國立屏東教育大學 99 學年度研究所碩士班入學考試

化學 試題

（化學生物系碩士班 化學組）

※請注意：1.本試題共四頁。

2.答案須寫在答案卷上，否則不予計分。

一、選擇題（每題 3 分，共 45 分）

1. A compound has the empirical formula $CoCl3 \cdot 4NH3$. One mole of the compound yields one mole of silver chloride when treated with silver nitrate. Ammonia is not removed by treatment with concentrated sulfuric acid. The formula for the compound is best represented by
   (A) $Co(NH_3)_4\ Cl_3$
   (B) $[Co(NH_3)_2Cl_3]\ (NH_3)_2$
   (C) $[Co(NH_3)_3Cl_3]NH_3$
   (D) $[Co(NH_3)_4Cl_2]Cl$
   (E) $[Co(NH_3)_4Cl]Cl_2$

2. The half-reaction that occurs at the cathode during electrolysis of aqueous CuCl2 solution is:
   (A) $Cu^+ + e^- \rightarrow Cu$
   (B) $Cu^{2+} + 2e^- \rightarrow Cu$
   (C) $2H_2O + 2e^- \rightarrow H_2 + 2OH^-$
   (D) $Cl_2 + 2e^- \rightarrow 2Cl^-$
   (E) $2Cl^- \rightarrow Cl_2 + 2e^-$

3. Arrange the acids H2Se, H2Te, and H2S in order of increasing acid strength.
   (A) $H_2S < H_2Se < H_2Te$
   (B) $H_2S < H_2Te < H_2Se$
   (C) $H_2Te < H_2S < H_2Se$
   (D) $H_2Se < H_2S < H_2Te$
   (E) $H_2Se < H_2Te < H_2S$

4. Which salt dissolved in water will produce a solution with the highest pH?
   (A) NaCl
   (B) KBr
   (C) $NaNO_3$
   (D) NH_4Cl
   (E) NaF

5. What is the hybridization of the central atom in ClO_3^- ?
   (A) sp
   (B) sp^2
   (C) sp^3
   (D) sp^3d
   (E) sp^3d^2

6. The Lewis structure for chlorate ion, ClO_3^- should show ____ single bond(s), ____double bond(s), and ____ lone pair(s).
   (A) 2, 1, 10
   (B) 3, 0, 9
   (C) 2, 1, 8
   (D) 3, 0, 10
   (E) 2, 1, 9

7. Estimate the enthalpy change (ΔH) for combustion of one mole of acetylene, C_2H_2.
   H─ C≡C─ H(g) + O_2(g) → 2CO_2(g) + H_2O(g)
   BE(C─H) = 414 kJ
   BE(C≡C) = 812 kJ
   BE(O=O) = 498.7 kJ
   BE(C=O) = 799 kJ
   BE(O-H) = 460 kJ
   (A) ─611 kJ
   (B) +4689 kJ
   (C) +1759 kj
   (D) ─1977 kJ
   (E) ─1509 kJ

8. Identify the conjugate base of CH_3COOH in the following reaction:
   $CH_3COOH + HSO_4^- \rightarrow H_2SO_4 + CH_3COO^-$
   (A) HSO_4 ─
   (B) SO_4^{2-}
   (C) CH_3COO^-
   (D) H_2SO_4
   (E) OH^-

9. Which of the following is true about chemical equilibrium?
   (A) At equilibrium the total concentration of products equals the total concentration of reactants, that is [products] = [reactants].
   (B) Equilibrium is the result of the cessation of all chemical change.
   (C) There is only one set of equilibrium concentrations that equals the K_c value.
   (D) The rate constant of the forward reaction is equal to the rate constant for the reverse reaction.
   (E) At equilibrium the rate of the forward process is the same as the rate of the reverse process.

10. How many protons, neutrons, and electrons are in $^{200}_{80}Hg$?
   (A) 80, 80, and 120.
   (B) 80, 80, and 200.
   (C) 80, 120, and 80.
   (D) 80, 200, and 80
   (E) 120, 80, and 80.

11. The carbon atom in CH_2Cl_2 has what hybridization?
    (A) sp
    (B) sp^2
    (C) sp^3
    (D) sp^4
    (E) they are not hybridized

12. Which of the following statements are true of sp orbitals?
    (A) Orbitals of the sp type are 50% s and 50% p character.
    (B) They are hybrid orbitals.
    (C) They are linear.
    (D) They result when one s orbital and one p orbital are mixed.
    (E) all are correct

13. Which of the following molecules are most likely to be held together by a purely covalent bond?
    (A) NaCl
    (B) H_2
    (C) HF
    (D) BH_3
    (E) KI

14. Predict the geometries of SF_6 using the VSEPR method.
    (A) Linear
    (B) Trigonal planar
    (C) Tetrahedral
    (D) Trigonal dipyramidal
    (E) Octahedral

15. The solubility of calcium sulfate ($CaSO_4$) is found to be 0.67 g/L. What is the value of Ksp for calcium sulfate.
    (A) 1.2×10^{-5}
    (B) 2.4×10^{-5}
    (C) 1.2×10^{-6}
    (D) 2.4×10^{-6}
    (E) 1.2×10^{-7}

二、簡答題（共 55 分）

1. What is the coordination number and the oxidation number of cobalt in $[Co(NH_3)_6]Cl_3$? （5 分）

2. The complex ion (a) $[Fe(H_2O)_5NCS]^{2+}$ is red and (b) $[Co(H_2O)_6]^{3+}$ is violet. Which one has the larger crystal field splitting?（10 分）

3. For the reaction $CuS(s) + H_2(g) \rightarrow H_2S(g) + Cu(s)$ （10 分）
   ΔG^o_f (CuS) = －53.6 kJ/mole
   ΔG^o_f (H_2S) = －33.6 kJ/mole
   ΔH^o_f (CuS) = －53.1 kJ/mole
   ΔH^o_f (H_2S) = －20.6 kJ/mole
   Calculate ΔG^o and ΔH^o at 298 K and 1 atm pressure.

4. The equilibrium constant (Kc) for the reaction（10 分）

$$PCl_{5(g)} \leftrightarrow PCl_{3(g)} + Cl_{2(g)}$$

$$1\text{-}X \qquad 0.5+X \qquad X$$

is 2.45×10^{-2} at 250℃. If the initial pressure of PCl_5 and PCl_3 are 1.0 and 0.5 atm, respectively, what is the equilibrium pressure of PCl_5, PCl_3 , and Cl_2 at 250℃?

5. What is the pH of the buffer system containing 1.0M CH_3COOH and 1.0M CH_3COONa？ (The Ka of CH_3COOH is 1.8×10^{-5}.) (log 1.34 = 0.13， log 1.8 = 0.26， log 3.24 = 0.51) （10 分）

6. 請說明溫室效應、溫室氣體、人類活動與溫室效應之關連性及溫室效應對環境之影響. （10 分）