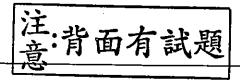
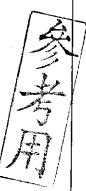
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※請在答案卷內作答

- 1. 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) SeCl₄, (b) IF₇, (c) N₃⁻, (d) SeOCl₄ (Se is central), (e) XeO₂F₂, (f) ClOF₄⁻, (g) ClO₃⁻, (h) carbon suboxide C₃O₂ (16%)
- Determine the point groups for (a) B₂H₆, (b) cyclohexane (chair form),
 (c) [Cr(C₂O₄)₃]³-, (d) Ni(cyclobutadiene)₂ (staggered), (e) allene
 (H₂C=C=CH₂), (f) IOF₃, (g) SF₄, (h) S₈ (puckered ring), (i) ethane
 (staggered form), (j) N₂H₄ (gauche conformation). (20%)
- 4. Choose (a) The least soluble halide in water: LiF, LiCl, LiBr, or LiI. (b) Which one has the largest solubility: MgSO₄, CaSO₄, SrSO₄, BaSO₄.
 - (c) Stronger hydrogen bond: $[OH_3 \cdots OH_2]^+$ or $OH_2 \cdots OH_2$. (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: BF₃, BCl₃, BBr₃, or BI₃. (g) The strongest Brønsted-Lowry basicity with hydrogen ion: pyridine, 2-methylpyridine, 2,6-dimethylpyridine, or 2-t-butylpyridine. (h) Longer N-S bond: Me₃N-SO₃ or H₃N-SO₃. (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%)
- 5. Describe the structures of CsCl, ZnS (wurtzite), and CaF₂. (6%)





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※請在答案卷內作答

- 6. The structure of high-temperature superconductor YBa₂Cu₃O₇ 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) $Cr(NH_3)_3Cl_3$, (b) $Pt(en)Cl_2$, (c) $[Pt(ox)_2]^{2-}$, (d) $[Cr(H_2O)_5Br]^{2+}$, (e) $[Fe(OH)_4]$ (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 [Ti(H₂O)₆]⁺ and [Fe(H₂O)₆]²⁺ show two closely overlapping absorption bands rather than a single band. (2%)
- 10. The d² ions CrO₄⁴⁻, MnO₄³⁻, FeO₄²⁻, and RuO₄²⁻ 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%)

$$[PtCl_4]^{2-} + NO_2^{-} \rightarrow (a), \quad (a) + NH_3 \rightarrow (b)$$

$$(a) + NH_3 \rightarrow (b)$$

$$[PtCl_3NH_3]^- + NO_2^- \rightarrow (c), \quad (c) + NO_2^- \rightarrow (d)$$

$$(c) + NO_2 \rightarrow (d)$$

$$[PtCl(NH_3)_3]^+ + NO_2^- \rightarrow (e), \quad (e) + NO_2^- \rightarrow (f)$$

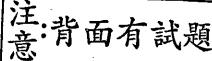
$$(e) + NO_2 \rightarrow (f)$$

$$[PtCl_4]^2 + \Gamma \rightarrow (g), \qquad (g) + \Gamma \rightarrow (h)$$

$$(g) + \Gamma \rightarrow (h)$$

$$[PtI_4]^{2-} + CI^- \rightarrow (i), \quad (i) + CI^- \rightarrow (j)$$

$$(i) + Cl^{-} \rightarrow (i)$$





台灣聯合大學系統 105 學年度碩士班招生考試試題

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※請在答案卷內作答

- 12.Is the reaction $[Co(NH_3)_6]^{3+} + [Cr(H_2O)_6]^{2+}$ 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) [Ni(CO)₃(NO)]² (contains linear M-N-O)
 - $(b)[Ru(CO)_4(GeMe_3)]^z$
 - (c) $[(\eta^3 C_3H_5)V(CNCH_3)_5]^z$
 - (d) $[(\eta^5 C_5H_5)Fe(CO)_3]^z$
 - (e) $[(\eta^5-C_5H_5)_3Ni_3(\mu_3-CO)_2]^2$
- 14. The ¹H NMR spectrum of (C₅H₅)₂Fe(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%)

