那些反應屬高碳鋼?(5%)



6.

(a)大多數的金屬及陶瓷材料均為結晶組織。然而結晶組織並非完美無缺，均有缺陷存在，何故?(5%)

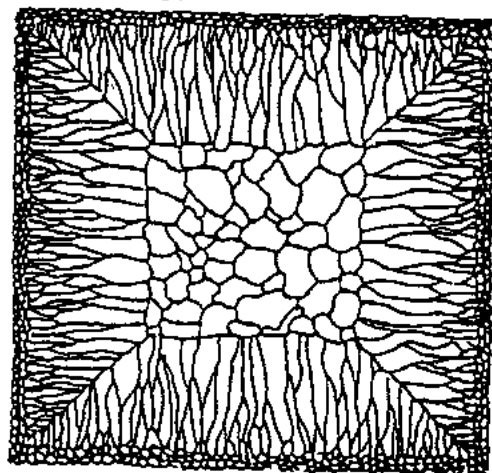
(b)結晶結構中常見的缺陷可分為點、線、面三類缺陷，敘述這三類缺陷之實例及其結構特性。(5%)

7.

右圖所示為一鑄件之晶粒結構分布圖，可明顯分為三區。

(a)分別標示此三區，每區為何種晶粒結構? 其凝固之順序為何?(5%)

(b)其成核(Nucleation)與成長(Growth)之機構為何?(5%)



8.

For self-diffusion in pure materials, the following equation can be used. Please define and describe each of the parameters used in this equation. (5%)

$$D = \alpha a^2 Z v \exp(-\Delta G_m + \Delta G_f)/RT$$

(b) Is this equation applied to the polycrystalline materials, why? (5%)