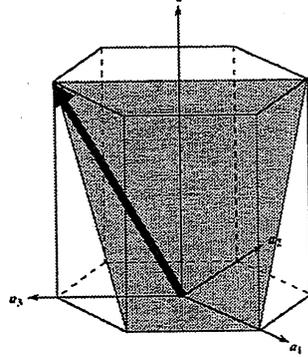
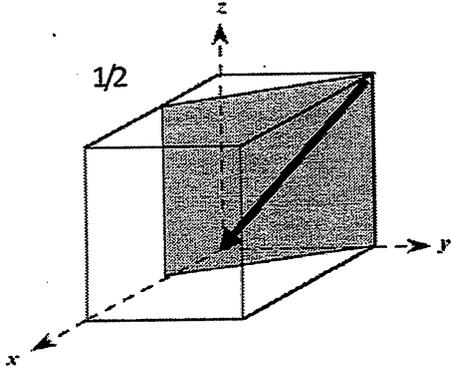


大同大學 100 學年度(寒)轉學入學考試試題

考試科目:材料科學導論 所別:材料工程學系 第 1/1 頁

註:本次考試 不可以參考自己的書籍及筆記; 不可以使用字典; 不可以使用計算器。

1. Determine the Miller indices for the **direction** and **plane** shown in the following cubic unit cell and hexagonal unit cells:
 (a) (2, 2%) (b) (2, 2%)



2. (a) The Miller indices for the **close-packed planes** for **hexagonal close-packed (HCP)** are ____ (2%)
 (b) The Miller indices for the **close-packed planes** for **face-centered cubic (FCC)** are ____ (2%)
3. Below Table 1, atomic radius, crystal structure, electronegativity, and the most common valence are tabulated, for several elements; for those that are nonmetals, only atomic radii are indicated.
 Which of these elements would you expect to form the following with copper (Cu):
 (a) A **substitutional solid solution** having complete solubility. (2%)
 (b) An **interstitial solid solution**. (3%)

Element	Atomic Radius (nm)	Crystal Structure	Electro-negativity	Valence
Cu	0.1278	FCC	1.9	+2
C	0.071			
H	0.046			
O	0.060			
Ag	0.1445	FCC	1.9	+1
Al	0.1431	FCC	1.5	+3
Co	0.1253	HCP	1.8	+2
Cr	0.1249	BCC	1.6	+3
Fe	0.1241	BCC	1.8	+2
Ni	0.1246	FCC	1.8	+2
Pd	0.1376	FCC	2.2	+2
Pt	0.1387	FCC	2.2	+2
Zn	0.1332	HCP	1.6	+2

4. Write Fick's first 1st and second 2nd law in equation form (公式) (3, 3%)
5. Cite the values of the **diffusion coefficients** for the interdiffusion of carbon (C) in both α-iron (Fe, BCC) and γ-iron (Fe, FCC) at 900°C. Which is large? Explain why this is the case. (4, 4, 2%)(reference: Table 2)

Table 2 A Tabulation of Diffusion Data

Diffusing Species	Host Metal	$D_0(m^2/s)$	Activation Energy Q_d		Calculated Value	
			kJ/mol	eV/atom	T(°C)	D(m ² /s)
Fe	α-Fe (BCC)	2.8×10^{-4}	251	2.60	500	3.0×10^{-23}
					900	1.8×10^{-15}
Fe	γ-Fe (FCC)	5.0×10^{-5}	284	2.94	900	1.1×10^{-17}
					1100	7.8×10^{-16}
C	α-Fe	6.2×10^{-7}	80	0.83	500	2.4×10^{-12}
					900	1.7×10^{-10}
C	γ-Fe	2.3×10^{-5}	148	1.53	900	5.9×10^{-12}
					1100	5.3×10^{-11}
Cu	Cu	7.8×10^{-5}	211	2.19	500	4.2×10^{-19}
Zn	Cu	2.4×10^{-5}	189	1.96	500	4.0×10^{-18}
Al	Al	2.3×10^{-4}	144	1.49	500	4.2×10^{-14}
Cu	Al	6.5×10^{-5}	136	1.41	500	4.1×10^{-14}
Mg	Al	1.2×10^{-4}	131	1.35	500	1.9×10^{-13}
Cu	Ni	2.7×10^{-5}	256	2.65	500	1.3×10^{-22}

Source: E. A. Brandes and G. B. Brook (Editors), *Smithells Metals Reference Book*, 7th edition, Butterworth-Heinemann, Oxford, 1992.

6. The plane strain fracture toughness (K_{Ic}) diminishes with ① decreasing or ② increasing strain rate, decreasing temperature. (2%)

<背面繼續>

大同大學 100 學年度(寒)轉學入學考試試題

考試科目:材料科學導論 所別:材料工程學系 第 2/2 頁

註:本次考試 不可以參考自己的書籍及筆記; 不可以使用字典; 不可以使用計算器。

7. Describe the 3 stages of annealing. (6%)

〈 複 習 頁 〉

8. Of those metals listed in right Table 3

(a) Which will experience the **greatest percent reduction in area**? Why? (2, 2%)

(b) Which is the **strongest**? Why? (2, 2%)

(c) Which is the **stiffest**? Why? (2, 2%)

Table 3 Tensile Stress-Strain Data for Several Hypothetical Metals to be Used with Concept Checks 6.2 and 6.4

Material	Yield Strength (MPa)	Tensile Strength (MPa)	Strain at Fracture	Fracture Strength (MPa)	Elastic Modulus (GPa)
A	310	340	0.23	265	210
B	100	120	0.40	105	150
C	415	550	0.15	500	310
D	700	850	0.14	720	210
E	Fractures before yielding			650	350

9. (a) Mark (A) **proportional limit**, (B) **yield strength**, (C) **(ultimate) tensile strength**, (D) **necking**, (E) **fracture** in Fig. 1. (10%)

(請畫圖並標示於答案卷上)

(b) Compare (A) **strength** and (B) **ductility** between curve X and Y in Fig. 2. (4%)

Fig. 1

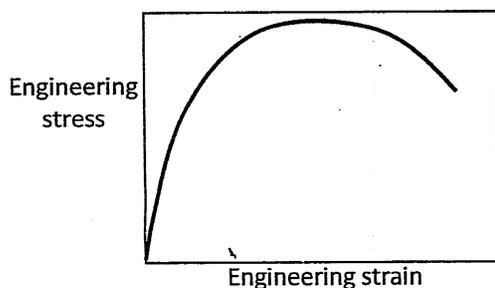
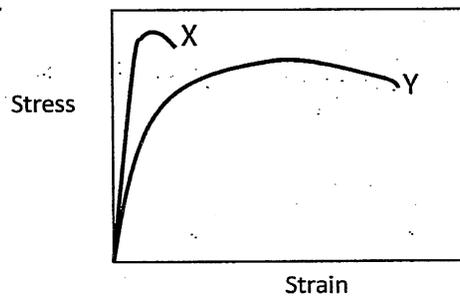


Fig. 2

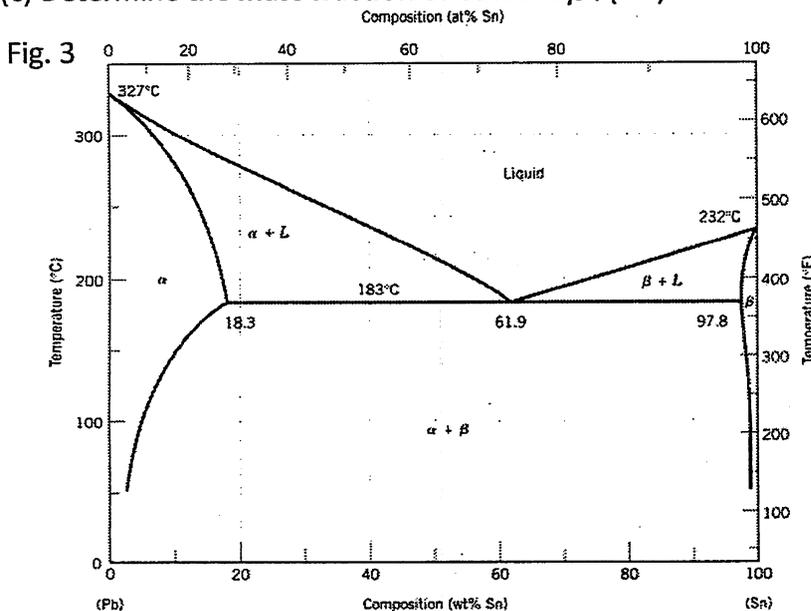


10. In Fig. 3, for a lead-tin (Pb-Sn) alloy of composition 80 wt% Sn-20 wt% Pb and at 180°C (355°F) do the following:

(a) Determine the **mass fractions of and phases**. (2, 3, 3%)

(b) Determine the **mass fractions of primary and eutectic microconstituents**. (3, 3%)

(c) Determine the **mass fraction of eutectic β** . (4%)



11. Name the 5 cast iron types and **match** from the Fig. 4 (1-5) below (3%*5)

Fig. 4

