Determination of K_{eq}

Spectroscopic Determination

What, why, how…

$$Fe^{3+} (aq) + SCN^{-} (aq) \leftrightarrow FeSCN^{2+} (aq)$$

- When you mix amounts of Fe^{3+} and SCN^{-}, a reaction occurs to produce $FeSCN^{2+}$, but not all of the reactants react. Thus, your beaker (or flask or cauldron) will contain some of each of these three species, which is your equilibrium system. To learn more about the system, we need to figure out a way to count the number of different ions in the reaction mixture. That is the major objective of this experiment, and to achieve this objective you will take advantage of something about $FeSCN^{2+}$ – in aqueous solution it has a reddish color. The two reactants, Fe^{3+} and SCN^{-}, are essentially colorless in solution, thus the red color you will see when you conduct the reaction is produced by the $FeSCN^{2+}$ ions.

Assume Room Temperature

$$K_{eq} = \frac{[FeSCN^{2+}]}{[Fe^{3+}][SCN^{-}]}$$

- To find the value of K_{eq} at a given temperature, it is necessary to determine the molar concentration of each of the three species in solution at equilibrium. You will determine the concentrations by using a Vernier Spectrometer to measure the amount of light of a specific wavelength that passes through a sample of the equilibrium mixtures. The amount of light absorbed by a colored solution is proportional to its concentration. The red $FeSCN^{2+}$ solution absorbs blue light. Spectrometer users will determine an appropriate wavelength based on the absorbance spectrum of the solution. The wavelength will be close to, but not exactly, 470 nm.

Need Beer's Law Curve first

- In Part I of the experiment, you will prepare a series of standard solutions of $FeSCN^{2+}$ from solutions of varying concentrations of SCN^{-} and constant concentrations of H^{+} and Fe^{3+} that are in stoichiometric excess.
- **Important**: The mixtures you will prepare are light sensitive. You need to measure the absorbance of these four mixtures **<u>within 2–5 minutes</u>** of preparing them

Beaker	0.200 M $Fe(NO_3)_3$ (mL)	0.0020 M SCN^- (mL)	H_2O (mL)
1	5.0	4.0	41.0
2	5.0	3.0	42.0
3	5.0	2.0	43.0
4	5.0	1.0	44.0

Then…Determine K_{eq}

- In Part II of the experiment, you will prepare a new series of solutions that have varied concentrations of the SCN^{-} ions and constant concentrations of H^{+} ions and Fe^{3+} ions. You will use the results of this test to accurately evaluate the equilibrium concentrations of each species and calculate the K_{eq} of the reaction

Beaker	0.0020 M $Fe(NO_3)_3$ (mL)	0.0020 M SCN^{-} (mL)	H_2O (mL)
A	3.00	3.00	4.00
B	3.00	4.00	3.00
C	3.00	5.00	2.00

Data

Open the Analyze menu and choose **Interpolate**. Trace along the best-fit line equation to find the $FeSCN^{2+}$ concentration for the sample in Beaker A

Group	Data File	Absorbance of $FeSCN^{2+}$		
		Beaker A	**Breaker B**	**Beaker C**
Even # Lab Benches	File KH	0.251	0.290	0.370
DO NOT USE	~~File DS~~	~~0.240~~	~~0.296~~	~~0.358~~
Odd # Lab Benches	File YL	0.297	0.357	0.458