

Chem 360: Inorganic Chemistry Exam/Homework

Due Wednesday, May 2nd (graduating seniors) or
Monday, May 7th (non graduating students).

1. All work to be done alone.
2. The exam is open book and unrestricted time.
3. No pencil or red pen.

Q.1. Transition metal complexes can undergo ligand exchange via an associated mechanism (A) or interchange mechanism (I). In contrast, carbon compounds (organic molecules) only have an analog to I (i.e., S_N2). What is the difference between "A" and "I". Then use this to explain why organic compounds have no analog to "A". (20 points)

Q.2. The rate of exchange of H_2O ligands on $[M(H_2O)_6]^{2+}$ with H_2O follows the trend $Be \ll Mg \ll Ba$. Explain this effect. Note the reaction occurs via a D mechanism and involves the breaking of the $M-O_{(H_2O)}$ bond. (10 points)

Q.3. Draw the d-orbital splitting for trigonal bipyramidal structure of a transition metal. Show your workings and rationale for which d-orbital is which (i.e., DON'T just try copying it from a text book). (20 points)

Q.4. Which M_{2+} ions of the 1st row of the transition metals will have Jahn Teller distortion for the following structures (a) octahedral, (b) trigonal bipyramid, (c) square planar. (15 points)

Q.5. Calculate the (corrected) magnetic moment of the following metal ions. (a) octahedral Cr(II), (b) octahedral Co(II), (c) square planar V(III), (d) trigonal bipyramid Ti(III). (20 points)

Q.6. The highest oxidation state for vanadium is +7 and the lowest is -1. Suggest which ligands will stabilize each of these oxidation states and why. (20 points)

Q.7. $[Cr(H_2O)_6]^{3+}$ is violet in color, the addition of base (OH^-) results in an increase in molecular weight and a change in color. Why? (15 points)

Q.8. The oxo centered compound $[Fe_3(O)(O_2CMe)_6(H_2O)_3]$ can have an overall charge of +1, 0 or -1. What is the structure of these compounds? Explain why the charge can vary? (15 points)

Q.9. (a) How has the annual consumption of crude oil in the US changed with population? (b) Provide the specific years and plot the data. (c) What is the consumption:population ratio for China (provide a specific year). (d) How will this value change over the next decade? (20 points)