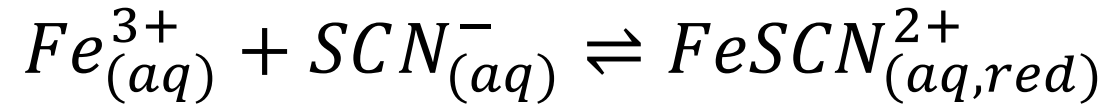


Determination of an Equilibrium Constant for the Iron (III) Thiocyanate Reaction

Experiment 3

Objectives

To determine K_f for the reaction

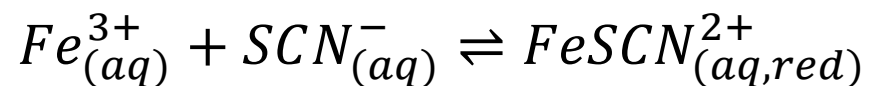


Where

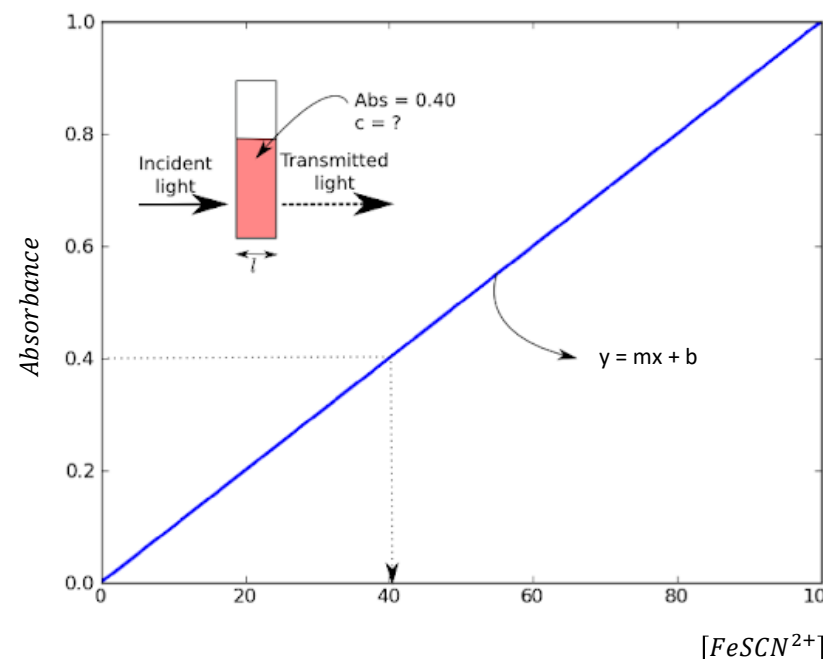
$$K_f = \frac{[FeSCN^{2+}]_{(eq)}}{[Fe^{3+}]_{(eq)}[SCN^{-}]_{(eq)}}$$

Part A: Preparation of the Calibration Curve

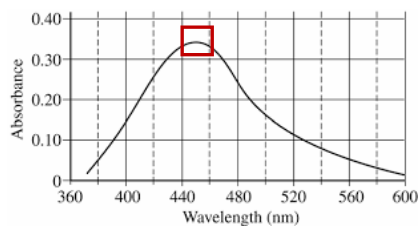
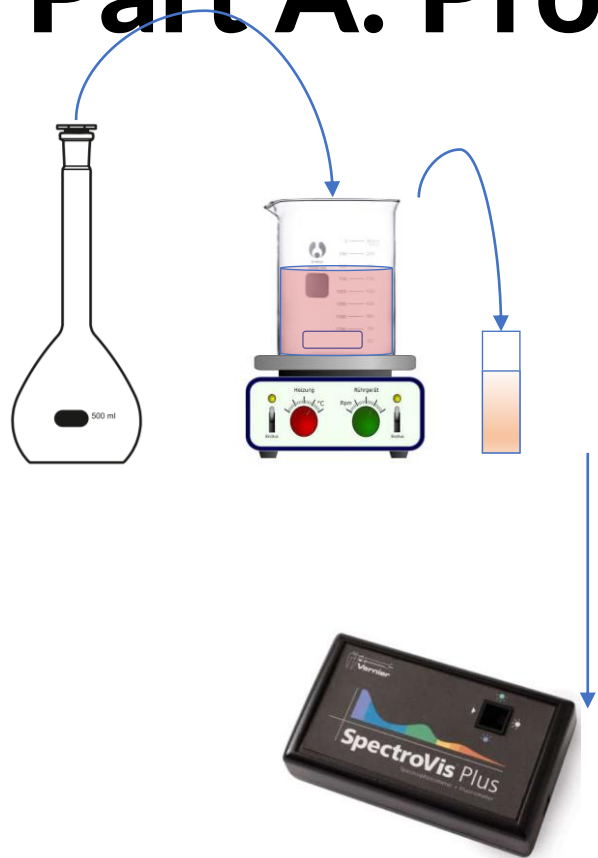
- When constructing a calibration curve, one measures the absorbance of a substance at an appropriate wavelength as a function of its concentration.



- Add a LOT of Fe^{3+} , and drive the reaction to completion (Le Châtelier's Principle); then $[SCN^{-}]_o \approx [FeSCN^{2+}]_{eq}$
- Note: This is only true in Part A*



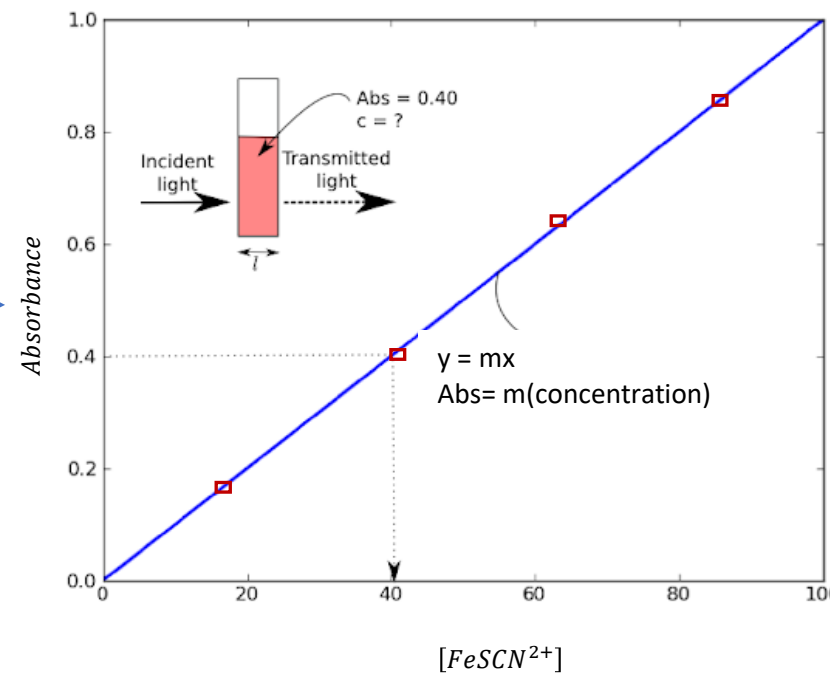
Part A: Procedure



Select the wavelength λ_{max}



Select Abs vs Concentration
and record the absorbance of
all six samples



Beaker #	0.200 M $\text{Fe}(\text{NO}_3)_3$ (mL)	0.00200 M KSCN (mL)	0.1 M HNO_3 (mL)
1	5.00	0.00	20.00
2	5.00	5.00	15.00
3	5.00	4.00	16.00
4	5.00	3.00	17.00
5	5.00	2.00	18.00
6	5.00	1.00	19.00

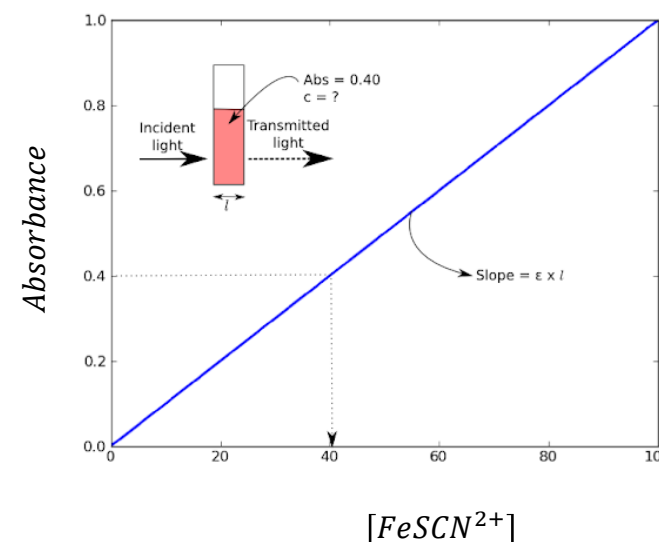
- Start with one beaker
 - Manual says 6 beakers. However, our samples needs to be measured within a time limit. Preparing all the samples at once will make measurement process inconsistent
- Into the beaker, pipette the appropriate amount of $\text{Fe}(\text{NO}_3)_3$, KSCN and 0.1M HNO_3
 - Order of adding chemicals is not really important because we will be mixing it for awhile. Just be consistent.
- Stir the solution with a magnetic stirring bar for 3 minutes
- NOTE: Beaker 1 is blank, not water

Test Tube #	0.200 M $\text{Fe}(\text{NO}_3)_3$ (mL)	0.00200 M KSCN (mL)	0.1 M HNO_3 (mL)	$[\text{Fe}^{3+}]$ after dilution	$[\text{SCN}^-]$ after dilution	$[\text{FeSCN}^{2+}]$ formed	Absorbance
1	5.00	0.00	20.00				
2	5.00	5.00	15.00				
3	5.00	4.00	16.00				
4	5.00	3.00	17.00				
5	5.00	2.00	18.00				
6	5.00	1.00	19.00				

- Calculate the initial concentrations $[\text{Fe}^{3+}]_o$ and $[\text{SCN}^-]_o$ using the dilution formula. $M_1V_1 = M_2V_2$
- So for example, in trial 1,

$$[\text{Fe}^{3+}]_o = \frac{0.200 \text{ M} \times 5.00 \text{ mL}}{25.00 \text{ mL}} = 0.0400 \text{ M}$$

- Assume $[\text{FeSCN}^{2+}]_{\text{eq}} \cong [\text{SCN}^-]$



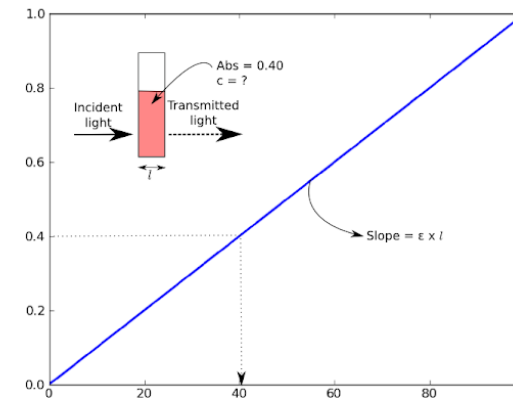
Part B: Determination of the Equilibrium Constant

Beaker #	0.00200 M $\text{Fe}(\text{NO}_3)_3$ (mL)	0.00200 M KSCN (mL)	0.1 M HNO_3 (mL)
1	6.00	0.00	19.00
2	6.00	2.00	17.00
3	6.00	4.00	15.00
4	6.00	6.00	13.00
5	6.00	8.00	12.00
6	6.00	10.00	10.00

- One beaker at a time
- Pipette the appropriate amount of the chemicals into the beaker
- Stir the solution with a magnetic stirring bar for 3 minutes
- Measure absorbance of each solution at max wavelength (from Part A)
- Use beaker 1 as blank

Beaker #	0.00200 M Fe(NO ₃) ₃ (mL)	0.00200 M KSCN (mL)	0.1 M HNO ₃ (mL)	[Fe ³⁺] after dilution	[SCN ⁻] after dilution	Absorbance
1	6.00	0.00	19.00			
2	6.00	2.00	17.00			
3	6.00	4.00	15.00			
4	6.00	6.00	13.00			
5	6.00	8.00	12.00			
6	6.00	10.00	10.00			

- Absorbance here represents the amount of [FeSCN²⁺] made from the reaction
- Concentration can be calculated using the equation from Part A



$$y = mx$$

$$\text{Abs} = m(\text{concentration})$$

Part B Calculation



	[Fe ⁺³]	[SCN ⁻]	[FeSCN ⁺²]
Initial	a. Calculated using initial concentrations and accounting for dilution	a. Calculated using initial concentrations and accounting for dilution	a. = 0 (why?)
Change	c. amount of Fe ⁺³ reacted = amount of FeSCN ⁺² formed (why?)	c. amount of SCN ⁻ reacted = amount of FeSCN ⁺² formed (why?)	b.= equilibrium value (see below)
Equilibrium	d. = Initial – Change	d. = Initial – Change	b. Determined spectrophotometrically using the equation of the line

Calculate the equilibrium concentration for all beakers

