Tutorial 1

Q1: Calculate the CFSE for the following complexes.

a) $[Fe(CN)_6]^{3-}$
b) $[Fe(H_2O)_6]^{3+}$
c) $[CoF_6]^{3-}$
d) $[CoCl_4]^{2-}$
e) $[Cr(H_2O)_6]^{2+}$

Q2: Which of the following are structural isomers?

I. coordination isomers
II. linkage isomers
III. geometric isomers
IV. optical isomers

A) I, III
B) II, IV
C) I, III, IV
D) II, III
E) I, II

Q3: Which of the following complexes shows geometric isomerism?

A) $[Co(NH_3)_5Cl]SO_4$
B) $[Co(NH_3)_6]Cl_3$
C) $[Co(NH_3)_5Cl]Cl_2$
D) $K[Co(NH_3)_2Cl_4]$
E) $Na_3[CoCl_6]$

Q4. How many of the following compounds exhibit geometric isomers?

I. $Pt(H_2O)_2Cl_2$ (square planar)
II. $[Co(H_2O)_6]Br_3$
III. $[Ni(H_2O)_4(NO_2)_2]$
IV. $K_2[CoCl_4]$

A) 0
B) 1
C) 2
D) 3
E) 4

Q5. Give the number of geometric isomers for the octahedral compound $[MA_2B_2C_2]$, where A, B, and C represent ligands.

A) 1
B) 2
C) 3
D) 5
E) none of these

Q6. For the process $[Co(NH_3)_5Cl]^{2+} + Cl^- \rightarrow [Co(NH_3)_4Cl_2]^+ + NH_3$, what would be the ratio of *cis* to *trans* isomers in the product?

A) 1:1
B) 1:2
C) 1:4
D) 4:1
E) 2:1

Q7. Which of the following statements about the complex ion $[Co(en)_2Cl_2]^+$ is true?
(en = ethylenediamine, $NH_2CH_2CH_2NH_2$)

A) The complex ion contains Co(I).
B) The complex ion exhibits *cis* and *trans* geometric isomers, but no optical isomers.
C) The complex ion exhibits two geometric isomers (*cis* and *trans*) and two optical isomers.
D) The geometric isomers of the complex ion have identical chemical properties.

Q8. Calculate the oxidation state of the metal and the number of *d* electrons in the following coordination complexes:

a) $[CoCl_4]^{2-}$; b) $[Fe(bpy)_3]^{3+}$; c) $[Cu(ox)_2]^{2-}$; d) $[Cr(CO)_6]$

Q9. Which of the following complexes will have larger crystal field splitting (Δ) in the given series? Give brief explanation for your choice.

(i) $[Co(en)_3]^{3+}$, $[Ir(en)_3]^{3+}$, $[Rh(en)_3]^{3+}$
(ii) $[Cr(H_2O)_6]^{3+}$, $[Cr(H_2O)_6]^{2+}$,$[Cr(NH_3)_6]^{3+}$,$[Cr(CN)_6]^{3-}$
(iii) $[CoF_6]^{3-}$, $[Co(H_2O)_6]^{3+}$, $[Co(NH_3)_6]^{3+}$
(iv) $[Fe(H_2O)_6]^{2+}$, $[Fe(CN)_6]^{4-}$, $[FeCl_4]^{2-}$