

科目：無機化學 適用：應化系

編號：493

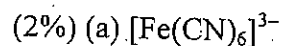
考生注意：

1. 依次序作答，只要標明題號，不必抄題。
2. 答案必須寫在答案卷上，否則不予計分。
3. 限用藍、黑色筆作答；試題須隨卷繳回。

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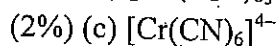
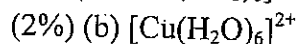
[1] (4%)

Predict the number of unpaired electrons for the following:



[2] (6%)

Determine the ligand-field stabilization energy for each of the following complexes:



[3] (6%)

What are the possible spin-only magnetic moment (μ_s) of Co(II) in a

(3%) (a) tetrahedral complex

(3%) (b) square-planar complex

[4] (6%)

Determine the ground state term (without J) for the following configurations:(3%) (a) d^4 (T_d symmetry)(3%) (b) High-spin d^6 (O_h symmetry)

[5] (6%)

AlF_3 is insoluble in liquid HF but dissolves if NaF is present. When BF_3 is added to the solution, AlF_3 precipitates. Explain.

[6] (10%)

Of the compounds $\text{Cr}(\text{CO})_5(\text{PF}_3)$ and $\text{Cr}(\text{CO})_5(\text{PCl}_3)$,

(5%) (a) Which would you expect to have the longer C—O bonds? Explain briefly.

(5%) (b) Which would you expect to have the higher energy Cr—C stretching bands in the infrared spectrum? Explain briefly.

[7] (10%)

The d^2 ions in CrO_4^{4-} , MnO_4^{3-} , FeO_4^{2-} , and RuO_4^{2-} have been reported.(5%) (a) Which of these has the smallest value of Δ_o ? Explain briefly.

(5%) (b) Of the first three, which ion has the shortest metal-oxygen bond distance? Explain briefly.

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[8] (8%)

Determine the packing efficiency of atoms in a cubic close-packed (ccp) structure.

[9] (10%)

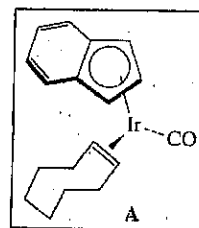
(3%) (a) Write the MO configurations (e.g., $(\sigma_{1s})^2$ for H_2) of NO^- .

(2%) (b) Would you expect this species to be diamagnetic or paramagnetic?

(5%) (c) The ion NO^- can react with H^+ to form a chemical bond. Which structure is more likely, HON or HNO ? Explain your reasoning.

[10] (10%)

Reaction of Ir Complex **A** with C_{60} gave black solid residue **B** with the following spectral characteristics: mass spectrum: $M^+ = 1056$; 1H NMR (ppm): δ 7.65 (multiplet, 2H), 7.48 (multiplet, 2H), 6.89 (triplet, 1H), and 5.97 (doublet, 2H); IR: $\nu(CO) = 1998\text{ cm}^{-1}$. (atomic mass for the most abundant isotope of Ir: 193)

(3%) (a) Propose a structure for **B**.(4%) (b) The carbonyl stretch of **A** was reported at 1954 cm^{-1} . How does the electron density at Ir change in going from **A** to **B**? Explain.(3%) (c) When **B** was treated with PPh_3 , a new complex **C** formed rapidly, along with some C_{60} . What is a likely structure of **C**?

[11] (12%)

Choose the stronger acid or base in the following pairs, and explain your choice.

(4%) (a) CH_3NH_2 or NH_3 in reaction with H^+ .(4%) (b) Pyridine or 2-methylpyridine in reaction with trimethylboron, BMe_3 .

(4%) (c) Triphenylboron or trimethylboron in reaction with ammonia.

[12] (12%)

(3%) (a) What is the linkage isomer?

(9%) (b) Compound bis(thiocyanato)(2,2'-bipyridine)platinum(II) has three linkage isomers, draw each of the molecular structures.