

Chemistry 6011 (Fall 2016)

Advanced Inorganic Chemistry I: From Atoms to Coordination Compounds

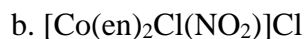
Problem Set #3

Chapter 6-

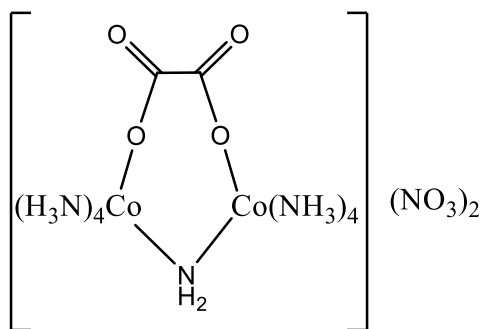
1. Define the equations for the Latimer diagram of iron (Appendix B). Assume the conditions are acidic. Which steps are spontaneous?

Chapter 9 and 10-

1. Name the following compounds:



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: $[\text{Co}(\text{NH}_3)_5]\text{Cl}_3$ and $[\text{Co}(\text{NH}_3)_5\text{Cl}]\text{Cl}_2$? 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 $[\text{NiF}_4]^{2-}$ 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?

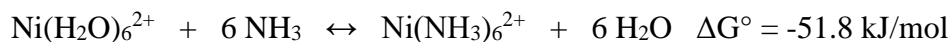
6. If one $[\text{CuL}_6]^{2+}$ solution is blue and another is green, which would be expected to have the higher value of Δ_o ?

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), $[\text{NiCl}_2(\text{PPh}_3)_2]$, 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.



Would you expect a major change in entropy?

11. Draw out all the isomers, geometric and optical, of the following: $[\text{Co}(\text{en})_2\text{Cl}_2]^+$ and $[\text{Co}(\text{en})_2(\text{NH}_3)\text{Cl}]^{2+}$

12. Draw the molecular structure of the following complexes:

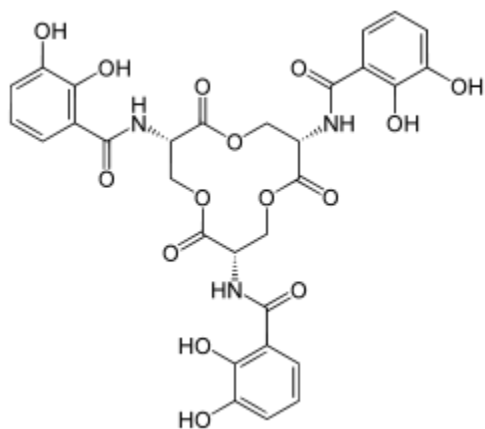
a. *cis*-dichlorotetracyanochromate(III)

b. *mer*-triamminetrichlorocobalt(III)

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

d. *fac*-triaquatrinocobalt(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?