

成功大學材料系 94 學年度碩士班入學考試試題

C 卷: 工程數學(10 題[1-10], 每題 3 分)、材料科學(30 題[11-40], 每題 1 分)、材料力學(15 題[41-55], 每題 2 分)。滿分 90 分。倒扣至零分為止。

科目名稱: 工程數學

每題為 4 選 1, 每一題答對得 3 分, 答錯倒扣 0.75 分。

- The integrating factor of the differential equation: $(2y + xy)dx + 2xdy = 0$ is
 (A) $1/y^2$ (B) $1/x^2$ (C) $1/xy$ (D) $1/(x + y)$.
- The equation of spring is $y'' + (c/m)y' + (k/m)y = 0$, for $c = 4$, $k = 1$, $m = 4$, the result is
 (A) underdamping (B) critical damping (C) overdamping (D) no damping.
- The inverse Laplace transform of the function $se^{-3s}/(s^2 + 4)$ is
 (A) $u(t-3)\sin[2(t-3)]$ (B) $u(t-4)\cos[2(t-4)]$
 (C) $u(t-4)\sin[2(t-4)]$ (D) $u(t-3)\cos[2(t-3)]$
- The general solution of the equation $y''' - 4y'' - y' + 4y = 0$ is
 (A) $y = c_1e^x + c_2e^{-4x} + c_3e^{-x}$ (B) $y = c_1e^{-x} + c_2e^{4x} + c_3e^x$
 (C) $y = c_1e^{-x} + c_2e^{2x} + c_3e^{-2x}$ (D) $y = c_1e^x + c_2e^{2x} + c_3e^{-2}$
- The inverse matrix of $A = \begin{bmatrix} -2 & 1 & 1 \\ 0 & 1 & 1 \\ -3 & 0 & 6 \end{bmatrix}$ is
 (A) $\frac{1}{12} \begin{bmatrix} 6 & -6 & 0 \\ -3 & 9 & 2 \\ 3 & 3 & 2 \end{bmatrix}$ (B) $\frac{1}{12} \begin{bmatrix} 6 & -6 & 0 \\ -3 & -9 & 2 \\ -3 & 2 & 3 \end{bmatrix}$ (C) $\frac{1}{12} \begin{bmatrix} -6 & 6 & 0 \\ 3 & 9 & -2 \\ -3 & 3 & 2 \end{bmatrix}$ (D) $\frac{1}{12} \begin{bmatrix} -6 & -6 & 0 \\ -3 & 9 & 2 \\ 3 & 3 & -2 \end{bmatrix}$
- $xy' = 3y$, and $y(1) = 1$, then $y(3) =$
 (A) 3 (B) 9 (C) 27 (D) 6
- $\frac{dz}{dx} = -Ax$, and $z(\delta) = 0$, then $z =$
 (A) $\frac{A\delta^2}{2} \left[1 - \left(\frac{x}{\delta}\right) \right]$ (B) $A\delta^2 \left[1 - \left(\frac{x}{\delta}\right) \right]$ (C) $\frac{A\delta^2}{2} \left[1 - \left(\frac{x}{\delta}\right)^2 \right]$ (D) $A\delta^2 \left[1 - \left(\frac{x}{\delta}\right)^2 \right]$

(背面仍有題目, 請繼續作答)

編號：G170 系所：材料科學及工程學系

科目：C科目

$$8. (1-a_3) = \frac{1}{1+a} + \left(1 - \frac{1}{1+a}\right) + \left(1 - \frac{1}{1+a}\right) \cdot \frac{\left(1 - \frac{1}{1+a}\right)}{\left(\frac{1}{1+a}\right)}, \text{ then } 1-a_3 =$$

$$\textcircled{A} \frac{1}{1+a} - \frac{a}{1+a} + \frac{a^2}{1+a}$$

$$\textcircled{B} \frac{1}{1+a} + \frac{a}{1+a} + \frac{a^2}{1+a}$$

$$\textcircled{C} \frac{a}{1+a} - \frac{a^2}{1+a} + \frac{a^3}{1+a}$$

$$\textcircled{D} \frac{a}{1+a} + \frac{a^2}{1+a} + \frac{a^3}{1+a}$$

$$9. \frac{d(rH)}{dr} = 0, \text{ and } H = -k \frac{dT}{dr}, \text{ and, } T(r_1) = T_0, T(r_2) = T_2, \text{ then which one is true?}$$

$$\textcircled{A} \frac{T - T_2}{T_0 - T_2} = \frac{\ln(r/r_2)}{\ln(r_1/r_2)}$$

$$\textcircled{B} \frac{T - T_0}{T_0 - T_2} = \frac{\ln(r/r_1)}{\ln(r_1/r_2)}$$

$$\textcircled{C} \frac{T_2 - T}{T_0 - T_2} = \frac{\ln(r/r_2)}{\ln(r_1/r_2)}$$

$$\textcircled{D} \frac{T_0 - T}{T_0 - T_2} = \frac{\ln(r/r_1)}{\ln(r_1/r_2)}$$

$$10. Z = -\mu \frac{dT}{dx}, T = \frac{A\delta^2}{2\mu} \left[1 - \left(\frac{x}{\delta}\right)^2 \right], \text{ and } F = \int_0^L \int_0^W z|_{x=\delta} dy dz, \text{ then } F = \textcircled{A} A \cdot LW \textcircled{B}$$

$$A \cdot \delta^2 LW \textcircled{C} A^2 \cdot LW\delta \textcircled{D} A \cdot LW\delta$$

科目名稱： 材料科學

每題為 4 選 1，每一題答對得 1 分，答錯倒扣 0.25 分。

11. What is the basic composition of the cubic soft ferrites?
Ⓐ $MO_6Fe_2O_3$ ($M = \text{Ca or Sr}$) Ⓑ $MOFe_2O_3$ ($M = \text{Fe, Mn or Zn}$)
Ⓒ Fe_3O_4 Ⓓ Fe
12. What is the SI unit for magnetization M ?
Ⓐ A/m (amperes per meter) Ⓑ T (teslas)
Ⓒ Oe (oersteds) Ⓓ Wb/m^2 (webers per square meter)
13. What types of impurities are particularly detrimental to light loss in silica optical fibers?
Ⓐ Ti^{4+} Ⓑ Al^{3+} Ⓒ Mn^{2+} Ⓓ Fe^{2+}
14. The expulsion of a magnetic field by a material in the superconducting state is called
Ⓐ Screen effect Ⓑ Meissner effect
Ⓒ Hall effect Ⓓ Ohm's law
15. What is the approximate wavelength range for visible light?
Ⓐ $0.39 \mu m \leq \lambda \leq 0.77 \mu m$ Ⓑ $0.39 \mu m \leq \lambda \leq 0.77 \mu m$
Ⓒ $0.39 \mu m \leq \lambda \leq 0.77 \mu m$ Ⓓ none of the above
16. What are the absolute volume percent ranges for the major components of normal concrete?
Ⓐ 7 to 15 percent cement Ⓑ 25 to 30 percent fine aggregate
Ⓒ 16 to 21 percent water Ⓓ all of the above
17. Annealing twins are typically found in metals that have
Ⓐ BCC structure Ⓑ FCC structure
Ⓒ HCP structure Ⓓ all of the above.
18. At room temperature, a typical vibrational frequency of atom is on the order of
Ⓐ 10^{11} Ⓑ 10^{12}
Ⓒ 10^{13} Ⓓ 10^{14} vibrations/s.
19. The highly leaded glasses containing 90 wt% PbO have an index of refraction of about
Ⓐ 1.5 Ⓑ 2.1
Ⓒ 3.0 Ⓓ 3.5

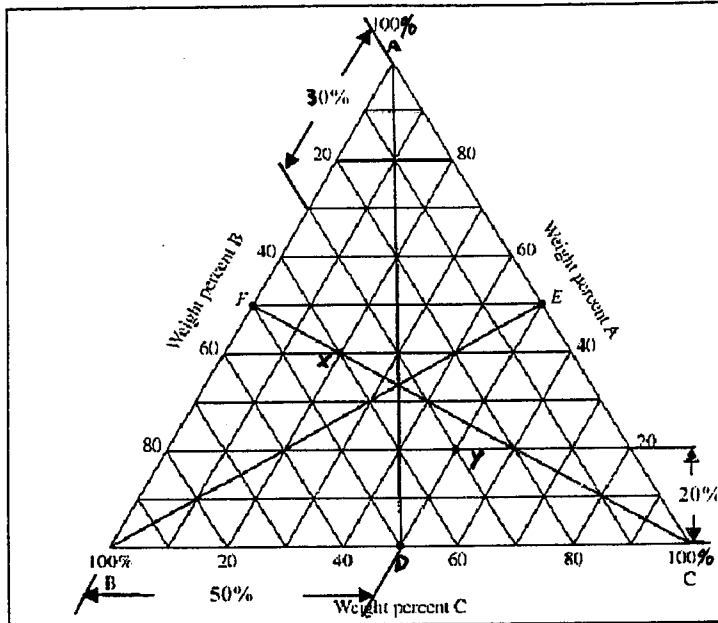
(背面仍有題目,請繼續作答)

編號: G170 系所: 材料科學及工程學系

科目: C 科目

20. What is the composition of point y in following figure

- Ⓐ 50%A, 30%B and 20%C Ⓑ 20%A, 30%B and 50%C
 Ⓒ 30%A, 20%B and 50%C Ⓓ 40%A, 40%B and 20%C.



21. Assume P is the number of phases present, F is the number of degree of freedom, C is the number of the components, N is the number of variables, then the Gibbs phase rule is

- Ⓐ $N+P=F+C$ Ⓑ $P+F=C-N$ Ⓒ $P+F=C+N$ Ⓓ $P+C=F+N$

22. Which of the following is the slip system for the simple cubic crystal structure?

- Ⓐ $\{100\}\langle 110\rangle$ Ⓑ $\{110\}\langle 110\rangle$ Ⓒ $\{100\}\langle 010\rangle$ Ⓓ $\{110\}\langle 111\rangle$

23. The surface energy of a single crystal depends on crystallographic orientation. Does this surface energy increase or decrease with an increase in planar density?

- Ⓐ increase Ⓑ decrease Ⓒ remain the same Ⓓ none of the above

24. Do noncrystalline materials have grain boundaries?

- Ⓐ yes Ⓑ no Ⓒ none of the above Ⓓ all of the above

25. Will Zn act as a donor or acceptor when added to the compound semiconductor GaAs?

- Ⓐ acceptor Ⓑ donor Ⓒ none of the above Ⓓ all of the above

26. For a rubber component that, in its final form is to be vulcanized, should vulcanization be carried out prior or subsequent to the forming operation?

- Ⓐ before Ⓑ after Ⓒ at the same time Ⓓ none of the above

27. Would you expect a crystalline ceramic material to strain harden at room temperature?
Ⓐ yes Ⓑ no Ⓒ none of the above Ⓓ all of the above
28. Would you expect the physical dimensions of a piezoelectric material such as BaTiO_3 to change when it is subjected to an electric field?
Ⓐ yes Ⓑ no Ⓒ none of the above Ⓓ all of the above
29. When two or more crystal structures are possible for a material of given composition, it is called
Ⓐ isomerism Ⓑ polymorphism Ⓒ isomeric Ⓓ isotactic
30. The tendency of a polymer to crystallize decrease as the molecular weight
Ⓐ increase Ⓑ decrease Ⓒ none of the above Ⓓ all of the above
31. The Bragg's law can be expressed on
Ⓐ $n\lambda = 2d \sin \theta$ Ⓑ $n\lambda = 2d / \sin \theta$ Ⓒ $2n\lambda = d \cos \theta$ Ⓓ $n\lambda = 2d \cos \theta$
32. The unit of stress intensity can be
Ⓐ $\text{MPa}\sqrt{\text{m}}$ Ⓑ $\text{psi}\sqrt{\text{in}}$ Ⓒ $\text{ksi}\sqrt{\text{in}}$ Ⓓ all of the above
33. Which one is **NOT** a metallurgical processin?
Ⓐ solid solution alloy Ⓑ dispersion strengthening
Ⓒ increase grain size Ⓓ decrease grain size
34. Which variable determines the microstructure of an alloy?
Ⓐ alloy element Ⓑ concentration of alloying element
Ⓒ heat treatment Ⓓ all of the above
35. The magnitude and direction of the lattice distortion associated with a dislocation can be expressed in terms of
Ⓐ Miller indices Ⓑ Burgers vector Ⓒ slip direction Ⓓ slip system
36. Derive from the equation of state of an ideal gas an equation for the density of an ideal gas in terms of pressure, temperature, and appropriate constants.
Ⓐ $\rho = PR/MT$ Ⓑ $\rho = PT/RM$ Ⓒ $\rho = TR/PM$ Ⓓ $\rho = PM/RT$
37. The difference of standard free energy ΔG^0 and enthalpies of formation ΔH^0 for a reaction is equal to
Ⓐ $-T\Delta S^0$ Ⓑ $T\Delta S^0$ Ⓒ $S^0\Delta T$ Ⓓ $-S^0\Delta T$.

(背面仍有題目,請繼續作答)

38. The alkaline dry cell lasts longer than the acidic cell mainly because the zinc anode corrodes less rapidly under basic conditions than under acidic conditions. Here the verb "corrodes" means
- Ⓐ energy loses Ⓑ anode reaction
Ⓒ cathode reaction Ⓓ heat transfer.
39. The net number of spheres in a face-centered cubic unit cell is
- Ⓐ 2, Ⓑ 3, Ⓒ 4, Ⓓ 6.
40. Silver crystallizes in a cubic closest packed structure. The radius of a silver atom is 1.44×10^{-8} cm. The density of solid silver is calculated as
- Ⓐ 10.6, Ⓑ 5.3, Ⓒ 2.6, Ⓓ 1.06 g/cm^3 .

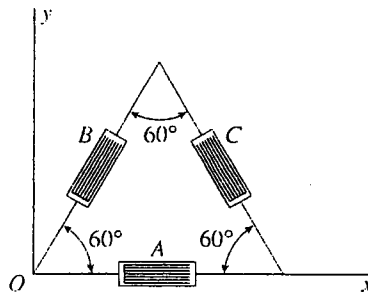
科目名稱: 材料力學

每題為 4 選 1, 每一題答對得 2 分, 答錯倒扣 0.50 分。

41. Mega pascal or MPa is often used as the unit of stress. The equivalent value of 1 MPa is
Ⓐ 10^6 kgf/m^2 ; Ⓑ 10^6 kgf/mm^2 ; Ⓒ 10^6 N/m^2 ; Ⓓ 10^6 N/mm^2 .
42. Two tensile specimens, which are prepared from the same material, differ only in dimension of the gage-length section. Which of the following statements is apparently not correct?
Ⓐ The two specimens will show virtually the same curve of true tensile stress vs. true tensile strain.
Ⓑ If the two specimens have initially the same length but different cross-sectional areas in the gage-length section, they will show different curves of true tensile stress vs. extension (displacement) of the gage length.
Ⓒ If the two specimens have initially the same cross-sectional area but different lengths in the gage-length section, they will show different curves of true tensile stress vs. extension (displacement) of the gage length.
Ⓓ The two specimens will show different curves of tensile load vs. extension (displacement) of the gage length.
43. At the proportional limit, an 8-in. gage length of a 0.5-in diameter alloy bar has elongated 0.032 in., and the diameter has been reduced 0.00066 in. The Poisson's ratio of this alloy is
Ⓐ 0.33; Ⓑ 0.32; Ⓒ 0.31; Ⓓ 0.30.
44. Which of the followings is not a stress state of pure shear?
Ⓐ $\sigma_x = 50 \text{ MPa}$, $\sigma_y = -50 \text{ MPa}$, $\tau_{xy} = 0$
Ⓑ $\sigma_x = 50 \text{ MPa}$, $\sigma_y = 0$, $\tau_{xy} = -50 \text{ MPa}$
Ⓒ $\sigma_x = 0$, $\sigma_y = 0$, $\tau_{xy} = 50 \text{ MPa}$
Ⓓ $\sigma_x = 50 \text{ MPa}$, $\sigma_y = -50 \text{ MPa}$, $\tau_{xy} = -50 \text{ MPa}$
45. When a material is tested under principal stresses $\sigma_1 = 2\sigma_2 = -3\sigma_3$, it will yield at $\sigma_2 = 210 \text{ MPa}$. What is the yield stress in simple tension? (Assume that yielding occurs when the maximum shear stress reaches the shearing yield stress.)
Ⓐ 540 MPa; Ⓑ 547 MPa; Ⓒ 560 MPa; Ⓓ 572 Mpa
46. From shear stress-strain diagrams, we can obtain material properties such as the proportional limit, modulus of elasticity, yield stress, and ultimate stress. These properties in shear are usually about Ⓐ 1/4 Ⓑ 1/3 Ⓒ 1/2 Ⓓ equal as large as those in tension.

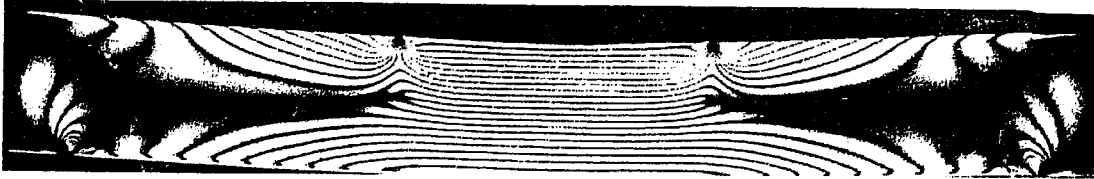
(背面仍有題目, 請繼續作答)

47. The transformation equations for plane stress can be represented in graphical form by a plot known as Mohr's circle. This graphical representation is extremely useful because it enable you to visualize the relationships between the normal stress and
- Ⓐ impact stress Ⓑ shear stress Ⓒ bending stress Ⓓ concentrated stress acting on various inclined planes at a point in a stressed body.
48. The significance of stress concentrations when a member is subjected to static loading depends upon the kinds of materials, which kind of materials that a stress concentration can often be ignored such as
- Ⓐ ductile steel Ⓑ cast iron Ⓒ ceramic Ⓓ glass
49. To minimize weight and save material, we usually select a beam that has the least cross-sectional area while still providing the required
- Ⓐ strength Ⓑ toughness Ⓒ section moduli Ⓓ fracture stress
50. Hooke was the first person to investigate scientifically the elastic properties of materials, he established the linear relationship between the applied loads and the resulting
- Ⓐ hardness Ⓑ toughness Ⓒ strain hardening Ⓓ elongation
51. The normal stress at a point were found $\sigma_x = 200$ MPa (tensile), $\sigma_y = 200$ MPa (tensile). The material has an E-modulus of $E = 20$ GPa and Poisson's ratio $\nu = 0.25$. Determine ϵ_x assuming "plane stress":
- Ⓐ 7.5 Ⓑ 0.1 Ⓒ 21.0 Ⓓ $15.7 (x10^{-3})$.
52. A 60° strain rosette consists of three electrical-resistance strain gages arranged to measure strains as shown in the figure. Determine the strain ϵ_y associated with ϵ_a , ϵ_b and ϵ_c :
- Ⓐ $\epsilon_y = (2\epsilon_b + \epsilon_c + \epsilon_a)/3$ Ⓑ $\epsilon_y = (2\epsilon_b + 2\epsilon_c - \epsilon_a)/3$
 Ⓒ $\epsilon_y = (2\epsilon_b - \epsilon_c - \epsilon_a)/3$ Ⓓ $\epsilon_y = (\epsilon_b + 2\epsilon_c - \epsilon_a)/3$.

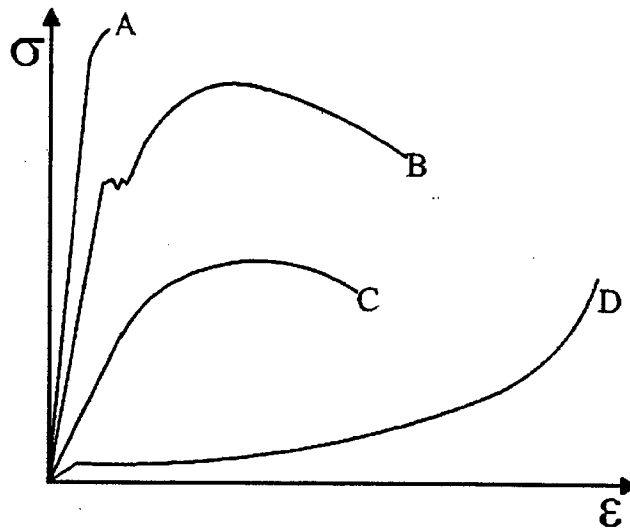


53. The stress distribution in a plate by using the photoelastic method is shown in the figure, where the density of distribution of dark fringes indicating high stresses. What kind of deformation state is applied in this mode?

- Ⓐ tensile test Ⓑ compression test Ⓒ rolling Ⓓ bending.



54. In the figure the stress-strain curves of ceramic, steel, aluminum and soft rubber are schematic sketched together. Which curve is the typical curve for aluminum?



55. When the material is compressed, it bulges outward on the sides and becomes barrel shaped. What can be mainly accounted for this bulging?

- Ⓐ friction Ⓑ stress concentration
Ⓒ geometrical effect Ⓓ nature of materials.