CHEM. 341 (DR. AQUINO) TEST #2 NOVEMBER 22, 2011

Answer all questions in the booklets provided. A periodic table is provided. You have 50 minutes.

[14] Question 1

a) Determine the term symbols for states with the angular momentum and spin quantum numbers (*L*, *S*):

i) (3, 3/2) ii) (4, 2)

b) Identify the most likely ground term from each set of terms:

i) ^{2}D, ^{4}F, ^{2}P, ^{4}G ii) ^{4}S, ^{3}P, ^{2}D, ^{1}F

c) Determine the ground state terms for:

i) V^{3+} ii) Co^{2+} iii) Sb

[10] Question 2

a) Draw and label (with the appropriate d orbital) the d-orbital splitting diagram for a T-shaped complex. (Remember that your z axis should correspond to your principal rotation axis!). (5 marks)

b) If $[Cu(dppp)(CN)]^+$ assumed this T-shaped geometry what would the theoretical value of μ_{eff} be? (dppp = 1,4-bis(diphenylphosphino)propane, $Ph_2PCH_2CH_2CH_2CH_2PPh_2$) (3 marks)

c) Give 2 reasons why this geometry would be highly unlikely for a transition metal complex. (2 marks)

[12] Question 3

a) Explain why the "chelate effect" is essentially entropy driven. (4 marks)

b) Explain the trends in the logβ values *across* the table below. These involve the reaction of NH_3, en (ethylenediammine, $H_2NCH_2CH_2NH_2$) and bn (butylenediammine, $H_2NCH_2CH_2CH_2CH_2NH_2$) with the aqueous ions Ni^{2+}, Cu^{2+} and Zn^{2+}. (4 marks)

	NH_3 (log β_6)	**en (log β_3)**	**bn (log β_3)**
Ni^{2+} (aq)	8.6	18.3	10.8
Cu^{2+} (aq)	8.7	18.7	11.5
Zn^{2+} (aq)	8.1	16.9	9.9

c) Again, using the table above, explain the trends of logβ *down* the table. Give a plausible explanation as to why the values for Cu^{2+} are *higher* than for Ni^{2+} despite the fact that Cu^{2+} has a d^9 configuration and is known to undergo the Jahn-Teller effect? (4 marks)

[14] Question 4

a) List ***all*** the d-electron configurations for *high-spin tetrahedral* complexes in which the Jahn-Teller effect is *theoretically* possible. (3 marks)

b) Determine x in the formula $[Mn(CN)_6]^{x-}$; μ_{eff} = 3.87 B.M. (3 marks).

c) $[Et_4N][NiBr_4]$ is paramagnetic, but $K_2[PdBr_4]$ is diamagnetic. Explain these observations. (4 marks)

d) A compound with the *empirical* formula $Fe(H_2O)_4(CN)_2$ has a magnetic moment corresponding to 2 2/3 unpaired electrons per iron. How is this possible? What is the actual *molecular* formula of this compound? (4 marks)