

編號: G 56 系所: 化學系

科目: 無機化學

本試題是否可以使用計算機: 可使用, 不可使用 (請命題老師勾選)

- I. 1. Determine the point group for each of the following species. (12%)
 (A) $B_3N_3H_6$ (B) XeF_2O_2 (C) ClF_3 (D) C_{70}
2. Formula N_2CO has three known isomer: ONCN, ONNC and NOCN. (4%)
 Draw the Lewis structure for each isomer and determine their relative stability.
3. Arrange the following elements in order of decreasing electron affinity: (4%)
 (A) Sodium (B) Phosphorus (C) Sulfur (D) Chlorine (E) Cesium
- II. 1. LiBr has a density of 3.464 g/cm^3 and the NaCl crystal structure. (6%)
 Calculate the interionic distance. (MW for LiBr = 86.85 g/mol)
2. What type of semiconductor is formed by increasing the amount of metal in TiO_2 ? Why? (4%)
3. Use molecular orbital theory to predict the bond order and the number of unpaired electrons in the following species: (8%)
 (A) C_2^+ (B) O_2^-
- III. 1. Find the ligand field stabilization energies for $[MnF_6]^{4-}$ and $[Co(CN)_6]^{3-}$. (4%)
2. Calculate the spin-only effective moments for $[CrF_6]^{3-}$ and $[RhF_6]^{3-}$. (4%)
3. Give explanations for that $[FeF_6]^{3-}$ is colorless, but $[Fe(CN)_6]^{3-}$ is red. (4%)
4. The energies of two triplet states 3F and 3P of d^2 are separated by $15B$ (Racah parameter). In an octahedral field the F state is split into three states designated as T_1 , T_2 and A_2 with the energies at $-6Dq$, $2Dq$ and $12Dq$, respectively, and the P state remains as a degenerate state T_1 .
 (A) Draw an Orgel diagram containing both d^2 and d^8 complexes. (4%)
 (B) For $[Ni(en)_3]^{2+}$ the complex displayed three absorption bands at 11.2 kK , 18.4 kK and 29.0 kK . Calculate the Dq , B and configuration interaction originated from two T_1 states in terms of kK . (6%)
5. Draw all isomers (geometric isomers, and enantiomers) of $[Co(en)(NH_3)_2Cl_2]^+$, and (8%)
 indicate clearly each pair of enantiomers. (en = ethylenediamine = $\overset{\text{N}}{\text{---}}\text{---}\text{N}$)
- IV 單選題, 每題答對三分, 答錯扣一分. (18%)
1. Which oxidant gives a **slower** electron transfer reaction with $[Ru(NH_3)_6]^{2+}$?
 (A) $[Co(NH_3)_5Cl]^{2+}$ (B) $[Co(NH_3)_5Br]^{2+}$ (C) $[Co(NH_3)_5I]^{2+}$ (D) $[Co(NH_3)_6]^{3+}$
2. Which complex gives a **faster** dissociation rate of CO *cis* to those ligands?
 (A) $[Cr(CO)_5Cl]^-$ (B) $[Cr(CO)_5Br]^-$ (C) $Cr(CO)_5(PPh_3)$ (D) $Cr(CO)_6$
3. Which ligand gives a **higher** rate for the following reaction?
 $cis\text{-}Mo(CO)_4L_2 + CO \rightarrow Mo(CO)_5L + L$ (L = phosphine or phosphite)
 (A) PH_3 (B) PPh_3 (C) $P(OPh)_3$ (D) $PMePh_2$

(背面仍有題目, 請繼續作答)

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4. Which of the following complexes has the bond order of 3 (triple bond)?
 (A) $[\text{Mo}_2(\text{SO}_4)_4]^{4-}$ (B) $[\text{Tc}_2\text{Cl}_8]^{2-}$ (C) $[\text{Re}_2\text{Cl}_8]^{2-}$ (D) $[\text{Os}_2\text{Cl}_8]^{2-}$
5. Classify the heteroborane SB_9H_9 by structural type:
 (A) *closo* (B) *nido* (C) *arachno* (D) *hypho*
6. Which of the following proteins does not contain metalloporphyrin?
 (A) myoglobin (B) catalase (C) ferritin (D) cytochrome c

V The following are ^{13}C nmr spectra of the carbonyl region of $(\eta^5\text{-C}_5\text{H}_5)_2\text{Rh}_2(\text{CO})_3$, at various temperatures. (^{103}Rh : 100%, $I = 1/2$)

- Determine the valence electron count for this complex. (2%)
- Draw the structure. (4%)
- Explain the spectrum at -80°C . (4%)
- Explain the spectrum at 20°C . (4%)

