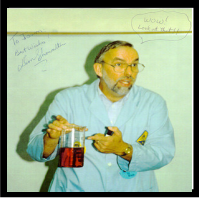


CHEMISTRY LAB

Reaction Rates

Sulfur Clock

MATERIALS

Four 25-mL Erlenmeyer flasks

0.161 M sodium thiosulfate solution ("hypo"), $Na_2S_2O_3 \cdot 5H_2O$

1.00 M HCl (aq) solution

distilled water

white paper with marked locations

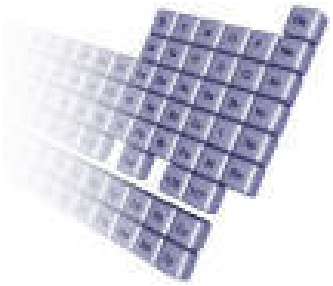
50-mL graduated cylinder for $Na_2S_2O_3 \cdot 5H_2O$

50-mL graduated cylinder for distilled water

10-mL graduated cylinder for HCl solution

marking pencil

SAFETY GOGGLES



PROCEDURE

The thiosulfate ion $S_2O_3^{-2}{}_{(aq)}$ decomposes in the presence of acid, $H^+_{(aq)}$, in the following manner:

$$S_2O_3^{-2}{}_{(aq)} + 2H^+_{(aq)} \Leftrightarrow \mathbf{S_{(s)}} + H_2SO_{3(aq)}$$

When sulfur is produced, it makes the solution opaque, and it is no longer possible to see through it. You will use this fact to determine reaction time, which is defined in this experiment to be the time it takes to no longer see a mark on a piece of paper under the flask. If you start timing the reaction as soon as the hydrogen ion is added, very good rate data can be obtained. The objective is to determine what relationship, if any, exists between the rate and the concentration of the thiosulfate ion.

READ ALL INSTRUCTIONS BEFORE PROCEEDING

SAFETY NOTE

1M hydrochloric acid **is corrosive** to skin and eyes. Wash off spills or splashes with plenty of water. Use the eyewash fountain if 1M HCl gets in your eyes.

1. Use the marking pencil to label the four flasks A, B, C, and D.

2. Take a piece of white paper and place on it whatever mark you wish to utilize during the experiment. It is important to use the same mark for all four runs.

3. Into flask A, put 5 mL of the thiosulfate solution and 15 mL of distilled water. Place the flask on the paper over the mark.

4. Into flask B, put 10 mL of the thiosulfate solution and 10 mL of distilled water.

5. Into flask C, put 15 mL of the thiosulfate solution and 5 mL of distilled water.

5 mL of distilled water.

6. Into flask D, put 20 mL of the thiosulfate solution and no distilled water.

7. Return to flask A and swirl the contents to make certain they are thoroughly mixed to a uniform concentration. Place the flask over the mark.

8. Measure, very carefully, 5 mL of 1.0 M HCl(aq). Get ready to start timing.

9. When ready, quickly pour the acid into flask A and start timing simultaneously. Swirl the flask and peer through the solution until the mark is no longer visible. Stop timing. Record this time in seconds in the data table.

10. Repeat steps 7 through 9 for flasks B, C, and D. Record all times in the data table.

11. The products should be rinsed down the drain. Clean and rinse all four flasks and the graduated cylinders. Make sure to clean up your laboratory station.

QUESTIONS

12. Calculate the concentration of thiosulfate solution in each of the flasks using the formula

$$M_a \times V_a = M_b \times V_b$$

where M_a = 0.161 M, V_a = initial volume of thiosulfate, and V_b = 20 mL (final total volume in each flask). Solve for M_b.

13. Using the graph paper, plot time against concentration of thiosulfate in seconds. Label the y-axis “time in seconds” and the x-axis “concentration of thiosulfate in moles per liter.” Be sure to expand your graph to utilize the entire page. Do not clutter your labels.

14. How does the concentration of thiosulfate affect the rate of reaction?

15. Explain what would happen to the reaction time if the hydrochloric acid were reduced by half. Why?

16. What are the variables in this experiment? The control?