What factors affect chemical equilibrium?

GUIDING QUESTION

What factors affect the equilibrium system?

INTRODUCTION

Addition of a solution of KSCN to a solution of $Fe(NO_3)_3$ results in a blood-red color. The more KSCN is added, the more intense the red color. Aqueous Fe^{3+} and SCN^- combine to form a complex ion in an equilibrium reaction:

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

There are many factors that can change the position of the equilibrium once the reaction appears to have stopped. In this investigation you will identify factors that have an effect on the above reaction.

MATERIALS AVAILABLE FOR USE

- 0.1 M $Fe(NO_3)_3(aq)$
- 0.1 M $KSCN(aq)$
- 0.1 M $KOH(aq)$
- 0.1 M $Na_2HPO_4(aq)$
- Test tubes
- Test tube rack/holder
- Hot plate
- Beakers
- Ice

SAFETY PRECAUTIONS

CAUTION: Wear goggles at all times.

CAUTION: Dispose of any excess liquids in appropriate containers.

CAUTION: You are working with a strong base that can damage skin and eyes.

GETTING STARTED

You should begin by observing the formation of the iron thiocyanate by placing a few drops of 0.1 M $Fe(NO_3)_3$ and a few drops of 0.1 M KSCN in each test tube and add water to same level in each tube. You should design an experiment that will test the effects on the equilibrium when other reagents are added to the system. Your design must minimize reagent use; that is, when placing the external stresses on the equilibrium you should observe what happens when reagents are added in a drop-by-drop fashion.

	Color Change After Addition	**$FeSCN^{2+}$**	
		Increases	**Decreases**
$Fe(NO_3)_3$			
KSCN			
KOH			
Na_2HPO_4			
Heat			
Cold			

Explain the patterns that emerge about the direction in which the equilibrium shifts when particular reagents are added in terms of Le Châtelier's principle.

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

Is the reaction exothermic or endothermic as written? Explain.

Beer's Law Calibration Curve

Solution #	Volume of 0.100 *M* Fe^{3+} (mL)	Volume of 5.00E^{-4} *M* SCN^- (mL)	Volume of Water (mL)	Total Volume (mL)	[$FeSCN^{2+}$]	Absorbance at 470 nm
Blank	1.00	0.00	5.00	6.00		
1	1.00	1.00	4.00	6.00		
2	1.00	1.50	3.50	6.00		
3	1.00	2.00	3.00	6.00		
4	1.00	2.50	2.50	6.00		
5	1.00	3.00	2.00	6.00		

The $FeSCN^{2+}$ concentration at equilibrium is calculated for each solution by assuming all SCN^- reacts, which is valid if the Fe^{3+} is in large excess. Show the calculation of SCN^- from dilution.

Linear regression equation for absorbance vs. concentration:

Correlation coefficient and reason for discarding data: