Chem 3034 In-Class Exam 2
Name___________________________

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

(1)(20 pts)(a) Write the cell shorthand for the following cell. An iron cathode immersed in a 0.500 M $FeSO_4$ solution connected by a salt bridge to a magnesium anode immersed in a 0.01 M $MgSO_4$ solution.

(b) find E and E° for the cell above

(2)(20 pts) How does an ion selective electrode work? Sketch a specific ion selective electrode and describe how it works.

(3)(20 pts) Why are reference electrodes used? Describe a specific reference electrode and how it works.

(4)(15 pts) Using the standard electrode potentials shown, make a cell with the largest potential that you can. Describe the cell below. Why are most batteries above 1.5 V made from several cells connected in series? Why aren't there reactions with E^o= 5V, 10V?

(5)(15 pts) To a solution of sodium carbonate (1.00 L), 0.100 moles of $CaCl_2$ was added. The precipitated calcium carbonate was collected and heated with 50.00 mL of 0.100 M EDTA. The resulting solution was titrated with 0.0500 M $MgCl_2$ (42.25 mL until the Eriochrome Black T endpoint). What was the concentration of the sodium carbonate solution?

Chem 3034 Take-Home Exam 2. Due Monday, April 7 by 4 PM

Name________________________

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

(1) An aluminum cathode and an SCE anode are used to determine the K_{sp} of $Al(OH)_3$. The potential of the cell wen the Al cathode was placed in a saturated $Al(OH)_3$ solution was -2.076 V. What is the K_{sp} of $Al(OH)_3$?

(2) Copper can be purified electrochemically by first oxidizing impure copper rods to $Cu^{2+}_{(aq)}$ and then rereducing the copper solution to copper. The two processes can be represented by the two cells below.

$Cu_{(s)}|Cu^{2+}_{(aq)}||SCE$ oxidation of impure copper rods (1)

$SCE||Cu^{2+}_{(aq)}|Cu_{(s)}$ formation of pure copper (2)

If the impurities present in the impure copper rods include Ag, Au, Mg, and Zn, determine suitable potentials for cells 1 and 2. You don't need to form a Cu^{2+} solution over 0.5 M in concentration and you shouldn't leave more than 10^{-5} M of Cu^{2+} in solution at the end.

(3) A 0.522 g sample containing CaF_2 was added to 50.00 mL of 0.1052 M EDTA at pH 5 and stirred for 3 weeks. The solution was titrated with 5.24 mL of 0.2207 M $MgCl_2$ solution to reach an Eriochrome Black T endpoint. What % of the sample was CaF_2?

(4) A 25.00 mL sample of 0.0100M $MgEDTA^{2-}$ solution was added to a 30.00 mL sample containing Fe^{3+}. The solution was then buffered to pH 10 and titrated with 8.83 mL of 0.0152 M EDTA to an Eriochrome Black-T endpoint. What was the $[Fe^{3+}]$ in the original sample?

(5) A 0.100 M Ce^{4+} (1.0 M HNO_3) solution is used to titrate 10.00 mL of a 0.250 M solution of Ti^{2+} (in 1 M HNO_3). What is the potential (with SCE reference electrode) of the soution at the following points in the titration?

(a) 2.00 mL

(b) 10.0 mL

(c) 25.00 mL

(d) 27.00 mL

(6) A sample containing Ag^+ ions were tested using a silver ISE. The response of the electrode is $E= k + 0.0592V\log[Ag^+]$. Into each 50.00 test solution was placed 25.00 mL of sample, 10 mL of buffer, and some 7.5×10^{-2} M $AgNO_3$. The data is shown in Table 1 (below). What is the concentration of Ag^+ in the sample?

Test Solution	**Potential**	**mL of $AgNO_3$ added**
1	0.221	0
2	0.235	1
3	0.241	2
4	0.276	10