CHEMICAL EQUILIBRIUM

This experiment is a short introduction to the qualitative aspects of chemical equilibrium. Start with a reaction at equilibrium, you will change the concentrations of various ions that are present and note the effect on the state of equilibrium. The equilibrium reaction:

$Fe^{+3}(aq)$ +	$SCN^{-1}(aq)$	<---------->	$FeSCN^{+2}(aq)$
ferric ion	thiocyanate ion		thiocyanato iron (III) ion

is chosen for study because the thiocyanato iron (III) ion, $FeSCN^{+2}$, is coloured. Changes in its concentration can be readily detected by a corresponding change in colour intensity.

Procedure:

1. Put about 50 mL of 0.002 M potassium thiocyanate solution, KSCN(aq), and 50 mL of distilled water into a beaker. Obtain a solution of 0.2 M ferric nitrate nonahydrate, $Fe(NO_3)_3 * 9H_2O(aq)$, in a dropper bottle. Describe each solution.

2. Add 10-12 drops of the ferric nitrate solution into the beaker containing KSCN and water. Swirl the mixture and describe the results.

3. Obtain a bottle with a solution of potassium nitrate, KNO_3. Describe the appearance of the solution.

4. Pour equal amounts of the solution from the beaker into four numbered petri dishes. Place the petri dishes over a white piece of paper. The solution in the first dish will be the reference solution.

5. To the second petri dish, add 2-3 small crystals of solid KSCN(s). Describe the results.

6. To the third petri dish, add 3 drops of the $Fe(NO_3)_3 * 9H_2O(aq)$ solution. Stir and describe the results.

7. To the fourth petri dish, add 5-10 small crystals of $Na_2HPO_4(s)$, a few at a time. Stir between additions and describe the results.

Questions and Regularities:

1. For **each** solution in step 1 (KSCN and ferric nitrate), what ions are present?

2. What **possible** combinations of ions could result for the results in step 2 (what would the products be once these solutions were mixed together)?

3. What ions are present in the potassium nitrate solution?

4. Could the ions in potassium nitrate be responsible for the change noted in step 2 of your observations?

5. Considering your answer to question 3 and 4, what ion combination must be responsible for the colour change noted in step 2?

6. How does the addition of the KSCN in step 5 affect the concentration of the SCN^{-1} ion?

7. Other experiments have shown that the formula for the coloured complex ion is $FeSCN^{+2}$. What affect does the addition of KSCN in step 5 have on the concentration of the $FeSCN^{+2}$ ion? Use Le Chatelier to explain your answer.

8. How does the addition of $Fe(NO_3)_3 * 9H_2O$ solution in step 6 affect the concentration of the Fe^{+3} ion?

9. What effect does the addition of $Fe(NO_3)_3 * 9H_2O$ solution in step 6 have on the concentration of the $FeSCN^{+2}$ ion? Use Le Chatelier to explain your answer.

10. Other experiments have shown that Fe^{+3} ion can readily combine with HPO_4^{-2} ions. This combination usually appears as a very slightly milky solution. What effect does the addition of HPO_4^{-2} ions (from $Na_2HPO_4(s)$) in step 7 have upon the concentration of Fe^{+3} ion in the solution? What efect does it have on the concentration of the $FeSCN^{+2}$ ion? Use Le Chatelier to explain your answer.

<u>Conclusions:</u>

One of the things to include would be to use the collision theory to explain the results of Petri dishes 2-4.