Spectrophotometric Determination of Kc

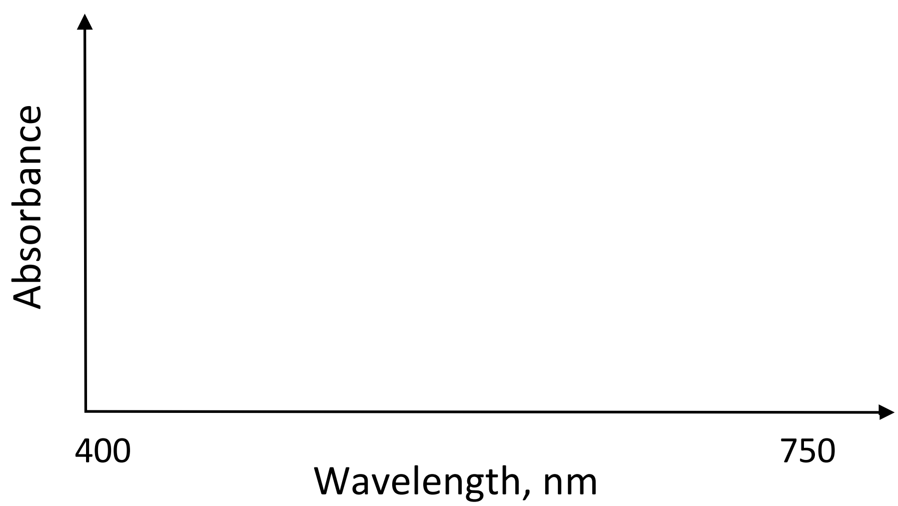
Purpose: To determine Kc for the reaction:

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

Colourless Reactants *Red-Orange Product*

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

Part A: Sketch Absorption Spectrum & Identify λ_{max} for $FeSCN^{2+}(aq)$



- *In the next two parts of the lab you will record absorbance values of $FeSCN^{2+}$ at or very near λmax*

Part B: Collect Data to Create Beer's Law Plot for $FeSCN^{2+}$(aq)

- *Use stock solution of 0.200 M $Fe(NO_3)_3$ dissolved in 0.50-M HNO_3*
- *Use stock solution of 0.00200 M KSCN*
- *Since $[Fe^{3+}] >> [SCN^-]$, **the reaction will proceed essentially to completion.***
- *One of the reactants will be consumed entirely (limiting reagent) and ICE tables can be filled in to determine $[FeSCN^{2+}]$* in these solutions
- *Create five solutions in 50.0-mL volumetric flasks with the same initial $[Fe^{3+}]$ but with increasing $[SCN^-]$ to get increasing $[FeSCN^{2+}]$*

Table 1: Preparing Five Standard Solutions of $FeSCN^{2+}$

Flask #	Volume of 0.200-M $Fe(NO_3)_3$, mL	Volume of 0.00200-M KSCN, mL	Total Volume in Flask after adding water
1	5.00	1.00	50.0
2	5.00	2.00	50.0
3	5.00	3.00	50.0
4	5.00	4.00	50.0
5	5.00	5.00	50.0

- *Use **dilution calculations** along with the initial concentration of each stock solution, the volume of the solutions used in each flask, and the total volume in each flask to **calculate the initial $[Fe^{3+}]$ and $[SCN^-]$ in each flask**.*
- ***Set up an ICE table for the reaction in each of the five flasks** and use your initial concentrations to fill it in completely. The reactions are **complete**, so **one reactant will get used up completely in each ICE table**.*
- ***Determine $[FeSCN^{2+}]$ in each flask from your ICE tables** and enter those values in the table below, along with the **measured absorbance value** for each solution at λmax.*

Table 2: Absorbance values at λmax for five $FeSCN^{2+}$ solutions

	Flask 1	Flask 2	Flask 3	Flask 4	Flask 5
$[FeSCN^{2+}]$, M					
Absorbance					

***Create a Beer's Law Plot from this data**. Graph Absorbance vs $[FeSCN^{2+}]$ and **determine the equation of the line of best fit** for the graph. You'll use this equation in Part 3.*

Part C: Collect Equilibrium Data to Create ICE Tables and Find Kc

- *Use stock solution of 0.00200 M $Fe(NO_3)_3$ dissolved in 0.50-M HNO_3*
- *Use stock solution of 0.00200 M KSCN*
- *Create five solutions in test tubes with the same initial [Fe^{3+}] but with increasing [SCN^-] to get increasing [$FeSCN^{2+}$]*
- *Since [Fe^{3+}] and [SCN^-] are similar in each test tube , **the reaction will NOT proceed to completion. Instead, equilibrium will be established with Fe^{3+}, SCN^- and $FeSCN^{2+}$ present in measurable quantities.***
- *After mixing the two stock solutions in each test tube, measure the absorbance of the $FeSCN^{2+}$ in each test tube.*

Table 3: Preparing Five Test Tubes with Equilibrium Mixtures

Tube #	Volume of 0.00200-M $Fe(NO_3)_3$, mL	Volume of 0.00200-M KSCN, mL	Total Volume in Flask after adding water
1	3.00	1.00	10.0
2	3.00	2.00	10.0
3	3.00	3.00	10.0
4	3.00	4.00	10.0
5	3.00	5.00	10.0

Table 4: Data & Results to Fill in ICE Tables and Calculate Kc

Tube #	Initial [Fe^{3+}], M	Initial [SCN^-], M	Absorbance of $FeSCN^{2+}$	Equilibrium [$FeSCN^{2+}$], M
1				
2				
3				
4				
5				

- *Use a dilution calculation to fill initial concentrations in the table*
- *Use the equation from your line of best fit on the Beer's Law plot to calculate the equilibrium [$FeSCN^{2+}$] from the absorbance values*
- *Set up five ICE tables, fill them in and calculate Kc for each one*