※ 注意：請於試卷內之「非選擇題作答區」作答，並應註明作答之題號。

1. Iodine has only one natural isotope I-127. The mass spectrum of ICl_3^+ shows four peaks (mass number) at 232, 234, 236, and 238 with relative intensities of 27, 27, 9, and 1, respectively. Assume that the mass of an isotope equals its mass number. Atomic number = 17 for chlorine and 53 for iodine.

(a) Give the natural isotopes of chlorine and their relative abundances. 5%

(b) Find the molar mass of ICl_3. 5%

(c) Give the Lewis structure and the shape of ICl_3 molecule. 5%

(d) Find the number of neutrons in 1.0×10^{-10} mg of ICl_3. 5%

2. A sample is a mixture of $AgNO_3$, $NiCl_2$, and $CrCl_3$. A 1.500-g of the sample is dissolved in water and treated with excess silver nitrate. 1.974 g of precipitate forms. Another 1.500-g of the sample is dissolved in water and treated with a reducing agent to reduce all the metal ions to pure metals. The total mass of the metals is 0.766 g. Calculate the mass percent of the three compounds in the original sample.

(Ag = 108.0, Ni = 59.0, Cr = 52.0, Cl = 35.5, N = 14.0, O = 16.0) 15%

3. Consider the galvanic cell: $Pb|Pb(NO_3)_2$ (1.0 M)||saturated $Ag_2SO_4(aq)|Ag$. By convention, lead is the anode. The cell develops a potential of 0.839 V when initially constructed. The cell discharges at a constant current of 1.0 A. Assume that the volume of each electrolyte solution is 100 mL and the electrodes and $Ag_2SO_4(s)$ are sufficient in amount. $E°(Pb^{2+} \rightarrow Pb) = -0.13$ V; $E°(Ag^+ \rightarrow Ag) = 0.80$ V; Faraday constant = 96500 coulombs.

(a) Write the balanced cell reaction and calculate its standard potential. 4%

(b) Calculate the equilibrium constant of the cell reaction. 5%

(c) Find K_{sp} of Ag_2SO_4. 6%

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(d) Find the mass of deposied silver after 1930 seconds of disscharge. 4%

(e) Find the cell potential after 1930 seconds of disscharge. 6%

4. Compound X is a monoprotic acid with the formula $C_xH_yO_z$, where x, y, z will be determned in this problem. Complete combustion of 1.22 g of X yields 3.08 g CO_2 and 0.54 g H_2O. It takes 20.0 mL of 0.100 M NaOH to react completely with 0.244 g of X. In another experiment, the solution made by mixing 0.244 g of X in 10.0 mL water with 4.0 mL of 0.100 M NaOH shows a pH value of 3.60.

(a) Find the molar mass of X. 4%

(b) Find the molecular forumla of X. 6%

(c) Find the pK_a of X. 6%

(d) Find the pH of 0.50 M solution of X. 4%

5. A compound of hydrogen and nitrogen (H_xN_y) can be decomposed to its elements by heating. A 0.86-g sample of the gaseous compound is introducted into a 1.0-L reaction vessel at 300 K; it exhibits a pressure of 0.492 atm. The compound is heated for complete decomposition and then the vessel is cooled to 300 K again. The final pressure of the gaseous mixture is 0.984 atm. R = 0.082 $L \cdot atm \cdot mol^{-1} \cdot K^{-1}$.

(a) Find the molar mass of the compound. 5%

(b) Find the molecular formula of the compound. 6%

(c) Write the Lewis structure of the compound and assign formal charges for each atom. 6%

(d) Write the balanced equaiton for the decmposition reaction. 3%