Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Chemistry

***Le Châtelier Principal’s Investigation***

**Background:** In his early years, Henry Louis Le Châtelier trained in the areas of mathematics, thermochemistry, mini-engineering, and metallurgy. He was particularly interested in the industrial processes behind creating better cements and synthesizing ammonia from air. While studying the effects of temperature on the solubility of cement salts and their reaction with water, Le Châtelier developed his principle of Equilibrium. This theory is widely used by industrial chemist to increase the yield and purity of materials. It is also used by environmentalist, pharmacologists, and others wishing to explain natural events or predict and manipulate outcomes.

A chemically reversible reaction will be created and place it in equilibrium. The ion concentrations and temperature will be manipulated to investigate their effects upon the system’s stability.

The equilibrium system that will be studied is as follows:



**Materials**

Hot plate

100 ml beaker (for hot water bath)

100-ml beaker (for ice bath)

test tube rack

test tube holder ice 5 test tubes

CuCl2 solution

0.1 M AgNO3 (aq),

NaCl(s)

balance

weighing paper/boat

**Pre-Lab**

1. Write out the balanced reaction between AgNO3 (aq) and CuCl2 (aq) and identify the precipitate formed. Does precipitation mean that the concentration of the compound that is the solid increases or decreases in solution?
2. Study the table below and the equilibrium equation above. Complete the column for the predictions of the changes which will occur. Look carefully at the change or stress in the procedure. Using your knowledge of Le Chatelier’s principle, state whether the color will become more green, blue, or whether no color change will occur.

**Data Table:**

|  |  |  |
| --- | --- | --- |
| **Test tube** | **Predicted Changes** | **Observed Changes** |
| 1 |  |  |
| 2 |  |  |
| 3 |  |  |
| 4 |  |  |
| 5 |  |  |

1. Add approximately 1 mL of the CuCl2 solution to each test tube. Stress each test tube by doing the following:
   1. Do nothing to the first test tube.
   2. Place the second test tube in a hot water bath for at least 5 min to raise the temperature.
   3. Place the third test tube in the ice bath for at least 5 min to lower the temperature.
   4. Add 5 drops of AgNO3 solution to the fourth test tube. Mix by using the stopper and inverting.
   5. Add a small scoop (tip of spatula) of NaCl to the last test tube. Mix by using the stopper and inverting.
2. Record observations for each test tube.

**Analysis & Conclusion**

1. Which reaction, forward or reverse, was favored by heating the system? Explain.
2. Which reaction, forward or reverse, was favored by cooling the system? Explain.
3. When silver nitrate was added to the solution, which ion was stressing the equilibrium, silver or nitrate? Which reaction, forward or reverse, was favored by this action? Explain.
4. When sodium chloride was added to the solution, which ion was stressing the equilibrium, sodium or chloride? Which reaction, forward or reverse, was favored by this action? Explain.
5. What purpose did the first tube serve?