AP Chemistry 30 – Lab Activity 8: Le Chatelier's Principle

Learning Objective

1. Predict and observe the effects of various stresses on a reversible reaction
2. Quantitatively examine the effect of a stress on an equilibrium system

Background Information:

Le Chatelier's Principle states that when a system equilibrium is disturbed by a change in environment, the stress will be relieved by a "shift" in the system, towards the reactants (left) or products (right).

For the first part of this lab, the system being observed is:

$$\underset{\text{green}}{CuCl_4^{2-}\,(aq)} + 4\,H_2O\,(l) \rightleftharpoons \underset{\text{blue}}{Cu(H_2O)_4^{2+}\,(aq)} + 4\,Cl^-\,(aq) + \text{heat}$$

Materials:

- Medium test tubes (5)
- Test tube rack
- Distilled water
- Solid calcium chloride
- 0.10M silver nitrate
- Scoopula
- Test tube clamps
- Hot water bath
- Two graduated cylinders of the same size (25-mL)
- Two straws, one "skinny" and one "fat"

Procedure:

Part A

1. Fill each test tube with about 2 cm of copper(II) chloride solution. (This is a qualitative lab; exact amount is not important!)
2. The first test tube will be a colour control. Do not add anything else to this test tube. For the other five tubes, perform the tests as outlined in the table below. For each, ensure a colour change occurs; add more reactant if necessary.

Tube 2	Add distilled water. Swirl the test tube to mix the liquids.
Tube 3	Add a small scoop of solid calcium chloride. Swirl the test tube to mix.
Tube 4	Add several drops of silver nitrate. Swirl the test tube to mix.
Tube 5	Lower the test tube into the hot-water bath. Wait until a colour change occurs.

Part B

1. Repeat the Straw Lab as you did before.
    a. Fill one graduated cylinder with 15 mL of water.

b. "Trade" water between the two cylinders three times, then record the volume of water. Continue this until you have a constant volume of water in each graduated cylinder for three consecutive trials. This is the first equilibrium.

2. Once the volumes are constant, add 5.0 mL of water to the graduated cylinder with less water. Record the new volumes. This is adding a stress to the system by increasing "concentration".
3. Continue to "trade" water between the two cylinders as in Step 1b, using the same straws in each as before. Once the volumes are constant for three trials, stop. This is the second equilibrium.

Discussion:

1. Identify what variable you were changing for each test tube in Part A. Indicate which direction (left or right) the equilibrium shifted.
2. Make a scatterplot that shows Trials on the x-axis and Volume (mL) on the y-axis. Graph your data for both reactants and products on the same graph. At the point when more water was added, indicate this with a vertical line (not with a new trial). (This can be done electronically.)
3. Use your graph and your data to determine which way the equilibrium shifted in Part B. (Hint: it may help to compare the volumes in each cylinder at the first equilibrium and the second – did they both increase by the same amount?)