系所組別：化學工程學系乙組
考試科目：無機化學及分析化學
考試日期：0223，節次：2
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Inorganic Chemistry and Analytical Chemistry

Part I: Inorganic Chemistry (50%)

(1) Give the valence electron count for the following species, and indicate whether they obey the EAN rule or not? (10%)

(a) $W(CO)_6$ (b) $Ni(PPh_3)_4$ (c) $Cr(CNMe)_6$

(d) $HRh(CO)_4$ (e) $[Mn(CO)_5]^-$

(2) Balance the following equations. Also give the details how you balance them. (10%)

(a) $H_2O + P_2I_4 + P_4 \rightarrow PH_4I + H_3PO_2$

(b) $ICl + H_2S_2O_7 \rightarrow I_2^+ + I(HSO_4)_3 + HS_3O_{10}^- + HSO_3Cl + H_2SO_4$

(3) (a) Explain why the ligand field (*d-d*) bands are shifted only slightly for the $[Co(NH_3)_5X]^{2+}$ ions, but the charge transfer bands are shift greatly. (5%)

(b) Explain why square planar complexes of transition metals are limited (other than those of planar ligands such as porphyrins) to those of (i) d^7, d^8, and d^9 ions and (ii) very strong field ligands which can be serve as π acceptors. (5%)

(4) What is a generalized acid-base concepts? Based on this concept, what is the “ultimate” acid? What is the “ultimate” base? (10%)

(5) Qualitatively sketch the Orgel diagram for the Cr^{3+} ion an octahedral field. (10%)

(背面仍有題目,請繼續作答)

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Part II: Analytical Chemistry (50%)

(6) List general properties of activity coefficients (8%). Make a distinction between activity and activity coefficient (2%).

(7) Calculate the molar solubility of $BaSO_4$ (Ksp $=1.1\times10^{-10}$, K_2 of H_2SO_4= 1.02×10^{-2}) in a solution that has a fixed H^+ concentration of (a) 2.5 M (5%) and (b) 0.060 M (5%).

(8) Please describe the difference between crystalline precipitates process and coagulated colloids-filtration process (10%).

(9) An iron ore was analyzed by dissolving a 1.1324-g sample in concentrated HCl. The resulting solution was diluted with water, and the iron(III) was precipitated as the hydrous oxide $Fe_2O_3 \cdot xH_2O$ by the addition of NH_3. After filtration and washing, the residue was ignited at a high temperature to give 0.5394 g of pure Fe_2O_3 (159.69 g/mol). Calculate (a) the % Fe (55.847 g/mol) and (b) the % Fe_3O_4 (231.54 g/mol) in the sample (10%).

(10) The arsenic (74.92 g/mol) in a 1.010-g sample of a pesticide was converted to H_3AsO_4 by suitable treatment. The acid was then neutralized, and exactly 40.00 mL of 0.06222 M $AgNO_3$ was added to precipitate the arsenic quantitatively as Ag_3AsO_4. The excess Ag^+ in the filtrate and in the washings from the precipitate was titrated with 10.76 mL of 0.1000 M KSCN. Calculate the percent As_2O_3 in the sample (10%).