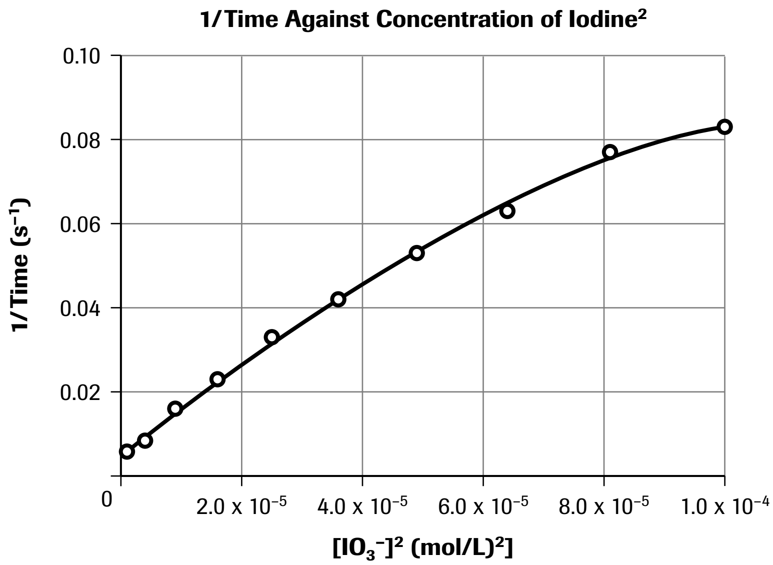

The graph of 1/time against $[IO_3^-]^2$ is more linear than the graph of 1/time against $[IO_3^-]^1$. This indicates a second-order dependence. (The theoretically expected result is first order.)

(f) According to the evidence, $r \propto [IO_3^-]^2$.

Evaluation

(g) Temperature, starch concentration, and acid concentration were also controlled.

(h) (Answers will vary.) Repetition of trials and more accurate volume measurements, perhaps with larger quantities, might improve results.

(i) (Sample answer) The prediction was validated qualitatively, as no particular prediction was made as to whether the reaction was first or second order.

Synthesis

(j) Keeping the total volume of solution A constant by adding water was necessary so that no changes would occur to the concentrations of bisulfite and acid in solution B.

LAB EXERCISE 6.4.1 THE SULFUR CLOCK

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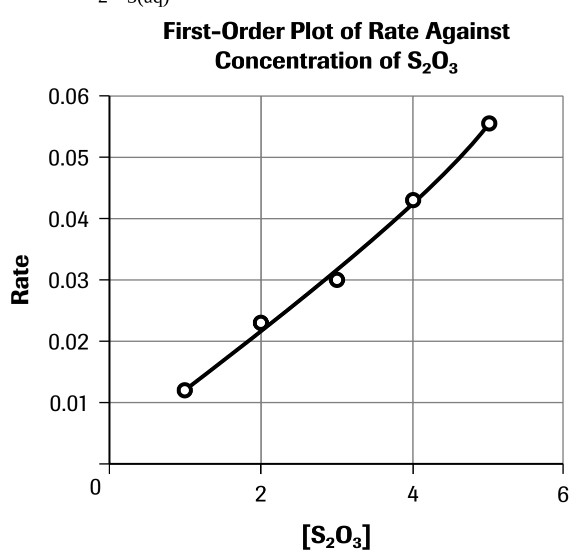
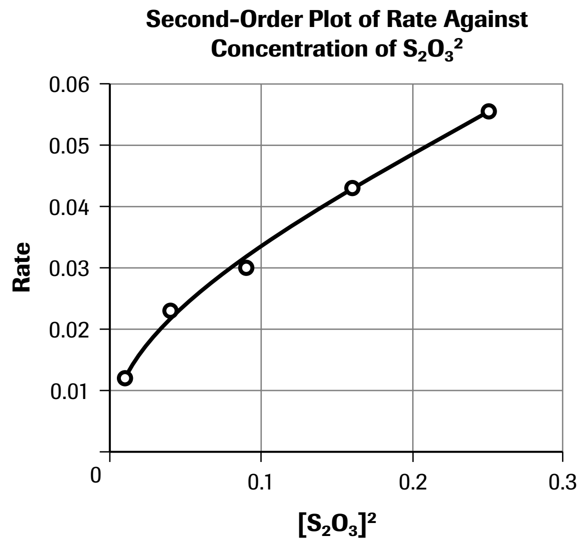
Analysis

(a) Colourless solutions on mixing gradually formed a cloudy, pale-yellow mixture which eventually became opaque. As initial $[S_2O_{3(aq)}^{-2}]$ increases, the time of reaction decreases or rate increases.

(b)





The first-order plot is most linear, so we would conclude that the reaction is first order overall.

(c) $r = k\,[S_2O^{-2}_{3(aq)}]^1$

(d) One thiosulfate ion is involved in the rate-determining step.

Evaluation

(e) The "X," which gradually disappears, must be one of the controlled variables.

(f) Time for the disappearance of the letter can be somewhat subjective.

(g) (Answers will vary.) More trials at each concentration could be done to improve accuracy. A more quantitative measure of concentration might be achieved by using a colorimeter to measure absorbency.

Synthesis

(h) Any mechanism that includes a slow step with a single thiosulfate ion will be acceptable.

$S_2O^{-2}_{3(aq)} + H^+_{(aq)} \rightarrow HSO^{-2}_{3(aq)} + S_{(s)}$ (SLOW)

$HSO^{-2}_{3(aq)} + H^+_{(aq)} \rightarrow H_2SO_{3(aq)}$ (FAST)

(i) The experiment would involve varying the acid concentration while keeping all other variables constant.

ACTIVITY 6.5.1 CATALYSTS IN INDUSTRY AND BIOCHEMICAL SYSTEMS

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(a), (b), and (c) (Answers will vary depending on the catalyst or enzyme chosen. If the student chooses an industrial catalyst such as vanadium(V) oxide, the focus will be on the particular industrial reaction (e.g., sulfuric acid production); the step in the process that it catalyzes (the production of sulfur trioxide); and the economic implications (sulfuric acid production is an indicator of a country's economic strength). If the student chooses an enzyme (e.g., cytochromases, necessary for respiration), the focus will be on physiological implications (e.g., cyanide is poisonous because it blocks the active sites of these enzymes and asphyxiates the cell). The students may pick enzymes that have direct effects on their own family (e.g., lactase).)