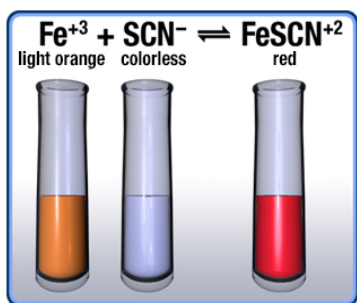


Equilibrium Lab

Introduction: A system is at “equilibrium” when its opposing forces are balanced. In chemistry, equilibrium is dynamic rather than static; it is reached when the rate of the forward reaction is equal to the rate of the reverse reaction. When a system at equilibrium is stressed, whether the stress is biological, chemical, or something else, the equilibrium position will change. Le Chatelier’s Principle lets us predict what will happen when we change the conditions of a system at chemical equilibrium. In this lab, you will see how scientists use Le Chatelier’s Principle to control chemical reactions and thereby obtain products that can be used in industry, manufacturing, or the environment.



TEACHER NOTES:

This lab is an alternate activity to the “gas tube” experiment seen in our classroom.

Objectives:

- Define a chemical equilibrium system.
- Write an equilibrium constant expression.
- Explain how a reversible reaction can be different colors and still be at equilibrium (LeChatelier’s Principle).
- Demonstrate a particulate understanding of LeChatelier’s Principle.

Materials:

- 0.0010 M KSCN (640 mL: 0.062 g of KSCN in 640 mL of solution)
- 0.10 M KSCN (28 mL: 0.272 g of KSCN in 28 mL of solution)
- 0.20 M $\text{Fe}(\text{NO}_3)_3$ (48 mL: 3.88 g of $\text{Fe}(\text{NO}_3)_3 \cdot 9\text{H}_2\text{O}$ in 48 mL of solution)
- 0.10 M Na_2HPO_4 (28 mL: 0.396 g Na_2HPO_4 in 28 mL of solution)
- (4) small test tubes
- (1) large test tube
- eyedropper



SAFETY

Students should wear safety goggles, aprons, and gloves.

Procedure:

1. Fill one small test tube with SCN^- (KSCN) solution. In another small test tube place ten drops of Fe^{+3} ($\text{Fe}(\text{NO}_3)_3$) solution. Record the color of the solutions, and confirm that the colors are the same as listed above.
2. Mix the two solutions together in the large test tube. Record the color of the solution when the Fe^{+3} , SCN^- , and FeSCN^{+2} are all present at the same time.
3. Pour equal amounts of the solution into three small test tubes, and number them 1, 2, and 3. Test tube 1 is the control tube. Tests will be run on test tubes 2 and 3.
4. Add five drops of 0.10 M KSCN to test tube 2. Stir, and record the results.
 - a. How does the color of test tube 2 compare to test tube 1?
 - b. Based on the color of the solution in the test tube, what do you think is happening to the concentration of Fe^{+3} ? What is happening to the concentration of FeSCN^{+2} ? Justify your answer.
5. Add four drops of 0.10 M Na_2HPO_4 , one at a time, to test tube 3. This compound will react with the Fe^{+3} to form $\text{Fe}(\text{HPO}_4)^{+2}$. (This is the same effect as removing the Fe^{+3} ion from the reaction.) Stir, and record the results.
 - a. How does the color of test tube 3 compare to test tube 1?
 - b. Based on the color of the solution in the test tube, do you see a change in the concentration of reactants or products? How do you know?

Post-lab Questions:

- 1. Look at the first reaction of the lab. KSCN is added to the reaction and, as a result, the reaction turns red. Why does the reaction turn red?**
- 2. How can this reaction mixture be either red or light orange in color and still be at equilibrium?**
- 3. Explain LeChatelier's Principle. Give two examples from the lab that illustrate this principle.**
- 4. Write the equilibrium expression for the reaction.**