DETERMINATION OF AN EQUILIBRIUM CONSTANT

The equilibrium constant for the following reaction will be determined:

$$Fe^{3+} + SCN^- \leftrightarrow FeSCN^{2+} \qquad K = [FeSCN^{2+}]/[Fe^{3+}][SCN^-]$$

The equilibrium concentration of $FeSCN^{2+}$ will be determined photometrically as described below. The equilibrium concentrations of Fe^{3+} and SCN^- will be determined by using known amounts of each (given the initial concentrations) and using the concepts of equilibrium. These concentrations can then be placed in the equilibrium constant expression to determine K.

The concentration of $FeSCN^{2+}$ will be determined by comparison of the color intensity of the unknown to the color intensity of samples with known concentrations. Actually, the ability of the solution to absorb light at a particular wavelength (447 nm), which is an indication of the intensity (or concentration), will be compared. A plot of absorbance versus concentration will be prepared from known samples. The absorbance of the unknown is then found and the corresponding concentration is determined from the plot.

To get known concentrations of $FeSCN^{2+}$, the above equilibrium is forced way to the right by combining a large amount of Fe^{3+} with a relatively small amount of SCN^-. The amount of $FeSCN^{2+}$ is then assumed to be the same as the amount of the limiting reactant SCN^- originally added.

The plot of absorbance versus concentration is theoretically linear (the mathematical expression is of the form y = mx + b). To actually make the plot, determine five points by finding the absorbance of five different solutions, each made with 6.3 mL of 0.2 M Fe^{3+}, but using 0.0, 0.5, 1.0, 1.5, and 2 mL of 0.002 M SCN^-, respectively. To each of these solutions add enough 0.1 M HNO_3 to make a total of 25 mL. Plot the absorbance versus $FeSCN^{2+}$ concentration (which is assumed to be the same as the concentration of SCN^- added, since it will be the limiting reactant). Plot absorbance along the y-axis and concentration along the x-axis.

Determine K for each of the following experiments and report the average with an uncertainty. Use the following solutions.

Experiment	0.002 M Fe^{3+}	0.002 M SCN^-	0.1 M HNO_3
1	5.00 mL	1.00 mL	4.00 mL
2	5.00 mL	2.00 mL	3.00 mL
3	5.00 mL	3.00 mL	2.00 mL
4	5.00 mL	4.00 mL	1.00 mL
5	5.00 mL	5.00 mL	0.00 mL

Discuss experiment #5 with the instructor before leaving the lab!