國　立　清　華　大　學　命　題　紙

九十三學年度 材料科學工程 系（所） ＿＿＿＿ 組碩士班入學考試

科目 理工學力測驗二 科號 1302 共 13 頁第 1 頁 *請在試卷【答案卷】內作答

普通物理

1. 月亮距離地球有 38 萬公里，繞地球一圈大約 30 天。現有一人造衛星離地球 3.8 萬公里，那這顆人造衛星繞地球一圈需要多久時間: (a)15 天　(b)10 天　(c)5 天　(d)1 天　(e)1 小時

2. 某高分貝比賽中，甲在距離 10 公分呼喊，測的分貝值是 120 dB; 乙在距離 20 公分呼喊，測到的分貝值是 117 dB。假設兩人音量不變且在同一個距離呼喊，請問哪一個會得冠軍: (a)甲　(b)乙　(c)平手　(d)視當天的溫度而定(e)以上皆非

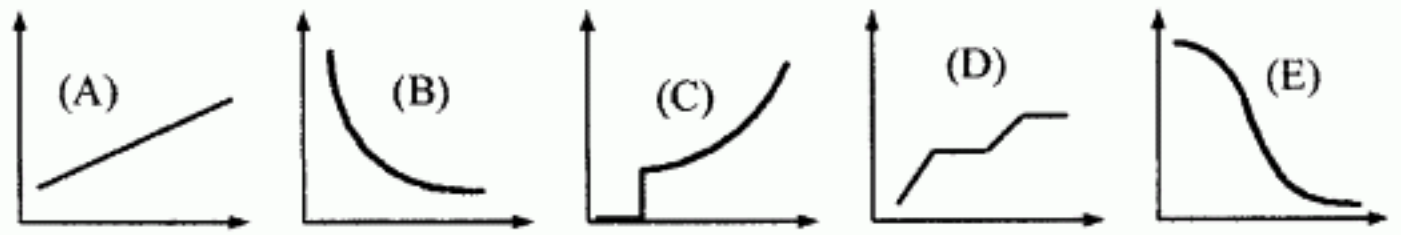
3. 一條金屬線長 2 公尺重 200 公克，在兩端施以 10 牛頓的力量。請問繩波在此金屬線上傳遞的速度是: (a)5　(b)10　(c)20　(d)200　(e)2000 m/s

4. 一均勻木棒質量 M 長度 L，以其質心爲轉動軸得到的轉動貫量 $1/12ML^2$。如果以其端點爲轉動軸，則其轉動慣量變爲: (a) $1/2ML^2$　(b)$1/3ML^2$　(c)$1/4ML^2$　(d)$1/12ML^2$　(e)$1/6ML^2$

5. 一物體質量 m 做簡諧震盪，它的位置與時間的關係是可以表示爲 $x(t) = A\cos(\omega t + \pi/2)$。請問動能最大值是發生在哪一個位置時: (a) $x = A$　(b) $x = -A$　(c) $x = 0$　(d) $x = \frac{1}{2}A$　(e) $x = -\frac{1}{2}A$

6. 下列敘述何者錯誤? (a)點電荷 q 在電位 V 處,則系統的電位能是 qV. (b)帶電荷 Q 的金屬球表面電位 V 時,金屬球的電位能是 QV. (c)導體表面附近的電場正比表面電荷密度. (d)即使導體空腔內有電荷,導體內部的電場仍爲零. (e)高斯(Gauss)定律適用於非靜電平衡條件下.

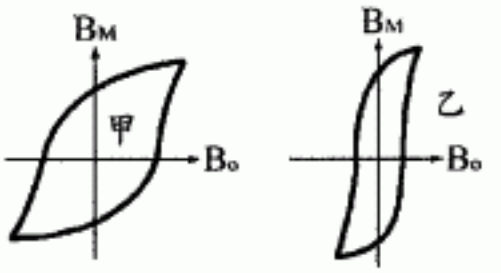
7. 橫軸爲溫度, 縱軸爲導電率 (conductivity), 下列何者最像半導體?



8. 帶負電的高速粒子由太空鉛直射向赤道, 因受地球磁場作用而 (a) 向東偏轉, (b) 向西偏轉, (c) 向南偏轉, (d) 向北偏轉, (e) 不偏轉且加速.

9. 理想螺旋管 (solenoid) 的電流隨時間變化, 產生導線內電荷加速度 a, 假設 r 是與管中心軸的距離, 則感應電場 (a) 在管內正比於 r^2a, (b) 在管內正比於 ra, (c) 在管外正比於 $r^{-2}a$, (d) 在管外正比於 $r^{-1}\,da/dt$, (e) 在管外爲零.

10. 有關磁性物質的描述, 何者不對? (a)物質的磁性來自不成對電子的自旋角動量. (b)抗磁性(diamagnetism)物質沒有永久磁矩(dipole moment). (c)室溫下順磁性(paramagnetism)不易顯現出來. (d)鐵磁性(ferromagnetism)物質在高於居里(Curie)溫度具有順磁性. (e)由下圖甲乙的磁滯曲線(B_M, B_0 分別是物質內磁場與外加磁場),知甲相對於乙是軟鐵磁物質.



普通化學

11. Which of the compounds is an example of network solid?

(a) $S_8(s)$ (b) MgO(s) (c) NaCl(s) (d) $C_{25}H_{52}(s)$ (e) $SiO_2(s)$

12. Rank the following compounds according to increasing solubility in water.

I. CH_3-CH_2-CH_2-CH_3

II. CH_3-CH_2-O-CH_2-CH_3

III. CH_3-CH_2-OH

IV. CH_3-OH

(a) I < III < IV < II (b) I < II < IV < III (c) I < II < III < IV

(d) III < IV < II < I (e) No order is correct.

13. Which of the following coordination compounds will form a precipitate when treated with an aqueous solution of $AgNO_3$?

(a) $[Cr(NH_3)_3Cl_3]$ (b) $[Cr(NH_3)_6]Cl_3$ (c) $[Cr(NH_3)Cl]SO_4$

(d) $Na_3[CrCl_6]$ (e) $Na_3[Cr(CN)_6]$

14. A d^6 ion (Fe^{2+}) is complexed with six strong-field ligands (for example, SCN^-). What is the number of unpaired electrons in this complex?

(a) 0 (b) 1 (c) 2 (d) 3 (e) 4

15. A radioactive isotope of vanadium $^{53}_{23}V$, decays by producing β particles and gamma rays. The nuclide formed has the atomic number:

(a) 22 (b) 21 (c) 23 (d) 24 (e) none of the above

16. What is the change in internal energy of a system that absorbs 455 J of the heat and does 325 J of work?

(a) 780 J (b) 130 J (c) -130 J (d) -780 J (e) 0 J

17. Calcium oxide(lime) reacts with water to form calcium hydroxide (salked lime)

$CaO_{(s)} + H_2O_{(l)} \rightarrow Ca(OH)_{2(s)}$ $\triangle H = -65.2$ kJ

How many kilojoules of heat are evolved in the reaction of 0.500 kg CaO(s) with an excess of water?

(hints: $^{40}_{20}Ca$ $^{1}_{1}H$ $^{16}_{8}O$)

(a) -581.2 kJ (b) -130.4 kJ (c) 1164.3 kJ (d) 581.2 kJ (e) 130.4 kJ

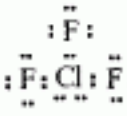
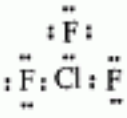
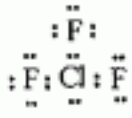
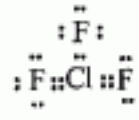
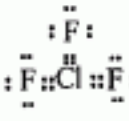
18. What is the lowest numbered principal shell in which the *f* subshell can be found?

(a) 1 (b) 2 (c) 3 (d) 4 (e) 5.

19. Which of the following salts shows that the lowest solubility in water (Ksp values are $Ag_2S = 1.6*10^{-49}$; $Bi_2S_3 = 1.0*10^{-72}$; $HgS = 1.5*10^{-5}$; $Mg(OH)_2 = 8.9*10^{-12}$; $MnS = 3.2*10^{-3}$)

(a) Ag_2S (b) Bi_2S_3 (c) HgS (d) $Mg(OH)_2$ (e) MnS

20. What is the Lewis structure of ClF_3

(a)  (b)  (c)  (d)  (e) 

工程數學

21. Let $\mathbf{u}_1 = (1,0,0,0)$, $\mathbf{u}_2 = (1,1,0,0)$, $\mathbf{u}_3 = (1,1,1,0)$, $\mathbf{u}_4 = (1,1,1,1)$, $\mathbf{u}_5 = (0,0,0,1)$, $\mathbf{u}_6 = (3,3,3,3)$. How many of the following vector spaces are 3-dimensional? $\text{span}\{u_1,u_3,u_5\}$, $\text{span}\{u_1,u_4,u_6\}$, $\text{span}\{u_2,u_4,u_6\}$, $\text{span}\{u_3,u_4,u_5,u_6\}$ (a) 1, (b) 2, (c) 3, (d) 4, (e) none of the above.

22. Evaluate the inverse matrix of $\begin{bmatrix} 0 & 0 & 1 \\ 0 & 1 & 0 \\ 1 & 0 & 0 \end{bmatrix}$. Which is its possible inverse matrix? (a) $\begin{bmatrix} 0 & & \\ & 1 & \\ & & 0 \end{bmatrix}$, (b) $\begin{bmatrix} 1 & & \\ & 0 & \\ & & 1 \end{bmatrix}$, (c) $\begin{bmatrix} 1 & & \\ & 0 & \\ & & 0 \end{bmatrix}$, (d) $\begin{bmatrix} 1 & & \\ & 1 & \\ & & 0 \end{bmatrix}$, (e) none of the above.

23. The eigenvalues of the matrix $\begin{bmatrix} 1 & 0 \\ 1 & 0 \end{bmatrix}$ are: (a) 1,1, (b) 0,0, (c) 0,1, (d) 0,-1, (e) none of the above.

24. The eigenvectors of the matrix $\begin{bmatrix} 1 & 0 \\ 1 & 0 \end{bmatrix}$ are: (a) $\begin{bmatrix} 0 \\ 1 \end{bmatrix}, \begin{bmatrix} 1 \\ 0 \end{bmatrix}$, (b) $\begin{bmatrix} 0 \\ 1 \end{bmatrix}, \begin{bmatrix} 1 \\ -1 \end{bmatrix}$, (c) $\begin{bmatrix} 0 \\ 1 \end{bmatrix}, \begin{bmatrix} -1 \\ 0 \end{bmatrix}$, (d) $\begin{bmatrix} 0 \\ 1 \end{bmatrix}, \begin{bmatrix} 1 \\ 1 \end{bmatrix}$, (e) none of the above.

25. The rank of the matrix $\begin{bmatrix} 2 & -1 & 1 & 0 \\ 0 & 3 & 3 & 6 \\ 1 & 4 & 5 & 9 \end{bmatrix}$ is: (a)1, (b)2, (c) 3, (d) 4, (e) none of the above

26. Which of the following equations is INCORRECT?

(a) $x = x(u,v),\ y = y(u,v)$, then $\dfrac{\partial(x,y)}{\partial(u,v)} \cdot \dfrac{\partial(u,v)}{\partial(x,y)} = 1$

(b) $x = x(u,v),\ y = y(u,v)$, then $\dfrac{\partial x}{\partial u} \cdot \dfrac{\partial u}{\partial x} + \dfrac{\partial x}{\partial v} \cdot \dfrac{\partial v}{\partial x} = 1$

(c) $x = x(u,v),\ y = y(u,v)$, then $\dfrac{\partial x}{\partial u} \cdot \dfrac{\partial u}{\partial y} + \dfrac{\partial x}{\partial v} \cdot \dfrac{\partial v}{\partial y} = 1$

(d) $f = f(x,y)$ and $x = x(t),\ y = y(t)$, then $\dfrac{df}{dt} = \dfrac{\partial f}{\partial x} \cdot \dfrac{dx}{dt} + \dfrac{\partial f}{\partial y} \cdot \dfrac{dy}{dt}$

(e) a, b are constants, then $\dfrac{d}{dt}\int_a^b f(x,t)\,dx = \int_a^b \dfrac{\partial}{\partial t} f(x,t)\,dx$

27. Which of the following vectors is normal to the parametric surface $S: x = u,\ y = u + v^2,\ z = v + 1$ at the point $u = 3, v = 2$?

(a) $\hat{\mathbf{i}} - \hat{\mathbf{j}} + 2\hat{\mathbf{k}}$ (b) $\hat{\mathbf{i}} + \hat{\mathbf{j}} + \hat{\mathbf{k}}$ (c) $\hat{\mathbf{i}} - 2\hat{\mathbf{j}} + 2\hat{\mathbf{k}}$ (d) $\hat{\mathbf{i}} - \hat{\mathbf{j}} + 4\hat{\mathbf{k}}$ (e) $2\hat{\mathbf{i}} + \hat{\mathbf{j}} + \hat{\mathbf{k}}$

28. The spherical coordinates (ρ, ϕ, θ) and the Cartesian coordinates (x, y, z) are related by $x = \rho\sin\phi\cos\theta,\ y = \rho\sin\phi\sin\theta$, and $z = \rho\cos\phi$. In a volume V, the integral $\iiint f(x,y,x)\,dx\,dy'dz$ can be transformed to $\iiint f(\rho,\phi,\theta)\,\alpha(\rho,\phi,\theta)\,d\rho\,d\phi\,d\theta$. The transformation function α(ρ, ϕ, θ) is equal to

(a) $\rho^2\sin\phi$ (b) $\rho^2\cos\phi$ (c) $\rho^2\sin\theta$ (d) $\rho^2\cos\theta$ (e) none of the above

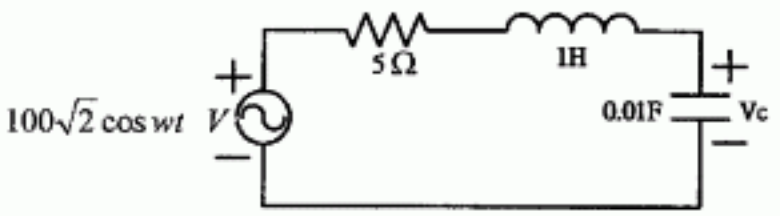
29. The integral $\iint e^{-(x^2+y^2)}dxdy$ in the area $R: r \le 1,\ 0 \le \theta \le \pi$, where r, θ are polar coordinates, is equal to

(a) $\pi(1-e^{-1})$ (b) $\pi(1-e^{-1})/2$ (c) $2\pi(1-e^{-1})$ (d) $4\pi(1-e^{-1})$ (e) $\pi(1-e^{-1})/4$

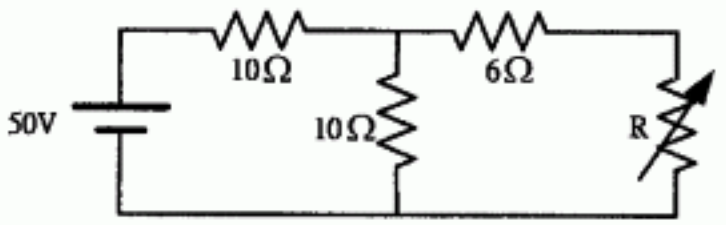
30. Consider a quadrant circle C on the x-y plane with a radius of 2 from (2, 0) to (0, 2). For a vector field $\mathbf{V} = y\hat{\mathbf{j}}$, the line integral $\int_C \mathbf{V}\cdot d\mathbf{s}$ ($d\mathbf{s}$ is the line element vector) along the quadrant circle is

(a) 1 (b) 2 (c) −1 (d) −2 (e) 0

31. It is known that the following circuit is operating at the resonant frequency. Find the rms voltage across the capacitor Vc.
Vc = (a) 80V (b) 100V (c) 160V (d) 180V (e) 200V.



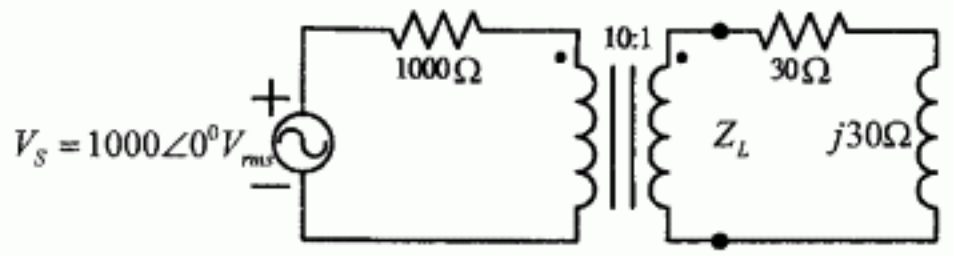
32. Given the following DC circuit , find the value of R such that maximum power dissipated on R can be achieved.
(a) 9Ω (b) 10Ω (c) 11Ω (d) 12Ω (e)13Ω.



33. Consider the following circuit containing an ideal transformer.

Find the real power delivered to the load Z_L.

(a) 120W (b) 140W (c) 160W (d)180W (e)200W.



34. A separately excited DC motor produces a back emf of $E_A = 240V$ at a speed of 1200rpm. Assume that the field current remains constant. Find the back emf for a speed of 600rpm.
(a) 100V (b) 120V (c) 140V (d) 160V (e) 180V

35. A 10-hp six-pole 60Hz three-phase induction motor runs at 1140rpm under full-load conditions. Determine the slip S.
(a) 2% (b) 3% (c) 4% (d) 5% (e) 6%.

36. Find the values (in mA) of I_{D1} and I_{D2} in the circuit of Fig. 1-3 for V_A = 14 V, assuming that the diodes are ideal.

(a) 0, 1 (b) 1.5, 2 (c) -0.5, 1 (d) 0, 2.33 (e) 0.5, 2

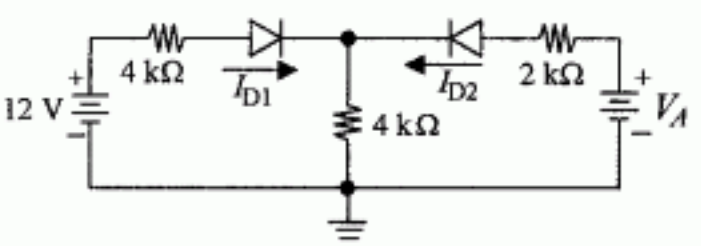


Fig. 1-3

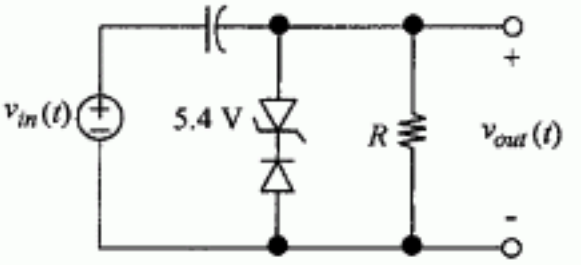


Fig. 4

37. Find the values (in mA) of I_{D1} and I_{D2} in the circuit of Fig. 1-3 for V_A = 12 V, assuming that the diodes are ideal.

(a) 0.75, 1.5 (b) 1.5, 0 (c) 0, 0 (d) 0, 2 (e) 1.75, -1.25

38. Find the values (in mA) of I_{D1} and I_{D2} in the circuit of Fig. 1-3 for V_A = 4 V, assuming that the diodes are ideal.

(a) 2, 0 (b) 1.5, 0 (c) 0, 0 (d) 0.5, 2 (e) 1.5, -4

39. Consider the circuit shown in Fig. 4. Assume the capacitor is large enough so that the voltage across it does not discharge through R appreciably during one cycle of input. What is the steady-state output voltage $v_{out}(t)$ if $v_{in}(t) = 8\sin(\omega t)$. The reverse breakdown voltage of the Zener diode is shown. Allow a 0.6-V forward drop for the diodes.

(a) $8\sin(\omega t)$ (b) - 6 (c) 6 (d) $8\sin(\omega t) + 2$ (e) $8\sin(\omega t) - 2$

40. An amplifier has an input resistance of 100 Ω, an output resistance of 5 Ω, and an open-circuit voltage gain of 500. What is its short-circuit transconductance gain (in S)?

(a) 500 (b) 10000 (c) 100 (d) 5 (e) 5000

熱力學

41. When a system undergoes a change of state by performing (A) and adsorbing (B) simultaneously the magnitude of (A) and (B) must be reaching (C) and the state change is a (D) process.

(a) A = Free energy, B = heat, C = minimum, D = irreversible.

(b) A = entropy, B = internal energy, C = maxima, D = reversible

(c)A = work, B = heat, C = maxima, D = reversible

(d) A = work, B = heat, C = minimum, D = irreversible

(e) A = internal energy, B = enthalpy, C = medium, D = irreversible

42. For an ideal gas the internal energy U is only a function of (A) and the heat capacity $C_p - C_v$ = (B)

(a) A = volume, B = 1 + R

(b) A = entropy, B = R

(c) A = free energy, B = 1- R

(d) A = free energy, B = 3/2R

(e) A = temperature, B = R

43. Given conditions

$H_{298\ K,(graphite)} - H_{298K,(diamond)} = -1900J$

$S_{298\ K,(graphite)} = 5.73J/K$

$S_{298\ K,(diamond)} = 2.43J/K$

P =1 = 0.1013 J

Densities of graphite and diamond at 298 K are 2.22g/cm^3 and 3.515g/cm^3 respectively, and the atomic mass of carbon = 12,

Based on the above conditions the value of ΔG for the transformation of graphite to diamond at p =1, T =298 K is equal to A. If the transformation$_{graphite \rightarrow diamond}$ occurs at any temperature T, then the value of $\Delta V_{graphite \rightarrow diamond} = (\partial \Delta G_{graphite \rightarrow diamond}/\partial P)_T$ = B. Combination of A and B gives a value of pressure (P = C) requirement in order to transform the graphite into diamond at 298 K.

(a) A = 33 J, B = -22 cm^3/mole, C = 11000 atm

(b) A = 168 J, B = 90 cm^3/mole, C = 1022 atm

(c) A = 2099 J, B = -92 cm^3/mole, C = 1500 atm

(d) A = 2883 J, B = -1.99 cm^3/mole, C = 143000 atm

(e) A = 3540 J, B = -143 cm^3/mole, C = 13450 atm

44. Which of following is incorrect

(a) The $\Delta S > 0$ means irreversible process under an isothermal condition.

(b) Carnot cycle represents the maximum heat engine efficiency

(c) $\Delta S = 0$ means reversible process and $\Delta S_{sys} \neq -\Delta S_{surr}$ under an adiabatic condition

(d) In an adiabatic condition the irreversible process means that $\Delta S_{surr} = 0$ and $\Delta S_{sys} = q/T$.

(e) A + B → C + heat, so $\Delta H < 0$, if A + B + heat → C, then $\Delta H > 0$.

45. In the case of ideal gas (PV=nRT) under isothermal condition the volume of combustion chamber is compressed by piston from V_1 to V_2 so the work (w) done to the heat engine system is expressed as

(a) $w = nRT\ (\ln V_2 - \ln V_1)$

(b) $w = nRT\ (\partial P/\partial V)_T$

(c) $w = nRT\ (\Delta Q/dT)_{V2\text{-}V1}$

(d) $w = \Delta V\ (\partial P/\partial T)_p$

(e) $w = \Delta P/P + \Delta V/V(C_p/C_v)$

46. The amount of energy possessed by a diatomic gas molecule for each Cartesian direction of translation motion is (a) kT/2 (b) kT (c) 3kT/2 (d) 2kT (e) 5kT/2.

47. If a pure substance system is under a thermodynamic equilibrium state, how many of the following conditions: (1)$dS_{U,V}\geq 0$, (2) $dG_{T,P}\geq 0$ (3) $dA_{T,V}\geq 0$ (4) $dH_{S,P}\geq 0$ (5) $dU_{S,V}\geq 0$, are correct?
(a) 1, (b) 2, (c) 3, (d) 4, (e) 5.

48. A phase change usually occurs, (1) at a specific temperature and pressure, (2) with the evolution or absorption of heat, (3) over a range of temperature at a given pressure, (4) spontaneously without the absorption or evolution of heat, (5) without passing through stable intermediate states. How many of above statements are correct? (a) 1, (b) 2, (c) 3, (d) 4, (e) 5.

49. A rigid container is divided into two compartments of equal volume with a partition. One contains 2 moles and the other contains 3 moles of the same ideal gas. When the partition is removed, the entropy change is
(a) Rln8, (b) Rln10, (c) Rln16, (d) Rln32 (e) none of above is correct.

50. Which of the following statement is appropriate for a binary regular solution model?
(a) $\Delta H^M=2500X_AX_B$, and $G^{XS}=3000X_AX_B$,
(b) $\Delta H^M=(2500+3000X_B)X_AX_B$, and $\Delta S^M=-R(X_A\ln X_A+X_B\ln X_B)$,
(c) $\Delta H^M=2500X_AX_B$, and $\Delta S^M=-R(X_A\ln X_A+X_B\ln X_B)+2RX_AX_B$,
(d) $G^{XS}=3000X_AX_B(1-RT)$,
(e) none of above is correct.

物理冶金

51. Which of the following factors has less influence on the recrystallization processes of a cold worked metal?
(a) temperature (b) strain or degree of cold work (c) impurity (d) composition (e) the original grain size.

52. The grain boundary energy could be measured using (a) the phenomenon of thermal grooving (b) the interaction between electron and the boundary (c) the relation between resistivity and grain boundary (d) the relation between hardness and grain boundary (e) all of the above

53. Strain aging and sharp yield point are phenomena resulted from (a) the interaction between dislocation and grain boundary (b) the interaction between dislocation and impurities (c) the interaction between stacking faults and grain boundary (d) the interaction between stacking faults and impurities (e) none of the above

54. For a binary system with positive deviation in the variation of the activities with concentration, it means (a) the mixing entropy is smaller (b) the enthalpy is higher (c) the composition is less (d) the bond strength between dissimilar atoms is stronger (e) the atoms of the same kind tend to attract to each other.

55. P is the number of phases, F is the number of degrees of freedom, and C is the number of components in a system. The phase rule is (a) P+C=F+2 (b) F+C=P+2 (c) P+F=C+2 (d) P+C+2=F (e) none of the above

56. 二元系統固定壓力下，有一成份 C 的合金，平衡時在某一溫度下爲固液相共存，且其固相成份爲 S，液相成份爲 L，則固相含量爲
(a) (L–S)/(L–C) (b) (L–S)/(C–S) (c) (L–C)/(C–S) (d) (C–S)/(L–S) (e) (L–C)/(L–S)

57. 利用 Matano 方法求取交互擴散(interdiffusion)係數，<u>不需要</u>下列哪一資料？
(a)誤差函數(the error function)值 (b)濃度隨位置分佈曲線 (c)所求濃度的分佈曲線斜率
(d)標線移動速率 (e) Matano 界面位置

58. 碳原子在 bcc 鐵中的擴散係數 $D = \alpha a^2/\tau_\sigma$，α爲幾何因子，a 爲晶格常數，$\tau_\sigma$爲定應力遲緩時間。其中的α爲多少？
(a) 6 (b) 8 (c) 12 (d) 24 (e) 36

59. 通常能形成金屬玻璃(metallic glass)的合金，其成份有哪一種特徵？
(a)位於包晶點(peritectic point)附近 (b)位於共晶點(eutectic point)附近
(c)位於偏晶點(monotectic point)附近 (d)位於共析點(eutectoid point)附近
(e)位於包析點(peritectoid point)附近

60. 組成過冷(constitutional supercooling)的主要原因是
(a)液體內正向溫度梯度 (b)液體內負向溫度梯度 (c)液體凝固溫度隨成分而變
(d)液體凝固溫度不隨成分而變 (e)固/液界面溫度太低

近代物理

61. The resistivity of Cu at room temperature is 1.72×10^{-8} ohm-m, and the free electron density in Cu is 8.48×10^{28} m^{-3}. What is its mean free path at room temperature? (a) 10.5 nm (b) 38.3 nm (c) 55.3 nm (d) 72.4 nm (e) 102.3 nm.

62. At what k values, the forbidden bands occur in 1-D case? (L is the lattice constant)
(a) $n\pi/L^2$ (b)$n^2\pi/L$ (c) n/L^2 (d) $n^2\pi^2/L^2$ (e) $n\pi/L$.

63. Which statement is **not** correct? (a) electrons in Cu has higher mobility than those in Si. (b) electron density of Cu is higher than that of Si. (c) electrons in GaAs has higher mobility than those in Si (d) GaAs has a direct band gap (e) Si has an indirect band gap.

64. Which statement is **not** correct? (a) Fermi energy of metals is the highest occupied state at 0K (b) Fermi energy of metals is the energy at which the occupancy of electrons is 0.5 at room temperature. (c) Fermi energy of metals is inversely proportional to electron density. (d) The density of state of metals is proportional to $E^{1/2}$ (E is energy of electrons) (e) Fermi energy of Al is higher than that of Li.

65. What is the ionization energy of the electron in the ground state of He^+.
(a) -13.6 eV (b) -3.4 eV (C) -1.51 eV (d) -54.4 eV (e) -27.2 eV.

66. A certain quantity of ice at 0℃ melts into water at 0℃ and in so doing gains 0.1 kg of mass. The latent heat of fusion of the ice is 334 kJ/kg. What was its initial mass?
(a) 2.69×10^{11} kg (b) 2.69×10^{10} kg (c) 2.69×10^{9} kg (d) 2.69×10^{8} kg, (e) none of the above.

67. A spaceship moves past us at 0.8c, and we measure it to be 360 m long. How long would we measure it to be if we were moving along with it?
(a) 300 m, (b) 400 m, (c) 500 m, (d) 600 m, (e) none of the above

68. In a Mössbauer-effect experiment, the change in frequency of a 3.5×10^{18} Hz electromagnetic wave can be detected if the source and absorber have a relative speed of 0.06 mm/s with respect to each other. What is the frequency shift for motion toward each other at this speed ?
(a) 0.35 MHz, (b) 3.5 MHz, (c) 0.7 MHz, (d) 7 MHz, (e) none of the above.

69. In the Compton-effect experiment, at what scattering angle will the recoiling particle have the maximum kinetic energy?
(a) 0° (b) 90° (c) 180° (d) 270° (e) none of the above

70. When the peak frequency from an ideal blackbody is doubled, what happens to the power output (assuming constant area)?
(a) 8 times greater (b) 16 times greater (c) 81 times smaller (d) 16 times smaller. (e) none of the above

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71. Which of the following correctly lists the conformations of cyclohexane in order of increasing energy?
(a). chair < boat < twist < half-chair
(b). half-chair < boat < twist < chair
(c). chair < twist < half-chair < boat
(d). chair < twist < boat < half-chair
(e). half-chair < twist < boat < chair

72. In electrophilic aromatic substitution reactions a chlorine substituent:
(a). is a deactivator and a m-director.
(b).is a deactivator and an o,p-director.
(c). is an activator and a m-director.
(d). is an activator and an o,p-director.
(e). none of the above

73. Predict the two most likely mechanisms for the reaction of 2-iodohexane with sodium ethoxide.
(a). SN2 and SN1
(b). E1 and E2
(c). SN2 and E2
(d). E1 and SN1
(e). E2 and SN1

74. In the proton NMR, in what region of the spectrum does one typically observe hydrogens bound to the aromatic ring?

(a). 1.0-1.5 ppm
(b). 2.0-3.0 ppm
(c). 4.5-5.5 ppm
(d). 7.0-8.0 ppm
(e). 9.0-10.0 ppm

75. While the carbonyl stretching frequency for simple aldehydes, ketones, and carboxylic acids is about 1710 cm-1, the carbonyl stretching frequency for amides is about:

(a) 1700 cm^{-1} (b) 1735 cm^{-1} (c) 1800 cm^{-1} (d) 1660 cm^{-1} (e) 2200 cm^{-1}

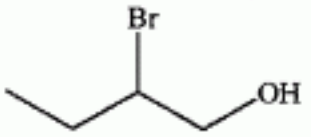
76. Which functional group is not found on an amino acid side chain?

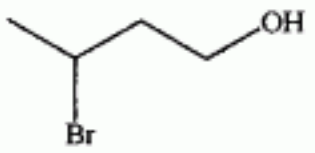
(a) amine
(b) alcohol
(c) carboxylic acid
(d) ester
(e) all of the above are correct

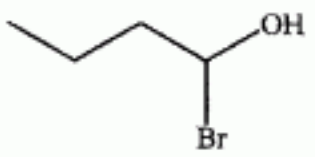
77. Which of the following is not an intermolecular force?

(a) dipole-dipole
(b) ion-ion
(c) resonance
(d) hydrogen bonding
(e) London force

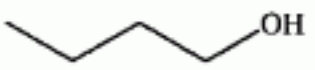
78. Which of the following alcoholic proton is expected to be the most acidic?

(a)


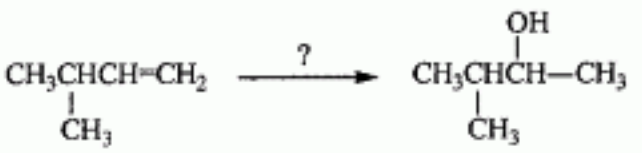
(b)


(c)


(d)


(e)


79. Which is the best reaction sequence to use if one wants to accomplish an alcohol synthesis shown below?



(a) $KMnO_4/H_2O$

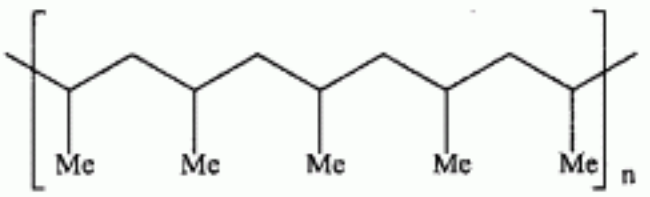
(b) $NaOH/H_2O$

(c) 1) BH_3; 2) H_2O_2/OH^-

(d) 1) $Hg(OAc)_2/H_2O$; 2) $NaBH_4$

(e) none of the above

80. Which monomer can be used to prepare the following polymer:



(a) propylene

(b) isoprene

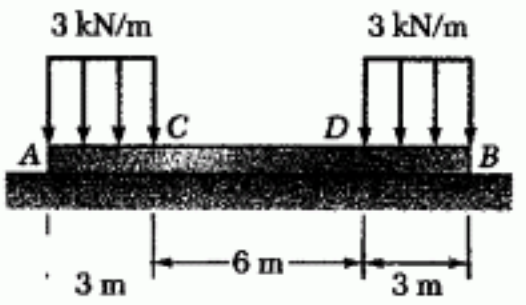
(c) isobutylene

(d) *trans*-pentene

(e) 2-methyl-1-butene

工程力學

81.~82. Assuming the upward reaction of the ground on beam AB to be uniformly distributed, as shown.



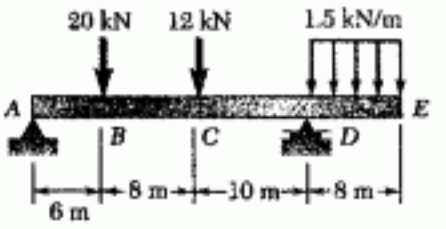
81. The maximum absolute values of the shear in the beam is

(a) 1.5 kN; (b) 3.0 kN; (c) 4.5 kN; (d) 6.0 kN; (e) None of the above

82. The maximum absolute values of the bending moment in the beam is

(a) 10.5 kN· m; (b) 15.0 kN· m; (c) 18.0 kN· m; (d) 20.0 kN· m; (e) None of the above

83.~85. For a beam subjected to the loadings as shown



83. The maximum shear force in the beam is
(a) 8 kN; (b) 12 kN; (c) 14 kN; (d) 18 kN; (e) None of the above

84. The maximum bending moment (in kN· m) is
(a) 24 (b) 48; (c) 92; (d) 108; (e) None of the above

85. Location where the maximum bending moment occurs
(a) Point B; (b) point C; (C) Point D; (d) Point E; (e) None of the above

86. A prismatic bar of diameter d=2 m is stretched by a force P= 7 kN. The tensile stress in the bar is
(a) 2.23 kPa (b) 2.23 MPa (c) 1.75 kPa (d) 1.75 MPa (e) 3.5 MPa

87. A circular prismatic bar of length L=2 m is stretched by a force to elongate 3 mm. The axial strain in the bar is
(a) 0.15 (b) 0.015 (c) 0.0015 (d) 0.00015 (e) 0.000015

88. A circular prismatic bar is stretched by a force. If the axial and the lateral strain are ε_1 and ε_2, respectively, then the Poisson's ratio is defined as.
(a) $\varepsilon_1 x \varepsilon_2$ (b) $-\varepsilon_1/\varepsilon_2$ (c) $\varepsilon_1/\varepsilon_2$ (d) $\varepsilon_2/\varepsilon_1$ (e) $-\varepsilon_2/\varepsilon_1$

89.~90. A prismatic bar of length L is stretched by a force P. The cross sectional area and the modulus of elasticity of the bar are A and E, respectively.

89. The elongation of the bar is
(a) PL/(EA) (b) P/(EA) (c) EA/(PL) (d) EA/P (e) EA/L

90. The strain energy in the bar is
(a) PL/(EA) (b) $(P^2L)/(EA)$ (c) $(P^2L)/(2EA)$ (d) EA/(PL) (e) $(PL^2)/(2EA)$