Factors That Affect the Rate of a Chemical Reaction Lab

I. Effect of Temperature on Reaction Rate

Hypothesis: The rate of a chemical reaction can be affected by a number of factors.

Objective: To determine the effect of temperature on reaction rate.

Materials and Equipment: 6 M hydrochloric acid, zinc metal, 10 mL graduated cylinder, 250 mL beaker, medium test tubes, test tube rack, thermometer, wood splints, and hot water bath.

Procedure: You will use the reaction of zinc metal with hydrochloric acid to study the effect of temperature on reaction rate. Pour 5 mL of 6 M hydrochloric acid, measured with a 10 mL graduated cylinder, into each of three clean test tubes. Place one of the tubes in a 250 mL beaker containing an ice-water mixture, place another in a water bath at 50°C, and place the third in a test tube rack at room temperature. Allow about 5 minutes for the tubes to reach the temperature of their surroundings. Get three clean, 1 cm X 1 cm pieces of zinc metal. Record the time as you drop a piece of zinc into each of the three test tubes, and record the time when each reaction ceases – when bubbling stops or no zinc remains. Hydrogen gas is a product of the reaction. Hydrogen can be detected by bringing a burning wood splint to the mouth of the test tube. A popping sound indicates the presence of hydrogen. Record your observations in the data table.

II. Effect of a Catalyst on Reaction Rate

Hypothesis: The rate of a chemical reaction can be affected by a number of factors.

Objective: To determine the effect of a catalyst on reaction rate.

Materials and Equipment: 6 M hydrochloric acid, 0.1 M iron (III) chloride, 0.1 M sodium chloride, 0.1 M iron (III) nitrate, 0.1 M calcium chloride, 0.1 M potassium nitrate, 0.1 M manganese chloride, 3% hydrogen peroxide solution, high purity water, 100 mL graduated cylinder, 250 mL polyethylene bottle, 10 mL graduated cylinder, and medium test tubes.

Procedure: The rate of decomposition of hydrogen peroxide into water and oxygen will be used to study the effect of catalysts on a chemical reaction. The reaction is followed by noting the rate at which oxygen gas is evolved.

Measure 90 mL of high-purity water into a clean 100 mL graduated cylinder, and add 10 mL of 3% hydrogen peroxide solution. Pour this solution into a clean 250 mL bottle, and label it 0.3% H_2O_2. This is your test solution.

Clean seven test tubes and a 10 mL graduated cylinder, and rinse each with a 2 mL portion of 0.3% hydrogen peroxide. Discard the rinse solutions. Use the graduated cylinder to measure 5 mL of 0.3% H_2O_2 into each of the test tubes, and place the tubes in a rack. Test solutions of compounds listed in the data table for catalytic activity by adding 5 drops of each solution to separate tubes containing 0.3% H_2O_2. Gently shake each tube to mix its contents.

Observe each solution carefully for several minutes. Use the terms fast, slow, very slow, or none to describe the rate of oxygen evolution and the words high, low or none to describe the catalytic activity. Report the rate of oxygen gas evolution and the catalytic activity for each solution in the data table.

All the substances tested for catalytic activity are ionic, and each produces an anion and a cation in solution. On the basis of your results, classify the individual ions according to their catalytic activity, and complete the data table by entering the name and symbol for each ion in the appropriate category.

III. Effect of Concentration on Reaction Rate

Hypothesis: The rate of a chemical reaction can be affected by a number of factors.

Objective: To determine the effect of reactant concentration on reaction rate.

Materials and Equipment: 0.1 M hydrochloric acid, 1 M hydrochloric acid, 6 M hydrochloric acid, concentrated hydrochloric acid, zinc metal, 10 mL graduated cylinder and medium test tubes.

Procedure: The reaction of zinc metal with hydrochloric acid solutions will be used to study the effect of concentration on a reaction rate. Using a clean 10 mL graduated cylinder, pour 5 mL of each of the following hydrochloric acid solutions into separate clean test tubes: 0.1 M HCl, 1 M HCl, 6 M HCl, and concentrated HCl. Clean four small, 1 cm X 1 cm, pieces of zinc metal. Record the time, and drop a piece of zinc into each of the acid solutions. Record the time each reaction ceases, and report your observations in the data table.

IV. Effect of Particle Size or Surface Area

Hypothesis: The rate of a chemical reaction can be affected by a number of factors.

Objective: To determine the effect of particle size and surface area on reaction rate.

Materials and Equipment: 1 M HCl, zinc metal, powdered zinc, medium test tubes and laboratory balance.

Procedure: The reaction of zinc metal with hydrochloric acid will be used to study the effect of particle size and surface area on the rate of a reaction. Get a 1 cm X 1 cm piece of zinc metal and determine its mass to the nearest 0.01 g. Place the metal in a clean, dry test tube. Measure an equal mass of powdered zinc into another clean, dry test tube. **Caution: Finely divided metals are flammable**. Put both tubes in a test tube rack, and add 5 mL of 1 M hydrochloric acid to each. Observe the reactions for several minutes and record your observations in the data table.

Effect of Temperature Laboratory Report

Reaction Conditions	**Reaction Start Time**	**Reaction Cease Time**	**Reaction Duration (min)**	**Test for Hydrogen**
Ice water, 0°C				
Room Temperature				
Hot water, 50°C				

Effect of a Catalyst Laboratory Report

Test	**HCl 6 M**	**$FeCl_3$ 0.1 M**	**NaCl 0.1 M**	**$Fe(NO_3)_3$ 0.1 M**	**$CaCl_2$ 0.1 M**	**KNO_3 0.1 M**	**$MnCl_2$ 0.1 M**
Oxygen Evolution							
Catalytic Activity							

Catalytic Activity	**Name**	**Ion Symbol**
High _____	_____	_____
Low _____	_____	_____
None _____	_____	_____

Effect of Concentration Laboratory Report

Reaction Concentration	**Reaction Start Time**	**Reaction Cease Time**	**Reaction Duration**	**Observation**
0.1 M HCl				
1 M HCl				
6 M HCl				
Conc. HCl				

Effect of Particle Size or Surface Area Laboratory Report

Substance Tested	**Observations**
Sheet Zinc	_____
Powdered Zinc	_____