INVESTIGATION 6.3.1 THE IODINE CLOCK REACTION

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Prediction

(a) As concentration increases, time decreases as rate increases.

Experimental Design

(b) Initial iodate concentrations will be 0.002, 0.004, 0.006, 0.008, 0.010, 0.012, 0.014, 0.016, and 0.018 mol/L, based on dilution.

Evidence

Analysis

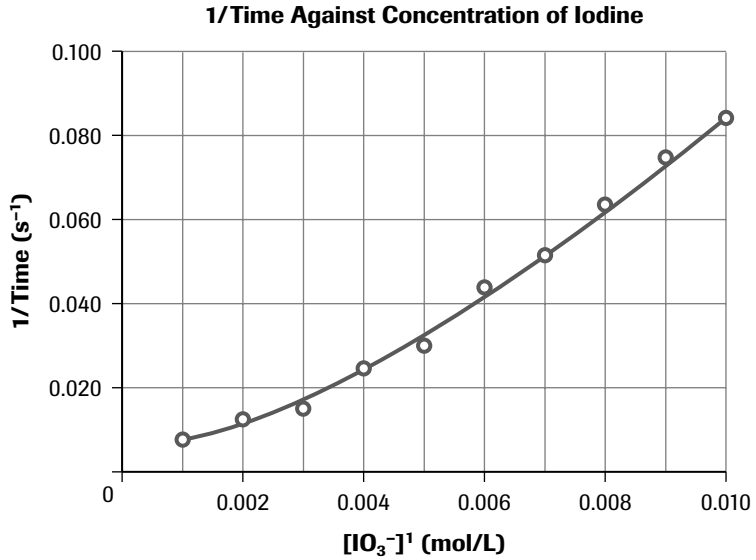
(c) After Step 3, the initial iodate concentrations will be 0.001, 0.002, 0.003, 0.004, 0.005, 0.006, 0.007, 0.008, and 0.009 mol/L, based on dilution.

(d) Two clear colourless solutions remained so on mixing until a sudden colour change to clear blue occurred.

(e) Note: At step 3, the concentration of iodate ions in each well is halved.

Table of Data for Establishing Order of Iodine Reaction

Trial	Initial $[IO_3^-]$ (mol/L)	Time to reaction (s)	1/Time (s^{-1})	Initial $[IO_3^-]^2$ $(mol/L)^2$
1	0.0010	172	5.8×10^{-3}	1.0×10^{-6}
2	0.0020	119	8.4×10^{-3}	4.0×10^{-6}
3	0.0030	64	1.6×10^{-2}	9.0×10^{-6}
4	0.0040	43	2.3×10^{-2}	1.6×10^{-5}
5	0.0050	30	3.3×10^{-2}	2.5×10^{-5}
6	0.0060	24	4.2×10^{-2}	3.6×10^{-5}
7	0.0070	19	5.3×10^{-2}	4.9×10^{-5}
8	0.0080	16	6.3×10^{-2}	6.4×10^{-5}
9	0.0090	13	7.7×10^{-2}	8.1×10^{-5}
10	0.0010	12	8.3×10^{-2}	1.0×10^{-4}



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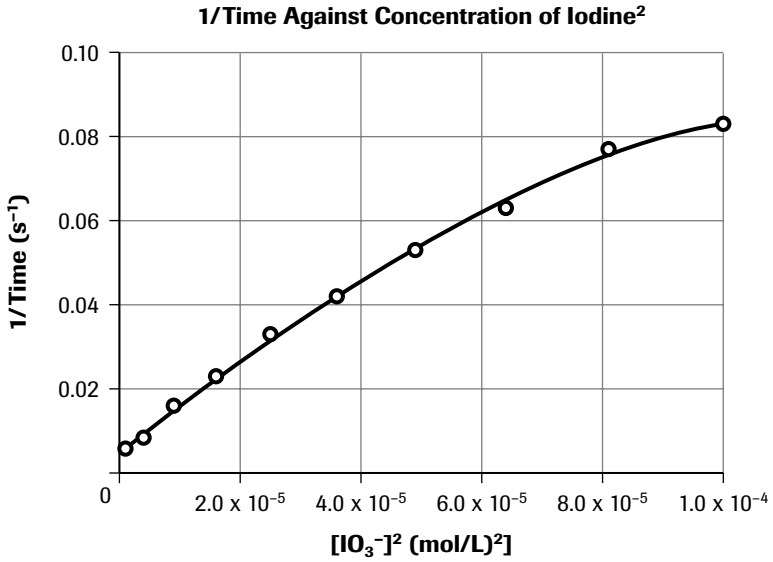

The graph of 1/time against $[IO_3^-]^2$ is more linear than the graph of 1/time against $[IO_3^-]^1$. This indicates a second-order dependence. (The theoretically expected result is first order.)

(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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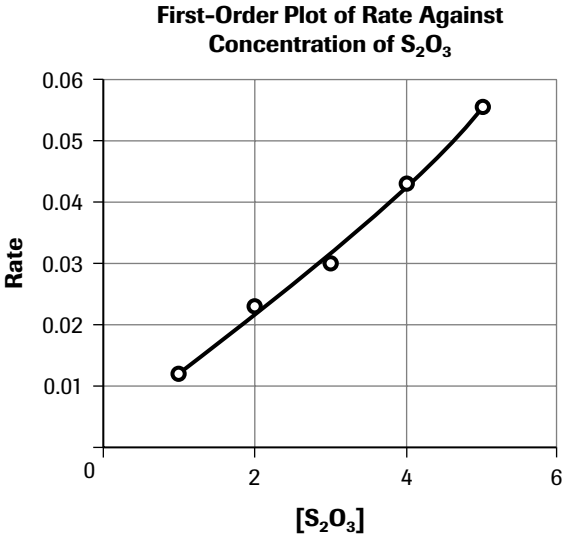
Analysis

(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)



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