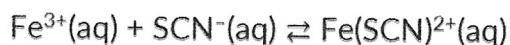


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PRELAB 4 QUIZ

The following questions have been adapted from Stanton, Zhu and Atwood, "Experiments in General Chemistry Featuring Measurement", 2nd ed.

- Complete the table below by calculating the initial SCN^- and final $\text{Fe}(\text{SCN})^{2+}$ concentrations for each of the five standard solutions. In addition to the volume of KSCN indicated in the table below, each solution contains 5.00 mL of $\text{Fe}(\text{NO}_3)_3$ and sufficient 0.050 M HNO_3 to produce a total volume of 25.00 mL of solution.



Molarity of KSCN = 0.00165 M Molarity of $\text{Fe}(\text{NO}_3)_3$ = 0.165 M

Solution	Volume SCN^-	Initial $[\text{SCN}^-]$ (M)	$[\text{Fe}(\text{SCN})^{2+}]_{\text{final}}$ (M)	Absorbance
1	5.00 mL	3.3×10^{-4}	3.3×10^{-4}	1.590
2	4.00 mL	2.64×10^{-4}	2.64×10^{-4}	1.320
3	3.00 mL	1.98×10^{-4}	1.98×10^{-4}	0.990
4	2.00 mL	1.32×10^{-4}	1.32×10^{-4}	0.690
5	1.00 mL	6.6×10^{-5}	6.6×10^{-5}	0.335

$$M_{\text{KSCN}} = M_{\text{SCN}^-} = 0.00165 \text{ M} \rightarrow n_{\text{SCN}^-} = 0.00165 \text{ M} \times 0.005 \text{ L} = 8.25 \times 10^{-6} \text{ mol}$$

$$M_{\text{SCN}^-} = \frac{8.25 \times 10^{-6} \text{ mol}}{0.025 \text{ L}} = 3.3 \times 10^{-4}$$

$$M_{\text{Fe}(\text{NO}_3)_3} = 0.165 \rightarrow n_{\text{Fe}(\text{NO}_3)_3} = 0.165 \text{ M} \cdot 0.005 \text{ L} = 8.25 \times 10^{-4} \text{ mol}$$

$$n_{\text{Fe}^{2+}} = n_{\text{Fe}(\text{NO}_3)_3} = 8.25 \times 10^{-4} \text{ mol} \quad \therefore (8.25 \times 10^{-4}) \text{Fe}^{3+} + (8.25 \times 10^{-6}) \text{SCN}^- \rightleftharpoons (X) \text{Fe}(\text{SCN})^{2+}$$

$$\text{SCN}^- \text{ is limiting reactant } \therefore X = 8.25 \times 10^{-6} \text{ mol SCN}^- \cdot \frac{1}{1} = 8.25 \times 10^{-6} \text{ mol Fe}(\text{SCN})^{2+}$$

$$\therefore n_{\text{SCN}^-} = n_{\text{Fe}(\text{SCN})^{2+}} \rightarrow M_{\text{SCN}^-} = M_{\text{Fe}(\text{SCN})^{2+}}$$

- Plot the absorbance versus the $\text{Fe}(\text{SCN})^{2+}$ concentration data in Question 1 to prepare a standard curve, then perform a linear regression analysis to determine the equation for the line. Write this equation below in standard $y = mx + b$ format:

$$\text{Standard Curve: } y = 4757.6x + 0.043$$

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3. An equilibrium solution is prepared by mixing 2.75 mL of 0.00165 M SCN^- , 5.00 mL of 0.00165 M Fe^{3+} and 2.75 mL of HNO_3 , where this solution's absorbance is determined to be 0.915. Using the standard curve prepared in Question 2, you then determine that the equilibrium concentration of $\text{Fe}(\text{SCN})^{2+}$ in this solution is 1.83×10^{-4} M. Prepare an ICE table for this equilibrium mixture, being sure to include the initial concentrations, changes in concentrations and the equilibrium concentrations of Fe^{3+} , SCN^- and $\text{Fe}(\text{SCN})^{2+}$:

$$M_{\text{Fe}^{3+}} = \frac{0.00165 \text{ M} \cdot 0.005 \text{ L}}{0.0105 \text{ L}} = 7.86 \times 10^{-4} \text{ M}$$

$$V_{\text{tot}} = (2(2.75) + 5) \text{ mL} = 10.5 \text{ mL}$$

$$M_{\text{SCN}^-} = \frac{0.00165 \text{ M} \cdot 0.00275 \text{ L}}{0.0105 \text{ L}} = 4.32 \times 10^{-4} \text{ M}$$

	$[\text{Fe}^{3+}]$	$[\text{SCN}^-]$	$[\text{Fe}(\text{SCN})^{2+}]$
i	$7.86 \times 10^{-4} \text{ M}$	$4.32 \times 10^{-4} \text{ M}$	0
	-x	-x	x
C	-1.83×10^{-4}	-1.83×10^{-4}	1.83×10^{-4}
e	6.03×10^{-4}	2.49×10^{-4}	1.83×10^{-4}

4. Determine K for the equilibrium mixture in Question 3.

$$K = \frac{1.83 \times 10^{-4}}{(2.49 \times 10^{-4})(6.03 \times 10^{-4})} = 1.22 \times 10^3$$

Absorbance of $\text{Fe}(\text{SCN})^{2+}$

