FLINN SCIENTIFIC

Name____

Laboratory Report

Complex-Ion Equilibrium of Iron(III) and Thiocyanate Ions

Color of $Fe(NO_3)_3$ Solution		Color of KSCN Solution	
Test tube 1	Color of control solution (step 5)		
Test tube 2	Color after addition of $Fe(NO_3)_3$ (step 6)		
Test tube 3	Color after addition of KSCN (step 7)		
Test tube 4	Color of solution after cooling (step 8)		
Test tube 5	Color of solution after heating (step 9)		
Test tube 6	Color after addition of NaH_2PO_4 (step 10)		

Acid–Base Equilibrium of Bromcresol Green

Initial color of indicator solution (step 12)	
Color after addition of HCl (step 13)	
Color after addition of NaOH (step 14)	
Number of drops of NaOH added (step 14)	
Amount of HCl required to obtain “transition” color (step 16)	
Transition color (step 16)	

1. Write the chemical equation for the reversible reaction of iron(III) ions with thiocyanate ions. Label this Equation A. Use the information in the data table to write the color of each reactant and product underneath its formula.

2. How did the color of the solution change when additional reactant—either $Fe(NO_3)_3$ in step 6 or KSCN in step 7—was added? **Explain the observed color changes:** Adding more reactant to an equilibrium mixture of reactants and products increases the rate of the (forward/reverse) reaction and thus (increases/decreases) the amount of product.

3. How do the results obtained in steps 6 and 7 demonstrate that both reactants and products are present at equilibrium?

4. How did the color of the solution change when it was cooled (step 8) or heated (step 9)? How do these results demonstrate that the reaction shown in Equation A does indeed occur in both the forward and reverse directions?

5. In step 10, $H_2PO_4^-$ ions combined with iron(III) ions and removed them from solution. How did the color of the solution change when NaH_2PO_4 was added? **Explain the observed color change:** Removing one of the reactants from an equilibrium mixture of reactants and products decreases the rate of the (forward/reverse) reaction and thus (increases/decreases) the amount of product.

6. After observing the effect of NaH_2PO_4 on the equilibrium mixture in step 10, a student was skeptical that both Fe^{3+} and SCN^- ions were still present. Suggest additional experiments that could be done to prove that both reactants are still present at this point.

7. Write the chemical equation for the reversible reaction of bromcresol green with water. Label this Equation B. **Hint:** Refer to Equation 3 in the *Background* section.

8. Use the color changes observed for the indicator before and after adding HCl (steps 12 and 13) to predict the colors of the HIn and In^- forms of bromcresol green. Write the colors of HIn and In^- underneath their formulas in Equation B. Explain your reasoning. **Hint:** Adding HCl increases the concentration of H^+ ions. Which reaction, forward or reverse, would that increase?

9. **Explain the observed color change:** Adding more product to an equilibrium mixture of reactants and products increases the rate of the (forward/reverse) reaction and thus (increases/decreases) the amount of product.

10. In step 14, hydroxide ions reacted with and removed H^+ ions from solution (see Equation 4 in the *Background* section). What color change was observed when NaOH was added? **Explain the observed color change:** Removing one of the products from an equilibrium mixture of reactants and products decreases the rate of the (forward/reverse) reaction and thus (increases/decreases) the amount of product.

11. What form(s) of the indicator were most likely present when the transition color was observed in step 16? How does this observation provide visual proof that not all reactions "go to completion?"