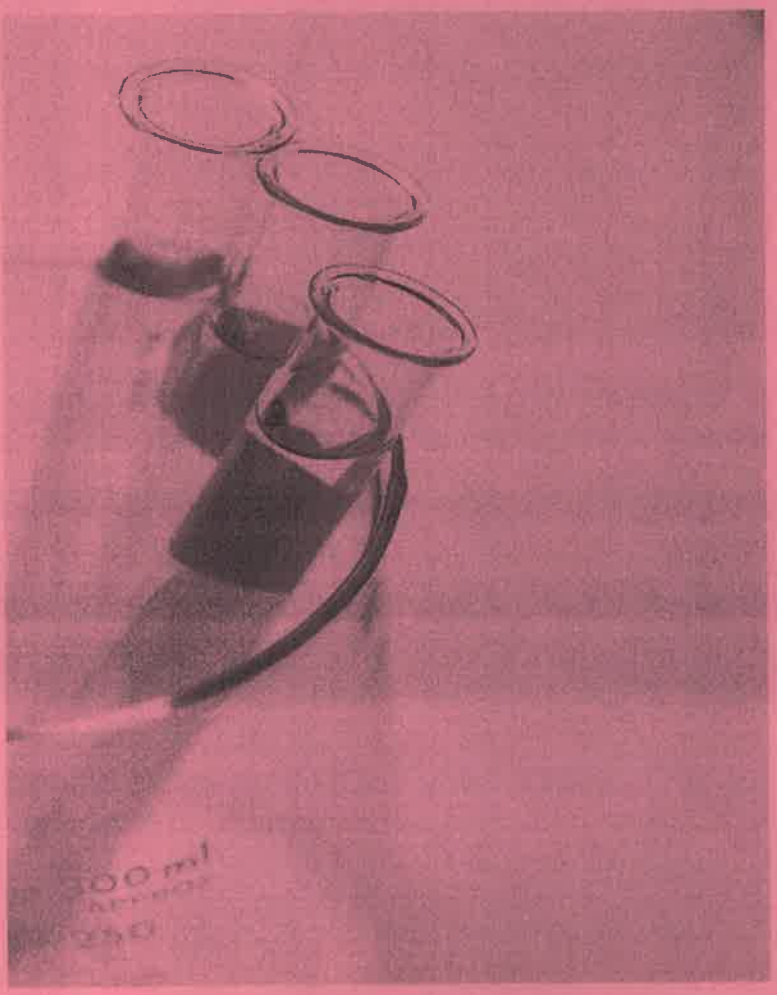
UNIT NINE:



Kinetics and Equilibrium

Name:_____ Date: _____

SUGAR CUBE KINETICS:

PURPOSE:

INTRODUCTION:

The rate at which something happens is evaluated by the amount of occurrences over a certain amount of time. The greater the amount of reactions over a certain time, the greater the rate will be. The greater the rate, the "faster" the reaction looks. A high reaction rate looks fast because many effective collisions are happening.

Several factors can increase the rate of dissolution for a solid. Temperature, concentration, surface area, adding catalysts, nature of bonds, and pressure it is a gas being tested are all factors that can affect reaction rate. In this demonstration, you will investigate some of these factors.

SAFETY:

MATERIALS:

3 Beakers	1 Stirring rod	1 Large Hot Plate
Balance	3 sugar cubes	1 mortar and pestle

PROCEDURE:

1. Measure 50 mL of water and place in a 100 mL beaker. Make sure there are no cracks or chips in the glass before you place the beaker on the hot plate and turn it to high. Bring to a boil. This will be your hot water sample.
2. Measure 50 mL of water and place in a 100 mL beaker of water. This will be your cold water sample.
3. On one paper towel, carefully crush a sugar cube and label it A. Repeat the process for cube 2 labeling it B. Measure the mass of the sugar cubes separately and record the results in the appropriate data table below.
4. Once the water reaches the boiling point, use heat resistant gloves to carefully remove the beaker and set on the table. Do not add the sugar when the water is on the hot plate. Place the crushed sugar sample A in the hot water and time how long it takes for the sugar to completely dissolve using a stop watch. Do not shake or stir the solution. Record your observations in your data table in your journal.
5. Rinse out all cups and prepare for the next set. Read the data tables for Sets 2 – 4 and conduct the investigations needed to complete the data tables. Once you are completely finished, WASH each beaker out and dry.

DATA AND OBSERVATIONS:

SET ONE-

CUP	SUGAR SAMPLE	WATER CONDITIONS	MASS (G)	TIME (MIN)
A	Crushed	Hot		
B	Crushed	Cold		

SET TWO-

CUP	SUGAR SAMPLE	WATER CONDITIONS	MASS (G)	TIME (MIN)
C	Cube	Hot		
D	Cube	Cold		

SET THREE-

CUP	SUGAR SAMPLE	WATER CONDITIONS	MASS (G)	TIME (MIN)
E	Cube	Hot, Stirred		

F	Cube	Hot, not Stirred		

SET FOUR-

CUP	SUGAR SAMPLE	WATER CONDITIONS	MASS (G)	TIME (MIN)
G	Crushed	Cold, Stirred		
H	Crushed	Cold, not Stirred		

QUESTIONS:

1. What was the independent variable in each of the four trials?

2. What was the dependent variable in this experiment? Was it the same for each of the four trials?

3. What was held constant in each of the four sets?
   a.
   b.
   c.
   d.
4. How does particle size affect the rate of dissolution of the sugar cube in water?

5. How does temperature affect the rate at which sugar dissolves in water? The higher the temperature, the faster the sugar dissolves.

6. How does stirring affect the rate at which sugar dissolves in water? Stirring causes the particles to move faster and break up faster causing the sugar to dissolve faster.

7. If you wanted to dissolve a substance faster, what should you do?

8. If you wanted to dissolve a larger amount of substance, say 10 sugar cubes, what should you do to dissolve the sugar?

9. Supposed you had a cube with 6 sides that measured 20 cm x 20 cm on each side. How much surface area would be exposed to the solvent? Show all your work with correct units.

10. What is the collision theory? What must happen in order for an effective collision to happen?

11. Based in terms of collision theory, how does stirring aid in the solution process?

. Based in terms of collision theory, how does increasing the temperature increased the rate of solution?

13. Based in terms of collision theory, will a 1.0 M solution or a 2.0 M solution have a greater reaction rate

Name:_____ Date: _____

LE CHATELIER'S PRINCIPLE: A STUDY OF DYNAMIC EQUILIBRIUM

PURPOSE:

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. 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. In chemistry, Le Chatelier's Principle, also called Chatelier's Principle, can be used to predict the effect of a change in conditions on a chemical equilibrium. When a system at equilibrium is subjected to a stress, the system will react so as to relive the stress. If a chemical system at equilibrium experiences a change in concentration, temperature, volume, or partial pressure, then the equilibrium shifts to counteract the imposed change and a new equilibrium is established. In chemistry, the principle is used to manipulate the outcomes of reversible reactions, often to increase the yield of reactions.

SAFETY:

- Goggle and Aprons must be worn during all experimentations.
- The HCl in this experiment is very corrosive. Handle with caution. The vapors are irritating.
- The $AgNO_3$ used in this experiment can stain skin and clothing.
- Acetone is flammable. There should be no open flames during this experiment.

MATERIALS:

Test Tubes and Rack	.2 M $CoCl_2$	Concentrated HCl
Stirring Rod	.1 M $AgNO_3$	Acetone
Hot Water Bath	Cold Water Bath	

PROCEDURE:

1. Divide equilibrium solution of $CoCl_2$ into six test tubes.
2. Apply the various stresses to the system and note the changes.
   a. Adding HCl, as a source of Cl- ions (common ion effect)
   b. Adding H2O
   c. Adding silver nitrate, AgNO3. Silver ions react with chloride ions to form an insoluble precipitate
   d. Adding acetone, acetone is often used by chemistry to remove water.
   e. Adding Heat
   f. Removing Heat

DATA AND OBSERVATIONS:

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

PINK BLUE

$$Co(H_2O)_6^{2+}{}_{(aq)} + 4\,Cl^-{}_{(aq)} \leftrightarrow CoCl_4^{2+}{}_{(aq)} + 6\,H_2O_{(l)}$$

TEST TUBE #	PROCEDURE	PREDICTIONS	OBSERVATIONS
1	Adding Hydrochloric Acid		
2	Adding Water		
3	Adding Silver Nitrate		
4	Adding Acetone		
5	Adding Heat		
6	Removing Heat		

QUESTIONS:

1. Hydrochloric acid is used as a source of chloride ions. Explain the observations in terms of Le Chatelier's principle.

2. Why did the addition of water cause the changes it did? Explain the observations in terms of Le Chatelier's principle.

3. Silver ions from the AgNO3 react with the 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 water. Use this fact and Le Chatelier's principle to explain the observations resulting from the addition of acetone.

5. Adding heat affected the equilibrium position. Use this fact and Le Chatelier's principle to explain the observations from the addition of heat.

6. Adding heat affected the equilibrium position. Use this fact and Le Chatelier's principle to explain the observation from the addition of heat.