Inorganic Cumulative Exam
Prof. Teo, April 5, 07

(Total 8 questions, 2x10+6x20=140 points)

Explain/calculate the following terms/parameters:

1. K_α and K_β of copper.
2. L_1, L_2, and L_3 edges of gold.
3. Predict the NMR spectra of B_2H_6 (Hint: ^{11}B, I = 3/2, 80.4%; ^{10}B, I = 3, 19.6%; $J(^{11}B\text{-}^{1}H_{bridging}) < J(^{11}B\text{-}^{1}H_{terminal})$):
   (a) ^{11}B NMR.
   (b) Proton-decoupled ^{11}B NMR.
   (c) ^{1}H NMR (terminal).
   (d) ^{1}H NMR (bridging).
   (e) Indicate the relative intensities of terminal vs. bridging protons.
   (f) Indicate how the coupling constants $J(^{11}B\text{-}^{1}H_{bridging})$ and $J(^{11}B\text{-}^{1}H_{terminal})$ can be obtained from the spectra.
4. Magnetic moments of $[Co(NH_3)_6]^{2+}$ and $[Co(NH_3)_6]^{3+}$.
5. Assuming that the electron transfer between $[Co(H_2O)_6]^{2+}$ and $[Co(H_2O)_6]^{3+}$ involves pre-excitations of both ions, calculate the activation energy for this reaction (by further assuming that it is the sum of the one-electron excitation energies for the two ions) in terms of the crystal field splittings, Δ_2 and Δ_3,

and the pairing energies, P_2 and P_3, for the divalent and trivalent metal ions, respectively. (In reality, the electron transfer reaction involves coupling of vibrational and electronic motions, among other effects.)

6. How are $[P_7]^{3-}$ and P_4S_3 related? Count electrons and predict the structures of these clusters.
7. How are $[Ge_9]^{2-}$, $[Ge_9]^{3-}$, and $[Ge_9]^{4-}$ related? Count electrons and predict the structures of these clusters.
8. Predict also the structure of the yet unknown Ge_9 and $[Ge_9]^{6-}$ clusters.