系所組別：化學系

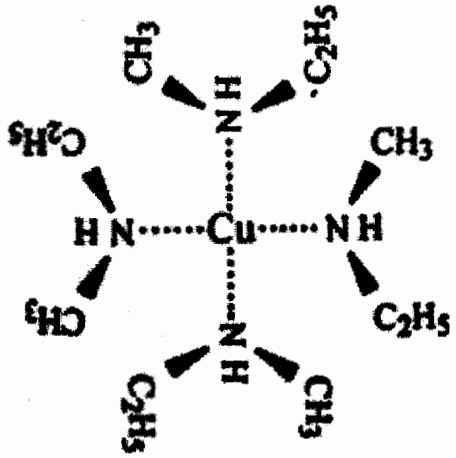
考試科目：無機化學　　考試日期：0224，節次：3

※ 考生請注意：本試題不可使用計算機　　請勿在本試題紙上作答，否則不予計分

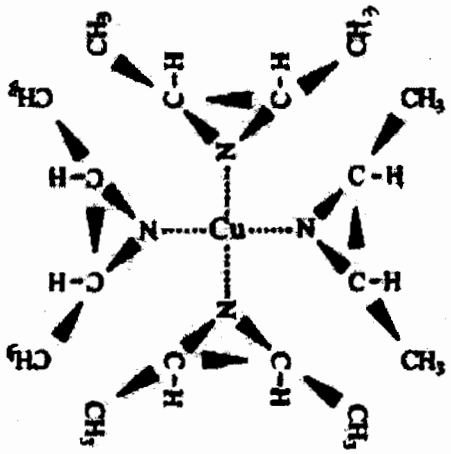
一、 選擇題： （60 分，每題 4 分）

1. Select the series with the order of increasing bond polarity (a) O–Cl > N–O > S–Cl (b) S–Cl > P–Br > O–Cl (c) N–O > O–Cl > P–Br (d) none of these.
2. Decide the point group of molecular **I** and **II**. (a) **I**: C_{4v}, **II**: D_4 (b) **I**: D_4, **II**: C_{4h} (c) **I**: C_{4h}, **II**: D_4 (d) none of these.

Molecule **I**

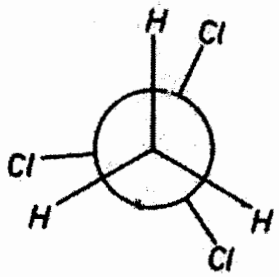


Molecule **II**



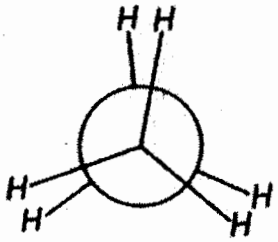
3. Decide the point group of molecular **I** and **II**. (a) **I**: C_{3v}, **II**: C_3 (b) **I**: C_3, **II**: D_3 (c) **I**: C_{3i}, **II**: D_{3d} (d) none of these.

Molecule **I**



CH_3CCl_3

Molecule **II**



C_2H_6 (Skew conformation)

4. Select the series with the order of increasing acidity in water (a) H_2SO_4 > H_3PO_4 > H_3AsO_4 (b) HCl > H_2SO_4 > $HClO_4$ (c) HSO_4^- > $H_2PO_4^-$ > HF (d) none of these.
5. Select the series with the order of increasing solubility (a) $Mn(OH)_2$ < $Ni(OH)_2$ < $Zn(OH)_2$ (b) $Sr(OH)_2$ > $Ca(OH)_2$ > $Mg(OH)_2$ (c) PbI_2 > $PbBr_2$ > $PbCl_2$ (d) none of these.
6. A mineral crystallized in a cubic close packed (*ccp*) array of Q anions with A cations in 1/4 octahedral holes and B cations in 1/2 tetrahedral holes. What is formula of this mineral? (a) AB_2Q_4 (b) A_2BQ_4 (c) ABQ_2 (d) none of these.

（背面仍有題目,請繼續作答）

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7. Using a Born-Harbor cycle to determine a lattice energy of KCl(*s*). ΔH = +89 kJ/mole for the sublimation of K(*s*), ΔH = +425 kJ/mole for the ionization of K(*g*), ΔH = +244 kJ/mole for the dissociation of Cl_2(*g*), ΔH = –355 kJ/mole for the electron attachment to Cl(*g*), and ΔH = –438 kJ/mole for the formation of KCl(*s*) (a) –541 kJ/mole (b) –157 kJ/mole (c) –719 kJ/mole (d) none of these.
8. The reaction $P_4(g) \leftrightarrow 2P_2(g)$ has ΔH = 200 kJ/mol. The bond energy of a single phosphorus-phosphorus bond is 200 kJ/mol. Calculate the bond energy of a quadruple phosphorus-phosphorus bond. (a) 300 kJ/mol (b) 500 kJ/mol (c) 600 kJ/mol (d) 800 kJ/mol.
9. Decide the expected structures of molecule **I**, Sn_9^{4-} and molecule **II**, Bi_4^{2-}. (a) **I**: Nido, **II**: Arachno (b) **I**: Arachno, **II**: Hypho (c) **I**: Closo, **II**: Hypho (d) **I**: Closo, **II**: Nido.
10. Decide the expected structures of molecule **I**, $B_3H_8Mn(CO)_3$ and molecule **II**, $As_2C_2B_7H_9$. (a) **I**: Nido, **II**: Arachno (b) **I**: Nido, **II**: Nido (c) **I**: Arachno, **II**: Nido (d) **I**: Hypho, **II**: Closo.
11. Decide which specie is paramagnetic? (a) $[RuF_6]^{4-}$ (b) $[Co(H_2O)_6]^{3+}$ (c) $[Co(CN)_6]^{3-}$ (d) none of these.
12. Which complex would you expected to have the lowest-energy charge transfer? (a) $[Co(NH_3)_5Cl]^{2+}$ (b) $[Co(NH_3)_5Br]^{2+}$ (c) $[Co(NH_3)_5I]^{2+}$ (b) $[Co(NH_3)_5F]^{2+}$.
13. Decide the ground term of configuration **I**, d^8 (O_h symmetry) and configuration **II**, d^4 (T_d symmetry). (a) **I**: $^3F_4$, **II**: $^5D_4$ (b) **I**: $^3F_2$, **II**: $^5D_0$ (c) **I**: $^3F_4$, **II**: $^5D_0$ (d) none of these.
14. Which of the following complexes are chiral? **I**: $[Cr(ox)_3]^{3-}$, **II**: cis-$[PtCl_2(en)]$, **III**: cis-$[RhCl_2(NH_3)_4]^+$, **IV**: $[Ru(bipy)_3]^{2+}$, **V**: face-$[Co(NO_2)_3(dien)]$ (a) I, III, IV (b) III, IV (c) II, III, V (d) I, IV.
15. Which compound is the most difficult to oxidize in the air (a) CoO (b) MnO (c) NiO (d) TiO.

二、 簡答題： （40 分，每題 8 分）

1. (a) Draw the resonance structures for the NSO^- and SNO^-. Assign the most stable resonance state for each compound. (b) Give Lewis dot structures and sketch the shapes for $I(CF_3)Cl_2$, IF_5, O_3, and XeO_3.
2. (a) Construct the MO of SH^-. (b) Explain how H^+ acid interacts with base SH^- form MO concept.

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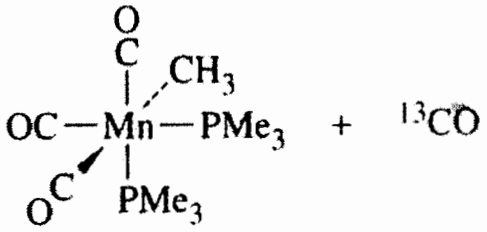
3. Using the angular overlap model, sketch simplified MO diagrams for tetrahedral and square planar complexes and determine (a) the energies splitting of d orbitals (in terms of eπ and eσ) and (b) energies obtained in ligands (in terms of eπ and eσ).

4. Predict the products of



5. Display how to synthesize acetic acid CH_3COOH from methanol CH_3OH.