Determination of an Equilibrium Constant

**1516L - Determination of an Equilibrium Constant**

Details of this experiment are found in the LSA manual. You will use the spectrophotometer built into the MicroLab analysis equipment in order to accurately measure the concentration of ions in different solutions. You will then use Beer’s Law to calculate an equilibrium constant for the following chemical reaction.

\[
\text{Fe}^{3+} + \text{SCN} \rightleftharpoons \text{FeSCN}^{2+}
\]

The instructions for preparing the solutions are found in the Catalyst Lab manual.

**The Experiment Setup**

The cavity on the top of the MicroLab box is the spectrophotometer which holds two sizes of vials. You will be using the larger vials as shown below:
Determination of an Equilibrium Constant

\[
\text{Fe}^{3+} + \text{SCN}^{-} \rightleftharpoons \text{FeSCN}^{2+}
\]

Combine these two solutions (We know their concentrations)

Measure how much of this is formed by spectroscopy (i.e. absorbance of light)

\[ A = \varepsilon \cdot b \cdot [\text{FeSCN}^{2+}] \]

i.e. a Linear relationship between A and [conc’n]

\[
K \text{ (equilibrium constant)} = \frac{[\text{FeSCN}^{2+}]}{[\text{Fe}^{3+}]_{eq} \cdot [\text{SCN}^{-}]_{eq}}
\]

You can calculate [Fe\(^{3+}\)]_{eq} and [SCN\(^{-}\)]_{eq} by subtraction
### The Experiment – Application of Beer’s Law

**5 samples needed;**
1 blank (water), 4 of different concentrations of Fe\(^{3+}\) and SCN in 1 M HClO\(_4\) solution. Prepare as directed in text.

- Measure Transmittance/Absorbance using MicroLab
- Apply those numbers to Beer’s Law to get concentrations of [FeSCN\(^{2+}\)] in each vial

\[
A = \varepsilon \cdot b \cdot [\text{FeSCN}^{2+}] \\
\varepsilon = 1750 \text{ L mol}^{-1} \text{ cm}^{-1} ; \ b = 2.5 \text{ cm} \\
(\text{for measurements at 470 nm})
\]

### Calculations – need to know [Fe\(^{3+}\)]\(_o\) and [SCN]\(_o\)

**Before you begin taking readings:**
Need to calculate initial concentrations of
[Fe\(^{3+}\)]\(_o\) and [FeSCN\(^{2+}\)]\(_o\) in each vial – add to report sheet

**Taking readings:**

* Spectrophotometer cavity
Setting the Samples in the Spectrophotometer

Sample cover applied – ready to collect data
The MicroLab interface before readings

After taking a reading - %T at different wavelengths
After taking a reading - A at different wavelengths

After all four readings

You should have:

• 4 sets of data, you need %T as well as A for the report sheet

• Data to be used are at the Wavelength of 470 nm (click on that bar in the Spectrum Profile)

• Check to see shape of the plot of %T versus Concentration

• Change this to A versus Concentration to validate Beer’s Law

\[ A = \varepsilon \cdot b \cdot [\text{FeSCN}^{2+}] \]
For Next Lab Session:

- Read the corresponding web page material on **Determination of an Ionization Constant** to see if there are any modifications or suggestions for that experiment. This will save you time in lab.

- Bring goggles, lab coat, paper towels, dishwashing gloves, handout from website.

- Email me with any concerns.