

編號: 61 系所: 化學系

科目: 無機化學

- 1-1. Determine the number of microstates for the p^1d^1 configuration. 2%
- 1-2. Construct a microstate table and reduce the table to its constituent term symbols (Russell-Saunders terms, $^{2S+1}L_J$) for carbon atom. 6%
- 1-3. Identify the ground-state term symbol ($^{2S+1}L_J$) of Co^{2+} free ion. 2%
- 2-1. Write down all possible Lewis structures for thiazyl dichloride ion, NSCl_2^- , which is isoelectronic with OSCl_2 . 6%
- 2-2. Which of these species has the smaller Cl-S-Cl angle? **Explain.** 4%
- (A) NSCl_2^- (B) OSCl_2
3. Show all symmetry elements and identify the point group of the following: 10%
- (1) C_{60} (2) $\text{Os}_2\text{Cl}_8^{2-}$
- 4-1. AB_5 is a square pyramidal structure. Using the group theory method, determine the possible hybridization schemes for the central A atom in AB_5 . 10%
- 4-2. Which of these schemes would you expect to be most unlikely? **Explain your answer.**

C_{4v}	E	$2C_4$	C_2	$2\sigma_v$	$2\sigma_d$		
A_1	1	1	1	1	1	z	x^2+y^2, z^2
A_2	1	1	1	-1	-1		
B_1	1	-1	1	1	-1		x^2-y^2
B_2	1	-1	1	-1	1		xy
E	2	0	-2	0	0	(x,y)	(xz,yz)

- 5-1. Which of following order of basicity is correct when reacting with BF_3 ? 4%
- Explain your answer.**
- (A) pyridine < 2-*t*-butylpyridine < 2,6-dimethylpyridine
 (B) 2-*t*-butylpyridine < 2,6-dimethylpyridine < pyridine
 (C) 2,6-dimethylpyridine < 2-*t*-butylpyridine < pyridine
 (D) pyridine < 2,6-dimethylpyridine < 2-*t*-butylpyridine
- 5-2. KF behaves as a base in BrF_3 , whereas SbF_5 behaves as an acid. 4%
- Write balanced chemical equations for these acid-base reactions of fluorides with BrF_3
- 5-3. Which trend of Madelung constant (A) for lattice of NaCl , ZnS , and CsCl is correct? 4%
- (A) $A_{\text{NaCl}} > A_{\text{ZnS}} > A_{\text{CsCl}}$ (B) $A_{\text{ZnS}} > A_{\text{CsCl}} > A_{\text{NaCl}}$
 (C) $A_{\text{CsCl}} > A_{\text{NaCl}} > A_{\text{ZnS}}$ (D) $A_{\text{CsCl}} > A_{\text{ZnS}} > A_{\text{NaCl}}$
- Explain your answer.**
- 5-4. Calculate the potential for the $\text{NO} \rightarrow \text{N}_2\text{O}$ reaction in acidic solution, given the 4%
- following:
- $$\text{NO} \rightarrow \text{N}_2 \quad \varepsilon^\theta = 1.68 \text{ V}$$
- $$\text{N}_2\text{O} \rightarrow \text{N}_2 \quad \varepsilon^\theta = 1.77 \text{ V}$$
- 5-5. How many stereoisomers of an octahedral complex $\text{Cr}(\text{ABA})(\text{H}_2\text{O})(\text{OH})\text{Br}$ are possible? 4%
- (ABA = the tridentate ligand $\text{H}_2\text{N}-\text{CH}_2\text{CH}_2-\text{PH}-\text{CH}_2\text{CH}_2-\text{NH}_2$)
 How many of these consist of pairs of enantiomers?
- 6-1. Explain why tetrahedral geometry is more stable for $\text{Co}(\text{II})$ than for $\text{Ni}(\text{II})$ by calculating 6%
- the ligand stabilization energies for octahedral and tetrahedral $\text{Co}(\text{II})$ and $\text{Ni}(\text{II})$.

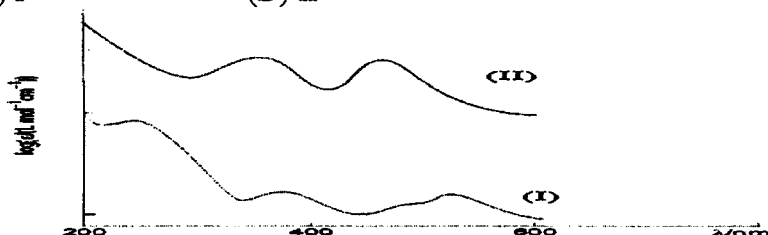
(背面仍有題目,請繼續作答)

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- 6-2. Which of the following complexes will **not** show Jahn-Teller distortion? **Explain.** 4%
- (A) $\text{Ni}(\text{NH}_3)_6^{2+}$ (B) $\text{Cu}(\text{NH}_3)_6^{2+}$ (C) $\text{Mn}(\text{H}_2\text{O})_6^{2+}$ (D) $\text{Ti}(\text{H}_2\text{O})_6^{3+}$
 (E) $\text{Cr}(\text{H}_2\text{O})_6^{3+}$ (F) $\text{Co}(\text{NH}_3)_6^{2+}$ (G) CoF_6^{3-} (H) MnF_6^{3-}

- 7-1. The UV spectra of $[\text{Cr}(\text{NH}_3)_6]^{3+}$ and $[\text{Cr}(\text{NH}_3)_5\text{Cl}]^{2+}$ are given below. 6%
- Which spectrum is assigned to be UV spectrum of $[\text{Cr}(\text{NH}_3)_5\text{Cl}]^{2+}$? Give two main reasons
 (A) I (B) II

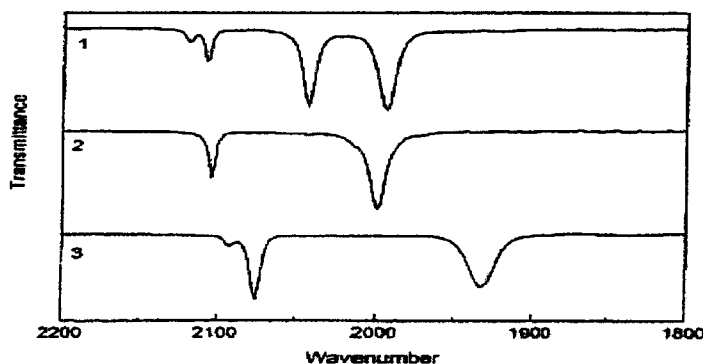


- 7-2. How does each of the following modifications affect the rate of a Pt or Pd square-planar complex substitution reaction? 6%
- (i) Addition a bulky substituent to a *cis* ligand.
 (ii) Increasing the positive charge on the complex.

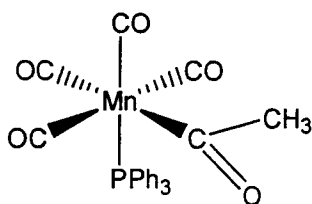
- 7-3. The infrared spectra of $[\text{Fe}(\text{CO})(\text{CN})_5]^{3-}$, *trans*- $[\text{Fe}(\text{CO})_2(\text{CN})_4]^{2-}$ and *cis*- $[\text{Fe}(\text{CO})_2(\text{CN})_4]^{2-}$ are shown in the figure below. 6%

Which of the following assignments is correct with their spectra? **Explain.**

- (A) 1: $[\text{Fe}(\text{CO})(\text{CN})_5]^{3-}$, 2: *trans*- $[\text{Fe}(\text{CO})_2(\text{CN})_4]^{2-}$, 3: *cis*- $[\text{Fe}(\text{CO})_2(\text{CN})_4]^{2-}$
 (B) 1: $[\text{Fe}(\text{CO})(\text{CN})_5]^{3-}$, 2: *cis*- $[\text{Fe}(\text{CO})_2(\text{CN})_4]^{2-}$, 3: *trans*- $[\text{Fe}(\text{CO})_2(\text{CN})_4]^{2-}$
 (C) 1: *cis*- $[\text{Fe}(\text{CO})_2(\text{CN})_4]^{2-}$, 2: *trans*- $[\text{Fe}(\text{CO})_2(\text{CN})_4]^{2-}$, 3: $[\text{Fe}(\text{CO})(\text{CN})_5]^{3-}$
 (D) 1: *trans*- $[\text{Fe}(\text{CO})_2(\text{CN})_4]^{2-}$, 2: $[\text{Fe}(\text{CO})(\text{CN})_5]^{3-}$, 3: *cis*- $[\text{Fe}(\text{CO})_2(\text{CN})_4]^{2-}$



- 7-4. 6%



Propose a synthesis for _____, by starting with $\text{Mn}_2(\text{CO})_{10}$, PPh_3 , Na and MeI.

- 7-5. Classify the Ge_9^{4-} as *closo*, *nido*, or *arachno* and explain why? 3%

- 7-6. Draw an organic compound (C_mH_n) isolobal with a carbene complex $\text{Fe}(\text{CO})_4(\text{CH}_2)$. 3%