Chem 3034 In-Class Exam 2
Name_____

Useful information: $E = E^{o} - \frac{0.0592V}{n}\log Q$, $E^{\circ} = \frac{0.0592V}{n}\log K$, $\Delta G^{o} = -RT\ln K$,
$R = 8.314\ J/molK$, $q = n \bullet F$, $F = 9.65 \times 10^{4}\ C/mol$, $E_{cell} = E_{red} + E_{ox}$
Show all work for credit.

(1)(20 points) For the cell below, draw a picture of the cell and calculate E^{o} and E.

$Zn|ZnSO_4$ (aq, 0.0225 M)|| $CoCl_3$ (aq, 0.100 M), $CoCl_2$ (aq, 0.0050 M)| $C_{(glassy)}$

(2) SCE||Ag^+ (aq)| Ag

(a)(10 points) For the cell above, calculate the [Ag^+] at the following potentials

E_{cell} = 0.350 V

E_{cell} = 1.00 V

(b(10 points)) If the initial [Ag^+] in the solution was 0.0200 M, what is the minimum cell potential needed to recover 99% of the Ag?

(3) For the redox titration of 20.00 mL of 0.200 M $CrSO_4$ with 0.100 M $Ce(NO_3)_4$ to form Cr^{3+} (aq), answer the following questions. The reaction is monitored by an electrochemical cell with an SCE and a Pt working electrode.

(a)(10 points) Write the reaction of the cerium(IV) nitrate with the chromium(II)sulfate

(b)(10 points) Write (in shorthand notation) the electrochemical cells that will be used to monitor the reaction (you can just write SCE for the SCE half-cell).

(c)(10 points) Write the Nernst equations for the electrochemical cells in part b.

(4) Assume you wanted to make a 9 V batter (electrochemical cell).

(a)(5 points) what would the equilibrium constant have to be for the reaction?

(b)(5 points) What would ΔG be for the reaction?

(c)(5 points) Why are 9 V batteries made from 6, 1.5 V batteries in series?

(5)(15 points) A solution of 0.0500 M Na_2EDTA (25.00 mL) was added to a 50.00 mL solution of Fe^{3+}. Eriochrome Black T was added and 5.10 mL of a 0.0655 M Mg^{2+} solution was needed to reach the endpoint. What was the original concentration of Fe^{3+}?

Chem 3034 Take-Home Exam 2. Due Friday, April 6 at 4 PM

Name_____

You may use your book and notes on this portion of the exam, but you may not collaborate with anyone else on it. Show all work for credit.

(1)(20 points) A sample of thiocyanate was titrated with a 0.100 M Ag^+ solution. At the end point, the potential was 0.202 V using a Ag working electrode and SCE reference electrode. What is the K_{sp} of silver thiocyanate?

(2) A glass electrode has a potential of 0.305 V when immersed in a pH 7 electrode (using an SCE counter electrode).

(a)(15 points) What is the pH of the solutions below?

(i) 0.455 V

(ii) 0.030 V

(ii) -0.08 V

(b)(5 points) What limits the accuracy of the pH measurement?

(c)(5 points) If you want to know the pH of a solution (measured by the electrode above) to 0.0001 pH units, what do you need to measure and how precisely?

(3)(15 points) The sulfide content from a stream were determined with a sulfide selective electrode using the method of standard addition. The response of the electrode is $E = k - 0.0296V \log [S^{2-}]$.

A 10.0 mL sample of stream water and 10.00 mL of buffer were diluted to 25.00 mL with water to give a potential of -0.2164 V. A sample of 10.00 mL stream water, 10.00 mL buffer and 1.00 mL of 0.030 M Na_2S was diluted to 25.00 mL and had a potential of -0.224 V. What is the concentration of sulfide in the stream?

(4)(20 points) For the redox titration of 20.00 mL of 0.200 M $CrSO_4$ with 0.100 M $Ce(NO_3)_4$ to form $Cr^{3+}(aq)$, make a spreadsheet to plot the potentials during the titration. Calculate the potential every milliliter starting at 1.00 mL $Ce(NO_3)_4$ and ending at 50 mL. The reaction is monitored by an electrochemical cell with an SCE and a Pt working electrode.

(5)(15 points) Using EDTA titrations, devise a method to determine the specific amount of each metal in a water sample containing Cd^{2+}, Fe^{3+}, Bi^{3+} and Ca^{2+}.