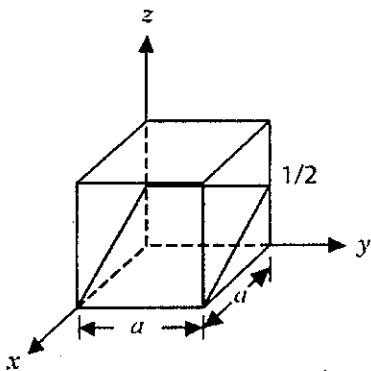


※ 考生請注意：本試題可使用計算機。請於答案卷(卡)作答，於本試題紙上作答者，不予計分。  
材料科學共 50 題選擇題，每題答對得 2 分，答錯倒扣 0.5 分；滿分 100 分，倒扣至 0 分為止。

1. What type(s) of bonding would be expected for **rubber**?

- (a) metallic bonding                      (b) ionic bonding                      (c) van der Waals bonding  
(d) covalent bonding with some van der Waals bonding

2. What are the **Miller indices** for the **plane** shown in the following cubic unit cell?



- (a) (201)                      (b) (102)                      (c) (012)                      (d) (120)

3. Atomic Packing Factor (APF), BCC=?

- (a) 0.52                      (b) 0.68                      (c) 0.74                      (d) 0.81

4. Coefficient of thermal expansion increase, bonding energy?

- (a) decrease                      (b) increase                      (c) no change                      (d) unable to determine

5. Bragg's Law, the meaning of **d** parameter?

- (a) grain diameter                      (b) angle                      (c) lattice space                      (d) density

6. For oxides, carbides, nitrides, sulfides, their are

- (a) ionic bonding                      (b) metallic bonding                      (c) hydrogen bonding                      (d) covalent bonding

7. Which one of the following is the main difference between iron and steel?

- (a) Appearance                      (b) Oxygen content                      (c) Carbon content                      (d) Nitrogen content

8. Which one of the following alloy elements has to exceed 12 wt% in the stainless steels?

- (a) Ti                      (b) Cr                      (c) Ni                      (d) Mn

9. Which one of the following is the main purpose for the annealing of metallic components?
- (a) Release the stress during working                      (b) Increase the strength of the component  
(c) Increase the hardness of the component                (d) Improve the precision of the component
10. Which metal has the lowest density?
- (a) aluminum              (b) magnesium              (c) copper              (d) titanium
11. Which manufacturing process is most commonly employed when a metallic component with complex shape is to be produced?
- (a) forging              (b) rolling              (c) powder metallurgy              (d) casting
12. Which one is a thermoplastic polymer synthesized by a condensation polymerization?
- (a) Melamine              (b) Poly(ethylene terephthalate)              (c) Poly(vinyl chloride)              (d) Polystyrene
13. Which description about polymers is NOT always true?
- (a) long chain molecules                                      (b) broad range of physical properties  
(c) various material processing methods available              (d) low-cost (cheap)
14. The crystalline states in polymeric and inorganic materials are not quite the same. Which description below is INCORRECT?
- (a) both have the melting temperatures  
(b) polymer crystallinity is consisted of more than one polymer chain  
(c) polymer crystallinity is stable even above its melting temperature  
(d) both have the steady/distinguish grain boundaries
15. Which processing can NOT increase the polymer crystallinity?
- (a) mechanical stretching              (b) thermal annealing              (c) solvent annealing              (d) freezing
16. About the glass transition temperature ( $T_g$ ) to a polymer, which description is CORRECT?
- (a) it refers to the polymer crystallinity  
(b) polymer's  $T_g$  is always above room temperature  
(c) it is the response from polymer's amorphous domain  
(d) polymer has low crystallization rate at the temperature higher than its  $T_g$ .
17. The cation-anion radius ratio is 0.550 for FeO. The coordination number for the  $Fe^{2+}$  ion is
- (a) 12              (b) 8              (c) 6              (d) 4

18.  $\text{SrZrO}_3$  has a (a) rock salt (b) zinc blende (c) spinel (d) perovskite crystal structure.
19. Which material has the highest melting point?  
(a) magnesium oxide (b) chromic oxide (c) aluminum oxide (d) silicon oxide
20. The structure of silicon carbide is known as "sphalerite". What is the coordination number for each cation and anion in silicon carbide?  
(a) 4, 8 (b) 6, 6 (c) 8, 4 (d) 4, 4
21. The anion packing in spinel ( $\text{MgAl}_2\text{O}_4$ ) is  
(a) simple cubic (b) BCC (c) FCC (d) HCP crystal structure.
22. (a) Talc (b) Kaolinite clay (c) Cristobalite (d) Mica has the formula  $\text{Mg}_3(\text{Si}_2\text{O}_5)_2(\text{OH})_2$ .
23. The fraction of atom sites that are vacant for lead at its melting temperature of  $327^\circ\text{C}$  (Assume an energy for vacancy formation of 0.52 eV, and  $k = 8.62 \times 10^{-5} \text{ eV/K}$ ) is  
(a)  $1.6 \times 10^{-5}$  (b)  $2.4 \times 10^{-4}$  (c)  $3.1 \times 10^{-4}$  (d)  $4.3 \times 10^{-5}$
24. The fraction of lattice sites that are Schottky defects for sodium chloride at its melting temperature ( $801^\circ\text{C}$ ) (Assume an energy for defect formation of 2.3 eV, and  $k = 8.62 \times 10^{-5} \text{ eV/K}$ ) is  
(a)  $4.03 \times 10^{-6}$  (b)  $3.26 \times 10^{-5}$  (c)  $2.98 \times 10^{-5}$  (d)  $1.84 \times 10^{-6}$
25. For complete substitutional solubility the following criteria must be met: the difference in atomic radii between the matrix element and the other element must be less than  
(a)  $\pm 5\%$  (b)  $\pm 10\%$  (c)  $\pm 15\%$  (d)  $\pm 20\%$
26. What point defects are possible for  $\text{Al}_2\text{O}_3$  as an impurity in  $\text{MgO}$ ?  
(a)  $\text{O}^{2-}$  interstitials (b)  $\text{Mg}^{2+}$  vacancies (c)  $\text{O}^{2-}$  vacancies (d)  $\text{Mg}^{2+}$  interstitials
27. Some hypothetical alloy is composed of 12.5 wt% of metal A and 87.5 wt% of metal B. If the densities of metals A and B are 4.25 and 6.35  $\text{g/cm}^3$ , respectively, whereas their respective atomic weights are 61.5 and 125.7  $\text{g/mol}$ , determine whether the crystal structure for this alloy is (Assume a unit cell edge length of 0.395 nm)  
(a) simple cubic (b) face-centered cubic (c) body-centered cubic, or (d) HCP
28. For an FCC single crystal, which plane has the lowest surface energy  
(a) (100) (b) (110) (c) (101) (d) (111)

29. Which of the following statement about microsegregation could be caused ?  
(a) dislocations      (b) stress concentration      (c) solidification      (d) heat-treatment
30. Which of the following statement about microsegregation is correct ?  
(a) dendritic spacing      (b) ingot center      (c) rolling structure      (d) recrystallization
31. Which of the following statement about Hall-Petch equation is correct?  
(a) conductivity      (b) tensile ductility      (c) tensile deformation resistance      (d) formability
32. Which of the following statement about kirkendal effect is correct ?  
(a) diffusion      (b) grain size      (c) recovery      (d) strain aging
33. Which of the following statement about GP zone could be caused ?  
(a) casting      (b) forging      (c) rolling      (d) heat-treatment
34. In the  $\text{MgO-Al}_2\text{O}_3\text{-SiO}_2$  system the tridymite-protoenstatite-cordierite eutectic temperature is at  $1345^\circ\text{C}$ .  
What is the freedom at this eutectic point according to Gibb's phase rule?  
(a) 4      (b) 3      (c) 2      (d) 1.
35. Sugar can dissolve in water to form a solution. According to Gibb's phase rule give the freedom for this case of the sugar-water solution.  
(a) 4      (b) 3      (c) 2      (d) 1.
36. For a Pb-62% Sn alloy a typical lamella structure is observed after casting. Give the reaction during casting.  
(a) Peritectic      (b) peritectoid      (c) eutectic      (d) eutectoid.
37. A peritectic reaction occurs at  $1186^\circ\text{C}$  for a Pt-42.4% Ag alloy. Which statement is correct for rapid casting?  
(a) A typical lamella structure is found.      (b) Two separated phases of alpha and beta occur.  
(c) A cored structure is formed.      (d) This process is in equilibrium.
38. For a Cu-Ag alloy the eutectic point is in 71.9% Ag at  $780^\circ\text{C}$ . In addition the solubility of Ag in Cu and that of Cu in Ag is 7.9% and 91.2%, respectively. Calculate the percentage of the primary alpha phase of pure Cu after slowly cooling for a Cu-50% Ag alloy.  
(a) 34%      (b) 66%      (c) 58%      (d) 42%.

39. Calculate the ratio of the solubility of carbon in austenite to ferrite iron.  
 (a) 100      (b) 10      (c) 1      (d) 1/10.
40. Which reaction is observed in the iron-iron carbide phase diagram?  
 (a) Peritectic at 1300°C    (b) peritectoid at 1148°C    (c) eutectoid at 723°C    (d) eutectic at 1495°C.
41. CMC, MMC and PMC composites are classified according to their  
 (a) matrix      (b) particles      (c) fibers      (d) layers
42. Which properties of a composites is its most concerned  
 (a) corrosion      (b) fatigue      (c) wear      (d) compression
43. Which of the following materials is more prone to corrosion.  
 (a) ceramics      (b) polymer      (c) composite      (d) metal
44. What is the main reason for a space shuttle shaped the way it is?  
 (a) to increase strength  
 (b) to reduce the amount of heat generated upon re-entry  
 (c) to increase strength and reduce the amount of heat generated  
 (d) to increase corrosion resistance
45. In the electromotive force (emf) series, metal with a negative standard half-cell potential value indicates this metal is  
 (a) anodic to H<sub>2</sub>O      (b) anodic to H<sub>2</sub>      (c) anodic to N<sub>2</sub>      (d) anodic to O
46. For intrinsic silicon, the room temperature electrical conductivity is  $4 \times 10^{-4} (\Omega\text{-m})^{-1}$ ; the electron and hole mobilities are 0.14 and 0.048 m<sup>2</sup>/V-s, respectively. What are the electron and hole concentrations at room temperature, respectively?  
 (a)  $1.33 \times 10^{16} \text{ m}^{-3}$ ,  $1.33 \times 10^{16} \text{ m}^{-3}$       (b)  $2.86 \times 10^3 \text{ m}^{-3}$ ,  $8.33 \times 10^3 \text{ m}^{-3}$   
 (c)  $1.79 \times 10^{16} \text{ m}^{-3}$ ,  $5.21 \times 10^{16} \text{ m}^{-3}$       (d)  $2.13 \times 10^3 \text{ m}^{-3}$ ,  $2.13 \times 10^3 \text{ m}^{-3}$
47. The room-temperature electrical conductivity of intrinsic silicon is  $4 \times 10^{-4} (\Omega\text{-m})^{-1}$ . An extrinsic n-type silicon material is desired having a room-temperature conductivity of  $150 (\Omega\text{-m})^{-1}$ . Specify an impurity type as well as its concentration in atom percent to yield these electrical characteristics?  
 (a)  $1.34 \times 10^{-5}$  at% of Phosphorus      (b)  $6.7 \times 10^{21}$  at% of Arsenic  
 (c)  $1.34 \times 10^{-5}$  at% of Boron      (d)  $6.7 \times 10^{21}$  at% of Aluminum

48. The electric conductivity and electron mobility for aluminum are  $3.8 \times 10^{-7} (\Omega\text{-m})^{-1}$  and  $0.0012 \text{ m}^2/\text{V-s}$ , respectively. What is the Hall voltage for an aluminum specimen that is 15 nm thick for a current of 25 A and a magnetic field of 0.6 Tesla (imposed in a direction perpendicular to the current)?  
(a)  $-3.16 \times 10^{-11} \text{ V}$       (b)  $3.16 \times 10^{-11} \text{ V}$       (c)  $3.16 \times 10^{-8} \text{ V}$       (d)  $-3.16 \times 10^{-8} \text{ V}$
49. Which kind of material has largest dielectric constant at room temperature?  
(a) Barium titanate      (b) Silicon      (c) Gold      (d) Polystyrene
50. What kind of polarization can be activated by external electric field at highest frequency?  
(a) Electronic polarization      (b) Ionic polarization  
(c) Orientation polarization      (d) Molecular polarization