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## 成功大學材料系 95 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)、材料科學導論(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。

1. $\int x \cos x\, dx =$

   Ⓐ $x\sin x - \cos x + C$        Ⓑ $x\sin x + \cos x + C$

   Ⓒ $x\sec x + \sin x + C$        Ⓓ $x\sec x - \sin x + C$

2. $\int_0^1 x\sqrt{x+1}\, dx =$

   Ⓐ $\dfrac{4}{15}(\sqrt{2}+1)$    Ⓑ $\dfrac{4}{15}(\sqrt{2}-1)$    Ⓒ $\dfrac{2}{15}(\sqrt{2}+1)$    Ⓓ $\dfrac{2}{15}(\sqrt{2}-1)$

3. $y'\tan x - 2y = 4$, $y(\frac{\pi}{2}) = 1$, then $y(0) =$

   Ⓐ 1        Ⓑ -1        Ⓒ 2        Ⓓ -2

4. We know that $\dfrac{d\tau_{xz}}{dx} = \rho g\cos\beta$ and $\tau_{xz} = -\eta\dfrac{dv_z}{dx}$, if the boundary conditions under consideration are: at $x = 0$, $\tau_{xz} = 0$ and at $x = \delta$, $v_z = 0$. Which one is true?

   Ⓐ $v_z = \dfrac{\rho g\delta^2\cos\beta}{2\eta}\left[1-\left(\dfrac{x}{\delta}\right)^2\right]$        Ⓑ $v_z = \dfrac{\rho g\delta\cos\beta}{2\eta}\left[1-\left(\dfrac{x}{\delta}\right)^2\right]$

   Ⓒ $v_z = \dfrac{\rho g\delta^2\cos\beta}{\eta}\left[1-\left(\dfrac{x}{\delta}\right)^2\right]$        Ⓓ $v_z = \dfrac{\rho g\delta\cos\beta}{\eta}\left[1-\left(\dfrac{x}{\delta}\right)^2\right]$

5. $\dfrac{d^2T}{dx^2} = 0$, $q = -k\dfrac{dT}{dx}$, when $T(0) = T_0$, $T(L) = T_L$, then $Q = qA = ?$

   Ⓐ $\dfrac{kA}{L}(T_L - T_0)$        Ⓑ $\dfrac{kA}{L}(T_0 - T_L)$

   Ⓒ $\dfrac{kA}{L}(T_0^2 - T_L^2)$        Ⓓ $\dfrac{kA}{2L}(T_0^2 - T_L^2)$

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6. Let $f(x)=e^{2x}$, $0\le x \le 1$. the sine expansion of $e^{2x}$ on $[0,1]$ is

   Ⓐ $\displaystyle\sum_{n=1}^{\infty}\frac{2n\pi}{4+n^2\pi^2}[1-e^2\cos(n\pi)]\sin(n\pi x)$　　Ⓑ $\displaystyle\sum_{n=1}^{\infty}\frac{2n\pi}{4+n^2\pi^2}[1+e^2\cos(n\pi)]\sin(n\pi x)$

   Ⓒ $\displaystyle\sum_{n=1}^{\infty}\frac{2n\pi}{n^2\pi^2-2}[1-e^2\cos(n\pi)]\sin(n\pi x)$　　Ⓓ $\displaystyle\sum_{n=1}^{\infty}\frac{2n\pi}{n^2\pi^2+2}[1+e^2\cos(n\pi)]\sin(n\pi x)$

7. The diagonal matrix of $A=\begin{pmatrix}5 & 4\\ 1 & 2\end{pmatrix}$ is

   Ⓐ $\begin{pmatrix}4 & 0\\ 0 & -1\end{pmatrix}$　　　Ⓑ $\begin{pmatrix}6 & 0\\ 0 & 1\end{pmatrix}$　　　Ⓒ $\begin{pmatrix}-4 & 0\\ 0 & 1\end{pmatrix}$　　　Ⓓ $\begin{pmatrix}-6 & 0\\ 0 & 1\end{pmatrix}$

8. The Fourier sine transform of the function $\quad f(x)=\begin{cases}k.....if\,0<x<a\\ 0.........if\,x>a\end{cases}$ is

   Ⓐ $\sqrt{\dfrac{2}{\pi}}k(\dfrac{1-\sin a\varpi}{\varpi})$　　　　　　Ⓑ $\sqrt{\dfrac{2}{\pi}}k(\dfrac{1+\sin a\varpi}{\varpi})$

   Ⓒ $\sqrt{\dfrac{2}{\pi}}k(\dfrac{1-\cos a\varpi}{\varpi})$　　　　　　Ⓓ $\sqrt{\dfrac{2}{\pi}}k(\dfrac{1+\cos a\varpi}{\varpi})$

9. The Laplace transform of f(t) is $\dfrac{1}{s(s^2+\varpi^2)}$, the function f(t) is

   Ⓐ $\dfrac{1}{\varpi}(1+\cos\varpi t)$　　　　　　Ⓑ $\dfrac{1}{\varpi}(1-\cos\varpi t)$

   Ⓒ $\dfrac{1}{\varpi^2}(1+\cos\varpi t)$　　　　　　Ⓓ $\dfrac{1}{\varpi^2}(1-\cos\varpi t)$

10. For the system $y'=Ay=\begin{bmatrix}-2 & 2\\ -2 & -2\end{bmatrix}y$, the critical point at origin is

   Ⓐ a node　　　Ⓑ a spiral　　　Ⓒ a center　　　Ⓓ a saddle.

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科目名稱: 材料科學導論    每題為4選1,每一題答對得1分,答錯倒扣0.25分。

11. Particle coalescence of a powdered aggregate by diffusion that is accomplished by firing at an elevated temperature is called:

Ⓐ Devitrification ⁚      Ⓑ Sintering          Ⓒ Drying          Ⓓ Vitrification

12. An atom or side group alternate regularly from side to side of an extended chain. Which configuration is correct below.

Ⓐ Isotactic configuration      Ⓑ Syndiotactic configuration
Ⓒ Atactic configuration        Ⓓ none of the above

13. Which is "not" the factor that affect the resistance of metal.

Ⓐ Temperature      Ⓑ Impurity      Ⓒ Plastic deformation      Ⓓ Fermi energy

14. For intrinsic silicon, the room-temperature electrical conductivity is $4 \times 10^{-4} (\Omega \text{-m})^{-1}$; the electron and hole mobilities are, respectively, 0.14 and 0.048 $m^2/V\text{-s}$. Compute the electron and hole concentrations at room temperature. ($e = 1.6 \times 10^{-19}$C, $k = 1.38 \times 10^{-23}$C, $N_A = 6.02 \times 10^{23}$ molecules/mole)

Ⓐ $1.33 \times 10^{16}$ $m^{-3}$      Ⓑ $2.127 \times 10^{-3}$ $m^{-3}$      Ⓒ $1.54 \times 10^{20}$ $m^{-3}$      Ⓓ $1.2 \times 10^{-23}$ $m^{-3}$

15. For most material, what is the relationship of temperature and vibrational contribution to the heat capacity at constant volume at lower temperature.

Ⓐ $C_V = AT$      Ⓑ $C_V = AT^2$      Ⓒ $C_V = AT^3$      Ⓓ $C_V = AT^4$

16. In high purity metals, what is the main mechanism of heat transport ?

Ⓐ Phonon      Ⓑ Photon      Ⓒ Electron      Ⓓ Hole

17. In ceramics, what is the main mechanism of heat transport ?

Ⓐ Phonon      Ⓑ Photon      Ⓒ Electron      Ⓓ Hole

18. For the following substance, which is correct for the sequence of these substance about thermal conductivity: (1) poly-crystalline (2) single crystalline (3) noncrystalline

Ⓐ (1)>(2)>(3)      Ⓑ (2)>(1)>(3)      Ⓒ (3)>(1)=(2)      Ⓓ (1)=(2)>(3)

19. The stress intensity factor (K) is related to the applied stress ($\sigma$) and crack length (a) by the follow equation ( Y is a dimensionless factor )

Ⓐ $K = Ya\sqrt{\pi\sigma}$      Ⓑ $K = \pi a \sqrt{Y\sigma}$      Ⓒ $K = Y\sigma\pi$      Ⓓ $K = Y\sigma\sqrt{\pi a}$

20. $Fe_3C$ is also called

Ⓐ cementite      Ⓑ pearlite      Ⓒ austenite      Ⓓ peritectoid

(背面仍有題目,請繼續作答)

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21. Which one is NOT one of the major sources for causing internal residual stresses in metal components
   Ⓐ mixing　　　　　　Ⓑ plastic deformation
   Ⓒ non uniform cooling　　　Ⓓ phase transformation

22. The slope of stress-strain plot in the elastic region is called
   Ⓐ strength　　Ⓑ modulus of elasticity　　Ⓒ poisson ratio　　Ⓓ toughness

23. Equilibrium is best described in terms of a thermodynamic quantity called
   Ⓐ enthalpy　　Ⓑ entropy　　Ⓒ kinetics　　Ⓓ free energy

24. Which one of the following material could be used at very high temperature
   Ⓐ copper　　Ⓑ plastics　　Ⓒ MgO　　Ⓓ Graphite

25. What is the typical microstructure of a quenched plain medium carbon steel?
   Ⓐ fine pearlite　　Ⓑ coarse pearlite　　Ⓒ martensite　　Ⓓ austenite

26. Heat treating a deformed metal specimen can diminish the dislocation density to the order of
   Ⓐ $10^9 \sim 10^{10}$　　Ⓑ $10^5 \sim 10^6$　　Ⓒ $10^{-1} \sim 10^0$　　Ⓓ non of the above

27. When a cold-worked metal is heated into the temperature range where recovery take place,
   Ⓐ the tensile strength is significantly increased
   Ⓑ the ductility of the metal is reduced
   Ⓒ the hardness of the metal is slightly reduced
   Ⓓ internal stresses are greatly increased.

28. Which of the following is correct in the brittle fracture of a metal?
   Ⓐ As a result of plastic deformation, dislocations become concentrated along slip planes.
   Ⓑ Shear stresses increase in areas where dislocations are impeded from movement. As a result, microcracks are nucleated.
   Ⓒ Microcracks propagate as a result of further increases in shear stress. Stored elastic strain energy also contribute to the propagation.
   Ⓓ all of the above

29. A fatigue test is made with a mean stress of 125 MPa and a stress amplitude of 160 MPa. Then the minimum stresses is
   Ⓐ −35 MPa　　Ⓑ -70 MPa　　Ⓒ 70 MPa　　Ⓓ 35 MPa

30. Ⓐ Tension　　Ⓑ Fatigue　　Ⓒ Creep　　Ⓓ Compression
   of a metal refers to the slow, progressive plastic deformation of a metal subjected to a constant load or stress. It is the time dependent strain of a metal.

31. Which description is not correct?

　Ⓐ In general, the greater the degree of undercooling of a liquid melt, the larger the critical radius of the nuclei formed.

　Ⓑ In heterogeneous nucleation, impurity atoms or container surfaces act as nucleating agents.

　Ⓒ A nucleus is a comparatively larger stable cluster which can grow into a crystal.

　Ⓓ The dimension defining the boundary between an embryo and a nucleus is the critical radius of a solidifying particle.

32. The Rockwell A hardness test uses a
　Ⓐ diamond pyramid　　　　　Ⓑ diamond cone
　Ⓒ 10 mm steel sphere　　　　Ⓓ 1/16 in. steel sphere indenter.

33. The most densely packed planes of the FCC structure are the

　Ⓐ <100>　　　Ⓑ <1$\bar{1}$0>　　　Ⓒ {111}　　　Ⓓ {100} planes.

34. What is the electron configurations of the samarium (Z = 62) by using *spdf* notation?
　Ⓐ [Xe] $4f^8$　　Ⓑ [Xe] $5d^8$　　Ⓒ [Xe] $4f^6 5s^2$　　Ⓓ [Xe] $4f^6 6s^2$

35. What is the coordination number for the atoms in the HCP crystal structure?
　Ⓐ 6　　　Ⓑ 8　　　Ⓒ 10　　　Ⓓ 12

36. Which atom position is at the corner of an FCC unit cell?
　Ⓐ (1, 0, 0)　　Ⓑ (1, 1, 0)　　Ⓒ (1, 1, 1)　　Ⓓ all of the above

37. A direction vector pass through a unit cube from the (1/2, 1, 1/2) to the (3/4, 0, 1/4) positions. What are its direction indices?

　Ⓐ [1, $\bar{4}$, $\bar{1}$]　　Ⓑ [1, 4, 1]　　Ⓒ [$\bar{4}$, $\bar{1}$, 4]　　Ⓓ [4, 1, 4]

38. How many degrees of freedom exist at invariant reaction points in binary phase diagrams?
　Ⓐ 3　　　Ⓑ 2　　　Ⓒ 1　　　Ⓓ 0

39. Brass is a copper-rich copper-
　Ⓐ zinc　　　Ⓑ cobalt　　　Ⓒ nickel　　　Ⓓ aluminum alloy.

40. $\alpha + L \xrightarrow{\text{cooling}} \beta$ is the
　Ⓐ eutectic　　　Ⓑ eutectoid　　　Ⓒ peritectic　　　Ⓓ peritectoid　reaction.

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科目名稱:　材料力學

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41. The following Figure presents a series of hypothetical stress-strain curves for three metals (Tungsten (W), Molybdenum (Mo), and Iron (Fe)), together with one ceramic (Quartz (SiO2)) and the polymer polyethylene. Which curve is most likely the stress strain response of the polymer polyethylene?

    Ⓐ curve A　　　Ⓑ Curve B　　　Ⓒ Curve C　　　Ⓓ. Curve D
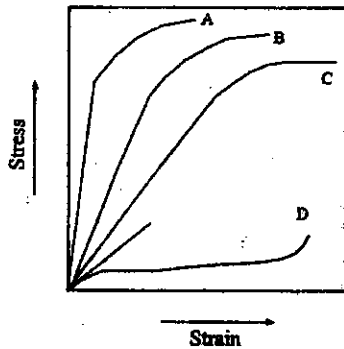
42. There is plane stress acting on a small element of material in the XY plane. Which of the followings is not correct?

    Ⓐ $|\sigma_z| + |\tau_{xy}| = 0$　　　　　　Ⓑ $|\sigma_z| + |\tau_{xz}| = 0$

    Ⓒ $|\sigma_x| + |\tau_{xy}| \neq 0$　　　　　　Ⓓ $|\tau_{xz}| + |\tau_{xy}| \neq 0$.

43. The strain on the surface of an experimental device made of pure aluminum (E = 70 GPa, $v = 0.33$) and were measured by means of strain gages as shown in figure (below left). The measured strains were $\varepsilon_A = 1100 \times 10^{-6}$, $\varepsilon_B = 1496 \times 10^{-6}$, $\varepsilon_C = -39.44 \times 10^{-6}$. What is the stress in the x direction?

    Ⓐ 183.2 MPa　　　Ⓑ 45.8 MPa　　　Ⓒ 22.9 MPa　　　Ⓓ 91.6 MPa.
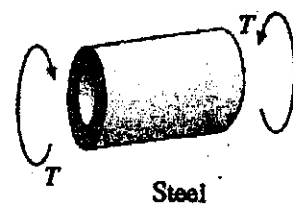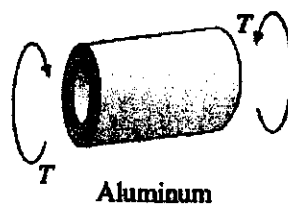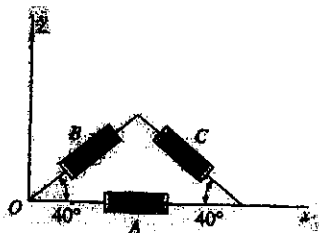
44. The shafts differ only in regards to materials from which they were made as shown in figure (above right). If the same torque is applied to each, which of the following states is correct? (Assuming $\tau_{Al}$ and $\tau_{St}$ the maximum shear stress for aluminum and steel, respectively)
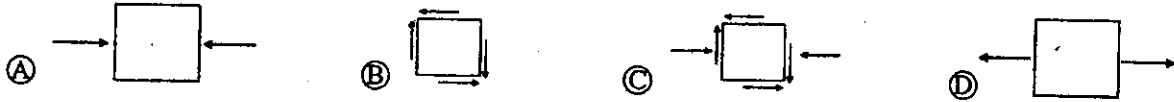
    Ⓐ $\tau_{Al} < \tau_{St}$　　　Ⓑ $\tau_{Al} > \tau_{St}$　　　Ⓒ $\tau_{Al} = \tau_{St}$　　　Ⓓ $3\tau_{Al} = \tau_{St}$.

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45. By inspection please determine the stress state at the point D in the figure (below left):

　Ⓐ compression　　　Ⓑ 0　　　　Ⓒ tension　　　Ⓓ none of the above.
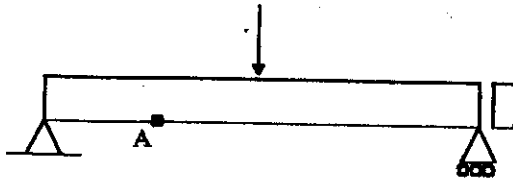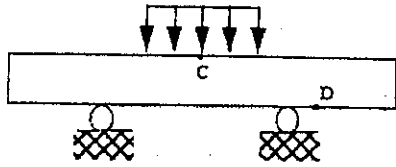
46. A simple beam of rectangle cross section is shown in figure (above right). What is the stress state acting at the neutral axis A?

　Ⓐ　　　Ⓑ　　　Ⓒ　　　Ⓓ

47. If A bar is subjected to a torque T, what are the stresses $\sigma_1$ and $\sigma_2$ acting on a rectangular element oriented at 45° to the longitudinal axis?

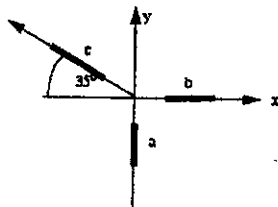　Ⓐ $\sigma_1 < 0$ and $\sigma_2 < 0$　　　　Ⓑ $\sigma_1 > 0$ and $\sigma_2 < 0$

　Ⓒ $\sigma_1 > 0$ and $\sigma_2 > 0$　　　　Ⓓ none of the above.

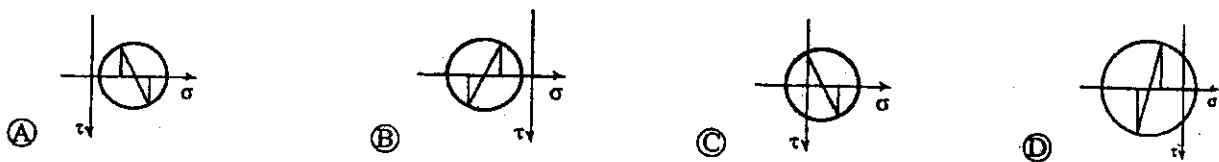48. The strain at a point as shown in figure (below left) are $\varepsilon_{xx} = -1000\mu$, $\varepsilon_{yy} = +2000\mu$ and $\gamma_{xy} = +2500\mu$. What is the strain $\varepsilon_a$ recorded by the strain gage a?

strains recorded by the three strain gages.

　Ⓐ $1500\mu$　　　Ⓑ $1800\mu$　　　Ⓒ $2000\mu$　　　Ⓓ $2500\mu$.

10.000 psi

10.000 psi
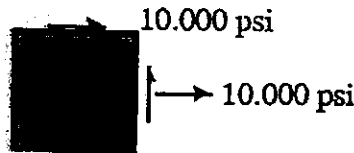
49. Which is the corresponding Mohr's circle for the stress state in figure (above right)?

　Ⓐ　　　Ⓑ　　　Ⓒ　　　Ⓓ

50. Which of the following states is correct?

　Ⓐ A theoretical upper limit for Poisson ratio is 0.3.

　Ⓑ For isotropic materials, Poisson's ratio is 0.2.

　Ⓒ Poisson's ratio remains constant, as the strain increases.

　Ⓓ Poisson's ratio is known as the ratio of the lateral strain to the axial strain.

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51. The following figure shows the load-displacement (P- δ) diagram (below left). (Assuming $E_e$ = elastic strain energy, $E_{in}$=inelastic strain energy, $El_e$=elastic elongation, $El_{in}$=permanent elongation.) Which is correct?

    Ⓐ $E_e$ =A2 and $El_e$=DC
    Ⓑ $E_e$ =A1 and $El_e$=DC
    Ⓒ $E_e$ =A2 and $El_e$=OD
    Ⓓ $E_e$ =A1 and $El_e$=OD.
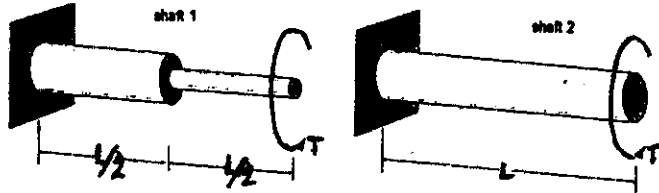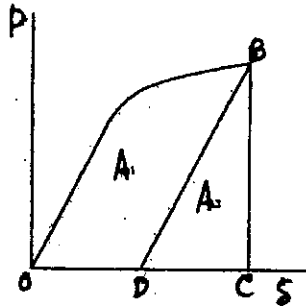
52. The torsion shafts shown (above right) are made of the same material. Which is correct under load by comparing the stress? (Assuming S1 and S2 the stress for shaft 1 and shaft 2, respectively)

    Ⓐ S1 < S2　　　Ⓑ S1 > S2　　　Ⓒ S1 = S2　　　Ⓓ none of the above.

53. By inspection determine the stress state at the point C in the following figure (below left):

    Ⓐ compression　　Ⓑ 0　　　Ⓒ tension　　　Ⓓ none of the above.
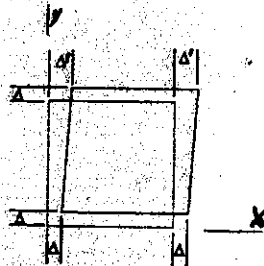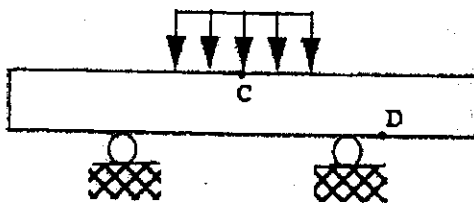
54. An s X s square plate of material is deformed as shown (above right). Assuming the displacements are small.) What is the shear stress $\tau_{xy}$?

    Ⓐ 0　　　Ⓑ $\Delta / s$　　　Ⓒ $(\Delta' - \Delta)/s$　　　Ⓓ $\Delta' / s$.

55. What is the change in length of a cylindrical pressure vessel loaded with an internal pressure of $p$ and having a wall thickness of $t$? Assuming the material is linear and isotropic in the mechanical properties with elastic constants $E$ and $v$.

    Ⓐ $\dfrac{prL}{2Et}(1-v)$　　Ⓑ $\dfrac{prL}{2Et}(1-2v)$　　Ⓒ $\dfrac{prL}{Et}(1-v)$　　Ⓓ $\dfrac{prL}{3Et}(1-2v)$.