

科目：無機化學 適用：應化系

編號：483

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
共 2 頁
第 / 頁

[1] (10 points, 2 points/per)

True (T) or False (F).

- (a) Molecular orbitals (MOs) with rotational symmetry about the bond axis (C_∞) are called sigma (σ) orbitals.
- (b) A close-packed structure with the sequence $ABCABC\dots$ is described as a hexagonal close-packed (*hcp*) arrangement, which shows that 74.0% of the sphere is occupied by spheres.
- (c) According to the Brønsted-Lowry concept of acids and bases, an acid is defined as an electron-pair acceptor and a base is defined as an electron-pair donor.
- (d) On the basis of molecular orbitals, O_2^+ has the shortest bond length (strongest bond) among O_2 , O_2^+ , O_2^- , and O_2^{2-} .
- (e) As the atomic number increase the atomic radii of rare earth elements, except Eu and Yb, decrease; this phenomenon is called Lanthanide contraction.

[2] (10 points, 2 points/per)

Name the following compounds according to the IUPAC rules.

- (a) $K_3[Fe(CN)_6]$
- (b) $[CoBr(NH_3)_5]SO_4$
- (c) $[Ag(NH_3)_2]Cl$
- (d) $[Fe(H_2O)_6](ClO_4)_3$
- (e) $[Ni(NH_2CH_2CH_2NH_2)_2Cl_2]$

[3] (10 points, 2 points/per)

Assign the following molecules to their appropriate point groups.

- (a) SF_4
- (b) B_2H_6
- (c) H_2O_2
- (d) PCl_3
- (e) $Mo(CO)_6$

[4] (10 points, 2 points/per)

Which the following complexes obey the 18-electron rule?

- (a) $W(CO)_6$
- (b) $[Ni(CN)_4]^{2-}$
- (c) $HRh(CO)_5$
- (d) $(Cp^*)_2ZrCl_2$
- (e) $cis-PtCl_2(NH_3)_2$
- (f) $Ir(CO)Cl(PPh_3)_2$
- (g) $[(\eta^5-C_5H_5)Fe(CO)_3]^+$
- (h) $Rh(C_2H_4)(PPh_3)_2Cl$
- (i) $CpMo(CO)_3(\eta^1-C_3H_5)$
- (j) $Ir(PPh_3)_2(CO)Cl(\eta^2-C_3H_6)$

科目：無機化學 適用：應化系

編號：483

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

共 2 頁

第 2 頁

[5] (10 points, 2 points/per)

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

- (a) Zn^{2+} in weak-field
- (b) Mn^{2+} in strong-field
- (c) Ti^{3+} in weak-field
- (d) Cu^{2+} in strong-field
- (e) Ni^{2+} in strong-field

[6] (10 points, 2 points/per)

Predict the number of unpaired electrons for each of the following:

- (a) $[Cr(NH_3)_6]^{3+}$
- (b) $[Ti(H_2O)_6]^{3+}$
- (c) $[Co(H_2O)_6]^{2+}$
- (d) $[Cr(CN)_6]^{4-}$
- (e) $[Fe(CN)_6]^{3-}$

[7] (10 points, 2 points/per)

Label the following structures as chiral or achiral.

- (a) $trans-Pt(NH_3)_2BrCl$
- (b) $[Co(ox)_3]^{3-}$
- (c) $cis-[Ni(bipy)_2Cl_2]$
- (d) $trans-[Co(NH_3)_4Cl_2]^+$
- (e) $fac-[Pt(NH_3)_3Cl_3]^+$

[8] (6 points, 2 points/per)

Find organic fragments isolobal with each of the following:

- (a) $Mn(CO)_5$
- (b) $Fe(CO)_4$
- (c) $Co(CO)_3$

[9] (15 points, 3 points/per)

Sketch structures of the following:

- (a) $Fe(CO)_5$
- (b) $Ir_4(CO)_{12}$
- (c) $cis-[Pt(NH_3)_2Cl_2]$
- (d) $trans-[Ni(en)_2Cl_2]$
- (e) $\Delta-mer-M(AB)_3$, in which AB is a bidentate unsymmetrical chelating ligand.

[10] (9 points)

Show that atoms occupy 68.0% of the total volume in a body-centered cubic structure in which all the atoms are identical.