

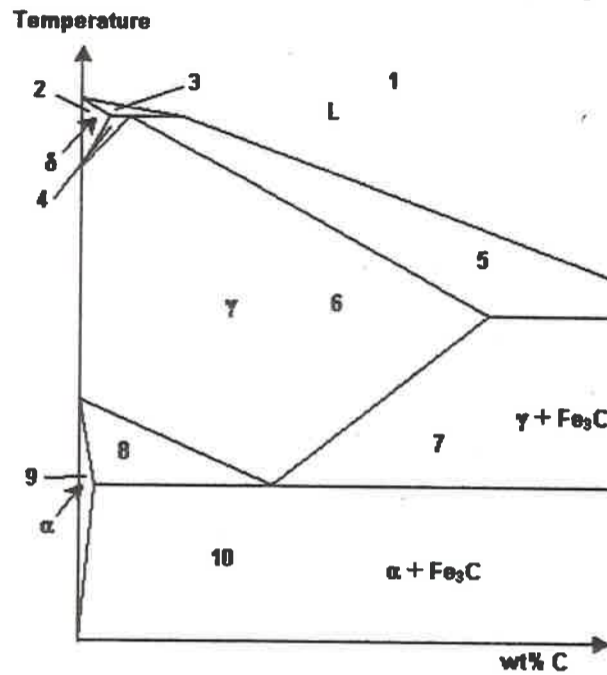
國立臺灣科技大學 112 學年度碩士班招生試題

系所組別：機械工程系碩士班戊組

科目：材料原理

(總分為 100 分；所有試題務必於答案卷內頁依序作答，否則不予計分)

1. Which of the regions of this Fe-C phase diagram are solid solutions? [5分]



2. (a) Please describe what primary particles and secondary particles are, respectively. [5分]
 (b) Please describe what single crystals, polycrystals, and amorphous solids are, respectively. [5分]
3. X-ray diffraction is a powerful tool to determine crystal structure. The Bragg equation tells about x-ray angle interaction and the factor that determines diffraction when a beam of x-rays is diffracted by a crystal. [共20分]
- (a) What is the smallest d-spacing that can be measured for the given wavelength of 1.5418 Å? [5分]
- (b) A crystal has a cubic unit cell of 4.2 Å. Using a wavelength of 1.5418 Å at what angle (2θ) would you expect to measure the (111) peak? [7分]
- (c) Given these experimental and reference data (A, B, C and D) which phases are: [8分]
- Definitely present
 - Not observable (implies absent at any significant level)
 - Unsure
- In each case give a reason for your answer and when unsure consider whether you could do something to clarify the situation.

	Reference Peak List
A	
B	
C	
D	



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4. 天然氣已成為最重要的發電能源來源，關於天然氣請回答下列問題。[共15分]
- (a) 天然氣主要成分為甲烷(CH_4)，一個甲烷分子由 1 個碳原子及 4 個氫原子所構成，請問此 5 個原子由彼此距離無窮遠到鍵結形成甲烷分子的過程為放熱還是吸熱，並說明原因。[5 分]
- (b) 接續(a)，定義 C 和 H 原子距離無窮遠時的化學位能為 0，請劃出此 5 個原子由彼此距離無窮遠到形成穩定共價鍵時之化學位能與 C-H 原子間距的關係圖，並在此關係圖中標示鍵結能與 C-H 鍵長。[5 分]
- (c) 天然氣的燃燒反應($\text{CH}_4 + 2\text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O}$)為放熱還是吸熱，請以反應式中各物質之鍵結強度、化學位能、鍵能說明。[5 分]
5. The lithium chloride-potassium chloride binary system attracts more attention as a low-temperature and low-viscosity electrolyte for electric power cells and for refining metals. [共 20 分]

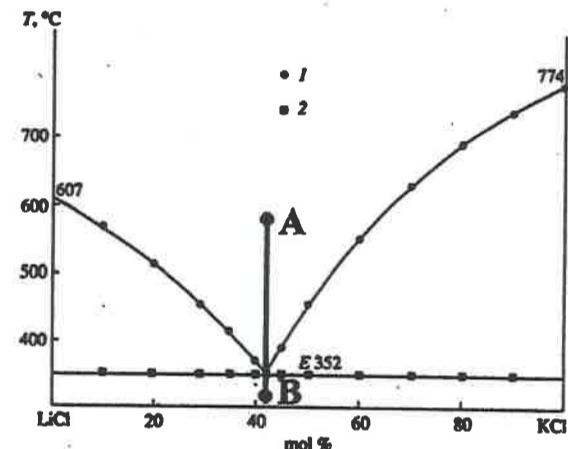
- (a) What are melting points of pure LiCl and pure KCl, respectively? [4分]

For the LiCl-KCl composition of 41.8 mol% KCl and 58.2 mol% LiCl, and the solid B is formed by a very slow cooling from the melt A as shown on the right phase diagram.

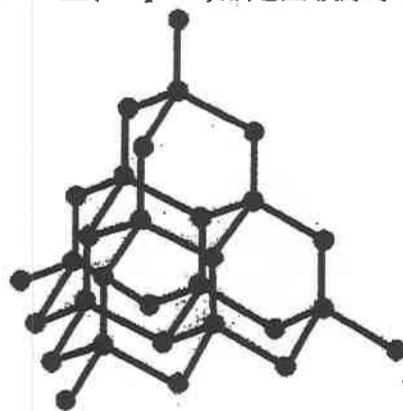
- (b) What is terminology of the phase reaction upon slow cooling? [4分]

- (c) what are the compositions of all the phases present for the points A and B, respectively? [6分]

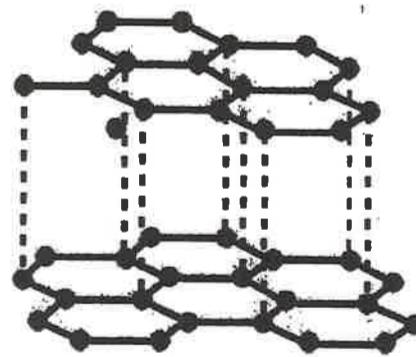
- (d) what are the relative fractions of the phases for the points A and B, respectively? [6分]



6. 鑽石(Diamond)與石墨(Graphite)都是由碳原子組成，為碳的同素異形體。[共30分]



diamond



graphite

- (a) 碳的原子序為 6，請問碳原子的質子數、電子數、價電子數、及電子組態。[8 分]
- (b) 請說明鑽石中每個碳原子的鍵結型態？請說明石墨中每個碳原子的鍵結型態？[6 分]
- (c) 請說明鑽石為何以四面體的方式架構起來？請說明為何石墨中的碳原子以層狀排列？[6 分]
- (d) 請說明為何鑽石具有高硬度而石墨卻容易碎裂，須說明你的理由。[5 分]
- (e) 請說明為何鑽石為絕緣體而石墨為導體，須說明你的理由。[5 分]

