

系所組別： 材料科學及工程學系

考試科目： 材料科學導論

考試日期：0223，節次：3

※ 考生請注意：本試題可使用計算機 請勿在本試題紙上作答，否則不予計分

材料科學導論共 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 can we do to enhance the tensile modulus of semicrystalline polymer? ① increase the molecular weight ② decrease the annealing temperature (no predeformation) ③ increase the degree of crystallinity ④ all of above
2. Which type of stainless steel is not magnetic? ① austenite type ② ferrite type ③ martensite type ④ all of above
3. Which of the statement is correct for the tempered glass? ① It needs uniform and continuous cooling rate during the fabrication ② The major stress on the surface of tempered glass is tension stress ③ The tempered glass should be heated above softening point temperature, and below the melting point ④ If we want to break the window of tempered glass, hit corner is better than hit center of the glass.
4. Which of the following statement is correct? ① The velocity of a phonon is the same as the velocity of light in the particular medium. ② The velocity of a photon is that of sound. ③ Phonons are electromagnetic energy packets that may exist in solid materials. ④ none of above.
5. Which of the following statement is correct? ① Repeatedly dropping a permanent magnet on the floor will cause it to become demagnetized. ② Ferrimagnetic, being metallic materials, are relatively good electrical conductors. ③ Saturation magnetizations of ferrimagnetic materials are higher than that of ferromagnetic materials. ④ All of above.
6. Which of the following statement is correct? ① Electronic, ionic, and orientation polarizations would be observed in lead titanate. ② The semiconducting materials will become extrinsic and the device will become inoperative, if the temperature is raised high enough. ③ Zinc will act as a donor in GaAs. ④ The electrical conductivity for a metallic glass will be greater than for its crystalline counterpart.
7. Which of the following statement is correct? ① Degradation of polymers is ordinarily electrochemical, whereas for metals, corrosion is physiochemical. ② Degradation mechanisms for metals are more complex than the corrosion mechanisms for polymers. ③ More types of degradation are possible for polymers—e.g., dissolution, swelling, and bond rupture (by means of radiation, heat, and chemical reactions). ④ none of above.
8. Which one of the bonding types is covalent: ① NaCl ② C (diamond) ③ Fe ④ Cl<sub>2</sub>.

(背面仍有題目，請繼續作答)

系所組別： 材料科學及工程學系

考試科目： 材料科學導論

考試日期： 0223，節次： 3

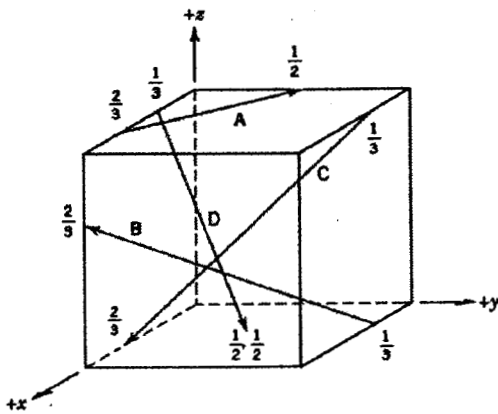
※ 考生請注意：本試題可使用計算機

9. Which one of the bonding types is not the Primary Interatomic Bonds: ① Ionic bonds ② metallic bonds ③ van der Waals bonds ④ covalent bonds.

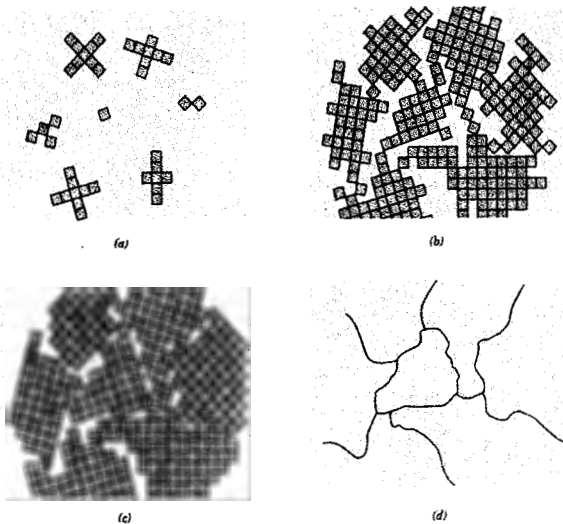
10. The atomic packing factor for the FCC crystal structure is ① 0.74 ② 0.68 ③ 0.78 ④ 0.64.

11. Which one of the indices for **the Direction B** in the following cubic unit cell is correct?

①  $[2\ -3\ 2]$  ②  $(2\ -3\ 2)$  ③  $[2\ 3\ 2]$  ④  $(2\ 3\ 2)$



12. Schematic diagrams of the various stages in the solidification of a polycrystalline material; the square grids depict unit cells. What are the dark lines in (d): ① dislocations ② cracks ③ plastic deformation lines ④ grain boundaries.



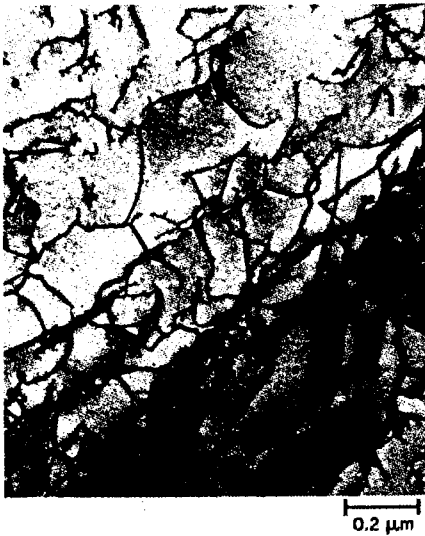
13. A transmission electron micrograph of a titanium alloy in which the dark lines are: ① dislocations ② cracks ③ plastic deformation lines ④ grain boundaries.

系所組別： 材料科學及工程學系

考試科目： 材料科學導論

考試日期： 0223，節次： 3

※ 考生請注意：本試題可使用計算機



14. The following description “The diffusion of atoms of a gas through a plate of metal for which the concentrations (or pressures) of the diffusing species on both surfaces of the plate are held constant.” Is called: (A) Vacancy Diffusion (B) Interstitial Diffusion (C) Steady-state Diffusion (D) Non-steady-state Diffusion.
15. The yield strength increment due to the “conventional” substitutional solid-solution strengthening is proportional to (A)  $c^{1/2}$  (B)  $c^{1/3}$  (C)  $c^2$  (D)  $\ln c^{1/2}$ , where  $c$  is the solute concentration
16. The twinning stress in f.c.c. metal depends strongly on (A) stacking fault energy (B) grain boundary energy (C) dislocation energy (D) lattice strain energy
17. The driving force for recrystallization comes from (A) grain boundary energy (B) subgrain boundary energy (C) stacking energy (D) dislocation stored energy
18. The recrystallized grain size depends on (A) the amount of deformation given (B) grain boundary energy (C) stacking fault energy (D) dislocation stored energy
19. The persistent slip bands are associated with (A) ductile fracture (B) brittle fracture (C) blue brittleness (D) fatigue
20. There are normally (A) 1 stage (B) 2 stages (C) 3 stages (D) 4 stages for the crack growth in fatigue fracture

(背面仍有題目，請繼續作答)

系所組別： 材料科學及工程學系

考試科目： 材料科學導論

考試日期： 0223，節次： 3

※ 考生請注意：本試題可使用計算機

21. Impact testing of some metals and alloys often results in a distinguished feature of ductile-to-brittle transition upon decreasing temperature. Which of the following statements is the most improper?
- Ⓐ For a material which possesses ductile-to-brittle transition, the transition will take place at some specific temperature. Ⓑ The ductile-to-brittle transition temperature of an alloy is a function of its composition. Ⓒ Ductile-to-brittle transition behavior of a material can be revealed not only by impact test but also by other testing methods such as tension. Ⓓ Ductile-to-brittle transition is a common characteristic of ferritic steels with body-centered cubic crystal structure.
22. Dislocations are line defect of crystalline materials. Which of the following statements might not be correct? Ⓐ The slip plane (glide plane) of an edge dislocation is unique. Ⓑ The slip plane of a mixed dislocation is unique. Ⓒ It is possible for a screw dislocation to cross slip. Ⓓ The Burgers vector of a dislocation is from a lattice site to a nearby lattice site.
23. Which of the following descriptions might not be correct? Ⓐ A twin boundary is a mirror plane reflecting the lattice points of the two adjacent grains mutually. Ⓑ Annealing twins can often be observed in an annealed brass of face-centered cubic (fcc) crystal structure. Ⓒ It is usually true that deformation twins can take place more easily in body-centered cubic metals than in fcc metals. Ⓓ It is usually true that deformation twins can take place more easily in hexagonal close packed metals than in fcc metals.
24. Choose the wrong description: Ⓐ Recrystallization is inhibited during cold working of a metal. Ⓑ The cold working temperatures of a metal are below roughly half of its melting temperature (in Kelvin). Ⓒ Dislocation motion is a predominant deformation mechanism of a crystalline solid. Therefore, cold working of a metal can usually improve its ductility by generating more dislocations. Ⓓ The crystallites of a cold-worked metal could reveal certain preferred crystal orientation (or texture).
25. Corrosion of underground steel pipelines can be inhibited by sacrificial protection. Which of the following metals can be used as the sacrificial anode? Ⓐ Mg; Ⓑ Ti; Ⓒ Pb; Ⓓ Sn.
26. Which of the following descriptions is improper? Ⓐ Metal corrosion is an electrochemical process. Ⓑ Corrosion of galvanized steel can be protected by a sacrificial layer of zinc. Ⓒ To impose a DC current could be an effective method of corrosion prevention. Ⓓ Anodizing treatment is not effective to protect aluminum alloys from corrosion.

系所組別： 材料科學及工程學系

考試科目： 材料科學導論

考試日期：0223，節次：3

※ 考生請注意：本試題可使用計算機

27. The melting temperature of  $\text{SiO}_2$  and  $\text{Al}_2\text{O}_3$  are  $1710^\circ\text{C}$  and  $1890^\circ\text{C}$  respectively. By adding about 10 wt%  $\text{Al}_2\text{O}_3$  into  $\text{SiO}_2$ , the melting point of the ceramic becomes (A)  $1800^\circ\text{C}$  (B)  $1728^\circ\text{C}$  (C)  $1700^\circ\text{C}$  (D)  $1590^\circ\text{C}$
28. The residual stress distribution over the cross section of a tempered glass plate shows (A) tensile stress (B) compressive stress (C) uniform stress (D) shear stress, on the surface.
29. (A) ABS (B) Acrylics (C) PET (D) Epoxies has outstanding strength and toughness that could be used as refrigerator livings, garden equipment, toys and high-way safety devices.
30. Zirconia ( $\text{ZrO}_2$ ) could be strengthened by adding some CaO, MgO or  $\text{Y}_2\text{O}_3$  due to (A) dispersing hardening (B) fiber reinforced (C) transformation toughening (D) precipitation hardening.
31. Electrochemical corrosion may occur as a consequence of concentration differences of ions or dissolved gases in the electrolyte solution, and called (A) pitting (B) galvanic (C) selective leaching (D) crevice, corrosion.
32. Which one is not semiconducting material? (A) Ge (B) InSb (C) ZnTe (D)  $\text{Al}_2\text{O}_3$
33. The Poisson's ratio of a metal is always less than (A) 1 (B) 0.8 (C) 0.5 (D) 0
34. Which strengthening mechanism can improve both the strength and ductility (A) precipitation hardening (B) solution hardening (C) work hardening (D) grain refinement
35. Which facility is commonly employed to reduce iron from iron ore (A) electric arc furnace (B) blast furnace (C) basic oxygen furnace (D) rotary furnace
36. Which alloy element is absolutely necessary in a stainless steel (A) magnesium (B) copper (C) chromium (D) aluminum
37. Which metal is listed in RoHS (Restriction on Hazardous Substances) by the European Union (A) tin (B) zinc (C) indium (D) lead

(背面仍有題目，請繼續作答)

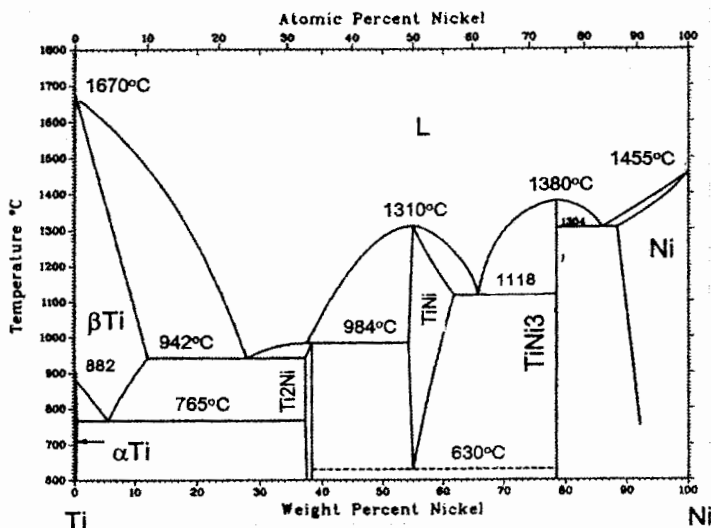
系所組別： 材料科學及工程學系

考試科目： 材料科學導論

考試日期：0223，節次：3

※ 考生請注意：本試題可使用計算機

38. Which one is the hardest phase in steel (A) pearlite (B) ferrite (C) austenite (D) martensite
39. For metal materials, which of the following is correct ( $\nu$  is poisson's ratio):  
(A)  $\nu=1$  (B)  $\nu=0.3$  (C)  $\nu=-0.5$  (D)  $\nu=0$
40. When the beam is bent concave upward, the curvature is positive. What is the stress type at the bottom of the beam? (A) tensile (B) compressive (C) none (D) tensile+ compressive
41. Which phase is induced by deformation? (A) bainite (B) austenite (C) ferrite (D) martensite
42. What can we obtain from the secondary dendrite arm spacing (SDAS)? (A) strength (B) hardness (C) activation energy (D) cooling rate
43. What relationship is discussed at Hall-Petch equation? (A) hardness-cooling rate (B) phase transformation-temperature (C) strength-grain size (D) hardness-grain size.
44. What is  $\alpha+L \rightarrow \beta$  under equilibrium condition? (A) eutectic (B) peritectic (C) age hardness (D) precipitate
45. Calculate the ratio  $r/R$  of the radius of the octahedral interstitial site to the radius of the lattice for bcc metals. (A) 0.41 (B) 0.22 (C) 0.291 (D) 0.155.
46. Which one is called an incongruently melting compound for Ti-Ni phase diagram?  
(A) Alpha-Ti (B) TiNi (C) Ti<sub>2</sub>Ni (D) TiNi<sub>3</sub>.



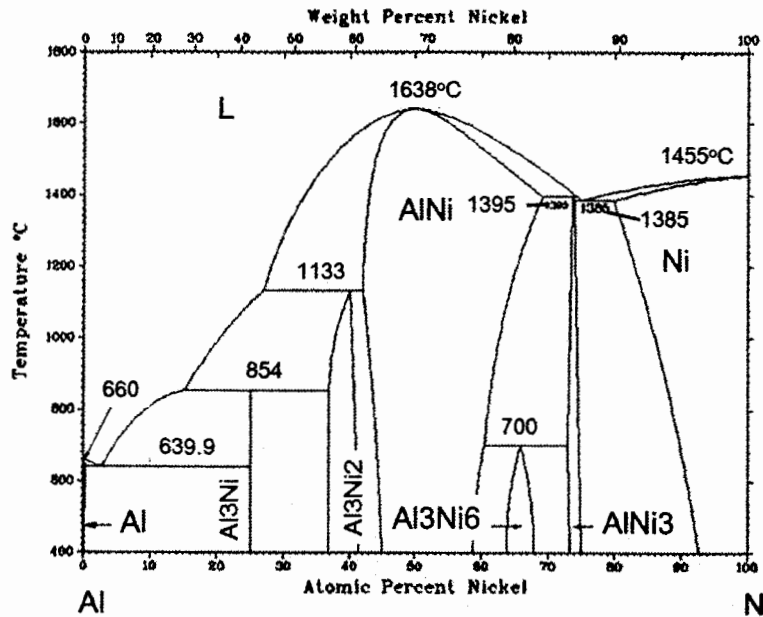
系所組別： 材料科學及工程學系

考試科目： 材料科學導論

考試日期： 0223，節次： 3

※ 考生請注意：本試題可使用計算機

47. Which temperature is for a peritectoid transformation in Al-Ni phase diagram?  A 700°C  B 1133°C  C 854°C  D 639.9°C.



48. What is the maximum solubility of C (wt% C) in ferrite?  A 0.02  B 0.8  C 2.0  D 4.3.
49. What is the maximum solubility of C (wt% C) in austenite?  A 0.02  B 0.8  C 2.0  D 4.3.
50. Which of the following is correct for diffusion (D):  A  $D_{\text{volume}} > D_{\text{g-boundary}}$   B  $D_{\text{volume}} = D_{\text{g-boundary}}$   C  $D_{\text{volume}} < D_{\text{g-boundary}}$   D  $D_{\text{volume}} = 3 D_{\text{g-boundary}}$