

※請在答案卷內作答

- The ion NO^- can react with H^+ to form a bond. Which structure is more likely, HON or HNO ? You need to show the molecular orbitals of NO^- to explain your reasoning. (2%)
- Give Lewis dot structures and sketch the shapes of the following: (a) SeCl_4 , (b) IF_7 , (c) N_3^- , (d) SeOCl_4 (Se is central), (e) XeO_2F_2 , (f) ClOF_4^- , (g) ClO_3^- , (h) carbon suboxide C_3O_2 (16%)
- Determine the point groups for (a) B_2H_6 , (b) cyclohexane (chair form), (c) $[\text{Cr}(\text{C}_2\text{O}_4)_3]^{3-}$, (d) $\text{Ni}(\text{cyclobutadiene})_2$ (staggered), (e) allene ($\text{H}_2\text{C}=\text{C}=\text{CH}_2$), (f) IOF_3 , (g) SF_4 , (h) S_8 (puckered ring), (i) ethane (staggered form), (j) N_2H_4 (gauche conformation). (20%)
- Choose (a) The least soluble halide in water: LiF , LiCl , LiBr , or LiI . (b) Which one has the largest solubility: MgSO_4 , CaSO_4 , SrSO_4 , BaSO_4 . (c) Stronger hydrogen bond: $[\text{OH}_3 \cdots \text{OH}_2]^+$ or $\text{OH}_2 \cdots \text{OH}_2$. (d) The strongest acid in aqueous solution: HMnO_4 , H_3AsO_4 , H_2SO_3 or H_2SO_4 . (e) Stronger gas-phase basicity: triphenylamine or triphenylphosphine. (f) The strongest Lewis acidity: BF_3 , BCl_3 , BBr_3 , or BI_3 . (g) The strongest Brønsted-Lowry basicity with hydrogen ion: pyridine, 2-methylpyridine, 2,6-dimethylpyridine, or 2-t-butylpyridine. (h) Longer N-S bond: $\text{Me}_3\text{N-SO}_3$ or $\text{H}_3\text{N-SO}_3$. (i) Both GaAs and GaN are used in LEDs. Which one is expected to emit lower energy? (j) A series of ZnSe quantum dots were prepared and the photoluminescence emission spectra were recorded. Were the lowest energy emission bands produced by the smallest or largest quantum dots? (10%)
- Describe the structures of CsCl , ZnS (wurtzite), and CaF_2 . (6%)

注意：背面有試題

參考用

※請在答案卷內作答

6. The structure of high-temperature superconductor $\text{YBa}_2\text{Cu}_3\text{O}_7$ consists of square-pyramidal and square-planar Cu-O units. Assign the oxidation state of the Cu atom in each unit. (2%)
7. Name these coordination complexes in English:
 (a) $\text{Cr}(\text{NH}_3)_3\text{Cl}_3$, (b) $\text{Pt}(\text{en})\text{Cl}_2$, (c) $[\text{Pt}(\text{ox})_2]^{2-}$, (d) $[\text{Cr}(\text{H}_2\text{O})_5\text{Br}]^{2+}$, (e) $[\text{Fe}(\text{OH})_4]^-$ (10%)
8. Determine the ground terms for low spin d^4 , high-spin and low-spin d^6 configurations in O_h symmetry? (4%)
9. Explain why the electronic spectra of $[\text{Ti}(\text{H}_2\text{O})_6]^+$ and $[\text{Fe}(\text{H}_2\text{O})_6]^{2+}$ show two closely overlapping absorption bands rather than a single band. (2%)
10. The d^2 ions CrO_4^{4-} , MnO_4^{3-} , FeO_4^{2-} , and RuO_4^{2-} have been reported.
 (a) Which of these has the largest value of Δ_t ? Which has the smallest? (2%)
 (b) Of the first three, which one has the shortest metal-oxygen bond distance? (2%)
 (c) The charge-transfer transitions for the first three complexes occur at 43,000, 33,000, and 21,000 cm^{-1} , respectively. Are these more likely to be ligand-to-metal or metal-to-ligand charge-transfer transitions? (2%)
11. Predict the products of these reactions. (10%)
 $[\text{PtCl}_4]^{2-} + \text{NO}_2^- \rightarrow$ (a), (a) + $\text{NH}_3 \rightarrow$ (b)
 $[\text{PtCl}_3\text{NH}_3]^- + \text{NO}_2^- \rightarrow$ (c), (c) + $\text{NO}_2^- \rightarrow$ (d)
 $[\text{PtCl}(\text{NH}_3)_3]^+ + \text{NO}_2^- \rightarrow$ (e), (e) + $\text{NO}_2^- \rightarrow$ (f)
 $[\text{PtCl}_4]^{2-} + \text{I}^- \rightarrow$ (g), (g) + $\text{I}^- \rightarrow$ (h)
 $[\text{PtI}_4]^{2-} + \text{Cl}^- \rightarrow$ (i), (i) + $\text{Cl}^- \rightarrow$ (j)

參考用

注意：背面有試題

類組：化學類 科目：無機化學(1003)

共 3 頁 第 3 頁

※請在答案卷內作答

12. Is the reaction $[\text{Co}(\text{NH}_3)_6]^{3+} + [\text{Cr}(\text{H}_2\text{O})_6]^{2+}$ likely to proceed by an inner-sphere or outer-sphere mechanism? (2%)
13. On the basis of the 18-electron rule, determine the expected charge on the following: (5%)
- (a) $[\text{Ni}(\text{CO})_3(\text{NO})]^{z}$ (contains linear M-N-O)
 - (b) $[\text{Ru}(\text{CO})_4(\text{GeMe}_3)]^{z}$
 - (c) $[(\eta^3\text{-C}_3\text{H}_5)\text{V}(\text{CNCH}_3)_5]^{z}$
 - (d) $[(\eta^5\text{-C}_5\text{H}_5)\text{Fe}(\text{CO})_3]^{z}$
 - (e) $[(\eta^5\text{-C}_5\text{H}_5)_3\text{Ni}_3(\mu_3\text{-CO})_2]^{z}$
14. The ^1H NMR spectrum of $(\text{C}_5\text{H}_5)_2\text{Fe}(\text{CO})_2$ shows two peaks of equal area at room temperature but has four resonances of relative intensity 5:2:2:1 at low temperature. Explain. (5%)

參考用