APPLICATIONS OF LeCHATELIER'S PRINCIPLE



GENERAL DISCUSSION

A system at equilibrium may be disturbed by subjecting the system to a stress. A stress is a change of conditions, such as changing the concentration of one of the participants or changing the temperature. LeChatelier's Principle indicates that the system readjusts so as to minimize the stress and restore equilibrium.

In this experiment you will investigate the equilibrium system

 Fe^{+3} + SCN⁻¹ ~ Fe(SCN)⁺²

You will vary the concentrations of the reactants and observe, by color changes which occur, how the system has shifted to regain equilibrium.

PROCEDURE:

 Examine solutions of KCI, KSCN, FeCl₃, and Hg(NO₃)₂. Write the color of each ion listed in Table I. Remember, a colorless solution can only have colorless ions. You will have to do Procedure 4 before you can observe the color of $Fe(SCN)^{+2}$.

the stress.

TABLE 1

ION	COLOR
K ⁺¹	
CI-1	
SCN ⁻¹	
Fe ⁺³	
Fe(SCN) ⁺²	
Hg ⁺²	
Hg(SCN) ⁻²	Colorless
FeCl ₄ -1	Colorless

2. Assume the wells in your spot plate are numbered in this manner:

	1	
2	5	4
	3	

- Place one drop of 0.1 M FeCl₃ solution into well # 5 and add two drops of 0.1 M KSCN.
- Get some pure water in a clean beaker. Add 25 drops of pure water to the solution in well # 5 and mix thoroughly by drawing up into the eyedropper and returning to the well several times. Now you can observe the color of Fe(SCN)⁺².
- Place five drops of the solution 5. in well # 5 into each of the cells 1 through 4. Return the excess to # 5. All five occupied well should appear to have the same lf # color. 5 looks darker because of a greater depth of solution, remove and discard a drop or two. Well # 5 will remain untouched throughout the rest of lab and will be used to compare color changes to the original color.
- 6. To well # 1 add a few small crystals of FeCl₃.

To well # 2 add a few small crystals of NaCl. To well # 3 add 4 drops of 0.1 M KSCN. To well # 4 add 1 drop of Hg(NO₃)2.

- 7. Stir each well and record any color changes in TABLE II.
- Pour your well plate into the waste beaker and then rinse and dry it. Rinse your eyedropper with pure water.

TABLE II

Species added	Color change
Fe ⁺³ from FeCl ₃	
CI ⁻¹ from KCI	
SCN ⁻¹ from KSCN	
Hg ⁺² from Hg(NO ₃) ₂	

QUESTIONS:

Remember you were applying stresses to the equilibrium system

Fe ⁺³	+	SCN ⁻¹	~	Fe(SCN)+2	On the blank lines fill in the colors of the ions.

- 1.a. In the first change did the color change indicate a shift the the left of the right? (Did the concentration of the red ion on the right increase or decrease?)
- b. Can you explain why the addition of iron III ions shifted the equilibrium in that direction.
- 2.a. In the second change did the color change indicate a shift the the left of the right? (Did the concentration of the red ion on the right increase or decrease?)
- b. Can you explain why the addition of CI⁻¹ ions from KCI shifted the equilibrium in that direction? Look for a clue in Table I.
- 3.a. In the third change did the color change indicate a shift the the left of the right? (Did the concentration of the red ion on the right increase or decrease?)
- b. Can you explain why the addition of SCN⁻¹ ions from KSCN shifted the equilibrium in that direction?
- 4.a. In the third change did the color change indicate a shift the the left of the right? (Did the concentration of the red ion on the right increase or decrease?)
- b. Can you explain why the addition of Hg⁺¹ ions from KCI shifted the equilibrium in that direction? Look for a clue in Table I.

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PRINCIPLE

PART II

In this part of the experiment you will investigate the equilibrium

Cr₂O₇⁻² + H₂O ~ 2 CrO₄⁻² + 2 H⁺¹

Procedure:

- 1. Examine solutions of $K_2Cr_2O_7$ and K_2CrO_4 . Fill in Table III.
- Put three drops of K₂CrO₄ into a well. Add three drops HNO₃. Record any color change. Record your observations in Table IV.

TABLE III

ION	COLOR
CrO4 ⁻²	
Cr ₂ O7 ⁻²	



- Place three drops of K₂Cr₂O₇ into an adjacent well. Add 3 drops of 0.1 M NaOH solutions. Record your observations in Table IV.
- Pour your well plate into the waste beaker and then rinse and dry it.

TABLE IV	'
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lon in Original Solution	Species added To original Solution	Color Change
CrO4 ⁻²	H ⁺¹ from HNO ₃	
Cr ₂ O7 ⁻²	OH ⁻¹ from NaOH	

QUESTIONS: You worked with this equilibrium system. Fill in the ion colors on the lines.

 $Cr_{2}O_{7}^{-2} + H_{2}O^{-2} + 2H^{+1}$

- 1. Why did the yellow chromate solution turn orange when acid was added?
- 2. Why did the orange dichromate solution turn yellow when a base was added?