

一、選擇題 (皆為單選, 每題 4 分, 共 40 分)

1. The unit cell geometry could be defined in terms of six parameters: the three edge lengths  $a$ ,  $b$ , and  $c$ , and the three interaxial angles  $\alpha$ ,  $\beta$ , and  $\gamma$  as indicated in figure 1. What is the crystal system with  $a = b = c$  and  $\alpha = \beta = \gamma \neq 90^\circ$ ?  
 (A) Orthorhombic (B) Tetragonal (C) Rhombohedral

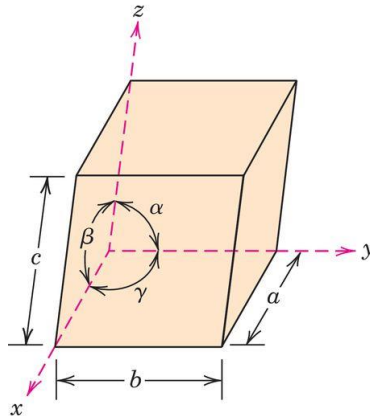


Figure 1 A unit cell showing axial lengths ( $a$ ,  $b$ , and  $c$ ) and interaxial angles ( $\alpha$ ,  $\beta$ , and  $\gamma$ ).

2. The table below shows the electronegativity values for the elements. Which compound has the highest percent ionic character of the interatomic bond?  
 (A) CsCl (B)  $\text{TiO}_2$  (C) ZnTe

IA																			0
H																			He
2.1	IIA											IIIA	IVA	VA	VIA	VIIA			-
Li	Be											B	C	N	O	F			Ne
1.0	1.5											2.0	2.5	3.1	3.5	4.1			-
Na	Mg											Al	Si	P	S	Cl			Ar
1.0	1.3	IIIB	IVB	VB	VIB	VIIIB	VIII			IB	IIB	1.5	1.8	2.1	2.4	2.9			-
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br			Kr
0.9	1.1	1.2	1.3	1.5	1.6	1.6	1.7	1.7	1.8	1.8	1.7	1.8	2.0	2.2	2.5	2.8			-
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I			Xe
0.9	1.0	1.1	1.2	1.3	1.3	1.4	1.4	1.5	1.4	1.4	1.5	1.5	1.7	1.8	2.0	2.2			-
Cs	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At			Rn
0.9	0.9	1.1	1.2	1.4	1.4	1.5	1.5	1.6	1.5	1.4	1.5	1.5	1.6	1.7	1.8	2.0			-
Fr	Ra	Ac	Lanthanides: 1.0-1.2																
0.9	0.9	1.0	Actinides: 1.0-1.2																

3. What is the coordination number of each atom in the HCP zinc?  
 (A) 12 (B) 8 (C) 6

4. What are the Miller indices for the plane in the hexagonal unit cell shown in figure 2?  
 (A) (0111)            (B)  $(\bar{2} 111)$             (C)  $(\bar{2} 112)$

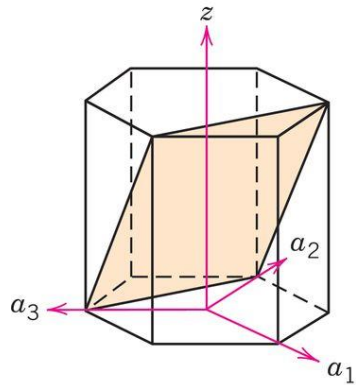


Figure 2 A plane in the hexagonal unit cell.

5. What are the Miller indices for plane A in the cubic unit cell shown in figure 3?  
 (A) (304)            (B) (234)            (C)  $(3 \bar{2} 4)$

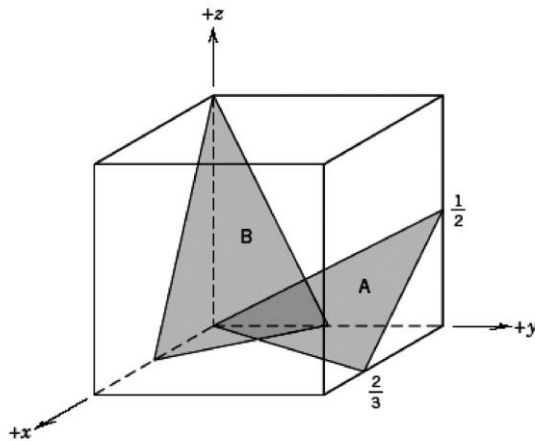


Figure 3 Planes in a cubic unit cell.

6. What are the indices for the direction in the hexagonal unit cell shown in figure 4?  
 (A) [1010]            (B)  $[1 \bar{2} 10]$             (C)  $[0 \bar{1} 00]$

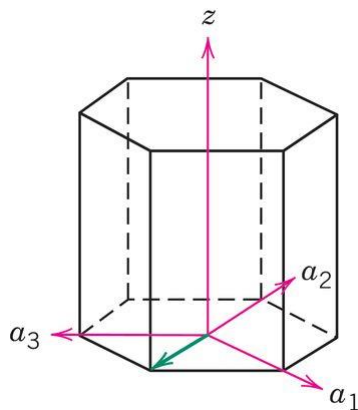


Figure 4 A direction in the hexagonal unit cell.

7. Which direction in the BCC iron has the lowest linear density?  
(A) [100]                      (B) [110]                      (C) [111]
8. The ionic radii of  $\text{Fe}^{2+}$  and  $\text{O}^{2-}$  are 0.077 and 0.140 nm, respectively. What is the coordination number for the  $\text{Fe}^{2+}$  ion in FeO?  
(A) 4                              (B) 6                              (C) 8
9. Which set of plans in the FCC copper has the smallest interplanar spacing?  
(A) (222)                      (B) (311)                      (C) (400)
10. Suppose that  $\text{Li}_2\text{O}$  is added as an impurity to CaO. If the  $\text{Li}^+$  substitutes for  $\text{Ca}^{2+}$ , what kind of defect would you expect to form?  
(A)  $\text{O}^{2-}$  vacancy      (B)  $\text{O}^{2-}$  interstitial      (C)  $\text{Ca}^{2+}$  vacancy

二、簡答題(共 60 分)

1. What is the chemical bonding type (or types) for the following material class. (a) metals, (b) ceramics, and (c) molecular solids. (6 分)
2. (a) What is anisotropy? (b) Explain why the properties of polycrystalline materials are most often isotropic. (8 分)
3. What is the major function for the following equipment used in materials characterization. (a) X-ray diffractometer, (b) scanning electron microscope, and (c) transmission electron microscope. (9 分)
4. (a) Briefly define the term “alloy”, (b) briefly define the term “solid solution”, and (c) list the two types of solid solutions. (from the atomic viewpoint) (10 分)
5. (a) Describe the Fick’s first Law. (b) List the two mechanisms of diffusion. (c) List 3 types of materials processing involving diffusion phenomena. (10 分)
6. Determine (a) the yield strength and (b) the tensile strength **in the stress-strain curves of metals**. (stress-strain curve should be included) (8 分)
7. (a) List three mechanisms to strengthen metals. (b) Describe the eutectoid reaction in the iron-carbon (or Fe- $\text{Fe}_3\text{C}$ ) system. (9 分)