

高雄醫學大學 109 學年度學士後醫學系招生考試試題

科目：化學

Choose one best answer for the following questions

【單選題】每題 1 分，共計 30 分，答錯 1 題倒扣 0.25 分，倒扣至本大題零分為止，未作答，不給分亦不扣分。1~15 題為物理，16~30 題為化學。

(A) 16. For 1.0 M of the following solution, which chemical gives the highest pH value?

- (A) NaF (B) $\text{Na}_2\text{S}_2\text{O}_3$ (C) NH_4Cl (D) $\text{Al}(\text{NO}_3)_3$ (E) Ethanol

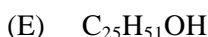
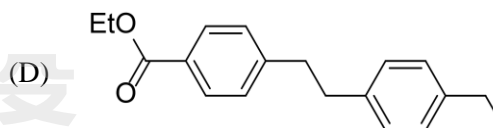
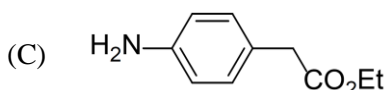
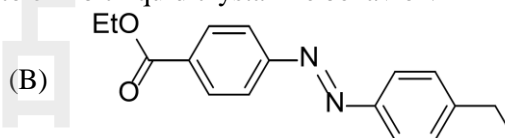
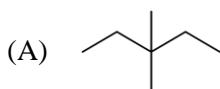
(D) 17. Which of the following complex is diamagnetic?

- (A) $[\text{Ni}(\text{CN})_6]^{4-}$ (B) $[\text{Ti}(\text{CN})_6]^{3-}$ (C) $[\text{Cr}(\text{CN})_6]^{3-}$ (D) $[\text{Co}(\text{CN})_6]^{3-}$ (E) All of these

(C) 18. Which of the following molecule doesn't exhibit the behavior of *s-p* mixing of molecular orbitals?

- (A) N_2 (B) B_2 (C) O_2 (D) NO (E) All of these

(B) 19. Which of the following substrate is most likely to exhibit liquid crystalline behavior?



(A) 20. What is the net number of tetrahedral holes contained in the close packing of spheres unit cell like face-center cubic?

- (A) 8 (B) 4 (C) 12 (D) 6 (E) 3

(B) 21. Which of the following active ingredient is most commonly used in liquid bleaches (Sanitizers)?

- (A) NaCl (B) NaClO (C) NaClO_2 (D) NaClO_3 (E) NaClO_4

(C) 22. Natural copper contains two isotopic forms. The most common isotope is ^{63}Cu (atomic mass 62.93 amu), which is 69.09% abundant. The average atomic mass of Cu is 63.55 amu. What is the mass of the other isotope?

- (A) 61.90 amu (B) 63.10 amu (C) 64.93 amu (D) 65.90 amu (E) 67.10 amu

(B) 23. 0.2 g of $\text{FeCl}_3(s)$ is dissolved in 20 mL water. The pH of this aqueous solution at 25 °C will be

- (A) $\text{pH} > 7$ (B) $\text{pH} < 7$ (C) $\text{pH} = 7$
(D) no effect on pH (E) this cannot be determined

(B) 24. Several possible combinations of ΔH and ΔS for a reaction are listed as below. Which of the following case is spontaneous for this reaction at all temperatures?

- (A) ΔH is positive, ΔS is positive (B) ΔH is negative, ΔS is positive
(C) ΔH is negative, ΔS is negative (D) ΔH is positive, ΔS is negative
(E) None of these

(E) 25. First-row transition metals play significant roles in biological system. Which of the following transition metal is a component of vitamin B_{12} ?

- (A) Cr (B) Zn (C) Fe (D) Cu (E) Co

(B) 26. What is the charge of NO molecule if the bond order is 2?

- (A) 1 (B) -1 (C) 0 (D) 2 (E) -2

- (D) 27. What is the range of wave number (cm^{-1}) for an organic molecule containing a carbonyl group in the infrared spectrum?
 (A) 3610–3640 (B) 2850–3300 (C) 2100–2300 (D) 1690–1760 (E) 1080–1300
- (E) 28. The complex *cis*-Pt(NH₃)₂Cl₂ showed high anti-tumor activity, but *trans*-Pt(NH₃)₂Cl₂ showed no effect on tumor therapy. These two complexes can be classified into which type of isomerism.
 (A) linkage isomerism (B) optical isomerism (C) coordination isomerism
 (D) ionization isomerism (E) geometric isomerism
- (B) 29. The decay of strontium-90 follows a first-order process and the rate constant is $0.02406 \text{ year}^{-1}$. How much of 2 mg sample of strontium-90 remains after 144 years?
 (A) 0.250 mg (B) 0.062 mg (C) 0.031 mg (D) 0.125 mg (E) 0.500 mg
- (D) 30. Which compound yields the largest van't Hoff factor (*i*) when dissolved in water?
 (A) NaCl (B) MgCl₂ (C) MgSO₄ (D) FeCl₃ (E) Glucose

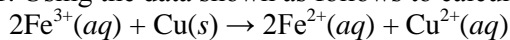
【單選題】每題 2 分，共計 120 分，答錯 1 題倒扣 0.5 分，倒扣至本大題零分為止，未作答，不給分亦不扣分。31~60 題為物理，61~90 題為化學。

- (B) 61. Which is an incorrect statement for heat capacity of ideal gases?
 (A) C_v is identical for monatomic ideal gases
 (B) Molecular motion of monatomic ideal gas is zero
 (C) C_v of polyatomic ideal gas is larger than C_v of monatomic ideal gas
 (D) $C_p > C_v$ in all ideal gases
 (E) $C_p = \frac{5}{2} R$ for monatomic ideal gas
- (D) 62. $C_{\text{diamond}}(s) \rightarrow C_{\text{graphite}}(s) \quad \Delta G^\circ = -2.9 \text{ kJ}$
 Which of the following is an incorrect statement?
 (A) The process is spontaneous
 (B) It occurs very slowly at 25 °C and 1atm
 (C) Smaller ΔS° for diamond
 (D) Smaller ΔH° for diamond
 (E) The process become reversible at high temperature and pressure
- (B) 63. Determine the number of nodal surfaces for a 3s orbital.
 (A) 3 (B) 2 (C) 1 (D) 0 (E) None of these
- (A) 64. Which molecule has only one resonance structure that obeys the Octet rule?
 (A) NO⁺ (B) NO₂⁻ (C) NO₃⁻ (D) O₃ (E) CO₃²⁻
- (A) 65. What is the resonance frequency (MHz) for ¹³C nuclei operated in a nuclear magnetic resonance spectrometer of 400 MHz? (gyromagnetic ratio of ¹H and ¹³C is ~4)
 (A) 100 (B) 200 (C) 400 (D) 800 (E) 1600
- (B) 66. The color difference between [CoCl₄]²⁻ and [Co(H₂O)₆]²⁺ can be supported by which concept?
 (A) Redox process (B) Spectrochemical series
 (C) Disproportionation reaction (D) van't Hoff factor
 (E) Hard-Soft Acid-Base
- (C) 67. How many net numbers of spheres are occupied in a face-centered cubic (f.c.c.) unit cell?
 (A) 1 (B) 2 (C) 4 (D) 6 (E) 8
- (C) 68. For a reaction involving changes of reactant concentrations ([A]), what is the reaction order (*m*) when the correlation of ln [A] versus time (*t*) is a straight line?
 (A) $m=0$ (B) $m=1/2$ (C) $m=1$ (D) $m=2$ (E) None of these

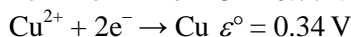
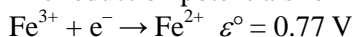
- (C) 69. Consider the reaction $\text{Fe}^{3+}(\text{aq}) + \text{SCN}^{-}(\text{aq}) \rightleftharpoons \text{FeSCN}^{2+}(\text{aq})$. Which one of the following statements is correct?
 (A) The equilibrium position shifts to the right after water is added to double the volume
 (B) The equilibrium position shifts to the right after $\text{AgNO}_3(\text{aq})$ is added
 (C) The equilibrium position shifts to the left after $\text{NaOH}(\text{aq})$ is added
 (D) The equilibrium position shifts to the left after $\text{Fe}(\text{NO})_3(\text{aq})$ is added
 (E) None of the above is correct
- (D) 70. Which "P" in the following compounds has the lowest oxidation state?
 (A) Phosphoric acid (B) Phosphorous acid (C) Hypophosphorous acid
 (D) Sodium phosphide (E) Black phosphorus
- (C) 71. How many π electrons are delocalized in 1,4-diphenyl-1,3-butadiene?
 (A) 4 (B) 8 (C) 16 (D) 24 (E) 32
- (D) 72. Based on MO theory, which molecule is not paramagnetic?
 (A) O_2^{-} (B) O_2^{+} (C) O_2 (D) N_2 (E) N_2^{+}
- (A) 73. Consider mixing equal volume of 0.1 M Na_2CO_3 solution and 0.1 M H_2SO_4 solution. Which statement is correct?
 (A) $[\text{H}^{+}]$ is less than 0.05 M (B) $[\text{H}^{+}]$ is between 0.1 M and 0.05 M
 (C) $[\text{H}^{+}]$ is 0.1 M (D) $[\text{H}^{+}]$ is 0.2 M (E) $\text{pH} > 7$
- (C) 74. Which is the major specie for a carbonate-containing solution at pH 8.5? ($K_{a1} = 4.3 \times 10^{-7}$, $K_{a2} = 4.8 \times 10^{-11}$ for carbonic acid)
 (A) CO_2 (B) H_2CO_3 (C) HCO_3^{-} (D) CO_3^{2-} (E) $\text{C}_2\text{O}_4^{2-}$
- (C) 75. What is the main contribution for the negative entropy value ($\Delta S_{\text{soln}}^{\circ} < 0$) when formation of $\text{LiF}(\text{aq})$ in water?
 (A) Random dispersal of water
 (B) Breaking ordered bonding of solids
 (C) Interaction of Li^{+} and F^{-} with water molecules
 (D) Dispersion of Li^{+} and F^{-} into solution
 (E) Fast equilibrium
- (E) 76. The energy required to remove the electron from a hydrogen atom in its ground state is 2.178×10^{-18} J. What is the energy required to excite the electron in the He^{+} ion from the $n = 1$ level to the $n = 2$ level?
 (A) 1.634×10^{-18} J (B) 2.178×10^{-18} J (C) 3.268×10^{-18} J
 (D) 8.712×10^{-18} J (E) None of these
- (D) 77. To increase the value of K for the endothermic reaction as mentioned below,
 $\text{N}_2\text{O}_4(\text{g}) \rightleftharpoons 2\text{NO}_2(\text{g})$
 a chemist should _____.
 (A) decrease the temperature (B) decrease the container volume
 (C) increase the total pressure (D) increase the temperature
 (E) None of these
- (E) 78. Two moles of an ideal gas undergo isothermal expansion from a volume of 1.0 L to a volume of 10.0 L against a constant external pressure of 1.0 atm. Calculate the changes of internal energy (ΔE). (1 L·atm = 101.3 J)
 (A) 9.12×10^2 J (B) 1.82×10^3 J (C) -9.12×10^2 J
 (D) -1.82×10^3 J (E) 0 J
- (E) 79. Which theory, phenomenon or equation can explain redox potential difference on ion concentrations?
 (A) Disproportionation (B) Electrogenated chemiluminescence
 (C) Galvanic displacement (D) Henderson-Hasselbalch equation
 (E) Nernst equation

- (D) 80. Using the data below, calculate the normal boiling point of liquid Br_2 at 1 atm. For the process,
 $\text{Br}_2(l) \rightarrow \text{Br}_2(g)$: $\Delta H^\circ = 31.0 \text{ kJ mol}^{-1}$ and $\Delta S^\circ = 93.0 \text{ JK}^{-1}\text{mol}^{-1}$
 (A) 300 K (B) 0.33 K (C) 0.30 K (D) 333 K (E) 433 K

- (A) 81. Using the data shown as follows to calculate ΔG° for the reaction (1 $F = 96,485$ coulombs):

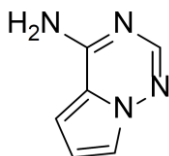


The reduction potentials for Fe^{3+} and Cu^{2+} are as follows:



- (A) $-8.3 \times 10^4 \text{ J}$ (B) $-1.2 \times 10^5 \text{ J}$ (C) $-4.2 \times 10^4 \text{ J}$
 (D) $-6.0 \times 10^4 \text{ J}$ (E) $-2.4 \times 10^5 \text{ J}$
- (D) 82. For corrosion of iron, which of the following statements is (are) true?
 I. Anode reaction: $\text{Fe} \rightarrow \text{Fe}^{2+} + 2e^-$
 II. Cathode reaction: $\text{O}_2 + 2\text{H}_2\text{O} + 4e^- \rightarrow 4\text{OH}^-$
 III. Moisture serving as a salt bridge
 (A) I (B) III (C) I and II
 (D) I, II, and III (E) None of the statement is true

- (E) 83.



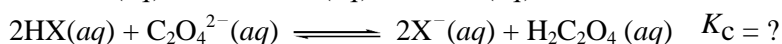
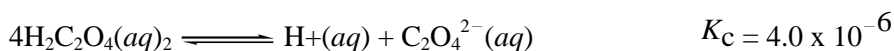
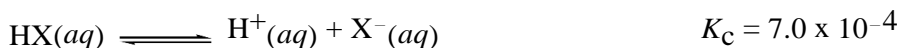
Above structure is the precursor of the Remdesivir (potential COVID-19 drug), which of the below statements are true?

- I. It is an aromatic compound II. It has 13 σ bond
 III. It shows dipole moment IV. It has 11 σ bond
 V. It contains sp hybridization

Please choose one of the answer below,

- (A) I and IV (B) II and IV (C) I, II, and III
 (D) I, II, III, and V (E) None of these
- (C) 84. What is the boiling-point change for a solution containing 18.0 g of glucose in 150.0 g of water at 1 atm? ($K_b = 0.51 \text{ }^\circ\text{C kg/mol}$ for water)
 (A) $2.2 \text{ }^\circ\text{C}$ (B) $0.06 \text{ }^\circ\text{C}$ (C) $0.34 \text{ }^\circ\text{C}$ (D) $4.3 \text{ }^\circ\text{C}$ (E) $1.8 \text{ }^\circ\text{C}$
- (D) 85. If the human eye has an osmotic pressure of 8.0 atm at 25°C , the concentration of solution particles in water will be _____ mmol/L in order to provide an isotonic eyedrop solution, a solution with equal osmotic pressure.
 (A) 620 (B) 4,110 (C) 0.62 (D) 327 (E) 79
- (E) 86. The solubility of CaCl_2 in cold water is 74.5 g per 100.0 g water. Assuming $i = 3.0$ for CaCl_2 , the freezing point for a saturated solution of CaCl_2 will be $^\circ\text{C}$. ($K_f = 1.86 \text{ }^\circ\text{C kg/mol}$ for water)
 (A) 0 (B) -0.32 (C) -13 (D) -32 (E) -37.4

- (C) 87. Determine the value of K_c for the reaction



- (A) 0.001 (B) 0.01 (C) 0.1 (D) 1 (E) 10
- (C) 88. 2-deoxy-2- ^{18}F fluoroglucose (^{18}F FDG) decays by _____ and ^{18}F will yield stable _____.
 (A) alpha emission, ^{18}O (B) beta emission, ^{19}F (C) positron emission, ^{18}O
 (D) photon emission, ^{19}F (E) neutron capture, ^{19}O

- (A) 89. For an unknown molecules A_2 , if the dissociation energy is 1204 kJ/mol, what is the maximum wavelength of electromagnetic radiation required to rupture this bond? (Planck constant: 6×10^{-34} J.s, light of speed: 3×10^8 m/s)
(A) 90 nm (B) 120 nm (C) 150 nm (D) 180 nm (E) 210 nm
- (D) 90. Calculate the ratio of the root-mean-square velocities (μ_{rms}) of H_2 to SO_2 .
(A) 1 (B) 0.18 (C) 32 (D) 5.6 (E) 180

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高雄醫學大學

梁傑(梁家榮)老師提供

本次高醫的普通化學試題看似簡單但其實帶有些許鑑別度，如果只是背誦公式、速解，知其然而不知所以然的同學，會考的不理想，例如第 18 題(p-s mixing)、第 19 題(液晶分子)、第 61 題(理想氣體熱容量概念)、第 62 題(鑽石變成石墨的概念)、第 82 題(鏽蝕原理)等，都是需要較深入探討細節才能寫出正確答案的考題。第 27 題和第 65 題屬於有機化學才會探討的題材，在普化課程沒有提及，但若曾經修習過有機化學的同學，應該可以拿到這兩題的分數。

其他題目都相當簡單，大部分同學應能順利作答。

第 16 題	第 17 題	第 18 題	第 19 題	第 20 題
判斷酸鹼性 普化分章(上) Page 4-37 私醫 93(29) 幾乎相同	complex 的磁性 普化分章(上) Page 6-117 私醫 100(1) 完全相同	s-p mixing 普化正課講義 Page 6-93 完全相同	液晶分子結構特色	fcc 晶體中的四面體洞數量 普化正課講義 Page 8-64 完全相同
第 21 題	第 22 題	第 23 題	第 24 題	第 25 題
漂白水的主要成分 普化分章(上) Page 2-27 私醫 104(26) 完全相同	由平均原子量計算同位素之原子量 普化分章(上) Page 2-12 高醫 108(24) 完全相同	半徑小價數高的酸性陽離子 普化分章(上) Page 4-20 中國 97(9) 完全相同	自發反應的 ΔH 、 ΔS 與 T 之關係 普化分章(下) Page 11-40 慈濟 104(9) 完全相同	維他命 B ₁₂ 的中心金屬種類 普化分章(上) Page 6-135 中國 103(25) 完全相同
第 26 題	第 27 題	第 28 題	第 29 題	第 30 題
分子軌域理論與鍵級的判斷 普化分章(上) Page 6-86 義守 101(24) 幾乎相同	計算金屬晶體密度 有機有教 有機分章(下) Page 14-36 義守 107(17) 完全相同	Complex 的立體異構物判斷 普化正課講義 Page 6-111 完全相同	一級反應的公式 普化分章(下) Page 14-21 私醫 97(12) 完全相同	i 值大小比較 普化正課講義 Page 9-58 完全相同
第 61 題	第 62 題	第 63 題	第 64 題	第 65 題
理想氣體的熱容量概念 普化正課講義 Page 10-59 觀念相同	鑽石變成石墨是自發過程 普化正課講義 Page 11-40 觀念相同	節點數量計算 普化正課講義 Page 5-59 完全相同	共振式數量 普化正課講義 Page 6-39 完全相同	¹ H 與 ¹³ C 在 NMR 上的差異 有機有教 有機分章(下) Page 14-46 高醫 97(33) 完全相同

第 66 題 化學光譜序列 普化正課講義 Page 6-149 完全相同	第 67 題 fcc 單位晶格粒子 數量判斷 普化分章(上) Page 8-29 私醫 102(48) 完全相同	第 68 題 一級反應濃度與時 間關係 普化分章(下) Page 14-26 中國 86(16) 完全相同	第 69 題 產生沉澱會影響平 衡反應方向 普化分章(上) Page 4-29 慈濟 108(22) 幾乎相同	第 70 題 氧化數判斷 普化正課講義 Page 4-41 完全相同
第 71 題 共軛系統中電子 數量的計算 普化正課講義 Page 6-99 觀念相同	第 72 題 MOT 判斷磁性 普化分章(上) Page 6-75 私醫 97(4) 完全相同	第 73 題 酸鹼反應後的 pH 判斷 普化分章(下) Page 12-22 中國 99(42) 幾乎相同	第 74 題 特定 pH 值時的溶 質種類判斷 普化分章(下) Page 12-57 私醫 106(18) 幾乎相同	第 75 題 $\Delta S < 0$ 的特殊溶解 過程 普化分章(下) Page 10-50 慈濟 106(17) 完全相同
第 76 題 Bohr 模型計算電 子躍遷所需能量 普化分章(上) Page 5-20 高醫 107(66) 幾乎相同	第 77 題 溫度對 K 值的影響 普化總複習 Page 11-29 UST103A1&A5(21) 完全相同	第 78 題 理想氣體的恆溫 過程 普化分章(下) Page 10-59 慈濟 108(26) 完全相同	第 79 題 Nernst Equation 普化正課講義 Page 13-9 觀念相同	第 80 題 液體的沸點計算 普化分章(下) Page 9-21 中國 104(25) 完全相同
第 81 題 $\Delta G = -nFE$ 普化分章(下) Page 13-4 慈濟 107(18) 完全相同	第 82 題 鏽蝕的原理 普化正課講義 Page 13-67 觀念相同	第 83 題 價鍵理論 普化分章(上) Page 6-62 私醫 108(35) 觀念相同	第 84 題 依數性質: T_b 上升 普化分章(下) Page 9-50 私醫 107(6) 完全相同	第 85 題 依數性質:滲透壓 普化分章(下) Page 9-54 中國 108(11) 完全相同
第 86 題 依數性質: T_m 下降 普化分章(下) Page 9-48 私醫 105(25) 完全相同	第 87 題 化學反應方程式 與 K 之關係 普化分章(下) Page 11-14 私醫 104(10) 完全相同	第 88 題 ^{18}F FDG 的正子放射 普化正課講義 Page 15-20 完全相同	第 89 題 $\Delta E = \frac{hc}{\lambda}$ 普化分章(上) Page 5-6 私醫 97(11) 完全相同	第 90 題 氣體的逸散速率 普化分章(上) Page 7-25 慈濟 102(2) 完全相同