

## Chemical Kinetics

# Factors Affecting Reaction Rate Teaching Notes

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### GENERAL COMMENTS

There are many quick experiments that can be done to demonstrate the effect of various factors on reaction rate. Any of the four quick experiments in this lab could be replaced with an alternative, which can be found in almost any lab manual that accompanies a student textbook. Alternatively, students could be asked to come up with their own experiments.

The purpose of the lab is for the student to see qualitatively how reaction rates can be altered; no graphing or calculations are involved.

### PURPOSE

- To examine factors that increase reaction rate

### SAFETY

- Portions of this lab may only be carried out under the supervision of a teacher
- Safety goggles must be worn when working with acids.

### EQUIPMENT AND MATERIALS

#### Part 1. Effect of Particle Size

- solid zinc, approx. 0.5 cm × 2 cm, or solid marble chips
- zinc powder or calcium carbonate powder
- balance
- 2 test tubes
- 1M HCl (approx 10 mL per group)

#### Part 2. Effect of Temperature

- 3 Alka Seltzer tablets
- 3 250-mL beakers
- water at three temperatures – with ice, room temperature, warm (around 70°C)

#### Part 3. Effect of Concentration

- 1M HCl, 5 mL per group
- 3M HCl, 5 mL per group
- 6M HCl, 5 mL per group
- 3 pieces of zinc metal, each approx 1 cm × 1 cm
- 3 test tubes

#### Part 4. Effect of a Catalyst

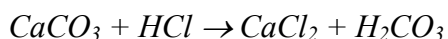
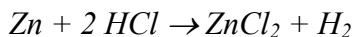
- 3% hydrogen peroxide, H<sub>2</sub>O<sub>2</sub> – 10 mL per group
- 0.1 M iron(III) nitrate, Fe(NO<sub>3</sub>)<sub>3</sub>
- 0.1 M sodium chloride, NaCl
- 0.1 M calcium chloride, CaCl<sub>2</sub>
- 0.1 M potassium nitrate, KNO<sub>3</sub>
- 0.1 M manganese chloride, MnCl<sub>2</sub>
- 100-mL graduated cylinder
- 10-mL graduated cylinder
- 7 test tubes per group

## PROCEDURES

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### Part 1. Effect of Particle Size on Reaction Rate

*Powdered calcium carbonate and marble chips may be used instead of zinc*

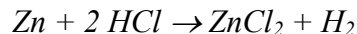


1. Obtain a piece of solid zinc metal, approximately 0.5 cm × 2 cm. Find the mass of this sample, and place it in a test tube.
2. Using the balance obtain a sample of powdered zinc that is close to the mass of your piece of solid zinc. Place this sample in the second test tube. *Caution: powdered zinc is flammable.*
3. Place both test tubes in a test tube rack. Add 5 mL of 1M HCl to both test tubes. Be sure to wear your safety goggles.
4. Observe both test tubes and record your observations and record your observations in the data table.

### Part 2. Effect of Temperature

1. Half fill three 250-mL beaker with water. In one beaker add several ice cubes. A second beaker will contain water at room temperature. In the third beaker add water that has been heated to about 70°C.
2. Record the water temperature in the three beakers, then add an Alka Seltzer tablet to each.
3. Record the time it takes for the Alka Seltzer tablet to completely dissolve.

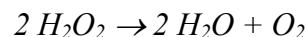
### Part 3. Effect of Concentration



1. Pour 5 mL of each of the three HCl solutions into separate test tubes. Place the test tubes in a test tube rack.
2. Add one piece of zinc to each test tube.
3. Record the time you added the zinc to the tubes, and the time each reaction stops. Also record your observations for each tube.

### Part 4. Effect of a Catalyst

*In this part of the lab you will determine which substance/substances act as a catalyst for the decomposition of hydrogen peroxide.*



1. Dilute the hydrogen peroxide by adding 10 mL of 3% H<sub>2</sub>O<sub>2</sub> to a 100-mL graduated cylinder. Add 90 mL of distilled water to obtain 100 mL of diluted (0.3%) hydrogen peroxide.
2. Use a small amount of this solution to rinse out a 10-mL graduated cylinder and 7 test tubes. Pour the rinses away.
3. Place 5-mL of the 0.3% H<sub>2</sub>O<sub>2</sub> solution into each of the 7 test tubes.
4. Add 5 drops of each of the following solutions to separate test tubes:

0.1 M FeCl<sub>3</sub>

0.1 M NaCl

0.1 M Fe(NO<sub>3</sub>)<sub>3</sub>

0.1 M CaCl<sub>2</sub>

0.1 M KNO<sub>3</sub>

0.1 M MnCl<sub>2</sub>

- Mix each tube by swirling the test tube or gently stirring with a clean stirring rod.
- Observe each solution, noting the production of any gas bubbles that form. Record each reaction rate as **fast**, **slow**, **very slow**, or **none** in your data table.

## RESULTS

Record your results for each part of the lab in the data tables provided on the following page.

## CONCLUSIONS

For each part of this lab present your results and conclusions in formal lab report format. A paragraph will be sufficient for each of the four parts to this lab.

In clearly worded and complete sentences describe what reactions were carried out and present your observations findings. When possible include the chemical equation involved. Refer the reader to the appropriate data table (for example – “See Table 1.”). Use the collision theory to explain your findings.

## RESULTS

**Table 1. Effect of Particle Size on Reaction Rate**

Substance Tested	Observations
powdered zinc or calcium carbonate	
solid zinc or marble chips	

**Table 2. Effect of Temperature**

Water Condition	Water Temperature (°C)	Time to Completion
cold		
room temperature		
warm		

**Table 3. Effect of Concentration**

Acid Concentration	Start Time	Time at Completion	Observations
1 M HCl			
3 M HCl			
6 M HCl			

**Table 4. Effect of a Catalyst**

	Possible Catalysts					
	FeCl <sub>3</sub>	NaCl	Fe(NO <sub>3</sub> ) <sub>3</sub>	CaCl <sub>2</sub>	KNO <sub>3</sub>	MnCl <sub>2</sub>
Reaction Rate						