類組：化學類　科目：無機化學(1003)　※請在答案卷內作答

1. Explain the order of the magnitudes of the following Δ_o (the energy gap between e_g and t_{2g} orbitals) values for octahedral Cr(III) complexes in terms of the σ and π donor and acceptor properties of the ligands.(8%)

Ligand	F^-	Cl^-	H_2O	NH_3	en	CN^-
Δ_o (cm^{-1})	15200	13200	17400	21600	21900	33500

2. Draw structures for the following compounds. What is the hapticity of the ligand CHT (cycloheptatriene) in these complexes? (9%)
   (a) $[Ni(CO)_3(CHT)]$ (b) $[Fe(CO)_3(CHT)]$ (c) $[Co(CO)_3(CHT)]$

3. Write equations for the following reactions: (9%)
   (a) The oxidative addition of CH_3I to $RhCO(PPh_3)_3$
   (b) The reductive elimination of dihydrogen from $HCo(CO)_4$
   (c) The oxidative addition of CH_3I to $[Co(CN)_5]^{3-}$

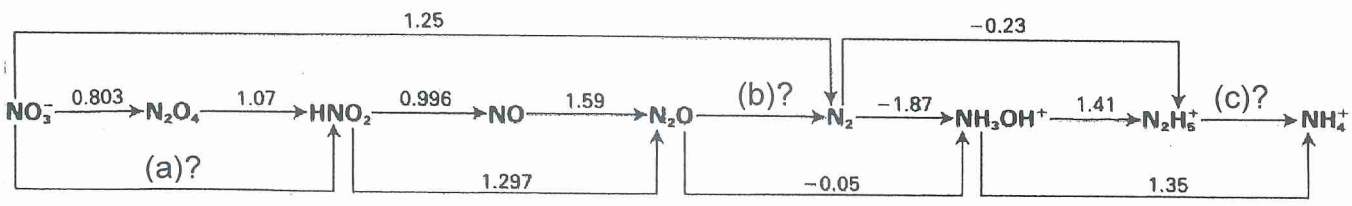
4. During a study of $Cr(NH_3)_3(CO)_3$, $Cr(CO)_6$, and $Ni(CO)_4$ by infrared spectroscopy, three spectra were obtained showing CO stretching bands at 1900, 2060, and 1980 cm^{-1}, but the spectra were not labeled. Match the spectra to the compounds and explain your answer. (9%)

5. For each metal ion listed, predict which of the ligands would give the more stable complex and explain your choice. (9%)
   (a) Cr^{3+} with NH_3 or CO
   (b) Zn^{2+} with $H_2NCH_2CH_2NH_2$ or $H_2NCH_2CH_2CH_2NH_2$
   (c) Ni^0 with $(C_2H_5)_2O$ or PCl_3

6. Which of the following complexes would undergo Jahn-Teller distortion? Explain your answer. (6%)
   (a) $[FeCl_6]^{3-}$ (b) $[MnCl_6]^{3-}$ (c) $[CuCl_6]^{4-}$ (d) $[CrCl_6]^{3-}$ (e) $[VCl_6]^{4-}$

7. Pleases draw structure of all isomers of the anion part of "Potassium diaquabis(oxalate)manganate(III)", state the types of isomerism that may be exhibited by these complexes, and indicate their point group. (13%)

8. Please calculate the potential (ε^0) of following reaction: (6%)



(d) According to above diagram, which is the most stable nitrogen species? (2%)
(e) Write down the chemical equation of the Haber–Bosch process with the condition. (2%)

注意：背面有試題

參考用

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9. (a) Draw the Lewis structure of "nitrogen dioxide" and the proper resonance form. (2%)
   (b) Indicate the formal charge and oxidation state of each atom. (6%)
   (c) What is the point group of "nitrogen dioxide"? (2%)
   (d) How many vibrational modes does "nitrogen dioxide" have? (2%)

10. Qualitatively demonstrate the change of Resistivity (Y-axis) versus Temperature (X-axis) for conductor, semiconductor, superconductor, and insulator. (8%)

11. In face-centered cubic, what is the coordination number? How many atoms per unit cell? and what is the package efficiency (Calculation process is required)? (7%)

參考用

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