Chemistry 12

Lab: Factors that Affect Reaction Rates

Name:

Block:

Introduction:

For a given set of conditions, every chemical reaction occurs at a characteristic rate. The rate of a reaction is always expressed as the change in some measured quantity of the reactant (or product) used up (or produce) per unit of time. Some quantities suitable for such studies may be mass, concentration, or colour. The rate of a chemical reaction is determined by a number of factors. Some reactions will take place very slowly under almost any conditions, while others are always extremely rapid. For most reactions, the rates can be affected by changing the conditions under which the reaction takes place.

Objectives

1. To observe and record the effect of reactant concentration on the rate of a reaction.

2. To observe and record the effect of reactant temperature on the rate of a reaction.

3. To observe and record the effect of reactant surface area on the rate of a reaction.

4. To observe and record the effect of the presence of a catalyst on the rate of a reaction.

Procedure:

Part I: Effect of Concentration on Reaction Rate

1. Put on safety goggles.
2. Record the given mass of the 100cm of the ribbon in the data table.
3. Obtain 3 pieces of magnesium that have been cut into 1.0 cm pieces.
4. **Label** 3 test tubes with the appropriate concentration of HCl (1.0M, 3.0M and 6.0M).
5. Using a dropper pipette and a graduated cylinder, measure 10.0mL of each of the concentration of acid and place in the appropriate test tube. (Don't pipette directly out of the HCl containers!)
6. Place a 1.0cm piece of magnesium in each test tube containing the acid.
7. Record reaction time.
8. All solutions may be carefully poured down the sink and any left over magnesium may be thrown away.
9. Wash your hands with soap and water.
10. High five your partner with your clean hands.

Part II: Effect of Temperature on Reaction Rate

1. Put on safety goggles.
2. Obtain four beakers and make four water baths of **approximately** 100^{o}C, 50^{o}C, 20^{o}C and 0^{o}C. Use boiling water directly from a kettle or a hotplate for the first one and a mixture of boiling and room temperature in the second beaker. For the third beaker, use room temperature and for the fourth, add ice to room temperature water.
3. Obtain four test tubes.
4. Using a dropper pipette and a graduated cylinder, place 10.0mL of 1.0M HCl into each of the four test tubes. (Don't pipette directly out of the HCl containers!)
5. Place one test tube in each beaker and wait a couple of minutes to allow the acid to reach the temperature of the water in each beaker.
6. Place a 1.0cm piece of magnesium in the acid and record reaction time.
7. All solutions may be carefully poured down the sink and any left over magnesium may be thrown away.
8. Wash your hands with soap and water.
9. High five your partner with your clean hands.

Part III: Effect of Surface Area on Reaction Rate

1. Put on safety goggles.
2. Using a weigh boat, determine the exact mass of a $CaCO_3$ chip and transfer it to a clean Erlenmeyer flask.
3. Add approximately 15mL of 3.0M HCl to the flask (don't pipette directly out of the HCl containers!) and record the time it takes for the reaction mixture to stop bubbling and/or the marble chip has dissolved. If there is still a portion of the chip left after 5 minutes, stop the reaction by pouring off the acid into the skink, rinsing the marble chip with water and setting it aside to dry on a paper towel. Weight the chip.
4. Using a weigh boat, obtain about 0.75g-1.00g of powdered $CaCO_3$. Record the exact mass and transfer it to an Erlenmeyer flask.
5. Add approximately 15mL of 3.0M HCl to the flask (don't pipette directly out of the HCl containers!) and record the time it takes for the reaction mixture to stop bubbling.
6. The reaction mixture may be poured down the sink with plenty of water.
7. Wash your hands with soap and water.
8. High five your partner with your clean hands.

Part IV: Effect of a Catalyst on Reaction Rate

1. Put on safety goggles.
2. Obtain two test tubes and **label** one as "catalyst" and the other as "no catalyst".
3. Using a graduated cylinder, add 3mL of 0.1M $Na_2C_2O_4$ and 1mL of 3M H_2SO_4 to both test tubes. (Sodium oxalate, $Na_2C_2O_4$, is poisonous. Do not get any in your mouth.)
4. To the test tube labeled "catalyst" add 3 drops of 0.1M $MnSO_4$.
5. Then to both tubes, add 5 drops of 0.02M $KMnO_4$.
   (Potassium permanganate $KMnO_4$ is a strong irritant and will stain skin and clothing. Wash any spills and splashes with plenty of water.)
6. Measure the time taken to reach a colourless solution in each case. (You can swirl both test tubes to ensure the solution is being mixed.)
7. The reaction mixtures may be poured down the sink with plenty of water.
8. Wash your hands with soap and water.
9. High five your partner with your clean hands.