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8:31 Reaction Rate Lab

Abstract: Scientists are continually concerned with the speed at which chemical reactions take place. Manufacturers of foods, drugs, and products are always looking for ways to speed up reactions in an effort to get products to market faster. Medical researchers are trying to find ways to control chemical reactions in humans. The rate of a reaction is how fast reactants are consumed and products are formed. If one can control the rate of the reaction and one can control an entire group of critical processes.
*Adapted from "Reaction Rates Factors I" by Jan Goaziou, Kemtec Science, Inc. West Chester Ohio 1-513-860-4949. Also adapted from J. Chem. Ed., Vol.79, No 1, pg 41, Stephen W. Wright.

Purpose:
Identify the factors that affect the rates of chemical reactions.

Materials (for every two or three students):

- aspirin
- 0.1 M sodium hydroxide solution
- phenolphthalien (1% solution)
- stirring rod
- graduated cylinder
- clock
- goggles
- mortar and pestle
- alka seltzer
- hydrochloric acid (0.1m)
- universal indicator solution
- test tube
- hot water bath
- ice bath
- "solutions a and b"
  - 0.01 M copper sulfate
- 100 and 250 ml beakers
- pipettes

Safety:

- Sodium hydroxide is an irritant, a poison, and a caustic liquid which may burn the skin, hand, and eyes. Avoid contact with eyes, skin, mouth, and hands.
- Phenolphthalein is an irritant, a poison, and a flammable liquid. Avoid contact with eyes, mouth, hands, skin, heat or an open flame.
- Hydrochloric acid is an irritant, a poison, and a corrosive liquid which may burn the skin, hands, and eyes. Avoid contact with eyes, skin, mouth, and hands.
- Universal indicator solution is an irritant, a poison, and a flammable liquid. Avoid contact with eyes, mouth, skin, hands, or an open flame.

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Procedure:

Part I
1.Wear goggles.
2. Measure out 10 ml of water in a beaker. Add 20 drops of sodium hydroxide solution to the water.
3. Add two drops of phenolphthalein to the dilute sodium hydroxide solution in the beaker. Notice the color of the solution.
4. Obtain a whole aspirin tablet. Drop this whole aspirin tablet into the dilute sodium hydroxide solution in the beaker. Time this reaction. Start timing the reaction as soon as you drop the tablet into the sodium hydroxide. Stop timing when the solution stays clear. Record the time in the data chart under reaction time.
5. Stir the reaction continuously.
6. Discard the chemicals when the reaction is complete.
7. Wash and dry the glassware.
8. Repeat these steps with a crushed aspirin tablet.

Data Chart

Reaction time of Sodium Hydroxide and whole aspirin tablet	
Reaction time of Sodium Hydroxide and crushed aspirin tablet.	

Part II
1. Measure out 3 ml of water. Pour this into a test tube. Add three drops of hydrochloric acid solution to the test tube containing the water.
2. Add 2 drops of universal indicator solution to the dilute hydrochloric acid solution. Notice the color of the solution. The liquid in the test tube should now be pink.
3. Obtain a fourth of an Alka Seltzer tablet.
4. Drop this into the dilute hydrochloric acid solution in the test tube. Time the reaction. Start timing when the tablet is dropped into the tube. Stir continuously. Stop timing when the solution turns green. Record your time in the data chart for the room temperature reaction.
5. Discard the chemicals.
6. Clean and wash the glassware.
7. Repeat the steps with a dilute acid solution that has been sitting in a hot water bath for 10 minutes.
8. Repeat the steps with a dilute acid solution that has been sitting in an ice bath for 10 minutes.

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Reaction	Reaction Time
Hydrochloric Acid (room temperature) and 1/4 alka seltzer	
Hydrochloric Acid (hot) and 1/4 alka seltzer	
Hydrochloric Acid (cold) and 1/4 alka seltzer	

Part III

1. Label two clean beakers "Solution A" and "Solution B".
2. Check with your instructor and obtain 40 ml of Solution A and 40 ml of Solution B.
3. Pour the solutions simultaneously in a third beaker. Begin timing as soon as the solutions are poured together. Mix continuously. Stop timing when a color change occurs. Record the time in the data table.
4. Repeat the experiments again. This time add 30 ml of distilled water to "Solution A" and 30 ml of distilled water to "Solution B" before the two solutions are added together. Record the time in the data table.
5. Repeat the experiments again. This time add 90 ml of water to "Solution A" and 90 ml of water to "Solution B" before adding the two mixtures. Record the time in the data table.
6. Repeat the last experiment again. Add 90 ml of water to "Solution A" and 90 ml of water to "Solution B". Also add a few drops of 0.01 M copper sulfate to "Solution B" before mixing the "Solution A" and "Solution B" together. Record the data in the data table.

Data Table Part III

40 ml of A and 48 ml of B	Time:
40 ml of A + 30 ml of water 40 ml of B + 30 ml of water	Time:
40 ml of A + 90 ml of water 40 ml of B + 90 ml of water	Time:
40 ml of A + 90 ml of water 40 ml of B + 90 ml of water	Time:

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Conclusion Questions:

1. Examine the data in Part I. Which reaction went faster? Which aspirin tablet has more surface area?

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2. Explain on a molecular level the effect of surface area on the rate of a reaction.

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3. Examine the data in Part II. What effect does temperature generally have on the rates of reactions?

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_____

4. Explain on a molecular level the effect of temperature on the rate of a reaction.

_____

_____

5. Examine the data in Part III. Which reaction was the most dilute?

_____

_____

6. What is the effect of concentration on the rate of a reaction?

_____

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7. Explain the effect of concentration on rates of reactions on a molecular level.

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8. Catalysts are substances that speed up chemical reactions but are not themselves changed in the process. Did copper sulfate, according to the data, speed up the reaction? If it was a catalyst, how could you prove it is still present?

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9. What could be done to make a reaction go as fast as possible?

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