**Name : \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ LeChatelier’s Principle**

Background Information: Equilibrium exists when the rates of the forward and reverse reactions are equal. When stress is added to the reaction, the rates are no longer equal. The reaction will proceed in such a way to make the rates back to equal and establish a new equilibrium. This is known as LeChatelier’s principle.

Guiding Questions: What changes stress equilibrium reactions and how can you determine the shift in equilibrium using observations?

Materials: 0.002M KSCN, Bromothymol blue, KSCN, 0.1M AgNO3, CoCl2**.**6H2O, 12M HCl, 0.1MHCl, 0.1M NaOH, 0.2M Fe(NO3)3, C2H5OH, Na2HPO4, CaCl2, test tubes racks and holders, beakers.

Procedure: Start at your assigned lab station and perform the task outlined below. At the commands of your teacher move to the next lab station and perform the task outlined below.

Station One: Equilibrium of Acid Base Indicator(HIN) HIN(aq) ↔ H+ + IN-

1. Fill a test tube halfway with water. Yellow ↔ blue
2. Add 5 drops of bromothymol blue indicator.
3. Add 5 drops of 0.1M H+ solution to the solution and record observations.
4. Add 0.10M OH- solution drop wise until a reaction is observed. Record observations.
5. Dispose of chemicals down the drain with lots of water.
6. Place test tubes in the tray upside down to dry.

Observations:

Step 2: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Step 3: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Step 4: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Conclusions:

* When H+ was added in step 3, the reaction shifted to the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ because H+ reacts with \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and forms more \_\_\_\_\_\_\_\_\_\_\_\_\_\_.
* When OH- was added in step 4, the reaction shifted to the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ because OH- reacts with \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and creates more \_\_\_\_\_\_\_\_\_\_\_\_\_\_.

Station Two: Pressure Equilibrium: Look at the diagram on the desk. Count the number of each particle and write the before and after below the reaction:

**N2 + 3H2 ↔ 2NH3**

**Before: \_\_\_ \_\_\_ \_\_\_**

**After: \_\_\_ \_\_\_ \_\_\_**

Questions:

1. Create a general rule to describe how pressure affects reactions in terms of moles of reactants and products.
2. Determine which way the reactions shift when pressure is added to the gaseous systems:

a. PCl5 ↔ PCl3 + Cl2 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

b. 2N2 + 5O2 ↔ 2N2O5 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Station Three: Equilibrium of Complex Ions Fe+3 + SCN- ↔ FeSCN+2

1. Pour SCN- equilibrium solution into 3 separate test tubes, 1/5 way filled. Clear ↔ Red
2. Into the first test tube add 1 scoop of solid SCN-. Record observations.
3. Into the second test tube add 6 drops of Fe+3 solution. Record observations.
4. Into the third test tube add 1 scoop of HPO4-2. Record observations.
5. Dispose of chemicals down the drain with lots of water.
6. Place test tubes in the tray upside down to dry.

Observations:

Step 2: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Step 3: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Step 4: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Conclusions:

* When SCN- was added in step 2, the reaction shifted to the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ because SCN- reacts with \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and creates more \_\_\_\_\_\_\_\_\_\_\_\_\_\_.
* When Fe+3 was added in step 3, the reaction shifted to the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ because Fe+3 react with \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and creates more \_\_\_\_\_\_\_\_\_\_\_\_\_\_.
* When HPO4-2 was added in step 4, the reaction shifted to the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ because HPO4-2 reacts with \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and creates \_\_\_\_\_\_\_\_\_\_\_\_\_\_.

Station Four: Equilibrium with Temperature Heat + Co(H2O)6+2 + 4Cl- ↔ CoCl4+2 + 6H2O

1. Place one test tube into a hot water bath. Pink ↔ Blue
2. Place the second test tube in the cold water bath.
3. Record observation about the third test tube at room temperature.
4. Wait for the solutions to come to the correct temperature and record observations.
5. Place test tubes back into the test tube holder.

Observations:

Room Temp: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Hot: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Cold: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Conclusions:

* When placed in the hot water bath, the reaction shifted to the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ because the heat reacts with \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and creates more \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
* When placed in the ice water bath, the reaction shifted to the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ because the heat was removed and creates more \_\_\_\_\_\_\_\_\_\_\_\_\_\_.

Station Five: Equilibrium of a Cobalt Complex Ion heat + Co(H2O)6+2 + 4Cl- ↔ CoCl4+2 + 6H2O

1. Pour the Cobalt solution into three test tubes, 1/5 filled. Pink ↔ Blue
2. Into the first test tube add 5 drops of 12M Cl- solution. Record observations.
3. Into the third test tube add 1 scoop of solid Cl-. Record observations.
4. Into the fourth test tube add 5 drops of Ag+ solution. Record observations.
5. Dispose of chemicals down the drain with lots of water.
6. Place test tubes in the tray upside down to dry.

Observations:

Step 2: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Step 3: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Step 4: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Conclusions:

* When Cl- was added in step 2, the reaction shifted to the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ because Cl- reacts with \_\_\_\_\_\_\_\_\_\_and creates more \_\_\_\_\_\_\_\_\_\_\_\_\_\_.
* When solid Cl- was added in step 3, the reaction shifted to the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ because Cl- reacts with \_\_\_\_\_\_\_\_\_\_and creates more \_\_\_\_\_\_\_\_\_\_\_\_\_\_.
* When Ag+ was added in step 4, the reaction shifted to the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ when Ag+ because Ag+ reacts with \_\_\_\_\_\_\_\_\_\_\_ and creates more \_\_\_\_\_\_\_\_\_\_\_\_\_\_.

Station Six: Water and solution Equilibrium H2O(g) ↔ H2O(l)

1. Observe both beakers of water on the desk. They were placed out yesterday with the same volume of liquid in each beaker. Beaker 1 is at equilibrium and beaker 2 is not.
2. Write observations below and answer the questions.

Observations:

Beaker 1: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Beaker 2: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Questions:

1. Which is true about equilibrium? Circle one.
   1. Rate of condensation equals rate of evaporation
   2. Amount of water equals amount of vapor
2. Why are unsaturated solutions not at equilibrium?
3. Why are supersaturated solutions not at equilibrium?
4. What is the name given to a solution at equilibrium?
5. What is equal about solution equilibrium: rates of reaction or concentration of reactants and products?