

CHEM 120
Spring 2006
Pre-Exam Assignment 3

Name: _____

Instructions

Write your answers in blue or black ink. Work done in pencil will be accepted, but you will not be able to appeal any apparent grading mistakes (except simple addition errors). Write neatly. If I can't read it, I can't grade it.

Show all work for full credit! For the word problems write your final answer in a complete sentence. Indicate what you are doing at important steps (you do not need to tell me about every mathematical manipulation you do). If you change your mind on a question, cross out the incorrect answer and clearly indicate your final answer.

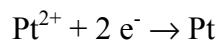
There are **8** pages, none blank.

You may use your book to look up any needed physical constants, equations, etc. However, you may not work with anyone else, and you may not ask any other faculty members to help you with the specific questions given here. You may ask any chemistry faculty member for help on the concepts involved, and you may ask me anything you want.

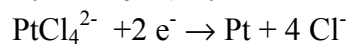
You may use the back of any page as additional workspace. Please indicate that you have done so.

Problem	Possible Points	Points Received
1	5	
2	20	
3	7	
4	10	
5	17	
6	20	
Free	21	21
Total	100	
	Bonus	
	Grand Total	

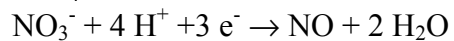
1. (5 Points) Explain why platinum will dissolve in *aqua regia* (a mixture of hydrochloric and nitric acids), but not in either concentrated nitric or concentrated hydrochloric acid individually.



$$E^{\circ} = +1.188 \text{ V}$$



$$E^{\circ} = +0.755 \text{ V}$$



$$E^{\circ} = +0.96 \text{ V}$$

2. One can buy a Ag/AgCl reference electrode like that shown in Figure 1, below. The electrode contains a Ag wire coated with solid AgCl and a saturated KCl solution inside the body of the electrode. A glass frit serves as the salt bridge to the test solution.

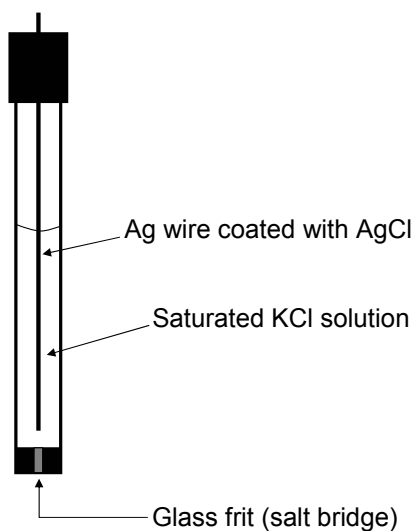


Figure 1. The Ag/AgCl reference electrode

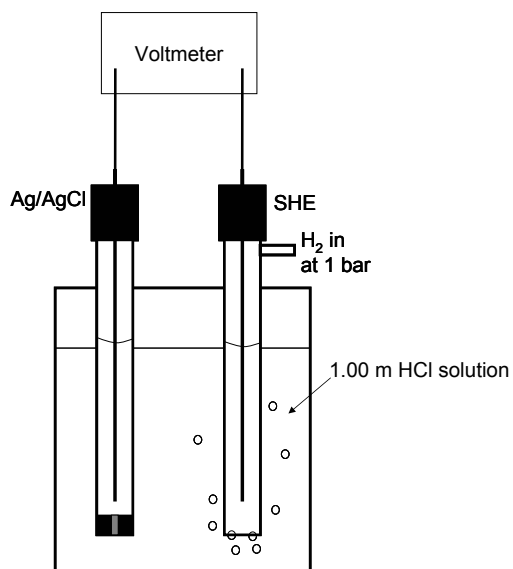


Figure 2. The Ag/AgCl reference electrode in a galvanic cell with the SHE.

a. (5 Points) Write the half reactions and balanced chemical reaction that describe the cell shown in Fig. 2 where the Ag/AgCl electrode is one half-cell and the SHE electrode is the other half-cell. Identify the anode and the cathode and determine the potential that the voltmeter will read.

b. (5 Points) If the solution in Fig. 2 is replaced by a 1.00 M CuCl_2 solution (with HCl as the supporting electrolyte) and the SHE is replaced by a Cu electrode, what will the meter read?

c. (10 Points) What will the meter read when the solution in part b is replaced by a 1.00 M CuCl_2 solution buffered at pH 8.00?

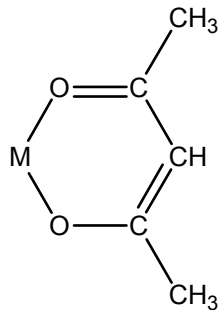
3. (7 Points) What is the molarity of a saturated solution of O_2 in water at an O_2 pressure of 1.00 atm and a temperature of 298.15 K? Assume that O_2 when dissolved in water obeys Henry's law and that the density of water is 1.00 g/cm^3 .

4. (10 Points) Benzene and toluene form ideal solutions. A solution of benzene and toluene was prepared at $25.0 \text{ }^\circ\text{C}$ and it was found that the mole fractions of the two compounds in the vapor phase were equal. Calculate the composition of the solution given that at $25.0 \text{ }^\circ\text{C}$ the vapor pressures of benzene and toluene are 95. and 28. torr, respectively.

5a. (7 Points) Draw all geometrical and linkage isomers for $\text{Co}(\text{NH}_3)_4(\text{NO}_2)_2$.

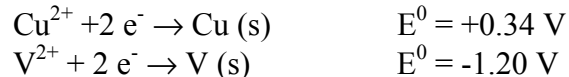
b. (4 Points) The $\text{Co}(\text{NH}_3)_6^{3+}$ ion is diamagnetic, but the $\text{Fe}(\text{H}_2\text{O})_6^{2+}$ is paramagnetic. Explain.

c. (6 Points) Acetylacetonone (acacH) is a bidentate ligand. It loses a proton and coordinates to metal ions as acac^- , as shown below, where M is a transition metal ion.



Which of the following complexes are optically active (can have enantiomers): *cis*- $\text{Cr}(\text{acac})_2(\text{H}_2\text{O})_2$, *trans*- $\text{Cr}(\text{acac})_2(\text{H}_2\text{O})_2$ and $\text{Cr}(\text{acac})_3$? Hint: draw them.

6. (20 Points) A galvanic cell is based on the following half reactions:



In this cell, the copper compartment contains a copper electrode and the $[\text{Cu}^{2+}]$ equals 1.00 M, and the vanadium compartment contains a vanadium electrode and V^{2+} at an unknown concentration. The compartment containing the vanadium (1.00 L of solution) was titrated with 0.0800 M $\text{H}_2\text{EDTA}^{2-}$, resulting in the reaction



The potential of the cell was monitored to determine the equivalence point for the process, which occurred when a volume of 500.0 mL of the $\text{H}_2\text{EDTA}^{2-}$ solution had been added. At the equivalence point, E_{cell} was observed to be 1.98 V. The solution was buffered at a pH of 10.00.

Calculate the following quantities. Write your answers in the space provided, show your work in the blank space below and attach additional sheets, as needed. Be sure to clearly label what work goes with which part of the problem.

a. E_{cell} before the titration was carried out is _____.

b. The equilibrium constant for the titration reaction, K , is _____.

c. E_{cell} at the halfway point of the titration is _____.