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　　C 卷　材料科學導論(30題[1-30]，每題 1 分)、材料力學(10題[31-40]，每題 3 分)、工程數學(10題[41-50]，每題 3 分)。滿分 90 分。倒扣至零分為止。

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。

1 The units for diffusion coefficient are
Ⓐ erg/m²-s 　　　Ⓑ kg/m²-s 　　　Ⓒ m²/s 　　　Ⓓ non of the above.

2. Atoms of one metal diffuse into another is termed
Ⓐ interdiffusion 　Ⓑ self-diffusion 　　Ⓒ Frenkel dffusion 　Ⓓ Schottky diffusion

3. Ⓐ Polyester resin 　Ⓑ Polyethylene 　　Ⓒ Poly(vinyl chloride) Ⓓ Polystyrene
is thermosetting polymers.

4. In the ship system of materials with FCC structure, the ship plane is on the family of Ⓐ { 110 }
Ⓑ { 111 } Ⓒ { 211 } Ⓓ { 321 } Which one of the following materials has the highest specific heat?
Ⓐ Zirconium 　　Ⓑ Graphite 　　　Ⓒ Diamond 　　　Ⓓ Phenolic

5. The minimum stress necessary to introduce yielding occurs when a single crystal is oriented such that Φ equals
Ⓐ180° 　　　　Ⓑ120° 　　　　　Ⓒ90° 　　　　　Ⓓ45°

6. The strength of materials can be improved by grain size reduction according to
ⒶFick's law 　　ⒷNewton's law 　　ⒸHall-Petch equation 　ⒹEinstein equation

7 Diamond is very hard and has a high refractive index. Its structure is
Ⓐrocksalt 　　　Ⓑperovskite 　　Ⓒderivative zinic blende Ⓓcorundum

8. The fracture toughness of materials indicates the properties of
Ⓐhardness 　　　　　　　　　Ⓑenergy absoption at fracture
Ⓒstrength 　　　　　　　　　Ⓓresistance to crack propagation

9. The strength of ceramics is usually determined by
Ⓐbending test 　Ⓑtensile test 　　Ⓒcompressive test 　Ⓓshear test

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10. The materials relatively sensitive to temperature in ductile to brittle transitive are
　　Ⓐlow strength FCC metals　　　　　　Ⓑlow strength BCC steels
　　Ⓒhigh strength materials　　　　　　Ⓓ low strength HCP matals

11 The fatigue fracture is characterized by fractographs with
　　Ⓐbrittle　　　　　　Ⓑductile　　　　　　Ⓒbeachmarks　　　　　　Ⓓcup and cone

12. The purpose of Na_2O addition to glass is
　　Ⓐto increase strength　　　　　　Ⓑto decrease melting point
　　Ⓒto improve chemical resistance　　　　　　Ⓓto increase refractive index

13 In a phase diagram of Al_2O_3-SiO_2 , you can not find the phases of
　　Ⓐcorundum　　　　　　Ⓑmullite　　　　　　Ⓒglass　　　　　　Ⓓcristobalite

14. A phase transformation of δ (s) +L↔ϵ (s) is
　　Ⓐperitectic　　　　　　Ⓑeutectic　　　　　　Ⓒentectoid　　　　　　Ⓓspinodal decomposition

15 Using the Gibbs phase rule to calculate the number of degrees of freedom F for the Cu-Ag
　　binary system in the single phase field α , F is
　　Ⓐ1　　　　　　Ⓑ2　　　　　　Ⓒ3　　　　　　Ⓓ4

16. Following the Fe-C phase diagram, an iron alloy containing 0.76% C is slowly cooled down to
　　a temperature just below 727℃, the phases determined could be
　　Ⓐ$\alpha+\gamma$　　　　　　Ⓑ$\alpha+C$　　　　　　Ⓒ$\alpha+Fe_3C$　　　　　　Ⓓ$\gamma+Fe_3C$

17 Most rubber materials are vulcanized by adding
　　ⒶC　　　　　　ⒷS　　　　　　ⒸP　　　　　　ⒹN
　　to improve its mechanical properties.

18. A phase composed of a ferrite matrix and elongated particles of Fe_3C in a needle or plate form is
　　called
　　Ⓐmartensite　　　　　　Ⓑbanite　　　　　　Ⓒaustenite　　　　　　Ⓓpearlite

19. To increase the hardenability of a carbon steel alloying elements like
　　ⒶMn　　　　　　ⒷNa　　　　　　ⒸK　　　　　　ⒹCa
　　could be added to change the positions and shapes of the curves in the isothermal transformation

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diagrams.

20. The densisty of a glass depends on
　　Ⓐcooling rate　　　　　　　　　　　Ⓑheating rate
　　Ⓒforming pressure　　　　　　　　　Ⓓmelting point during processing.

21 In a semiconductor the band gap is about
　　Ⓐ4 eV　　　　　Ⓑ3 eV　　　　　Ⓒ2 eV　　　　　Ⓓ0 eV

22. The diffusion of NaCl polycrystals at temperatures below 500 ℃ is dominated by diffusion of
　　Ⓐlattice　　　　Ⓑstacking fault　　　Ⓒgrain boundary　　Ⓓpoint defects.

23. An Si semiconductor doped with Sb is called
　　Ⓐp-type　　　　Ⓑn-type　　　　　Ⓒa-type　　　　　Ⓓd-type.

24. The electrical conductivity and electron mobility for aluminum are $3.8 \times 10^7 (\Omega\text{-m})^{-1}$ and 0.0012 $m^2/v\text{-s}$ respectively. For an aluminum specimen of 15 mm thick for a current of 25A and a magnetic field of 0.6 tesla, the Hall voltage is calculated as
　　Ⓐ$+2.45 \times 10^{-2}$ V　Ⓑ$+3.16 \times 10^{-8}$ V　Ⓒ-2.45×10^{-2} V　Ⓓ-3.16×10^{-8} V

25 The 304 stainless steel is used extensively as characterized with corrosion resistance and behaviors of
　　Ⓐmagnetic　　　Ⓑnonmagnetic　　　Ⓒhard　　　　　Ⓓlow electrical resistivity.

26. Ductile iron can be made by adding a small cemount of
　　ⒶCa　　　　　　ⒷMg　　　　　　ⒸTi　　　　　　　ⒹZn
　　to the gray iron before casting.

27 The alloys of
　　ⒶZr　　　　　　ⒷTi　　　　　　ⒸW　　　　　　　ⒹAl
　　could be used as bone surgical implants due to its low density, high elastic modulus and chemical inertness.

28. Which one of the following can not happen for superconductor below Curie temperature?
　　Ⓐ Deceasing dramatic of resistivity　　　Ⓑ Diamagnetic property
　　Ⓒ Meissner effect　　　　　　　　　　　Ⓓ Increasing of thermal conduction

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29. For the alumina sintering, the density can be promoted by adding

    ⒶMgO　　　　　ⒷZrO_2　　　　　ⒸNa_2O　　　　　ⒹTiO_2

30. Color in aluminum oxide, ruby is caused by

    Ⓐ oxygen vacancy　　　　　　　Ⓑ aluminum vacancy

    Ⓒ defect level created by doped ions　　Ⓓ luminescence

系所組別　材料科學及工程學系

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科目名稱　材料力學

每題為 4 選 1，每一題答對得 3 分，答錯倒扣 0.75 分。

31 A circular brass rod (weight density r is 85 kN/m^3) of length L, and diameter d is hung vertically to support a weight W at its lower end. The maximum stress in the rod can be expressed as:

  Ⓐ $W+rL$　　　Ⓑ $W/2\pi d + r^2L$　　　Ⓒ $4W/\pi d^2 + rL$　　　Ⓓ $4W/r^2L$.

32. (Continued). Now we know $L=20m$, $d=6mm$, and $W=0.3 kN$　The maximum stress (MPa) is

  Ⓐ 5.7　　　Ⓑ 9.8　　　Ⓒ 3.3　　　Ⓓ 12.3

33 (Continued). From Tresca criterion, the maximum shear stress in the rod is

  Ⓐ 6.2　　　Ⓑ 4.9　　　Ⓒ 5 7　　　Ⓓ 7 1

34. According to Considère, the work hardening coefficient is numerically equal to

  Ⓐ strain rate　　　Ⓑ true stress　　　Ⓒ yield stress　　　Ⓓ uniform strain.

35 A block of silicon nitride is in the following state of stress. $\sigma_x=5$, $\sigma_y=-3$, $\tau_{xy}=2$ (MPa). What is the maximum normal stress (in MPa)?

  Ⓐ 3.47　　　Ⓑ 5.47　　　Ⓒ 13.3　　　Ⓓ 4.47

36. (Continued). What is the maximum shear stress (in MPa)?

  Ⓐ 3.47　　　Ⓑ 5.47　　　Ⓒ 13.3　　　Ⓓ 4.47

37 The beam having the cross-sectional area shown in the figure is subjected to a moment of 15kN.m. Determine the bending stresses at points A, B and C in the beam.

  Ⓐ $\sigma_A > \sigma_B > \sigma_C$　　Ⓑ $\sigma_A > \sigma_C > \sigma_B$　　Ⓒ $\sigma_B > \sigma_A > \sigma_C$　　Ⓓ $\sigma_B > \sigma_C > \sigma_A$

（背面仍有題目，請繼續作答）

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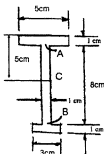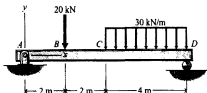
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38. The beam is loaded and supported as shown in figure and determine the bending moment at points of B, C and D.

Ⓐ $M_B > M_C > M_D$　Ⓑ $M_B > M_D > M_C$　Ⓒ $M_C > M_B > M_D$　Ⓓ $M_C > M_D > M_B$

39. Assuming the bending stress at point K is tension stress of 35.0 MPa and the cross-sectional dimensions of the beam as shown in figure, what is correct for the bending stress at point H?
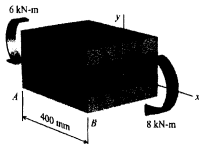
Ⓐ $\sigma_H = 102$ MPa　Ⓑ $\sigma_H = 68$ MPa　Ⓒ $\sigma_H = 34$ MPa　Ⓓ $\sigma_H = 17$ MPa.
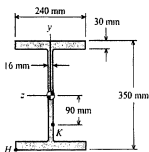
40. A beam segment subjected to internal bending moments of $M_A = -6$ kN-m and $M_B = -8$ kN-m at sections A and B about the z-axis is shown along with a sketch of the cross-sectional dimensions. What is correct for the bending stress at points A and B?

Ⓐ $\sigma_B / \sigma_A = 3/4$　Ⓑ $\sigma_B > 0$　Ⓒ $\sigma_A > 0$　Ⓓ $\sigma_B / \sigma_A = 4/3$

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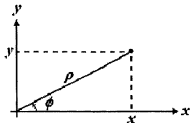※ 考生請注意．本試題 ☑可 □不可 使用計算機

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。

41 Which of the following equations regarding the differential distance dx is correct?

Ⓐ $dx = \sin\phi \; d\rho + \rho \cos\phi \; d\phi$ 　　　Ⓑ $dx = \sin\phi \; d\rho - \rho \cos\phi \; d\phi$

Ⓒ $dx = \cos\phi \; d\rho + \rho \sin\phi \; d\phi$ 　　　Ⓓ $dx = \cos\phi \; d\rho - \rho \sin\phi \; d\phi$

42. $\dfrac{d^2 z}{dy^2} = 0$, and $z(0) = \nabla, z(L) = 0$, then $z =$

Ⓐ $\nabla y + \nabla L$ 　　Ⓑ $-\dfrac{\nabla}{L} y + \nabla$ 　　Ⓒ $-\nabla y + \nabla$ 　　Ⓓ $-\nabla y - \nabla L$

43 The eigenvalues of $\begin{bmatrix} 1 & -1 \\ -1 & 1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} = \lambda \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$ are

Ⓐ 2 and 1,　　Ⓑ 2 and 0;　　Ⓒ 1 and 0;　　Ⓓ 1 and -1.

44. Which of the following equations is not correct?

Ⓐ $e^{i\theta} = \cos\theta + i\sin\theta$

Ⓑ $\cos(n\theta) + i\sin(n\theta) = (\cos\theta + i\sin\theta)^n$

Ⓒ $\cos\theta = (e^{i\theta} + e^{-i\theta})/2$

Ⓓ $\sin\theta = (e^{i\theta} - e^{-i\theta})/2$

45 The particular solution of the initial value problem. $(\cos wx + w\sin wx)dx + e^x dy = 0$, $y(0) = 1$ is

Ⓐ $y = e^{-x}\cos wx$ 　　　　　　　　Ⓑ $y = e^{-x}\sin wx$

Ⓒ $y = e^x \cos wx$ 　　　　　　　　Ⓓ $y = e^x \sin wx$

46. The general solution of the equation. $20y'' + 4y' + y = 0$

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    (A) $y = e^{-0.1x}(A\cos 0.2x + B\sin 0.2x)$ (B) $y = e^{-0.1x}(A\cos 0.2x + Bx\sin 0.2x)$

    (C) $y = e^{-0.1x}(A\cos 0.2x + B\sin 0.2x)$ (D) $y = A\cos 0.2x + B\sin 0.2x$

47. The mathematic model for a mass-spring system is $my^{''} + cy^{'} + ky = 0$. If the mass moves in the case of underdamping. Then which of the following condition is correct?

    (A) $c^2 = 4mk$ (B) $c^2 > 4mk$ (C) $c^2 < 4mk$ (D) $c^2 \geq 4mk$

48. For a differential equation. $y^{''} + ay^{'} + by = 0$, if $a^2 - 4b > 0$. Which of the following solutions is correct?

    (A) $y = c_1 e^{\lambda_1 x} + c_2 e^{\lambda_2 x}$ (B) $y = e^{\frac{-a}{2}x}(c_1 + c_2 x)$

    (C) $y = e^{\frac{-a}{2}x}(c_1 + c_2 \ln x)$ (D) $y = e^{\frac{-a}{2}x}(A\cos wx + B\sin wx)$

49. For a differential equation. $x^2 y^{''} + axy^{'} + by = 0$, if $a^2 - 2a - 4b + 1 > 0$. Which of the following solutions is correct?

    (A) $y = c_1 x^{m_1} + c_2 x^{m_2}$ (B) $y = x^m(c_1 + c_2 \ln x)$

    (C) $y = x^m(A\cos wx + B\sin wx)$ (D) $y = x^m(c_1 + c_2 x)$

50. The Laplace transform of $e^{at}\cos wt$ is

    (A) $\dfrac{w}{(s-a)^2 + w^2}$ (B) $\dfrac{s-a}{(s-a)^2 + w^2}$

    (C) $\dfrac{s-a}{(s-a)^2 - w^2}$ (D) $\dfrac{w}{(s-a)^2 - w^2}$