Chemistry 112 Name_____

Practice Exam 3

Show all work and set ups in an organized way. See last page for constants.

1) A particular complex ion absorbs light at a wavelength of 520 nm. What is the frequency of this light? What is the energy in joules? What color of light is observed? Is the ligand most likely a weak field ligand or strong field ligand?

Answer: Energy_____ Observed Color_____
Frequency _____ Type of Ligand_____

2) Complete and balance the following equation and use the appropriate values of *K*sp and *K*f to find the equilibrium constant for the following reaction:
$FeS(s) + \_\_CN^-(aq) \rightleftharpoons$

Answer_____

3.) Find the solubility of
CuI in 0.67*M* HCN solution. The *K*sp of CuI is 1.1×10^{-12} . Show balanced equation.

Answer_____

4. For the following complex ion draw the valence bond theory diagram and the crystal field theory diagram. Label the diagrams as shown in lecture. Label all orbitals.

$[ZnCl_2F_2]^{-2}$

a. Valence bond diagram:

b. Crystal Field diagram

c. Is the species high spin or low spin	
d. Is the species paramagnetic or diamagnetic	
e. State the hybridization	
f. State the shape	
g. Which is greater crystal field splitting energy or pairing energy?	
h. Is(are) the ligand(s) weak field or strong field	
i. Coordination number	
j. Name the species	

Draw all of the isomers of **$[ZnBrClFH_2O]^{-2}$.** Label the isomers as cis/trans, fac/mer etc. where appropriate.

5. For the following complex ion draw the valence bond theory diagram and the crystal field theory diagram. Label the diagrams as shown in lecture. Label all orbitals.

$[Au(en)_2]^{3+}$

a. Valence bond diagram:

b. Crystal Field diagram

c. Is the species high spin or low spin	
d. Is the species paramagnetic or diamagnetic	
e. State the hybridization	
f. State the shape	
g. Which is greater crystal field splitting energy or pairing energy?	
h. Is(are) the ligand(s) weak field or strong field	
i. Coordination number	
j. Name the species	

6. For the following complex ion draw the valence bond theory diagram and the crystal field theory diagram. Label the diagrams as shown in lecture. Label all orbitals.

$[Cr(H_2O)_2Cl_2F_2]^{1-}$

a. Valence bond diagram:

b. Crystal Field diagram

c. Is the species high spin or low spin	
d. Is the species paramagnetic or diamagnetic	
e. State the hybridization	
f. State the shape	
g. Which is greater crystal field splitting energy or pairing energy?	
h. Is(are) the ligand(s) weak field or strong field	
i. Coordination number	
j. Name the species	

7. For the following complex ion draw the valence bond theory diagram and the crystal field theory diagram. Label the diagrams as shown in lecture. Label all orbitals.

$[Cu(en)_2(CN)_2]$

a. Valence bond diagram:

b. Crystal Field diagram

c. Is the species high spin or low spin	
d. Is the species paramagnetic or diamagnetic	
e. State the hybridization	
f. State the shape	
g. Which is greater crystal field splitting energy or pairing energy?	
h. Is(are) the ligand(s) weak field or strong field	
i. Coordination number	
j. Name the species	

8. Draw two linkage isomers of

$Al[Co(CN)_2(C_2O_4)_2]$

Name the compound $Al[Co(CN)_2(C_2O_4)_2]$_____

What type of bond exists between the aluminum and the complex ion? _____

9. Draw two enantiomers of

$Al[Co(CN)_2(C_2O_4)_2]$

10. The complex ion $[NiCl_4]^{2-}$ has two unpaired electrons whereas $Ni(CN)_4^{2-}$ is diamagnetic. Draw structures of these two complex ions that explain the magnetism. Give a brief explanation.

11. [Cr(H2O)6]2+ is violet. Another chromium complex is green. Would that compound most likely be $[Cr(CN)_6]^{4-}$ or $[Cr(Cl)_6]^{4-}$ Draw and label the CF diagrams and give a brief explanation for you claim.

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Weaker field----------> Stronger Field

Color	Wavelength
Violet	400-430
blue	430-480
green	480-560
yellow	560-590
orange	590-630
red	630-750

Plank's Constant =6.626×10^{-34} J (sec)

K formation for complex ions

Complex Ion	K_f .
$Ag(CN)_2^-$	3.0×10^{20}
$AgCl_2^-$	1.0×10^{-5}
$Fe(CN)_6^{4-}$	3.0×10^{35}
$Fe(CN)_6^{3-}$	4.0×10^{43}
$Hg(CN)_4^{2-}$	9.3×10^{38}
$Zn(CN)_4^{2-}$	4.2×10^{19}
AlF_6^{3-}	4×10^{19}
$Cd(NH_3)_4^{2+}$	1.3×10^{7}
$Cd(CN)_4^{2-}$	7.7×10^{16}
CdI_4^{2-}	1×10^{6}
$Ag(NH_3)_2^+$	1.7×10^{7}
$Cu(NH_3)_4^{2+}$	5.6×10^{11}
$Zn(NH_3)_4^{2+}$	7.8×10^{8}
$Al(OH)_4^-$	3×10^{33}
$Be(OH)_4^{2-}$	4×10^{18}
$Co(OH)_4^{2-}$	5×10^{9}
$Ni(OH)_4^{2-}$	2×10^{28}
$Pb(OH)_3^-$	8×10^{13}
$Sn(OH)_3^-$	3×10^{25}
$Zn(OH)_4^{2-}$	3×10^{15}
$Ag(S_2O_3)_2^{3-}$	4.7×10^{13}