All Things Being Equal!

OBJECTIVES
To study equilibrium and understand what happens to the concentration of reactants and products in an equilibrium system.

PROBLEM / QUESTION
What does it mean to have a chemical equilibrium system? What are factors that affect a chemical equilibrium system? What happens to the chemical equilibrium system if you change one of these factors?

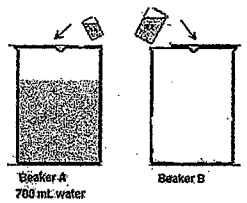
PRIOR KNOWLEDGE
You will need to understand a reversible reaction and what it means when a reaction is reversed. You also need to know the collision theory.

SAFETY
No safety issues for Part I and III. Potassium thiocyanate causes irritation to eyes, skin and respiratory tracts. Iron (III) nitrate nonahydrate is a strong oxidizer. Disodium hydrogen phosphate causes irritation to eyes, skin and respiratory tracts.

MATERIALS
Part I: Graph paper
Part II: Dropper bottles of chemicals will be provided at your lab tables, 4 small test tubes and 1 large test tube
Part III: Reaction kit: Red/yellow chips, colorless chips, and reaction paper

BACKGROUND INFORMATION
When you first learn about chemical reactions, you learn that reactants form products. As such we generally think that in a reaction all of the reactant species break apart and form new product species such that, at the end of a reaction all of the reactants have been used up and only products remain. This, however, is not the case for many reactions. Many reactions do not go just from reactants to products, they can also go from products to reactants. Additionally, many reactions do not go to completion, but rather there are always some reactants and some products present in the reaction mixture. For these types of reactions we talk about "equilibrium systems". Equilibrium systems are everywhere. Understanding how an equilibrium system works and the factors that affect equilibrium systems is very important for understanding a lot of chemistry; how our body maintains a very narrow pH range and how to maximize the desired output of chemical industrial process to name just a couple of examples.

PROCEDURE
Part I: Investigating a simple physical equilibrium system.
Materials: 4 beakers: 100 mL and 50 mL and **two** 1000 mL beakers (A and B)



Read step a-e and make a data table for the activity.

a) Fill beaker according to the picture above.
b) Record the volume of water in the beakers in the data table (cycle 0)
c) Transfer water from beaker A→B and B→A according to the following rules
   - Use the 100 mL beaker to transfer water from A to B;
   - Use the 50 mL beaker transfer water from B to A.
   - Fill the small beakers as full as possible **without tipping the large beakers** in any way.
   - One cycle consists of one A □ B transfer and one B □ A transfer.
   - **For each cycle**, record the volume of water in beakers A and B.
d) Continue cycles and recording the volumes, until the level of water in beakers A and B are unchanging for at least four cycles.

DATA TABLE:(prepare on a separate sheet)

ANALYSIS

A. Graphing

Graph the volume of water (in beakers A and B) versus cycle. Make sure you label both axes and title the graph. Be sure the reader can distinguish between the A and B points on the graph (use different colors or symbols for points). Trace the points to make smooth curves for each plot.

B. Questions

1. What do think is meant by equilibrium?

2. On the graph, circle the points where you believe the reaction has reached equilibrium.

3. What cycle(s) of the experiment did the reaction reach equilibrium? B) How do you know?

B)

4. Compare your ideas about equilibrium with another group (see your teacher for your partner group). Look up the textbook definition of equilibrium and write it here. Does this definition match your definition? Why or why not? With your partner group, look at the graph and determine where the reaction reaches equilibrium. If this position is not the same position you circled for question 2, circle the new point on your graph in a different color and indicate the color here.

5. At equilibrium, is the amount of water in Beaker A equal to the amount of water in Beaker B?

6. Based on the graph what must be the same in order for a reaction to be at equilibrium?

Chemistry1
Data Table

Name:
Date:
Hour:

Number of Cycles	Volume Beaker A (mL)	Volume Beaker B (mL)
0		
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

Chemistry1
Graph

Name:
Date:
Hour: