Chemistry 6011 (Fall 2016)
Advanced Inorganic Chemistry I: From Atoms to Coordination Compounds
Problem Set #3

Chapter 6-

1. Define the equations for the Latimer diagram of iron (Appendix B). Assume the conditions are acidic. Which steps are spontaneous?

Chapter 9 and 10-

1. Name the following compounds:

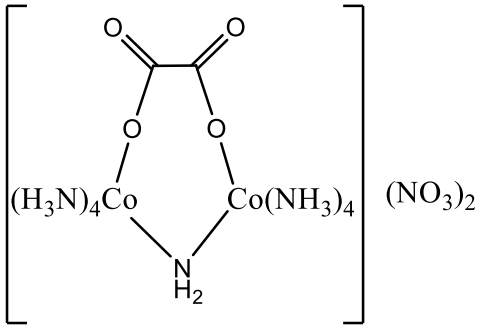
a. $[Cu(NH_3)_4][PtBr_4]$

b. $[Co(en)_2Cl(NO_2)]Cl$

c. $Na_3[Al(C_2O_4)_3]$

d. $W(CO)_5PMe_3$

e.



2. Write structural formulas for the following:

a. diamminetriaquahydroxochromium(III) nitrate

b. tetrakis(pyridine)platinum(II) tetraphenylborate

c. dibromotetracarbonyliron(II)

d. tetraamminecobalt(III)-μ-amido-μ-hydroxobis(ethylenediamine)cobalt(III)

3. How might Werner have been able to distinguish between the following two formulations for a compound: $[Co(NH_3)_5]Cl_3$ and $[Co(NH_3)_5Cl]Cl_2$? The cation would be trigonal bipyramidal in the former and octahedral in the latter.

4. To show your understanding of basic bonding models, describe the bonding in $[NiF_4]^{2-}$ with each of the following:

a. Valence bond theory

b. Crystal field theory

c. Molecular orbital theory

5. What bond angle would you expect for M-O-R

a. if there is no metal-oxygen π bonding?

b. if the alkoxide donates two π electrons?

c. if the alkoxide donates four π electrons?

6. If one $[CuL_6]^{2+}$ solution is blue and another is green, which would be expected to have the higher value of Δ_o?

7. Write K and β expressions for the proton affinity of a tetraprotic ligand.

8. Write K and β expressions for the metal affinity of a tetraprotic ligand, which binds in a ratio of 1:1 metal:ligand.

9. A complex of nickel(II), $[NiCl_2(PPh_3)_2]$, is paramagnetic. The analogous complex of palladium(II) is diamagnetic. Predict the number of isomers that will exist for each of these formulations.

10. Determine the equilibrium constant for the following chemical reaction.

$Ni(H_2O)_6^{2+} + 6\ NH_3 \leftrightarrow Ni(NH_3)_6^{2+} + 6\ H_2O \quad \Delta G° = -51.8$ kJ/mol

Would you expect a major change in entropy?

11. Draw out all the isomers, geometric and optical, of the following: $[Co(en)_2Cl_2]^+$ and $[Co(en)_2(NH_3)Cl]^{2+}$

12. Draw the molecular structure of the following complexes:

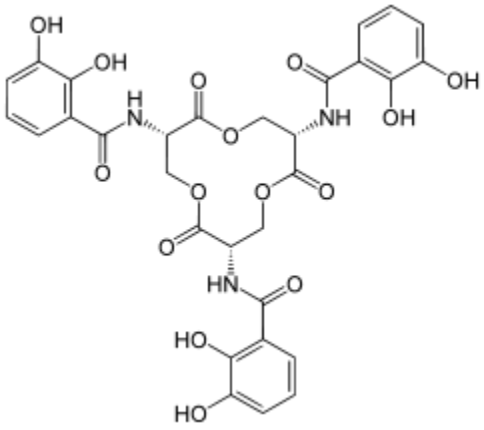
a. *cis*-dichlorotetracyanochromate(III)

b. *mer*-triamminetrichlorocobalt(III)

c. *trans*-dichlorobis(trimethylphosphine)palladium(II)

d. *fac*-triaquatrinitrocobalt(III)

13. The macrocycle ligand enterobactin has an extremely high affinity for Fe(III) with a stability constant of 10^{52} (the largest known stability constant for Fe(III) with a naturally occurring substance).



Harris, W.R.; Carrano, C. J.; Cooper, S.R.; Soften, S. R.; Aydeef, A.E.; McArdle, J.V.; Raymond, K.N. *J. Am. Chem. Soc.* **1979,** *101*, 6097-6104.

a. Suggest a structure for the Fe(III) enterobactin complex that explains its high stability.

b. If the concentration of the Fe(III)-enterobactin complex within the microorganism is 10^{-7} mol/L, how many liters of bacteria would have to be searched to find a single free Fe(III) ion?