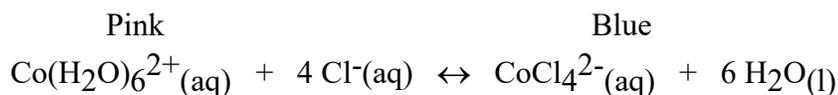


USING LE CHATELIER'S PRINCIPLE

Introduction:

Many chemical reactions do not go to completion. In these reactions there will be measurable amounts of reactants and products even after a considerable period of time. An equilibrium is established and the ratio of products to reactants will remain constant if temperature is kept constant. It is possible to shift the equilibrium in a desired direction by applying a stress to the system. This process is explained by Le Chatelier's Principle which states that, "When a system at equilibrium is subjected to a stress, the system will react so as to relieve the stress." Some examples of stresses that can be applied to a system are changes in concentration (both increasing and decreasing), pressure (for systems involving gases), and temperature. In this experiment the effects of changes in concentration will be observed.

The system studied is :



With this system, it is easy to observe the shifts in equilibrium because the cobalt compounds involved have two distinct colors. When a stress is applied to this system, the direction in which the equilibrium was shifted may be readily observed.

Purpose:

The purpose of this laboratory activity is to predict the changes observed in an equilibrium system involving cobalt complexes and to explain the changes in terms of Le Chatelier's principle.

Equipment/Materials:

3 test tubes, 15 X 150 mm	test tube rack
10 mL graduated cylinder	stirring rod
0.2 M CoCl ₂	concentrated HCl
0.1 M AgNO ₃	acetone

Safety:

- Goggles and an apron must be worn during all experiments.
- The HCl used in this experiment is very corrosive. Handle with caution. The vapors are irritating.
- The AgNO₃ used in this experiment can stain skin. Handle carefully.
- Acetone is flammable. There should be no open flames during this experiment.

Procedure:

1. Before beginning the experiment, complete Section 1 of the data page. This section asks one to predict the changes that will occur when changes (stresses) are made to the equilibrium system.
2. Label three test tubes 1-3. Equally divide 10 mL of the 0.2 M CoCl₂ solution between test tubes 1 and 2.
3. Under a fume hood, pour 10 mL of concentrated HCl into test tube 1. Stir the contents gently and record observations in Section 2 of the data table.
4. Pour half of the contents of test tube 1 into test tube 3.
5. Add 7 mL of water to test tube 1. Stir the contents and record observations in the data table.
6. Add 8 mL of 0.10 M AgNO₃ to test tube 3. Stir the contents gently, and record the results in the data table.
7. Measure 10 mL of acetone. Tilt test tube 2 and gently pour the acetone down the side of the test tube to avoid mixing the acetone and the cobalt solution. This step will not work unless the acetone remains in a separate layer. Record results on the data table.

Name _____

Name _____

Period _____

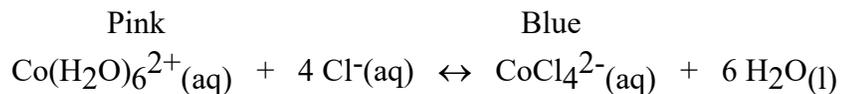
Date _____

USING LE CHATELIER'S PRINCIPLE

Data Table:

Section 1:

Refer to the equation of the reaction being studied and answer the questions in this section before beginning the experiment.



Predict the affect the following changes have on the equilibrium system:

1. Adding HCl, a source of Cl^- ions
2. Adding H_2O
3. Adding silver nitrate, AgNO_3 (Silver ions and chloride ions react to form an insoluble precipitate.)
4. Adding acetone (Acetone is often used by chemists to remove the last traces of water from glassware.)

Section 2:

Observation Table

Step	Procedure	Observations
3	HCl added	
5	H ₂ O added	
6	AgNO ₃ added	
7	Acetone added	

Questions:

1. In step 3, hydrochloric acid is used as a source of Cl⁻ ions. Explain the observations in terms of Le Chatelier's principle.
2. In step 5, why did the addition of H₂O cause the change that it did? Explain the observations in terms of Le Chatelier's principle.
3. In step 6, silver ions from the AgNO₃ react with Cl⁻ ions to produce an insoluble precipitate. Use this information and Le Chatelier's principle to explain the observations.
4. Acetone has an attraction for H₂O. Use this fact and Le Chatelier's principle to explain the observations resulting from step 7.