

科目：無機化學

適用：應化系

考生注意：

1. 依次序作答，只要標明題號，不必抄題。
2. 答案必須寫在答案卷上，否則不予計分。
3. 限用藍、黑色筆作答；試題須隨卷繳回。

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編號：373

一、True (T) or False (F). (30%, 2% each)

- (1) Both I_3^- and NH_2^- have a linear molecular structure.
- (2) Acetylene ($HCCH$) has 6 vibration modes.
- (3) H_2O and CH_2Cl_2 belong to the same point group.
- (4) O_2 is a paramagnetic compound, while N_2 is a diamagnetic compound.
- (5) On the basis of molecular orbitals, NO^+ has the shortest bond length among NO , NO^- , and NO^+ .
- (6) A close-packed structure showing an ABCABC structure is called hexagonal close packing (hcp).
- (7) The formation constant for $[Ni(NH_2CH_2CH_2NH_2)_3]^{2+}$ is smaller in magnitude than that for $[Ni(CH_3NH_2)_6]^{2+}$.
- (8) For an s^1p^1 configuration, there are 12 microstates.
- (9) Triammineaquadichlorocobalt(III) chloride has three stereoisomers.
- (10) Metals from the second and third transition series form low-spin complexes more readily than metals from the first transition series.
- (11) Cyanide (CN^-) is a weaker σ donor and a substantially stronger π acceptor than carbonyl (CO).
- (12) Brønsted and Lowry defined an acid as a species with a tendency to gain a hydrogen ion and a base as a species with a tendency to lose a hydrogen ion.
- (13) For a d^3 configuration in an octahedral geometry, the ground term is 4F .
- (14) $[Mn(CO)_6]^+$ has the shortest C—O bond among these metal carbonyl complexes $[V(CO)_6]^-$, $[Cr(CO)_6]$, and $[Mn(CO)_6]^+$.
- (15) The CH_3 fragment is isolobal with the $[Fe(CO)_5]^+$ fragment.

二、(6%)

Draw the ligand-field splitting of the d energy levels in an octahedral complex.

三、(8%)

Draw an appropriate molecular orbital energy-level diagram for CO .

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四、(8%, 2% each)

According to VSEPR model, predict the structures of the following compounds:

- (a) NO_2^- (b) XeF_4 (c) ICl_3 (d) O_3

五、(8%, 2% each)

Assign the following molecules or ions to their appropriate point groups.

- (a) CHCl_3 (b) CO_2 (c) $\text{Fe}(\text{CO})_5$ (d) $\text{trans-}[\text{Co}(\text{NH}_3)_4\text{Cl}_2]^+$

六、(8%, 2% each)

Calculate the ligand-field stabilization energy (LFSE) of octahedral complexes in Δ_o unit.

- (a) $[\text{MnF}_6]^{4-}$ (b) $[\text{Cr}(\text{CN})_6]^{3-}$ (c) $[\text{Ti}(\text{H}_2\text{O})_6]^+$ (d) $[\text{Co}(\text{NH}_3)_6]^{3+}$

七、(8%, 2% each)

Give the valence electron count for the following species.

- (a) $(\eta^5\text{-Cp})_2\text{Ti}(\text{CO})_2$ (b) $[\text{Co}(\text{CN})_5]^{3-}$
(c) $[\text{Ni}(\text{CN})_4]^{2-}$ (d) $\text{cis-PtCl}_2(\text{NH}_3)_2$

八、(8%, 2% each)

Classify the following as *closo*, *nido*, or *arachno*:

- (a) $\text{B}_6\text{H}_6^{2-}$ (b) $\text{C}_4\text{B}_2\text{H}_6$ (c) $\text{Co}_4(\text{CO})_{12}$ (d) P_4

九、(8%)

The solubilities of silver halides in water decrease, going down the column of halogens in the periodic table:

AgF ($K_{sp} = 205$) \gg AgCl ($K_{sp} = 1.8 \times 10^{-10}$) $>$ AgBr ($K_{sp} = 5.2 \times 10^{-13}$) $>$ AgI ($K_{sp} = 8.3 \times 10^{-17}$). Explain briefly.

十、(8%)

Determine the packing efficiency of atoms in a body-centered cubic structure.