CHM 115 Lab 11

Equilibrium in Aqueous Solutions

The purpose of this experiment is to determine the equilibrium constant for a reaction in aqueous solution.

For the reaction: $Fe^{3+}_{(aq)} + SCN^{-}_{(aq)} \leftrightarrows FeSCN^{2+}_{(aq)}$ various concentrations of reactants will be used and the concentration of the $FeSCN^{2+}$ ion measured spectrophotometrically. The equilibrium concentrations of all ions can be determined and the equilibrium constant then calculated. Primarily because the Fe(III) ion requires an acidic solution to remain stable, the solvent for the reaction will be 0.05 M HNO_3. Every solution will be 0.05 M HNO_3 and it is not necessary to do any calculations involving the H^+ ions.

Procedure

Work in pairs. Obtain from the stockroom: 50 and 100 mL volumetric flasks; 1, 3, and 5 mL transfer pipets; 5 mL Mohr pipet; bulb; 9 special Spectronic 20 tubes; and test tube rack.

I. Standard Curve for $FeSCN^{2+}$

1. Obtain about 30 mL (and only 30 mL) of the stock 0.00200 M KSCN, which provides the SCN^- ions, in a clean *dry* 50 mL beaker. Obtain about 30 mL (and only 30 mL) of the stock 0.200 M $Fe(NO_3)_3$ solution, which provides the Fe^{3+} ions, in a clean *dry* 50 mL beaker. Obtain about 300 mL (and only 300 mL) of the stock 0.050 M HNO_3 solution in a clean *dry* 400 mL beaker. Use the 50 mL volumetric flask to prepare the standard solutions, beginning with the most dilute. Pipet 1.0 mL of the SCN^- solution into the flask, use a graduated cylinder to add about 10 mL of the Fe^{3+} solution, and fill to the line with the HNO_3 solution. Mix thoroughly; rinse and fill one of the special Spectronic 20 tubes with this solution. For the other two standards, repeat the above except use 3.0 mL and 5.0 mL of the SCN^- solution.

We will presume that the concentration of the Fe^{3+} is sufficient to drive the equilibrium completely to the right, which means that the equilibrium $[FeSCN^{2+}]$ equals the initial $[SCN^-]$.

II. Aqueous Equilibrium of $FeSCN^{2+}$

1. Prepare the 0.00200 M Fe^{3+} solution by pipeting 1.0 mL of the 0.200 M Fe^{3+} solution into the 100 mL volumetric flask, fill to the mark with 0.05 M HNO_3, and mix thoroughly.

2. Label your 16 x 150 mm test tubes, from your drawer, with numbers 1 through 5.

Use the Mohr pipet to prepare the various concentrations of reactants as follows:

	0.00200 M Fe^{3+}	0.00200 M SCN^-	0.050 M HNO_3
(1)	5.0 mL	1.0 mL	4.0 mL
(2)	5.0	2.0	3.0
(3)	5.0	3.0	2.0
(4)	5.0	4.0	1.0
(5)	5.0	5.0	----

Stir each solution thoroughly with a glass rod. Be careful not to transfer any solution from one test tube to the next. Rinse and fill a special Spectronic 20 tube with each solution. The remaining Spectronic 20 tube is to be filled with 0.050 M HNO_3 and used as the blank.

3. Set the wavelength to 447 nm and adjust zero (no sample) and 100% T (sample with only solvent). Measure the absorbance of each of the standards and the samples.