說明：一、請一律以「答案卷」作答，作答時不得使用鉛筆，違者該科答案卷不予計分；限用黑色或藍色墨水的筆書寫。
二、考生應在答案卷上規定範圍內作答，且不得書寫任何與答案無關之文字、符號，違者該科不予計分。
三、答案卷以每人一張為限，不得要求增補；試題與答案卷必須繳回，不得攜出試場。

*可使用工程型計算機

第一部分 單選題 (60%, 4% each)

1. Which of the following names is correct?
(A) iodine trichlorite, ICl_3 (B) phosphorus pentoxide, P_2O_5 (C) chlorous acid, $HClO_2$
(D) lithium hydrogen, LiH (E) calcium(II) oxide, CaO

2. Calculate the pH of a 0.010 *M* aluminium chloride solution. The K_a value for $Al(H_2O)_6^{3+}$ is 1.4×10^{-5}.
(A) pH=1.35 (B) pH=2.38 (C) pH=3.43 (D) pH=4.31 (E) pH=5.36

3. Hydrogen cyanide gas (HCN), a powerful respiratory inhibitor, is highly toxic. It is a very weak acid (K_a =6.2 × 10^{-10}) when dissolved in water. If a 50.0 mL sample of 0.100*M* HCN is titrated with 0.100 *M* NaOH, calculate the pH of the solution at the equivalence point of the titration.
(A) pH=3.05 (B) pH=8.49 (C) pH=9.21 (D) pH=10.95 (E) pH=11.36

4. Which of the following molecules are nonlinear?
NO_2^-, C_2H_2, N_3^-, HCN, CO_2, H_2O_2, N_2O (central atom is N)
(A) C_2H_2, HCN (B) NO_2^-, H_2O_2 (c) CO_2, N_3^- (D) N_3^-, NO_2^- (E) N_2O, H_2O_2

5. Calculate the concentration of Ag^+ in a solution prepared by mixing 150.0 mL 1.0×10^{-3} *M* $AgNO_3$ with 200.0 mL 5.00 *M* $Na_2S_2O_3$.($K_1 = 7.4\times10^8$, $K_2 = 3.9\times10^4$)
(A) 1.8 x 10^{-18} mol/L (B) 4.3 x 10^{-4} mol/L (C) 3.8 x 10^{-9} mol/L (D) 8.30 x 10^{-4} mol/L
(E) 2.86 x 10^{-3} mol/L

6. An aqueous solution of 10.00 g of catalase, an enzyme found in the liver, has a volume of 1.00 L at 27℃. The solution's osmotic pressure at 27℃ is found to be 0.745 torr. Calculate the molar mass of catalase.
(A) 3.86 x 10^8 g/mol (B) 4.15 x 10^4 g/mol (C) 9.8 x 10^6 g/mol (D) 3.30 x 10^2 g/mol
(E) 2.51 x 10^5 g/mol

7. You have 75.0 mL of 0.10 *M* HA. After adding 30.0 mL of 0.10 *M* NaOH, the pH is 5.50. What is the *Ka* value of HA ?
(A) 2.1 x 10^{-6} (B)3.8 x 10^{-6} (C) 4.7 x 10^{-2} (D) 7.4 x 10^{-8} (D) 6.3 x 10^{-4}

8. Which of the following is the correct order for molecules from most to least polar?
(A) $CH_4 > CF_2Cl_2 > CF_2H_2 > CCl_4 > CCl_2H_2$
(B) $CH_4 > CF_2H_2 > CF_2Cl_2 > CCl_4 > CCl_2H_2$
(C) $CF_2Cl_2 > CF_2H_2 > CCl_2H_2 > CH_4 = CCl_4$

(D) $CF_2H_2 > CCl_2H_2 > CF_2Cl_2 > CH_4 = CCl_4$

(E) $CF_2Cl_2 > CF_2H_2 > CCl_4 > CCl_2H_2 > CH_4$

9. Which of the following molecules exhibits chirality?

I. 1-chloroethanol II. 2-chloroethanol III. 2-chloropropane IV. 2-chlorobutane V. 3-chloropentane

(A) I, III (B) II, IV (C) II, III (D)I, IV (E) II, V

10. At a particular temperature, 12.0 moles of SO_3 is placed into a 3.0 L rigid container, and the SO_3 dissociates by the reaction

$$2SO_{3(g)} \rightleftarrows 2SO_{2(g)} + O_{2(g)}$$

At equilibrium, 3.0 moles of SO_2 is present. Calculate *K* for this reaction.

(A) 0.033 (B) 0.056 (C) 0.44 (D) 0.22 (E) 0.55

11. Assuming that the combustion of hydrogen gas provides three times as much energy per gram as gasoline, calculate the volume of liquid H_2 (density = 0.0710 g/mL) required to furnish the energy contained in 80.0 L (about 20 gal) of gasoline (density = 0.740 g/mL). Calculate also the volume that this hydrogen would occupy as a gas at 1.00 atm and 25°C.

At 1.00 atm and 25°C, the hydrogen gas needed to replace 20 gal of gasoline occupies a volume of _____L.

(A) 277 (B) 19700 (C) 59200 (D) 239000 (E) 977000

12. Consider the following orderings.

I. $Al < Si < P < Cl$ II. $Be < Mg < Ca < Sr$

III. $I < Br < Cl < F$ IV. $Na^+ < Mg^{2+} < Al^{3+} < Si^{4+}$

Which of these give (s) a correct trend in ionization energy?

(A) III (B) I, II (C) I, IV (D) III, IV (E) I, III, IV

13. A 0.739-g sample of an iron ore is dissolved in acid. The iron is then reduced to Fe^{2+} and titrated with 47.22 mL of 0.02242 *M* $KMnO_4$ solution. Calculate the results of this analysis in terms of ___ % Fe (55.847 g/mol).

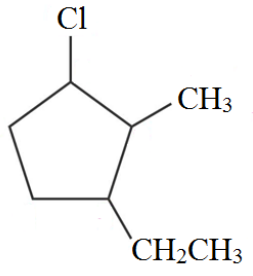
(A) 16 (B) 22 (C) 32 (D) 40 (E) 50

14. Which of the following are paramagnetic?

O_2 O_2^- O_2^{2-} B_2 C_2 N_2 F_2 P_2

(A) O_2, O_2^{2-}, B_2 (B) O_2^-, C_2, N_2 (C) B_2, F_2, P_2 (D) O_2^{2-}, N_2, F_2 (E) O_2, O_2^-, B_2

15. Name the following:



(A) 1-chloro-2-methyl-3-ethylcyclopentane

(B) 1-ethyl-2-methyl-3- chlorocyclopentane

(C) 1-chloro-3-ethyl -2-methylcyclopentane

(D) 3-chloro-1-ethyl -2-methylcyclopentane

(E) 3-chloro-2-methyl -1-ethylcyclopentane

第二部分 非單選題 (請將答案填寫於答案卷表格內，40%)

1. What is molar concentration of K^+ in a solution that contains 63.3 ppm of $K_3Fe(CN)_6$(329.3 g/mol)?(4%)

2. What concentration of sodium chloride in water is needed to produce an aqueous solution isotonic with blood (II=7.70 atm at 25℃)(4%)

3. Calculate the pH of the resulting solution when mixing 75.0 mL of 0.05 M hydrochloric acid with 0.093 g of magnesium hydroxide.(Magnesium:24.3050 g/mol)(4%)

4. At 25℃, calculate the pH of a 0.25 *M* hydroxylamine hydrochloride solution. The K_b value for hydroxylamine is 9.1×10^{-9}. (4%)

5. Calculate the molar concentration of H_2SO_4 (98.0 g/mol) in a solution that has a specific gravity of 1.84 and is 96.5% H_2SO_4 (w/w). (4%)

6. In the Lewis structure for ICl_2^-, how many lone pairs of electrons are around the central iodine atom?(2%)

7. Using the molecular orbital model, write electron configuration for NO^+ and predict the bond order and magnetism. (8%)

8. Extraction of a three-component mixture containing benzoic acid, m-nitroaniline and azobenzene dissolved in CH_2Cl_2. Combination of the extraction flow sheet can also be used to isolate each of the components of a ternary mixture containing benzoic acid, m-nitroaniline and azobenzene. Please predict A, B, C, D, E. (10%)