

國立中央大學 107 學年度碩士班考試入學試題

所別：機械工程學系 碩士班 製造與材料組(一般生)

共4頁 第1頁

科目：材料科學(金屬材料)

本科考試可使用計算器，廠牌、功能不拘

*請在答案卷(卡)內作答

共計 40 題，每題答對得 2.5 分，答錯倒扣 0.5 分，未答不計分。

1. Why HCP metals are more brittle than FCC or BCC metals? (A) atoms are harder in HCP metals (B) the number of atoms in HCP metals is less (C) active slip systems in HCP metals are fewer (D) atoms agglomerate in HCP metals (E) none of above.
2. If the mobility of dislocations is constrained, the metal will be (A) softer (B) weaker (C) easy to deform (D) brittle (E) weight.
3. The purpose of recrystallization is to (A) introduce strain in metal grains (B) increase the dislocation density in metals (C) enhance the cold-work effect on metal crystals (D) prevent crystal growth (E) restore metals to the characteristics of precold-worked condition as much as possible.
4. What is the meaning of critical resolved shear stress? (A) the minimum shear stress required to initiate slip (B) the minimum shear stress required to prevent dislocation motion (C) the maximum shear stress required to deform crystalline (D) the maximum normal stress required to break crystalline (E) none of above
5. The strengthening in metals can be obtained by (A) reducing grain size (B) introduce impurities for solid-solution (C) increasing strains via cold-work (D) restricting dislocation movement (E) all of above
6. Resilience is the capacity of a metal to absorb energy when it (A) deformed plastically (B) deformed elastically (C) deformed permanently (D) has a fracture strain of less than about 5% (E) is indicative of a material's resistance to fracture when a crack is present.
7. What is the measure of the degree of plastic deformation that has been sustained at fracture? (A) toughness (B) hardness (C) ductility (D) shear modulus (E) diffusivity.
8. According to what theory, each electron in an atom can be characterized by four quantum numbers? (A) the law of conservation of matter (B) photoelectric effect (C) the law of atomic conservation (D) wave mechanics (E) theory of relativity
9. What determine material to be constructed by covalent bonding, ionic bonding, or metallic bonding? (A) protons (B) valence electrons (C) quarks (D) electronegativity (E) neutrons
10. From a plot of interatomic separation versus potential energy for two atoms/ions, the bonding energy correspond to (A) the value at zero force (B) the value at minimum energy (C) the value at minimum separation (D) the value at maximum energy (E) the value at middle separation.
11. Single crystal metals in which measured mechanical properties are (A) isotropic, independent of the direction of measurement (B) isotropic, dependent of the direction measurement (C) anisotropic, independent of the direction of measurement (D) anisotropic, dependent of the direction measurement (E) unable to judgement.

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12. The planar density of FCC (100) planes in terms of the atomic radius R is (A) $1/\sqrt{2}R^2$ (B) $1/3R^2$ (C) $1/4R^2$ (D) $1/R^2$ (E) $1/0.7R^2$
13. What is the lowest the atomic packing factor in the following crystalline? (A) BCC (B) FCC (C) HCP (D) diamond (E) Zinc Blende structure
14. Why interstitial diffusion is normally more rapid than vacancy diffusion? (A) interstitial atoms are more stable (B) the probability of an empty adjacent interstitial site is greater than for a vacancy adjacent to a host atom (C) vacancies are more mobile (D) the probability of a vacancy formation is greater than that of an empty adjacent interstitial site (E) the probability of a vacancy formation equals to that of an empty adjacent interstitial site.
15. In the diffusion study for a semi-infinite solid, what parameter is held constant in the whole diffusion process? (A) diffusing solute atoms in the solid (B) concentration of the diffusing solute atoms in the solid (C) diffusion depth (D) surface concentration (E) solubility of solid.
16. Mechanical twins generally occur in (A) FCC metals (B) BCC ceramics (C) HCP polymers (D) FCC ceramics (E) BCC metals.
17. The activation energy of diffusion can be changed by (A) temperature (B) diffusing species (C) the gas constant (D) diffusion coefficient (E) concentration
18. What factor causes the properties of polycrystalline materials to be most often isotropic? (A) anisotropic grains (B) small atomic radius (C) lots of valence electrons attached on atom (D) chemical property of element (E) high bonding energy.
19. A quenching treatment for the precipitation hardening, what microstructure will be produced? (A) stable supersaturation phase (B) hardening phase (C) equilibrium saturation phase (D) non-equilibrium saturation phase (E) meta-stable supersaturation phase.
20. What does not belong to the interfacial defect? (A) stacking fault (B) phase boundary (C) dislocation (D) twin boundary (E) grain boundary.
21. Toughness is defined as the (A) ability of a material to store elastic energy in the elastic region, (B) energy to break a unit volume of material, (C) resistance to permanently indenting the surface, (D) stress at which noticeable plastic deformation has occurred, (E) resistance to permanently indenting the surface.
22. Brittle fracture is a fracture (A) after adsorption of elastic and plastic energy, (B) of small toughness, (C) of large toughness, (D) of good ductility, (E) of metallic materials.
23. Choose the right answer by comparison of yield strength (σ_y) in the following materials: (A) high density polyethylene (HDPE) is higher than pure titanium (HCP), (B) pure copper (FCC) is higher than pure tungsten (BCC), (C) pure tin (Tetra) is

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- higher than pure aluminum, (D) high density polyethylene (HDPE) is higher than low density polyethylene (LDPE), (E) pure iron (BCC) is higher than pure aluminum (FCC).
24. Ductility of metals can be expressed by (A) $\% EL = \frac{L_0 - L_f}{L_0}$, (B) $\% EL = \frac{L_0 - L_f}{L_f}$, (C) $\% EL = \frac{L_f - L_0}{L_0}$, (D) $\% RA = \frac{A_f - A_0}{A_0}$, (E) $\% RA = \frac{A_f - A_0}{A_f}$.
25. What is true in the following statements: (A) A metal in poly-crystal is stronger than that of single crystal at high temperatures, (B) A metal in poly-crystal is stronger than that of single crystal at room temperatures, (C) A metal prior to rolling is stronger than that post rolling at room temperature, (D) A pure metal is stronger than that is impure at room temperatures, (E) Recrystallization leads to metal strengthening.
26. For the metals treated by cold work, choose the right answer in the following: (A) the metal post cold-work is an anisotropic material, (B) the metal prior to cold-work is an anisotropic material, (C) the dislocation density decreases after cold-work, (D) with increasing cold work, the yield strength decreases, (E) with increasing cold work, the ductility increases.
27. Recrystallization temperature (T_R) indicates (A) the temperature at which recrystallization just reaches completion in 1 h, (B) $T_R > 0.6 T_m$ (C) $T_R < 0.3 T_m$ (D) T_R increases with increasing cold-work percentage for a specific metal, (E) T_R increases with increasing purity of the metal. T_m is the melting point of the metal.
28. Heat treatment of the cold-worked metal may led to subsequent stages in (A) recovery, recrystallization, grain growth, (B) fine-grain, solid solution, precipitate hardening, cold work, (C) fine-grain, recrystallization, grain growth, (D) solid solution, recrystallization, precipitate hardening, (E) recovery, solid solution, precipitate hardening.
29. As compared to ductile failure, brittle failure (A) leads to one piece with large deformation, (B) accompanied by significant plastic deformation, (C) reveals smaller cross-sectioned area of fracture, (D) indicates a large percentage of elongation, (E) provides no warning to failure.
30. According to Fracture mechanics, (A) brittle failure results in cup-and-cone fracture, (B) the tensile strength is greater for the engineering materials than for the perfect theoretic materials, (C) flaws in materials nothing to do with their strength, (D) flaws become stress concentrators, (E) the stress at crack tip (σ_m) amplified with increasing the radius of curvature (ρ_t) of the cracks.
31. Impact test (A) is carried out by impact loading of materials thus less severe case

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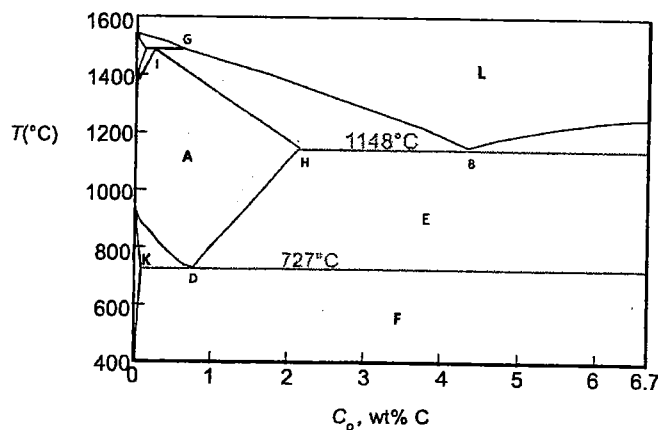
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than tensile test, (B) makes materials less brittle, (C) increases the toughness, (D) causes a transition of ductile-to-brittle at specific temperature for BCC metals, (E) leads to a brittle fracture for FCC metals like Cu.

32. What is wrong to improve the fatigue life: (A) Increase the amplitude of tensile stress (σ_m), (B) apply shot peening to put the surface into compression, (C) harden the metal surface by carburizing, (D) remove the stress concentrators, (E) impose compressive surface stresses
33. Regarding the Cu-Ni phase diagram, (A) it is binary eutectic system, (B) the component is α and β , (C) it is binary isomorphous system, (D) it is binary eutectoid system, (E) It is binary peritectic system.
34. In phase diagram, (A) tie line is used in the single phase, (B) tie line is nothing to do with temperature, (C) tie line is a composition line, (D) tie line is an isotherm in the two-phase region, (E) tie line relates to pressure change.
35. Which is true in the following: (A) Eutectic transformation is a liquid transforms to two solid phases such as Pb-Sn, (B) Eutectoid transformation is a liquid and one solid phase transform to a second solid phase, (C) Peritectic transformation is one solid phase transforms to two other solid phases, (D) Eutectic transformation expressed by $L + \alpha \rightleftharpoons \beta$, (E) Peritectic transformation expressed by $\epsilon + \alpha \rightleftharpoons \beta$.

Refer to the iron-carbon phase diagram to answer the questions (36) ~ (40):



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36. What point is the eutectic point? (A) B (B) D (C) I (D) H (E) K?
37. What is the phase located in the region A? (A) α -iron + cementite (B) γ -iron + cementite (C) α -iron (D) γ -iron (E) δ -iron.
38. Where is the eutectoid point? (A) B (B) D (C) I (D) H (E) K?
39. Where is the peritectic point? (A) B (B) D (C) I (D) H (E) K?
40. How many phases in the region of E? (A) α -iron + cementite (B) γ -iron + cementite (C) α -iron (D) γ -iron (E) δ -iron

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