AP Chemistry 30 – Lab Activity 7: Integrated Rate Laws

Learning Objective

- Determine the rate law for a reaction using concentration-time data

Background Information

Students will determine the rate law for the reaction between hydrochloric acid and sodium thiosulfate solution. The reaction, which produces solid sulfur, will be followed by measuring the time needed for the reaction mixture to become opaque. When these results are graphed, the order of the reaction for each reactant can be determined.

To determine concentration of the sodium thiosulfate (or acid) solution after dilution, use the equation:

$$C_iV_i = C_fV_f$$

C_i and V_i are the initial concentration and volume of the sodium thiosulfate (or acid) solution, and C_fV_f are the final concentration (the unknown) and the volume of the water and sodium thiosulfate (or acid) solution mixed together.

Procedure

Time from when the solutions are mixed until the X on the bottom of the beaker disappears.

Part A

Beaker	1	2	3	4	5
0.15 M $Na_2S_2O_3$	50.0 mL	40.0 mL	30.0 mL	20.0 mL	10.0 mL
Distilled water	0 mL	10.0 mL	20.0 mL	30.0 mL	40.0 mL
Hydrochloric Acid	5.0 mL	5.0 mL	5.0 mL	5.0 mL	5.0 mL

Part B

Beaker	1	2	3	4	5
0.15 M $Na_2S_2O_3$	50.0 mL	50.0 mL	50.0 mL	50.0 mL	50.0 mL
Distilled water	0 mL	1.0 mL	2.0 mL	3.0 mL	4.0 mL
Hydrochloric Acid	5.0 mL	4.0 mL	3.0 mL	2.0 mL	1.0 mL

Results

Make a data table to record concentration (C_f) of the variable reactant and time for the reaction to occur.

Discussion

Make the following graphs.
For Part A: $[S_2O_3^{2-}]$ vs t, $\ln[S_2O_3^{2-}]$ vs t, and $1/[S_2O_3^{2-}]$ vs t
For Part B: $[H^+]$ vs t, $\ln[H^+]$ vs t, and $1/[H^+]$ vs t

Use the graphs to determine the order of the reaction with respect to each reactant, and write the overall rate law.