Chemistry 4000
Introduction to Inorganic Chemistry: The Different Perspectives of Bonding

Problem Set #4

Chapter 7-

1. a. Define the expressions of $K_{1\text{-}6}$ and $\beta_{1\text{-}6}$ for:

$$Ni(H_2O)_6^{2+} + 6\ NH_3 \rightleftharpoons Ni(NH_3)_6^{2+} + 6\ H_2O$$

b. To which ligand will Ni^{2+} have a higher affinity and why: $PhNH_2$ or PhSH.

Chapter 20-

2) Using molecular orbital theory, what is the bond order you determine for $[Co(H_2O)_6]^{3+}$?

3) Using molecular orbital theory, what is the bond order you determine for $[Co(I)_6]^{3-}$?

4) What is the CFSE for $[Co(CN)_6]^{3-}$ and $[Co(I)_6]^{3-}$? What is the spin-only magnetic moment for both?

5) Why can't H_2O be a good π donor or acceptor?

6) Consider the following electronic transition frequencies (in cm^{-1}) for the nickel(II) complex:

Complex	v_1	v_2	v_3
$[Ni(NH_3)_6]^{2+}$	10,750	17,500	28,200

Determine appropriate values of Δ_o and B for the complex.

7) When visible light passes through a solution of nickel(II) sulfate, a green solution results. What are the spin allowed transitions responsible for this color? Would you expect a Jahn-Teller distortion for this complex?

8) The ligand-to-metal charge transfer bands increase in energy in the series: $[CoI_4]^- < [CoBr_4]^- < [CoCl_4]^-$. Explain.

Chapter 26-

9) Predict the geometries of the complexes which result from the following reactions:

a. $[Pt(NO_2)Cl_3]^{2-} + NH_3 \rightarrow [Pt(NO_2)(NH_3)Cl_2]^- + Cl^-$

b. cis-$[Pt(RNH_2)_2(NH_3)(NO_2)]^+ + Cl^- \rightarrow Pt(RNH_2)(NH_3)(NO_2)Cl + RNH_2$

10) Nickel complexes are observed to undergo substitution much faster than platinum complexes. Offer an explanation.

11) The following data were collected for the reaction [dien = diethylenetriamine]:

$[Pd(dien)SCN]^+ + py \rightarrow [Pd(dien)py]^{2+} + SCN^-$

k_{obs}	[py] (M)
6.6×10^{-3}	1.24×10^{-3}
8.2×10^{-3}	2.48×10^{-3}
2.5×10^{-2}	1.24×10^{-2}

Use the data to calculate k_1 and k_2 for substitution in this square planar complex.

12) Sketch energy/reaction coordinate diagrams for ligand-substitution reactions in which products are more stable than reactants, and

a. no intermediate is formed.

b. an intermediate is formed and bond breaking is more important than bond making.

c. an intermediate is formed and bond breaking is less important than bond making.

Literature Review-

Find a 2017 publication focused on coordination compounds and structural characterization and that emphasize at least two themes that we evaluated in our coordination chemistry lectures. In two pages, describe the coordination chemistry discussed in this article emphasizing the set of techniques used to characterize the compounds and also how the article expands on the themes we addressed in lecture.