Tutorial 1: Chemical Kinetics Answers

 Consider the following concentration-time data for the reaction of iodide ion and hypochlorite ion (OCI). The products are chloride ion and hypoiodite ion (OI).

Experiment	Time (s)	100	[OCF]	[OH]
1	0	2.40 × 10 4	1.60 × 10 ⁻⁴	1.00
	10	2.16 × 10 ⁻⁴	1.36 × 10 ⁻⁴	1.00
2	0	1.20×10^{-4}	1.60 × 10-4	1.00
	10	1.08 × 10 ⁻⁴	1.48 × 10 ⁻⁴	1.00
3	0	2.40 × 10 ⁻⁴	4.00 × 10°	1.00
	10	2.34 × 10 ⁻⁴	3.40×10^{-5}	1.00
4	0	1.20 × 10 ⁻⁴	1.60 × 10 4	2.00
	10	1.14 × 10 ⁻⁴	1.54 × 10 ⁻⁴	2.00

- (a) Write a balanced equation for the reaction.
- (b) Determine the rate law, and calculate the value of the rate constant.
- (c) Does the reaction occur by a single-step mechanism? Explain.
- (d) Propose a mechanism that is consistent with the rate law, and express the rate constant in terms of the rate constants for elementary steps in your mechanism. (Hint: Transfer of an H⁺ ion between H₂O and OCI is a rapid reversible reaction.)

a)
$$I^-(aq) + OCl^-(aq) \rightarrow Cl^-(aq) + OI^-(aq)$$

b) assume that rate = $\frac{-\Delta[l^-]}{\Delta t}$ = $k[OCl^-]^a[I^-]^b[OH^-]^c$ compare experiments 1 and 3:

$$\frac{2.4 \cdot 10^{-4} - 2.17 \cdot 10^{-4}}{2.4 \cdot 10^{-4} - 2.34 \cdot 10^{-4}} = \left(\frac{1.6 \cdot 10^{-4}}{4 \cdot 10^{-5}}\right)^{\alpha}$$

$$\frac{4^{\alpha} \approx 4}{3 \cdot 3 = 1}$$

compare experiments 1 and 2:

$$\frac{2.4 \cdot 10^{-4} - 2.17 \cdot 10^{-4}}{1.2 \cdot 10^{-4} - 1.08 \cdot 10^{-4}} = \left(\frac{2.4}{1.2}\right)^{b}$$

$$\frac{2^{b} \approx 2}{2^{b} \approx 1}$$

compare experiments 1 and 4:

$$\frac{2.4 * 10^{-4} - 2.17 * 10^{-4}}{1.2 * 10^{-4} - 1.14 * 10^{-4}} = 2 \left(\frac{1}{2}\right)^{e}$$

$$2 \left(\frac{1}{2}\right)^{e} \approx 4$$

$$\therefore c = -1$$

$$rate = \frac{-\Delta[I^-]}{\Delta t} = k \frac{[OCI^-][I^-]}{[OH^-]}$$

$$\frac{1.2 * 10^{-4} - 1.08 * 10^{-4}}{10} = k \frac{1.2 * 10^{-4} (1.6 * 10^{-4})}{1}$$

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Guillaume Favre

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