Some Review Problems for the Final Exam – Part 3
(Note: this selection of problems is NOT comprehensive!)

1. $Fe(H_2O)_5(SCN)^{2+}$ is orange. $Fe(H_2O)_6^{3+}$ is yellow.
   a. Name each of the above complexes.
   b. According to the information given, which ligand is stronger, water or thiocyanate? Explain. Show d-orbital splitting diagrams. Speculate on whether each one is high or low spin.
2. How could you tell whether a complex with 4 ligands is tetrahedral or square planar?
3. Does a complex with 4 ligands have a coordination number of 4?
4. Draw the structure of the predominant form of Arg-Trp-Cys at pH 5.0 and at pH 11.0.
5. List as many ways as possible of determining whether a reaction is product-favored or reactant-favored.
6. How can you tell which way a reaction will proceed to reach equilibrium?
7. What is the difference between the statements "lies to the right" and "shifts to the right"? Can you have one without the other? Can they both be true at the same time?
8. a. Balance the following reaction. It occurs in acidic solution.
   CH_3OH + $Cr_2O_7^{2-}$ → CH_2O + Cr^{3+}
   b. Draw the structure of each of the above organic molecules. Relate the redox definition for organic molecules to the regular definition of redox.
9. Explain how organic solvents can denature proteins.
10. a. A Au^{3+}/Au half-cell is connected to a Fe^{2+}/Fe^{3+} half-cell. Determine the cell potential if $[Au^{3+}]=[Fe^{2+}]=[Fe^{3+}]= 1.0$ M.
    b. Calculate $\Delta G°$ and K for the reaction that corresponds to the potential you found in part a.
    c. How could you adjust the concentrations to make this reaction more favorable? What would happen to the voltage?
    d. When enough $NaCl_{(s)}$ is added to the compartment containing gold to make the $[Cl^-] = 0.10$ M, the cell potential is observed to be 0.31 V. Assume that Au^{3+} is reduced and assume that the reaction in the compartment containing gold is Au^{3+} + $4 Cl^-$ ⇔ $AuCl_4^-$ $_{(aq)}$
    Calculate the value of K for this reaction at 25°C.
11. Draw the condensed structural formulas for all isomers of $C_5H_{11}Br$.
12. For the following reaction: $CaCO_{3\,(s)}$ → $CaO_{(s)}$ + $CO_{2\,(g)}$
    a. Predict the sign of ΔS and explain your reasoning.
    b. Is this reaction spontaneous at 25°C?
    c. How could you adjust the temperature to make this reaction more favorable?
    d. Determine the temperature at which the reaction becomes spontaneous under standard conditions.
    e. Below the temperature determined in part d, will any CO_2 be formed?
13. If NaBr is slowly added to a solution containing 0.010 M lead (II) ion and 0.20 M silver ion, which ion will precipitate first? What will be the concentration of the first ion when the second ion starts to precipitate?

14. a. Predict the half reactions that would occur in the electrolysis of aqueous $FeCl_2$. What would you expect to see at each electrode?
b. Predict the half reactions that would occur in the electrolysis of aqueous KCl.
c. If you performed the above electrolysis reactions in the lab and you didn't observe what you expected, what is a likely explanation?

15. a. What is a good confirmatory test for the presence of Cu^{2+} ions in solution? (Cu^{2+} is blue, but at low concentrations, the blue color doesn't show up well.)
b. What is a good confirmatory test for the presence of Fe^{3+} ions in solution? (Fe^{3+} is light yellow and hard to see.)

16. Sketch the titration curve for the reaction of 25.0 mL 0.10 M acetic acid ($K_a = 1.8 \times 10^{-5}$) with 0.10 M NaOH. Calculate the pH at the beginning, at the halfway point, and at the equivalence point.

Half-reaction	E°
$Au^{3+}_{(aq)} + 3\ e^- \rightarrow Au_{(s)}$	1.50 V
$Fe^{3+}_{(aq)} + e^- \rightarrow Fe^{2+}_{(aq)}$	0.771 V
$Fe^{2+} + 2\ e^- \rightarrow Fe_{(s)}$	- 0.447 V
$2\ H_2O_{(l)} + 2\ e^- \rightarrow H_{2\ (g)} + 2\ OH^-$	- 0.828 V
$O_{2\ (g)} + 4\ H_3O^+ + 4\ e^- \rightarrow 6\ H_2O_{(l)}$	1.229 V
$Cl_{2\ (g)} + 2\ e^- \rightarrow 2\ Cl^-$	1.358 V
$K^+ + e^- \rightarrow K_{(s)}$	- 2.931 V

Substance	ΔH_f^* (kJ/mol)	ΔG_f^* (kJ/mol)	S° (J/mol•K)
$CaCO_{3\ (s)}$	- 1206.92	- 1128.79	92.9
$CaO_{(s)}$	- 635.09	- 604.03	39.75
$CO_{2\ (g)}$	- 393.509	- 394.359	213.74

Some Answers:
1. H_2O is stronger
3. Not necessarily
10. a. 0.73 V   b. $\Delta G° = -210$ kJ, K= 10^{37} d. $K_f = 10^{25}$
12. a. $\Delta S +$ b. $\Delta G° = +130.40$, so not spontaneous
c. higher T   d. 837°C   e. yes
13. Ag^+ ppts first. When $PbBr_2$ starts to ppt, $[Ag^+] = 1.3 \times 10^{-11}$
16. pH = 2.87, 4.74, and 8.72

My recommendations for studying:
1. Read through all of your lecture notes.
2. Write your sheet of notes as you go.
3. Try problems from the quizzes, exams and review problems.
4. Whatever problems you don't have time to do, at least look at the answers.
Also – make sure to look over the most recent material (Ch 25).