Work Session 23, 24: Transition Elements, Coordination Compounds, Nuclear Reactions

1. What oxidation state is the most common one for transition and inner transition elements?

2. What is the highest oxidation state for elements in columns 5, 6, 7, 8, and 9 (in the 1-18 system)?

3. What can be said about the ionic or covalent character of transition elements in a 2+ oxidation state as compared to a 5+ or 6+ oxidation state?

4. What do all ligands have in common?

5. Name the following:
   $K_3[CoCl_6]$

   $[Zn(H_2O)_6](NO_3)_2$

   $K[Pt(NH_3)Cl_3]$

6. Write the formula for iron(III) hexacyanoferrate(III)

7. Crystal field splitting has what effect on d orbital energies? What effect does this have on the appearance of complex ions?

8. How many unpaired electrons would be in $[FeF_6]^{3-}$? In $[Fe(CN)_6]^{3-}$ Why is there a difference?

9. Let M stand for the metal, A for one ligand, and B for another ligand. Which combinations could form geometric isomers?
   MA_6 MA_5B MA_4B_2 MA_3B_3 MA_2B_4 MAB_5 MB_6

10. A bidentate ligand has two Lewis base atoms, a tridentate ligand has 3 Lewis base atoms. Is this all that is required, or is some geometric consideration also necessary? If so, what?

11. Explain how crystal field splitting causes complexes of the same metal atom with various ligands to have different colors and different magnetic properties.

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12. What kind of radioactive decay would you predict for Ge-68? For Ge-78? For elements heavier than bismuth?

13. What would be the products formed from the decay of Ge–68, Ge–78, and Po–209?

14. Complete the following nuclear reactions:

$$^{11}_{6}C \rightarrow \_\_\_ + {}^{0}_{1}\beta$$

$$^{14}_{6}C \rightarrow {}^{14}_{7}N + \_\_\_$$

$$^{249}_{98}Cf + {}^{12}_{6}C \rightarrow \_\_\_ + 4\,{}^{1}_{0}n$$

15. A radioactive element has a half-life of 24 days. What is the rate constant? How long would it take for 1.5×10^{21} atoms of the substance to decay down to 2.7×10^{19} atoms? How many atoms would be left after a year (365 days)?

16. Cesium–134 is a β emitter with a half-life of 2 years. It forms barium–134. How long will it take for 2.5 moles of Cs–134 to form 0.3 moles of Ba–134? Careful: need to know how much Cs remains.

17. If a 52 Kg person were exposed to 5.8×10^{6} nuclear disintegrations (β) from Sr-90, each with an energy of 2.9×10^{-13} J, how many rads did the person receive?

18. The mass of a $^{12}_{6}C$ nucleus is 11.99671 amu. The mass of a proton is 1.00728 amu. The mass of a neutron is 1.00867 amu. What is the mass defect and the binding energy of a carbon-12 atom?

19. Sketch a binding energy curve, indicating where some key elements lie.

20. Explain what is required for a nuclear reaction to release energy. Where are the elements that produce fusion reactions? Fission reactions? Use the graph in question 19 to show why fusion produces more energy than fission.