

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。

本試題

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編號：373

9. (8%, 4% each)

(a) Reactions of a series of amines with hydrogen ions show this order of Lewis base strength in the gas phase: $\text{NMe}_3 > \text{NHMe}_2 > \text{NH}_2\text{Me} > \text{NH}_3$. Explain this trend.

(b) Reactions of a series of acids with ammonium (NH_3) show this order of acid strength: $\text{BF}_3 > \text{BMe}_3 > \text{BEt}_3 > \text{B}[2,4,6\text{-C}_6\text{H}_2\text{Me}_3]_3$. Explain.

10. (4%)

The (2-aminoethyl)phosphine ligand has the structure $\text{H}_2\text{NCH}_2\text{CH}_2\text{PH}_2$; it often acts as a bidentate ligand toward transition metals. When this ligand forms monodentate complexes with palladium, it bonds through its phosphorus atom rather than its nitrogen. Suggest an explanation.

11. (12%, 3% each)

Glycine has the structure $\text{H}_2\text{NCH}_2\text{COOH}$. It can lose a proton from the carboxyl group and form chelate rings bonded through both the N and one of the O atoms. Draw structures for all possible isomers of tris(glycinato)cobalt(III), and assign absolute configurations (Λ or Δ) to each.

12. (10%)

Sample of $\text{Fe}(\text{CO})(\text{PF}_3)_4$ shows two carbonyl stretching bands, at 2038 and 2009 cm^{-1} .

(a) (4%) How is it possible for this compound to exhibit two carbonyl bands?

(b) (6%) $\text{Fe}(\text{CO})_5$ has carbonyl bands at 2025 and 2000 cm^{-1} . Would you place PF_3 above or below CO in the spectrochemical series? Explain briefly.

13. (6%)

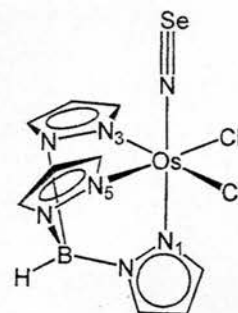
The first complex of the ligand NSe (selenonitrosyl), $\text{TpOs}(\text{NSe})\text{Cl}_2$ [Tp = hydrotris-(1-pyrazolyl)borate], is shown. The osmium—nitrogen distances are:

$\text{Os}-\text{N}(1)$: $210.1(7)\text{ pm}$

$\text{Os}-\text{N}(3)$: $206.6(8)\text{ pm}$

$\text{Os}-\text{N}(5)$: $206.9(7)\text{ pm}$

Which ligands, Cl or NSe, has the larger trans influence? Explain briefly.



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1. (8%, 2% each)

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

- (a) PF_5 (b) SF_4 (c) BrF_3 (d) XeF_2

2. (8%, 2% each)

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

- (a) CrF_6^{3-} (b) $\text{Fe}(\text{CN})_6^{4-}$ (c) $\text{Co}(\text{H}_2\text{O})_6^{3+}$ (d) $\text{Ni}(\text{NH}_3)_5^{2+}$

3. (8%, 2% each)

Give the valence electron count for the following species.

- (a) $\text{CpMn}(\eta^6\text{-C}_6\text{H}_6)$ (b) $\text{CpMo}(\text{CO})_3(\eta^1\text{-C}_3\text{H}_5)$
 (c) $\text{Rh}(\text{C}_2\text{H}_4)(\text{PPh}_3)_2\text{Cl}$ (d) *trans*- $\text{Ir}(\text{PEt}_3)_2(\text{CO})\text{Cl}$

4. (10%, 2% each)

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

- (a) CH_2Cl_2 (b) $[\text{PtCl}_4]^{2-}$ (c) HCl (d) $\text{Cr}(\text{CO})_6$ (e) P_4

5. (4%, 2% each)

Determine the bond order of the M—M bond for the following.

- (a) $[\text{Re}_2\text{Cl}_8]^{2-}$ (b) $[\text{Os}_2\text{Cl}_8]^{2-}$

6. (4%)

 ICl_2^- is linear, but NH_2^- is bent. Explain.

7. (6%)

Nickel has a face-centered cubic unit cell. The density of nickel is 6.84 g/cm^3 . Calculate a value for the atomic radius of nickel (r_{Ni}). Atomic mass of Ni: 58.69.

8. (12%, 6% each)

(a) Prepare a molecular orbital energy-level diagram for NO, showing clearly how the atomic orbitals interact to form MOs.

(b) NO^+ and NO^- are also known. Determine the bond orders of NO, NO^+ and NO^- .