

所別：機械工程學系碩士班 乙組(製造與材料) 科目：機械材料及材料力學

A. 機械材料 (50%) (注意事項 (請務必閱讀): • 題目均是單一選擇題, 計二十五題, 每題答對得 2 分, 答錯倒扣 0.7 分, 未答不計分。 • 答案需填於答案卷指定題號之填寫答案處之空格內, 否則不予計分。)

1. For an ASTM grain size of 8, how many grains per square inch is at a magnification of 100? (A) 3, (B) 4, (C) 128, (D) 256.
2. What is **not** the interfacial defect? (A) Dislocation, (B) Phase boundary, (C) Grain boundary, (D) Twin boundary.
3. The tensile strengths for 4 specimens of the same aluminum alloy are 237MPa, 243MPa, 249MPa, and 251MPa, respectively. What is the standard deviation? (A) 8MPa, (B) 6.3MPa, (C) 5.4MPa, (D) 4MPa.
4. What is the major mechanism for iron diffusion in iron crystalline solid? (A) interstitial, (B) ring, (C) vacancy, (D) none of the above.
5. For a FCC crystal solid, which slip system is activated during plastic deformation? (A) $\{111\}\langle 110\rangle$, (B) $\{111\}\langle 111\rangle$, (C) $\{110\}\langle 111\rangle$, (D) $\{110\}\langle 110\rangle$.
6. AISI 304 stainless steel (Fe-19Cr-9Ni-2Mn-0.08C) may **not** be protected from intergranular corrosion by the following measures: (A) subjecting the sensitized material to a high-temperature heat treatment, (B) alloying elements such as Nb or Ti, (C) increasing the carbon content, (D) none of the above.
7. Which type of the following cast irons can be transformed to become a malleable cast iron? (A) white cast iron, (B) gray cast iron, (C) nodular cast iron, (D) ductile cast iron.
8. Which type of the following stainless steels is **not** heat treatable? (A) Martensitic, (B) precipitation hardenable, (C) Austenitic, (D) all of the above.
9. Which of the following material's characteristics will **not** improve a material's creep resistance: (A) finer grain size, (B) higher melting temperature, (C) greater elastic modulus, (D) all of the above.
10. Ceramic materials are composed of cations and anions to form ionic crystal structure. Which one is true in the following? (A) Cathions are positively charged and anions are negatively charged. (B) Cathions are negatively charged and anions are positively charged. (C) Frankel defects change the neutrality of the materials. (D) Schottky defects change the neutrality of the materials.
11. Which one is true in the following statements with respect to the polymorph of carbon? (A) Diamond is more stable than graphite at room temperature and atmosphere. (B) Diamond is the hardest known material with high electric conductivity. (C) Diamond is the hardest known material with high thermal conductivity. (D) Diamond is a crystal of layered hexagons.
12. Porosity will result in deleterious influence on both the elastic properties and strength of the (A) polyethylene, (B) aluminum alloys, (C) zirconium oxide, (D) stainless steel.
13. Which is true in the hardness order for the following materials? (A) diamond < boron carbide < tungsten carbide < aluminum oxide < quartz < glass, (B) diamond > glass > tungsten carbide > aluminum oxide > quartz > boron carbide, (C) diamond > polyethylene > tungsten carbide > aluminum alloy > quartz > glass, (D) diamond > boron carbide > tungsten carbide > aluminum oxide > quartz > glass.
14. Tempered glass is a glass strengthened by inducing (A) compressive residual surface stress, (B) tensile residual surface stress, (C) tearing residual surface stress, (D) tensile residual surface stress.
15. Piezoelectric ceramics (A) includes tungsten carbide, (B) includes boron carbide, (C) are used as transducers between electric and magnetic energies, (D) are used as transducers between electric and mechanical energies.
16. Relaxation modulus is (A) a time-independent elastic modulus for ceramic materials, (B) the ratio of the measured time-dependent stress to the constant strain for polymers, (C) the ratio of the measured time-independent stress the time-dependent strain for polymers, (D) is the ratio of the measured constant stress to the time-dependent strain for polymers.
17. When two pieces of steel are immersed in to two compartments of seawater different in oxygen content, choose the best answer in the following: (A) the steel immersed in the compartment with dilute concentration of oxygen acts as a cathode, (B) electrons release from the steel immersed in the compartment with lower concentration of oxygen through the outer conducting lead to the steel put in seawater with higher concentration of oxygen, (C) the steel in diluted oxygen seawater is corroded in a lower rate than that in concentrated seawater, (D) this corrosion is an example of galvanic corrosion.

注意：背面有試題

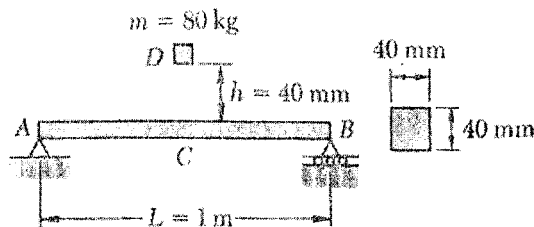
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18. What factor is assumed to be constant in Fick's first law? (A) concentration gradient, (B) diffusion length, (C) diffusion coefficient, (D) diffusion flux.
19. For compound semiconducting materials, the magnitude of the band gap energy increase, the materials tend to become more (A) conductive, (B) insulative, (C) void, (D) dense.
20. For a silicon based p-n junction, the forward bias is to connect the positive terminal of a battery to (A) boron-doped side, (B) carbon-doped side, (C) arsine-doped side, (D) nitrogen-doped side.
21. A typical MOSFET consists of two small islands of p-type semiconductor created within a substrate of n-type semiconductor; the islands are joined by (A) a metal channel, (B) an oxide channel, (C) a narrow n-type channel, (D) a narrow p-type channel.
22. What is the main factor for much more efficient heat transport in a high purity metal? (A) holes, (B) phonons, (C) electrons, (D) activity energy.
23. A hard magnetic material has low (A) remanence, (B) hysteresis energy losses, (C) coercive force, (D) initial permeability.
24. The maximum band gap energy E_g for absorption of visible light ($\lambda = 0.4 \text{ m}$) is (A) 0.8 eV, (B) 1.2 eV, (C) 2.8 eV, (D) 3.1 eV. ($h = 4.13 \times 10^{-15} \text{ eV/s}$ and $c = 3 \times 10^8 \text{ m/s}$.)
25. The index of refraction n of a material is defined as the ratio of (A) the velocity in a vacuum to the velocity in the air, (B) the velocity in the air to the velocity in the medium, (C) the velocity in a vacuum to the velocity in the medium, (D) the velocity in medium to the velocity in the air.

B. 材料力學 (50%)

一、(25%) The block D of mass m is released from rest and falls a distance h before it strikes the midpoint C of the steel beam. Using $E = 200 \text{ GPa}$ and $\sigma_y = 250 \text{ MPa}$, determine

- (a) the maximum deflection of point C , (8%)
- (b) the stress distribution in the cross section passing through the midpoint, and (8%)
- (c) will the beam yield due to the action of the block, according to Tresca yield criterion. (9%)



二、(25% = 15%+10%)

1. (15%) 何謂平面應力(plane stress)狀態? 在工程應用及分析上其適用之情況為何? 請繪出下列三種平面應力狀況下之莫耳圓(Mohr's circle): (1) 靜液壓(hydrostatic pressure)狀態, (2) 純剪(pure shear)狀態, (3) 單軸拉伸(uniaxial tension)狀態。
2. (10%) A solid circular shaft AB of diameter d is fixed at both ends (see figure). A circular disk is attached to the shaft at the location shown. If the allowable shear stress in the shaft is τ_{allow} , and if $a > b$, what is the maximum permissible angle of rotation ϕ of the disk?

