HW 5
CHEM 362

Due: October 22, 2019

1. Draw the molecular structures of the following complexes

   a. *mer*-triamminetribromocobalt(III)
   b. *trans*-dichlorotetracyanochromate(III)
   c. *cis*-dichlorobis(trimethylphosphine)palladium(II)

2. For each of the following compounds
   a. Give the proper name
   b. Give the coordination number of the central metal atom.
   c. Give the principle geometric arrangement(s) for the above coordination number *Hint: Be mindful of oxidation states!*

      i. $Pt(acac)(NH_3)Br$
      ii. $Co(NH_3)_5Cl$
      iii. $[Pt(phen)_2][PF_6]_2$
      iv. $K_3[Fe(CN)_6] \cdot 2H_2O$
      v. $Na_4[Fe(CN)_6$
      vi. $[Ni(en)_3][ClO_4]_2$
      vii. $Ni(CO)_4$

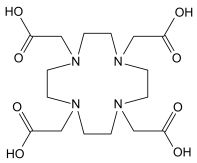
3. Give an example **not from the notes** of each of the following types of isomers
   a. Ionization isomer
   b. Linkage isomer
   c. Coordination isomer

4. For each of the following ligands
   a. Classify as sigma donor, pi donor or pi acceptor
   b. Draw the structure and give the common abbreviation (if there is one)

      i. CO
      ii. ethylenediamine
      iii. acetylacetonate
      iv. terpyridine
      v. ethylenediaminetetraacetic acid
      vi. ammonia

5. Why does K_i decrease with each subsequent step of a metal ligand complex formation equilibria?

6. Gadolinium-Based Contrast Agents (GBCA) are intravenous drugs used in diagnostic imaging procedures to enhance the quality of magnetic resonance imaging (MRI) or magnetic resonance angiography (MRA). Gadolinium as a free ion and gadolinium complexes with low denticity ligands are known to be highly toxic. However, compounds such as Gd(DOTA) are generally non-toxic and can be used for such imaging purposes. The chemical structure of the DOTA ligand is shown below



a. What is the denticity of the DOTA ligand? Draw how you think this ligand would bind to a gadolinium ion.
b. What are the thermodynamic considerations that make this complex more stable than a complex with a comparable coordination number but low denticity ligands?
c. What is the name of the effect that you described in part b)

7. The two main types of substitution reactions for coordination complexes are Associate and Dissociative. Draw the reaction coordinate diagram for each *and be sure to include all relevant labels.* What is the difference between these two types of reactions? How does the reaction rate give insight regarding the type of reaction?

8. Compare and contrast the general trends for substitution reactions of octahedral and square planar complexes regarding:
a. Leaving group effects
b. Charge effects
c. Steric effects

9. Describe in words each of the following reactions. What type of reaction is occurring?
a. $[Co(H_2O)_6]^{2+} + H_2O^* \rightarrow [Ni(H_2O)_5(H_2O^*)]^{2+} + H_2O$
b. $[Co(NH_3)_5Cl]^{2+} + OH^- \rightarrow [Co(NH_3)_4(NH_2)Cl]^{+} + H_2O$
c. *cis*-$Pt(PEt_3)_2(CN)(Cl) + H_2O \rightarrow [Pt(PEt_3)_2(CN)(H_2O)]^{+} + Cl^-$