九十一學年度材料科學工程學系碩士班研究生招生考試

科目 理工學力測驗二 科號 1102 共 10 頁第 1 頁

單選題，以 2B 鉛筆劃在答案卡上：答對一題得 1 分，答錯一題倒扣 0.25 分，未答不計分。

普通物理

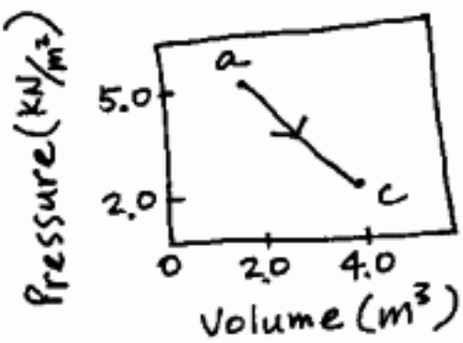
1 假設大氣中的 N_2 和 O_2 的比例是 4 : 1，如果不考慮分子的振動能量，請問大氣的定容比熱是幾 R（R 是理想氣體常數）？(A)0.5, (B)2, (C)2.5, (D)3, (E)以上皆非。

2 理想氣體在絕熱過程中，(A)溫度會上升, (B)滿足 $PV = nRT$, (C)沒有作功, (D) $PV^{\frac{3}{3}} = \text{constant}$, (E)以上皆非。

3 請問繩波的的速度會和繩子的質量密度 ρ 成什麼關係？(A)正比於 ρ, (B)正比於 $\sqrt{\rho}$, (C)反比於 ρ, (D)主要和繩子的張力有關，ρ 其實不重要, (E)以上皆非。

4 如果質點從球頂由於重力而沿著球面滑下來，已知它會在 $\cos\theta = \frac{2}{3}$ 時(θ 是一般的球座標，從頂端量起)被甩開（即脫離球面）；現在如果把質點的大小考慮進來，當成一個小球，並且假設它是用滾的（不滑）下來，請問脫離球面的角度會比θ (A)大（指在低一點的緯度）, (B)小, (C)一樣, (D)答案會隨質點球的大小而異, (E)以上皆非。

5 一摩耳單原子理想氣體由 a 狀態，經 ac 過程，膨脹到 c 狀態，(A)內能增加 3000 *joule*, (B)需吸收 4000 *joule* 的熱量, (C)答案會隨路徑而異，所以如果 ac 過程不是直線，答案會變,(D)需放出 4000 *joule* 的熱量, (E)以上皆非。

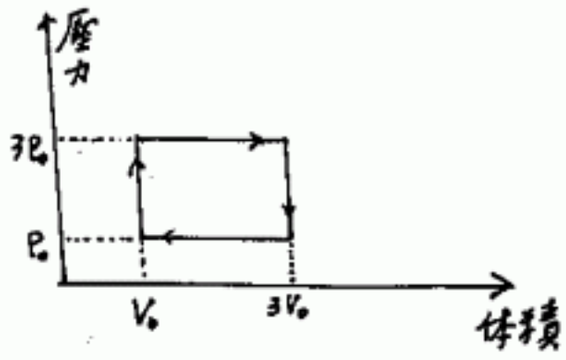


6 兩質量爲 m 的木塊以一力常數爲 k 的彈簧相連接，此系統被放置在水平的光滑桌面上。起始時彈簧在其自然長度，今敲擊其中一木塊，使其在彈簧長度方向產生一速度 v，另一木塊在此瞬時仍爲靜止，則在此以後系統運動過程中，彈簧的最大壓縮量爲 (A) $\frac{v}{3}\sqrt{m/k}$ (B) $\frac{v}{\sqrt{3}}\sqrt{m/k}$ (C) $\frac{v}{2}\sqrt{m/k}$ (D) $\frac{v}{\sqrt{2}}\sqrt{m/k}$ (E) $v\sqrt{m/k}$。

7 A、B 兩質點質量皆爲 1 公斤，A 質點向 x 方向以速度 60 公尺/秒運動，B 質點向 y 方向以速度 80 公尺/秒運動，兩質點在原點發生非彈性碰撞，碰撞後兩質點合而爲一，質量爲 2 公斤；則在此碰撞過程中，兩質點損失的動能爲
(A)1200 (B) 2500 (C) 3000 (D) 3600 (E) 4800 焦耳。

8 一質量爲 m 的質點，由一半徑爲 R 的半圓形軌道上端，自靜止下滑(如附圖所示)；設此軌道內面完全光滑，重力加速度爲 g；則質點在軌道最低點時，受到軌道之正向力爲 (A) mg (B) 3/2mg (C) 2mg (D) 5/2mg (E) 3mg。

9 一熱力系統進行如附圖所示的循環過程，則每一循環此系統所吸收的淨熱能爲 (A) P_0V_0 (B) $2P_0V_0$ (C) $3P_0V_0$ (D)4 P_0V_0 (E)6 P_0V_0。



單選題，以 2B 鉛筆劃在答案卡上：答對一題得 1 分，答錯一題倒扣 0.25 分，未答不計分。

10 一理想氣體系統，其中分子爲 CH_4，假定各分子中原子的相互振盪未能被激發，僅考慮分子的移動及轉動，依能量等配原理，此氣體的莫耳定壓比熱 C_p(以氣體常數 R 表示)爲(A)2R (B) $\frac{5}{2}$R (C)3R (D)$\frac{7}{2}$R(E)4R。

普通化學

11 How many different first ionization energies are there for sodium in its ground state? (A) 1 (B) 2 (C) 3 (D) 4 (E) none of the above.

12 Which of the lists of substances is in the order of increasing nitrogen-nitrogen bond strength?
(A) N_2, HNNH (B) HNNH, H_2NNH_2 (C) HNNH, N_2 (D) N_2, H_2NNH_2 (E) none of the above.

13 Rust is formed by the action of water and oxygen on iron. The formula for rust is (A) FeO (B) Fe_2O_3 (C) $Fe_2O_3.H_2O$ (D) FeO_2 (E) none of the above.

14. Consider the reaction, CaC_2 + water ----> products. Which of the following is a product? (A) Ca (B) CH_4 (C) $Ca(OH)_2$ (D) H_2 (E) none of the above.

15. Which of the following does not affect the pH of its aqueous solution?
(A) KF (B) NH_4NO_3 (C) HCN (D) NaCN (E) none of the above.

16. Which of the following is not a pure substance? (A) pure gold (B) clean air (C) distilled water (D) refined sugar (E) diamond crystal

17. Which of the following molecules is polar?
(A) CCl_4 (B) CO_2 (C) CH_4 (D) $CHCl_3$ (E) I_3

18. Which of the following has a zero bond order?
(A) H_2 (B) H_2^- (C) H_2^+ (D) He_2 (E) He_2^+

19. Which of the following is not a paramagnetic substance? (A) B_2 (B) C_2 (C) N_2^+ (D) O_2 (E) F_2^+

20. Which of the following metals has a molar heat capacity different from others at 300 K? (A) Al (B) Fe (C) B (D) Mg (E) Ga

工程數學

21 Find the inverse matrix of $\begin{bmatrix} 3 & -1 \\ 3 & -2 \end{bmatrix}$. Which one of the following is the diagonal elements of the inverse matrix? (A) $\begin{bmatrix} 2/3 & ? \\ ? & -1/3 \end{bmatrix}$,(B) $\begin{bmatrix} 2/3 & ? \\ ? & 1 \end{bmatrix}$,(C) $\begin{bmatrix} -2/3 & ? \\ ? & 1 \end{bmatrix}$,(D) $\begin{bmatrix} 2/3 & ? \\ ? & -1 \end{bmatrix}$, (E) none of the above.

22 What are the eigenvalues of the matrix $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$?
(A)0,0, (B) 0,1, (C) 1,1, (D) -1,-1, (E) none of the above.

單選題，以 2B 鉛筆劃在答案卡上；答對一題得 1 分，答錯一題倒扣 0.25 分，未答不計分。

23 What is the eigenspace of the matrix $\begin{bmatrix}1 & 0\\ 0 & 1\end{bmatrix}$?

(A) Span $\left\{\begin{bmatrix}1\\0\end{bmatrix},\begin{bmatrix}0\\1\end{bmatrix}\right\}$, (B) Span $\left\{\begin{bmatrix}1\\1\end{bmatrix},\begin{bmatrix}2\\1\end{bmatrix}\right\}$, (C) Span $\left\{\begin{bmatrix}-1\\0\end{bmatrix},\begin{bmatrix}0\\1\end{bmatrix}\right\}$, (D)all of the above, (E) none of the above.

24 Diagonalize the matrix $A = \begin{bmatrix}1 & 0\\ 1 & 0\end{bmatrix}$ such that $Q^{-1} A Q = D$ is diagonal. Which one is the possible Q?

(A) $\begin{bmatrix}1 & 1\\ 0 & -1\end{bmatrix}$ (B) $\begin{bmatrix}1 & 0\\ 0 & 1\end{bmatrix}$ (C) $\begin{bmatrix}0 & 1\\ 1 & 1\end{bmatrix}$ (D) $\begin{bmatrix}0 & 1\\ 1 & 0\end{bmatrix}$ (E) none of the above.

25 What is the possible diagonalized matrix of the previous matrix $\begin{bmatrix}1 & 0\\ 1 & 0\end{bmatrix}$?

(A) $\begin{bmatrix}0 & 0\\ 0 & 1\end{bmatrix}$ (B) $\begin{bmatrix}1 & 0\\ 0 & 1\end{bmatrix}$ (C) $\begin{bmatrix}0 & 0\\ 0 & -1\end{bmatrix}$ (D) $\begin{bmatrix}-1 & 0\\ 0 & -1\end{bmatrix}$ (E) none of the above.

26 The tangent plane at (1, 3, –2) on the surface $3x^2 + y^2 + z^2 = 16$ is (A) $3x + y + z = 4$

(B) $3x + 3y - 2z = 16$ (C) $x + 3y - 2z = 14$ (D) $3x + 3y + 2z = 8$ (E) $3x + y - z = 8$.

27 If $(y - 2x)e^y - x^2 + 1 = 0$, the first-order expansion of $y(x)$ about $x = 1$ is (A) $y(x) = 2 + 2e^2(x - 1)$ (B)

$y(x) = 2 + 2(e^2 + 1)(x - 1)$ (C) $y(x) = 2 + 2(e^2 - 1)(x - 1)$ (D) $y(x) = 2 + 2e^{-2}(x - 1)$

(E) $y(x) = 2 + 2(1 + e^{-2})(x - 1)$.

28 The integral $\iint_R x^2 y dx dy$ in the region R defined $x = 0$, $y = 1$, and $y = x$ is equal to

(A) $\frac{1}{15}$ (B) $\frac{1}{12}$ (C) $\frac{1}{5}$ (D) $\frac{1}{4}$ (E) $\frac{1}{3}$.

29 The integral $\int_0^{\pi/2}\int_x^{\pi/2} \frac{\sin y}{y} dy dx$ is equal to (A) 1/2 (B) 1 (C) 2 (D) π (E) $\pi/2$.

30 The spherical coordinates (r, θ, ϕ) and the Cartesian coordinates (x, y, z) are related by

$x = r\sin\theta\cos\phi$, $y = r\sin\theta\sin\phi$, and $z = r\cos\theta$. The Jacobian $\frac{\partial(x,y,z)}{\partial(r,\theta,\phi)}$ is equal to

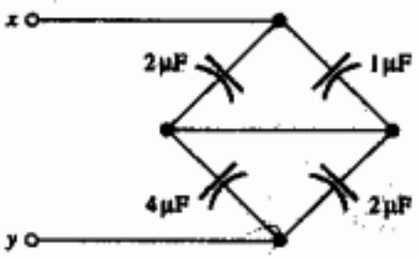
(A) $r^2\sin\theta\sin\phi$ (B) $r^2\cos\theta\sin\phi$ (C) $r^2\cos\theta\cos\phi$ (D) $r^2\cos\theta$ (E) $r^2\sin\theta$.

應用電子學

31 Find the equivalent capacitance between terminals x and y for the circuit shown in below. (A) 6 μF

(B) 5 μF (C) 4 μF (D) 3 μF (E) 2 μF.

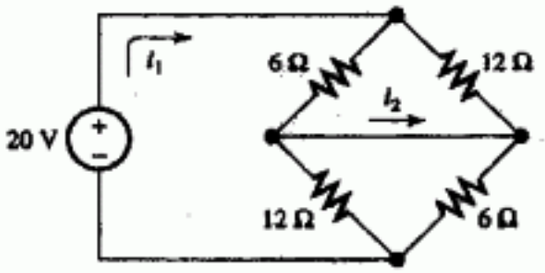
單選題，以 2B 鉛筆劃在答案卡上；答對一題得 1 分，答錯一題倒扣 0.25 分，未答不計分。



32 What is the banding width of silicon at room temperature? (A) 0.9eV (B) 1eV (C) 1.1eV (D) 1.3eV (E) 1.4eV.

33 What is the dielectric constant of SiO_2 at room temperature? (A) 3 (B) 4 (C) 5 (D) 5.5 (E) 6.

34 Find the value of i_1. (A) 2.5A (B) 3A (C) 3.5A (D) 4A (E) 1A.



35 Repeat the problem 34, find the value of i_2. (A) 0.533A (B) 0.633A (C) 0.733A (D) 0.833A (E) 0.933A.

36 Find the values (in mA) of I_{D1} and I_{D2} for the circuit of Figure 36, assuming that the diodes are ideal. (A) 0, 0.5 (B) 1, 0 (C) 0, 0 (D) 1.75, -1.25 (E) 1.75, -1.25.

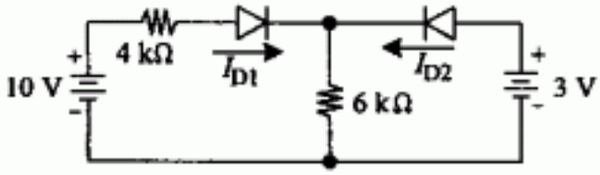


Figure 36

37 Consider the circuit shown in Fig. 37. What is the steady-state output voltage $v_{out}(t)$ if $v_{in}(t) = 10\sin(\omega t)$, assuming that the diode is ideal. (A) $10\sin(\omega t) + 6$ (B) $10\sin(\omega t)$ (C) 0 (D) - 4 (E) $10\sin(\omega t) + 4$.

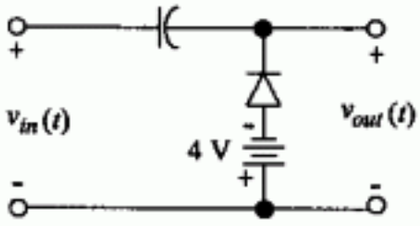


Figure 37

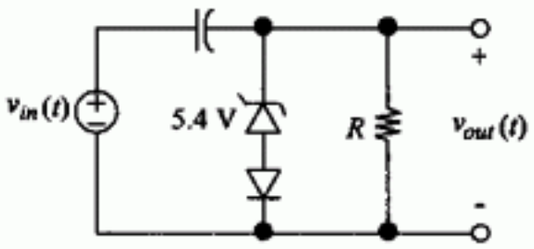


Figure 38

單選題，以 2B 鉛筆劃在答案卡上；答對一題得 1 分，答錯一題倒扣 0.25 分，未答不計分。

38 Consider the circuit shown in Fig. 38. 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 $v_{in}(t) = 4\sin(\omega t)$. The reverse breakdown voltage of the Zener diode is shown. Allow a 0.6-V forward drop for the diodes.
(A)4sin(ωt) (B) 4sin(ωt) + 6 (C) 5.4 (D) 4sin(ωt) + 2 (E) 4sin(ωt) + 1.4.

39 For the circuit shown in Fig. 39, let the transistor have $\beta = 100$ and neglect the effect of r_o. Use $V_{BE} = 0.7$ V and assume all capacitances are infinite. What is the dc Q-point collector current I_{CQ}?
(A)4.3 mA (B) 4.8 mA (C) 4.1 mA (D) 7.5 mA (E) 5.0 mA.

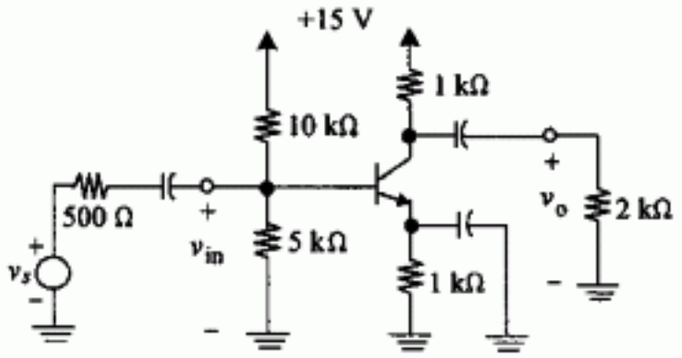


Figure 39

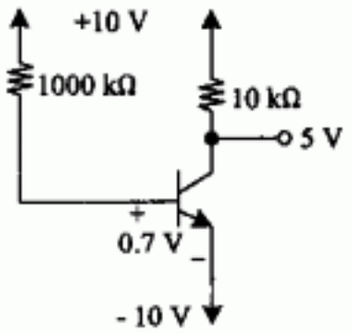


Figure 40

40 Find the value of β for the transistor of Fig. 40. (A) 78 (B) 54 (C) 161 (D) 100 (E) 26.

熱力學

41 One mole of ideal gas undergoes a thermal process that changes its state from (G_i, S_i, T_i) to (G_f, S_f, T_f). Which of the following statement is correct
(A) $\Delta S = S_f - S_i = 0$ as long as $G_i = G_f$ and $T_i = T_f$,
(B) $\Delta S = S_f - S_i$ is identical for all reversible and isothermal processes,
(C) $\Delta S = S_f - S_i$ is identical for all reversible and isobaric processes,
(D) $\Delta S = S_f - S_i$ is identical for all reversible and isometric processes,
(E) none of above is correct.

42 About the thermodynamic equations, which of the followings is correct, (A) $T = (\partial U / \partial S)_{V,comp}$,

(B) $T = (\partial H / \partial S)_{V,comp}$, (C) $T = (\partial A / \partial S)_{V,comp}$, (D) $T = (\partial G / \partial S)_{V,comp}$, (E) none of above is correct.

43 About the statistical interpretation of entropy, which of the following statement is correct, assuming that P is the partition function and Ω is the number of arrangement within the most probable distribution,
(A) $S = k \ln P$, for a given temperature, (B) $S = k \ln \Omega$, for a given temperature,
(C) $S = k \ln P$, for a given total energy, (D) $S = k \ln \Omega$, for a given total energy,
(E) none of above is correct.

單選題，以 2B 鉛筆劃在答案卡上；答對一題得 1 分，答錯一題倒扣 0.25 分，未答不計分。

44 At 0 °K, which of the following statement is correct,
(A) $\Delta G = 0$ for any thermodynamic process, (B) $\Delta U = 0$ for any thermodynamic process,
(C) $\Delta A = 0$ for any thermodynamic process, (D) $\Delta H = \Delta G$ for any thermodynamic process,
(E) none of above is correct.

45 About the ideal gas, which of the following statement is correct,
(A) $dG = -SdT$ at constant volume, (B) $dA = -SdT$ at constant volume, (C) $dU = -SdT$ at constant volume, (D) $dH = -SdT$ at constant volume, (E) none of above is correct.

46 The molar Gibbs free energy of formation of binary solution A-B is given by
(A) $\Delta G^M = RT(X_A \ln X_A + X_B \ln X_B)$, (B) $\Delta G^M = RT(X_A \ln X_A + X_B \ln a_B)$,
(C) $\Delta G^M = RT(X_A \ln a_A + X_B \ln a_B)$, (D) $\Delta G^M = RT(X_A \ln X_A + X_B \ln X_B + X_A \overline{H_A} + X_B \overline{H_B})$,
(E) 以上皆非.

47 The critieria for equilibrium between the phase α and β in the binary system A-B are
(A) $a_A(in\alpha) = a_B(in\beta)$ and $a_B(in\alpha) = a_B(in\beta)$, (B) $a_A(in\alpha) = a_A(in\beta)$ and $a_B(in\alpha) = a_B(in\beta)$,
(C) $a_A(in\alpha) = a_B(in\alpha)$ and $a_B(in\alpha) = a_B(in\beta)$, (D) 以上皆是, (E) 以上皆非.

48 An ideal solution has the properties (A) $a_i = X_i$ and $\overline{V_i} = V_i^0$ (B) there is zero heat of mixing, (C) $\overline{S_i}$ is independent of temperature and is simply an expression for the maximum number of spatial configuration available to the system, (D) all above items are correct, (E) only two above items are correct.

49 The activity of a component I in a solution, with respect to a given standard state: (A) bears the same dimensions as that of entropy, (B) equal to 1 at pure state, (C) equal to 0.5 for ideal solution, (D) is negative for concentrated solutions, (E) is constant for dilute solutions.

50 About regular solution: (A) Regular solution behavior is predicted by a statistical solution model in which it is assumed that the atoms mix randomly and that the energy of the solution is the sum if the individual interatomic bond energies in the solution, (B) Random mixing can be assumed only if, in the system A-B, the A-B bond energy is not significantly different from the average of the A-A abd B-B bond energies in the pure components, (C) For any such deviation the validity of the assumption of random mixing increases with increasing temperature, (D) The statistical model predicts tendency toward ideal behavior and Henrian behavior as, respectively, $X_i \to 1$ and $X_i \to 0$, (E) The items listed above are all correct.

物理冶金

51 In a cold-worked metal, the recrystallized grain size is insensitive to which of the following parameters? (A) Purity of the metal (B) Initial grain size (C) Annealing temperature (D) Amount of deformation (E) none of the above.

52 A lot of phenomena is related to the interaction of a dislocation with solute atoms in the materials. Which of the following phenomena is the least related to the interaction? (A) Sharp yield point (B) Drag stress (C) Strain aging (D) Low energy grain boundary (E) dislocation atmosphere.

單選題，以 2B 鉛筆劃在答案卡上；答對一題得 1 分，答錯一題倒扣 0.25 分，未答不計分。

53 For a real solid solution, the activities are used to indicate the extent to which a solution departs from an ideal solution. Which of the following statements is correct? (A) The positive deviation of the activities with concentration means the interaction between unlike atoms is preferred. (B) The negative deviation of the activities means bonding between unlike atoms is stronger. (C) A component with positive deviation of the activity have lower partial molar free energy than the idea case (D) The activity coefficient is typically defined as the ratio of concentration to the activity. (E) none of the above.

54 When deriving the equilibrium vacancy concentration for a crystal, the energy is balanced by the work required to create vacancies and the energy lower by increase of entropy. The major entropy lowering is coming from _____ (A) Vibrational entropy (B) Rotational entropy (C) Stretching entropy (D) Configurational entropy (E) none of the above.

55 The fact that the dislocation movement is discontinuous in nature indicates the dislocation velocity is hindered by obstacles. Which of the following parameters is ineffective in changing the observed dislocation velocity? (A) Temperature (B) Distance between obstacle (C) Applied stress (D) Equilibrium vacancy concentration (E) none of the above.

56 二元合金中一個液相分解成一個液相及一個固相的反應稱爲（A）共晶(eutectic)（B）共析(eutectoid)（C）偏晶(monotectic)（D）包晶(peritectic)（E）同型(isomorphous)反應。

57 Kirkendall 效應可用來證明（A）直接交換（B）環形（C）間隙(interstitial)（D）孔缺(vacancy)（E）自由漫步(random walk)的擴散機制。

58 研究低溫下碳原子在碳鋼中的擴散，應採用何法最有效？（A）Matano（B）Grube（C）torsion pendulum（D）diffusion couple（E）decarburizing。

59 具何種相圖之合金最有可能以快速凝固法獲得金屬玻璃？（A）共晶（B）共析（C）偏晶(monotectic)（D）包晶(peritectic)（E）同型(isomorphous)。

60 面心立方結晶之金屬，其樹枝晶成長通常爲下列何方向？（A）[111]（B）[110]（C）[100]（D）[112]（E）[123]。

近代物理

61 For a particle confined in a 1-D box of dimension L, what is the probability of finding the particle between x=L/3 and x=2L/3 for the first excited state (A) 0.4 (B) 0.33 (C) 0.67 (D) 0.8 (E) 0.5.

62 Assume that a particle of energy E strikes a finite energy barrier of height U (E<U) and width *w* from the left, which of the following descriptions is false? (A) there is non-zero probability of finding the particle to the right of the barrier (B) the amplitude of the wavefunction on the right decreases with increasing barrier width *w* (C) the amplitude of the wavefunction on the right decreases with increasing barrier height U (D) the particle has a positive kinetic energy inside the barrier (E) α-particle decay is an example of the tunneling effect.

63 Which of the following descriptions about the Compton Effect is false? (A) an interaction between photons and electrons (B) the wavelength of the scattered light beam is larger than that of the incident beam (C) the Compton effect illustrates the particle-like behavior of electromagnetic waves (D) the Compton effect tends to be found at long-wave radiation (E) energy and momentum of the photons and the electrons are conserved.

單選題，以 2B 鉛筆劃在答案卡上；答對一題得 1 分，答錯一題倒扣 0.25 分，未答不計分。

64 For the electron of a hydrogen atom at ground state, the wave function is $\varphi = \pi^{-1/2} a_0^{-3/2} e^{-r/a_0}$, where a_0 is Bohr's radius. What is the expectation value of the hydrogen radius?
(A) 0.5 a_0 (B) 1 a_0 (C) 1.5 a_0 (D) 2 a_0 (E) 3 a_0.

65 What does Moseley's experiment tell us about characteristic X-ray spectra?
(A) $f \propto Z$ (B) $f^{1/2} \propto Z$ (C) $f^2 \propto Z$ (D) $\lambda^{1/2} \propto Z$ (E) $\lambda^2 \propto Z$
(f: frequency, λ:wavelength, Z: atomic number)

66 想知道一個物理量$\langle\hat{\Omega}\rangle$是否守恆（即是否會不隨時間改變），只要把它的量子力學算符拿來， (A)如果$\hat{\Omega}$的數學表示式裡有沒有明顯的(explicit)時間，應該就沒有問題， (B)$[\hat{H},\hat{\Omega}] \equiv \hat{H}\hat{\Omega} - \hat{\Omega}\hat{H}$是否等於零？($\hat{H}$代表系統的 Hamiltonian)， (C)得先從薛丁格方程式找出 eigenfunctions，再實際去算$\langle\hat{\Omega}\rangle$才能知道， (D)可以回到古典去判斷，即不用管算符形式，看它和 Lagrangian 的 Poisson bracket 會不會等於零？ (E)上面的四種選擇都太扯了，沒一個是對的。

67 量子穿隧(tunnelling)是個很有趣的現象，它說即使當粒子的能量比起位障(energy barrier)低，但是可以有非零的機率穿過。那麼爲什麼你無法穿過這個試場的牆壁？那是因爲 (A)撞的力氣還不夠大， (B)量子穿隧只適用於小物體， (C)撞的次數還不夠多， (D)要扯到渾沌(chaos)理論才能解釋， (E)以上皆非。

68 兩個電子的總自旋S可以是 1(叫 triplet)或 0(叫 singlet),其中$|S=1, S_z=0\rangle$的自旋態對應到什麼樣的$|S_{1z}, S_{2z}\rangle$組合？ (A)$|1/2, -1/2\rangle$， (B)$|-1/2, 1/2\rangle$, (C)$|0,0\rangle$， (D)$|1/2, -1/2\rangle + |-1/2, 1/2\rangle$， (E)以上皆非。

69 狹義相對論在近代物理的發展上，革命性地改變我們對於時空的認識，而其中有關光速不隨慣性座標系而變的假設是由 (A)Einstein 本人， (B)Michelson and Morley， (C)Davidsson and Germer, (D)Franck and Hertz， (E)其實是國父孫中山先生，實驗證實的。

70 如果把無窮位能井的寬度減半，電子在其間的能階能量(eigenenergies)會 (A)減半， (B)減爲原來的 1/4， (C)增倍， (D)增爲 4 倍， (E)不同能階改變的程度不同。

有機化學

71 Which of the following compounds absorbs the longest wavelength of UV-visible light? (A) (*E*)-2-butene (B) (*Z*)-2-butene (C) 1-hexene (D) (*Z*)-1,3-hexadiene (E) (*E*)-1,3,5-hexatriene.

72 Which of the following undergoes solvolysis in methanol most rapidly? (A) $PhCH_2Br$ (B) Ph_3CBr (C) $PhCH_2CH_2Br$ (D) PhBr (E) $PhCH_2CH_2CH_2Br$.

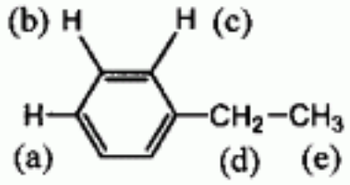
73 The nitration of anisole: (A) proceeds more rapidly than the nitration of benzene and yields predominantly the meta product. (B) proceeds more rapidly than the nitration of benzene and yields predominantly the ortho, para products. (C) proceeds more slowly than the nitration of benzene and yields predominantly the meta product. (D) proceeds more slowly than the nitration of benzene and yields predominantly the ortho, para products. (E) proceeds at the same rate as the nitration of benzene and yields predominantly the meta product.

單選題，以 2B 鉛筆劃在答案卡上；答對一題得 1 分，答錯一題倒扣 0.25 分，未答不計分。

74 What reagents can be used to convert 1-hexyne into 2-hexanone? (A) 1. Sia_2BH; 2. H_2O_2, NaOH (B) Hg^{2+}, H_2SO_4, H_2O (C) 1. O_3; 2. $(CH_3)_2S$ (D) 1. CH_3MgBr; 2. CO_2 (E) 1. H_2, Ni; 2. $Na_2Cr_2O_7$, H_2SO_4.

75 Lithium aluminum hydride reduces carboxylic acids to primary alcohols via what intermediate? (A) a ketone (B) a methyl ester (C) an aldehyde (D) a secondary alcohol (E) an acid chloride.

76 Which hydrogen atom on ethylbenzene is the most reactive toward light promoted chlorination?

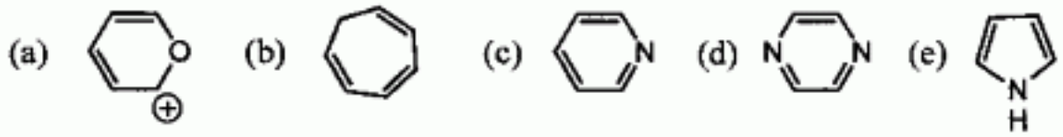


77 Which of the following compounds has the largest molecular dipolement? (A) CH_4 (B) CH_3Cl (C) CH_2Cl_2 (D) $CHCl_3$ (E) CCl_4.

78 Which of the following reagent(s) reacted with olefin did not follow Markovnikov's rule? (A) H^+, H_2O (B) HBr (C) BH_3; NaOH, H_2O_2 (D) $Hg(OCOCH_3)_2$, CH_3COOH; $NaBH_4$ (E) HCl, peroxide.

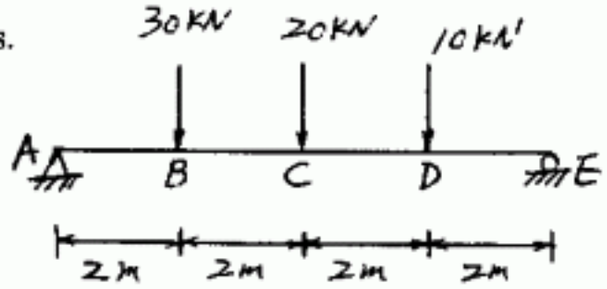
79 Which of the following functional groups exhibits highest IR stretching frequency? (A) C-H (B) C-D (C) C=O (D) C ≡N (E) C ≡C.

80 Which of the following compounds is not an aromatic compound?



工程力學

A simply supported beam AE is loaded by three concentrated loads.

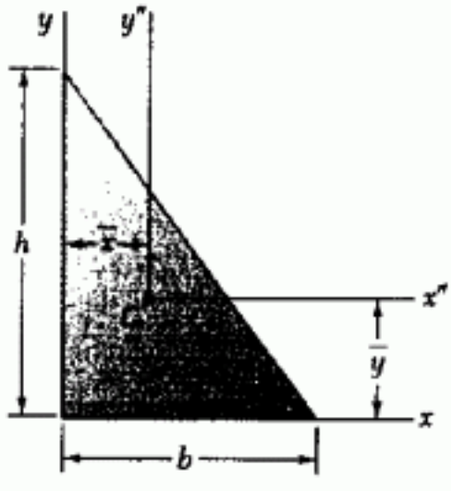


81 The maximum moment M_{max} (A) at point B (B) at point C (C) at point D (D) between B and C (E) between C and D.

82 The maximum moment is (A) 70 kN-m (B) 75 kN-m (C) 80 kN-m (D) 85 kN-m (E) 90 kN-m.

83 The maximum shear V_{max} is (A) 20 kN (B) 25 kN (C) 30 kN (D) 35 kN (E) 40 kN.

For the right triangle shown (point C indicate its centroid)



84 The central moment of inertia about x"-axis $I_{x"}$ is (A) $bh^3/24$ (B) $bh^3/36$ (C) $bh^3/48$ (D) $bh^3/60$ (E) $bh^3/72$.

85 The centroidal moment of inertia about y"-axis $I_{y"}$ is (A) $b^3h/24$ (B) $b^3h/36$ (C) $b^3h/48$ (D) $b^3h/60$ (E) $b^3h/72$.

單選題，以 2B 鉛筆劃在答案卡上：答對一題得 1 分，答錯一題倒扣 0.25 分，未答不計分。

86 The centroidal product of inertia $I_{x'y'}$ is
(A) $-b^2h^2/36$ (B) $-b^2h^2/48$ (C) $-b^2h^2/60$
(D) $-b^2h^2/72$ (E) $-b^2h^2/96$.

87 Dilatation is (A) volume change rate, (B) ratio of actual strength and required strength, (C) ratio of yield strength and factor of safety, (D) stress concentration factor, (E) ratio of thermal stress and thermal strain.

88 Which condition listed in the following can induce thermal stress (A) statically indeterminate truss (Figure a) heated uniformly, (B) statically indeterminate truss (Figure a) heated non-uniformly, (C) statically determinate truss (Figure b) heated non-uniformly, (D) statically determinate truss (Figure b) heated uniformly, (E) structure can free expansion when heated.

Figure a

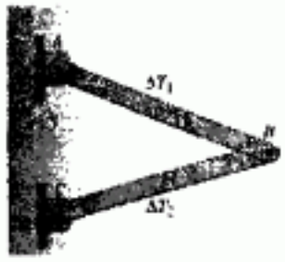


Figure b

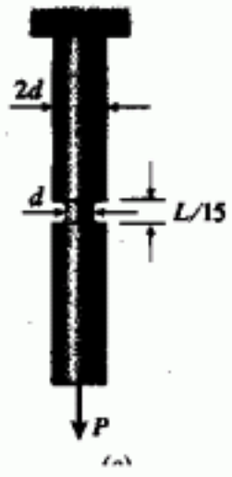


Figure c

89 A round bar with length of L and cross-sectional area of A is subjected to an axial load P (Figure c), if the elastic modulus of the bas is E, calculate the strain energy stored in the bar (disregard the effects of stress concentration and the weight of the bar). (A) $P^2L/(20EA)$ (B) $3P^2L/(20EA)$ (C) $5P^2L/(20EA)$ (D) $7P^2L/(20EA)$ (E) $9P^2L/(20EA)$.

90 A round steel bar has diameter of d, length of L, shear modulus of elasticity G. The bar is subjected to torques T acting at the ends. What is the angle of twist between the ends. (A) $(8TL)/(\pi Gd^4)$, (B) $(16TL)/(\pi Gd^4)$, (C) $(24TL)/(\pi Gd^4)$, (D) $(32TL)/(\pi Gd^4)$, (E) $(40TL)/(\pi Gd^4)$.