**LAB #17: Equilibrium Lab**

**Introduction:**

Most chemical reactions we have studied are irreversible, that is the reactants will form products and the reaction can’t be undone. Some reactions are reversible- the reaction can run in reverse so that the products can turn back into reactants. A reversible reaction will have a double arrow, like in the case of the formation of water from hydrogen and oxygen:

 2H2 + O2 <-> H2O

A reversible reaction is said to be in equilibrium when the rate of the forward reaction (reactants making products) is equal to the rate of the reverse reaction (products making reactants.)

LeChatelier’s Principle states that when a stress is placed on a system which is in equilibrium, the system will react in such a way to relieve the stress. These stresses include a change in concentration of a product or reactant, a change in gas pressure, or a change in temperature. To relieve this stress, a system may produce more reactants or products until equilibrium is reestablished.

**A color change will indicate which side (products or reactants) the reaction shifts towards.**

**Safety Information:**

**Fe(NO3)3, K2CrO4 and KSCN are moderately toxic. You can become ill if you ingest them! Please wash your hands after you are done.**

**HCl and NaOH are caustic at these concentration and may burn your skin. If you spill any on you, please immediately rinse the exposed area. You must wear goggles and an apron while you are performing this.**

**Part 1: Iron(Fe3+) <-> Thiocyanate(SCN-) Equilibrium system**

**Fe(NO3)3 + KSCN <-> FeSCN + KNO3**

pale brown <-> dark red

**Directions:**

**1. Add 1 ml of 0.2 M Fe(NO3)3 to beaker(A)**

**2. Add 2 ml of 0.1 M KSCN to beaker(A)**

**3. Slowly add H2O to beaker(A) until it turns a nice red**

**4. Pour 10 ml of the solution from beaker(A) into 4 separate test tubes. Set aside the extra solution for part 3.**

**#1 #2 #3 #4**

**Control add Fe(NO3)3  add KSCN add NaOH (removes Fe(NO3)3)**

(drop by drop) (drop by drop) (drop by drop)

**Observations:**

 **Test tube #1: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

 **Test tube #2: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

 **Test tube #3: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

 **Test tube #4: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Analysis: Which side (reactants or products) did the reaction shift to in**

**Test tube #2: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Test tube #3: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Test tube #4: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Part 2: Chromate(CrO4-2) <-> Dichromate(Cr2O7 -2) Equilibrium System**

 **K2CrO4 + H+ <-> Cr2O7-2 + OH-**

yellow **<->** orange

**Directions:**

**1. Obtain 30 ml of 1.0 M K2CrO4 in beaker(B)**

**2. Divide the solution from beaker(B) into equal volumes in 3 test tubes**

 **#1 #2 #3**

 **Control add HCl (H+) add NaOH (OH-)**

 **(drop by drop ) (drop by drop)**

**Observations:**

 **Test tube #1: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

 **Test tube #2: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

 **Test tube #3: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**\*\*see if you can change the orange test tube back to yellow. Why does this happen?**

**Analysis: Which side (reactants or products) did the reaction shift to in**

 **Test tube #2: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Test tube #3: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Conclusions:**

1. **When more reactants are added to a system in equilibrium, how are the products affected?**
2. **When more products are added to a system in equilibrium, how are the reactants affected?**
3. **When reactants are removed from a system in equilibrium, what happens to the concentration of the products?**
4. **When products are removed from a system in equilibrium, what happens to the concentration of the reactants?**
5. **List and explain 1 source of error in this experiment.**

**Part 3: The Effect of temperature on the Iron(Fe3+) <-> Thiocyanate(SCN-) Equilibrium system**

Using your remaining solution from beaker A, design an experiment to determine how temperature affects the equilibrium system.

**Fe(NO3)3 + KSCN <-> FeSCN + KNO3**

pale brown <-> dark red

Have your teacher approve the experiment before you carry it out. Can you determine whether the forward reaction is exothermic or endothermic?