國立臺北科技大學 100 學年度碩士班招生考試

系所組別：3301 材料科學與工程研究所

第二節　材料科學與工程導論　試題（選考）

注意事項：

1. 本試題共九題，配分共 100 分。
2. 請標明大題、子題編號作答，不必抄題。
3. 全部答案均須在答案卷之答案欄內作答，否則不予計分。

一、Explain or define the following terms: **(20%)**

(1). Spheroidite
(2). Piezoelectricity
(3). Poisson's ratio
(4). Galvanic corrosion
(5). Recrystallization temperature

二、Please completely describe the composition and differences of glass and glass-ceramic. **(10%)**

三、Please answer the following questions:

(a) The metal niobium has a BCC crystal structure. If the angle of diffraction for the (211) set of plane occurs at 75.99° (first–order reflection) when monochromatic x-radiation having a wavelength of 0.1659 nm is used, please compute the atomic radius for the niobium atom. **(5%)**

(b) For a FCC unit cell, could individual interstitial atoms or interstitial pairs give rise to an internal friction? And please explain your answer. **(5%)**

四、Please answer the following questions:

(a) Briefly describe the major difference between activation and concentration polarization. **(4%)**

(b) Under what condition is activation polarization rate controlling? **(3%)**

(c) Under what condition is concentration polarization rate controlling? **(3%)**

五、A cylindrical specimen of a brass alloy having a length of 60 mm must elongate only 10.8 mm when a tensile load of 50,000 N is applied. Under these circumstances, what must be the radius of the specimen? Consider this brass alloy to have the stress–strain behavior shown in Figure 1. **(10%)**

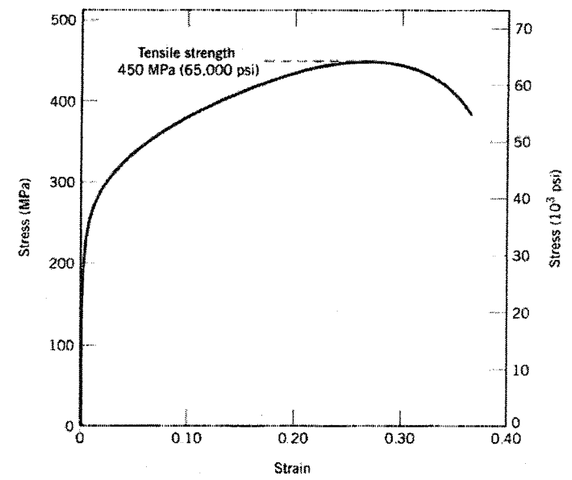

Figure 1 Tensile stress-strain behavior for a brass alloy.

六、The fatigue data for a brass alloy are given as follows:

Stress Amplitude (MPa)	Cycles to Failure
170	3.7×10^4
148	1.0×10^5
130	3.0×10^5
114	1.0×10^6
92	1.0×10^7
80	1.0×10^8
74	1.0×10^9

(a) Make an S-N plot (stress amplitude versus logarithm cycles to failure) using these data, and please answer the brass alloy has a fatigue limit or not? **(4%)**

(b) Determine the fatigue life for 120 MPa. **(3%)**

(c) Determine the fatigue strength at 4×10^6 cycles. **(3%)**

七、Please use a phase diagram and completely explain the two different heat treatments of precipitation hardening. **(10%)**

注意：背面尚有試題

八、For a lead-tin alloy of composition 80 wt% Sn-20 wt% Pb at 180°C (Figure 2) do the following:

(a) Determine the mass fractions of α and β phases. **(4%)**

(b) Determine the mass fractions of primary β and eutectic microstructures. **(4%)**

(c) Determine the mass fractions of eutectic β. **(2%)**

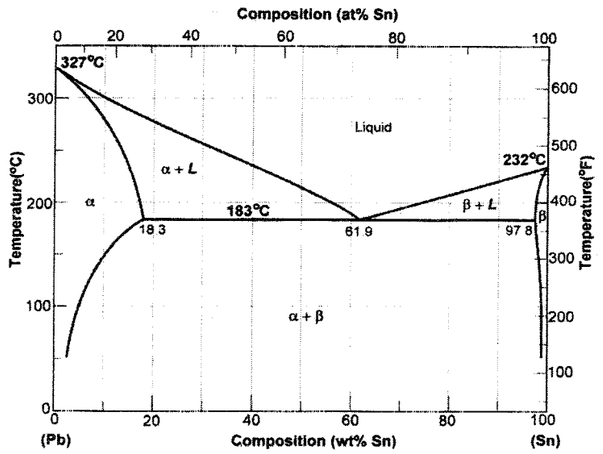

Figure 2 The lead-tin phase diagram.

九、The diffusion coefficients for silver in copper are given at two temperatures:

T (°C)	D (m^2/s)
650	5.5×10^{-16}
900	1.3×10^{-13}

(a) Determine the values of D_0 and Q_d? **(6%)**

(b) What is the magnitude of D at 875°C? **(4%)**