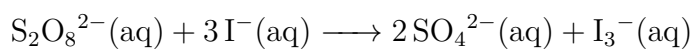


1. Determine the reaction order for the decomposition of N_2O_5 and calculate the time t .

Second order based on the units of k

$[\text{N}_2\text{O}_5]_0$ (M)	$[\text{N}_2\text{O}_5]_t$ (M)	k ($\frac{1}{\text{M}\cdot\text{s}}$)	$\frac{1}{[\text{N}_2\text{O}_5]_t} - \frac{1}{[\text{N}_2\text{O}_5]_0} = kt$
0.80	0.22	0.011	$\frac{1}{0.220 \text{ M}} - \frac{1}{0.800 \text{ M}} = (0.011 \frac{1}{\text{M}\cdot\text{s}}) t$
			$3.295 \frac{1}{\text{M}} = (0.011 \frac{1}{\text{M}\cdot\text{s}}) t$
			$t = \frac{3.295 \frac{1}{\text{M}}}{0.011 \frac{1}{\text{M}\cdot\text{s}}}$
			$t = 299.5 \text{ s}$

2. Determine the rate law for this reaction. Round orders to the nearest integer.



$[\text{S}_2\text{O}_8^{2-}]_0$ (M)	$[\text{I}^-]_0$ (M)	v_0 ($\frac{\text{M}}{\text{s}}$)
0.27	0.38	2.05
0.40	0.38	3.06
0.10	0.22	0.44

$$v(t) = k[\text{S}_2\text{O}_8^{2-}]^m[\text{I}^-]^n$$

Compare 1 and 2, only $[\text{S}_2\text{O}_8^{2-}]$ changes Compare 2 and 3

$$\frac{v_2}{v_1} = \left(\frac{[\text{S}_2\text{O}_8^{2-}]_2}{[\text{S}_2\text{O}_8^{2-}]_1} \right)^m$$

$$\frac{3.06 \frac{\text{M}}{\text{s}}}{2.05 \frac{\text{M}}{\text{s}}} = \left(\frac{0.40 \text{ M}}{0.27 \text{ M}} \right)^m$$

$$1.492 = (1.481)^m$$

$$m = \frac{\ln(1.492)}{\ln(1.481)} \approx 1$$

$$\frac{v_3}{v_2} = \left(\frac{[\text{S}_2\text{O}_8^{2-}]_3}{[\text{S}_2\text{O}_8^{2-}]_2} \right)^m \left(\frac{[\text{I}^-]_3}{[\text{I}^-]_2} \right)^n$$

$$\frac{0.44 \frac{\text{M}}{\text{s}}}{3.06 \frac{\text{M}}{\text{s}}} = \left(\frac{0.10 \text{ M}}{0.40 \text{ M}} \right)^m \left(\frac{0.22 \text{ M}}{0.38 \text{ M}} \right)^n$$

$$0.144 = (0.250)(0.579)^n$$

$$n = \frac{\ln(0.576)}{\ln(0.579)} \approx 1$$

$$v = k[\text{S}_2\text{O}_8^{2-}][\text{I}^-]$$

$$k = \frac{2.05 \frac{\text{M}}{\text{s}}}{(0.27 \text{ M})(0.38 \text{ M})} = 20 \frac{1}{\text{M}\cdot\text{s}}$$

$$v = (20 \frac{1}{\text{M}\cdot\text{s}})[\text{S}_2\text{O}_8^{2-}][\text{I}^-]$$

3. A first-order reaction has 24.0% of its reactant consumed in 19.7 min. Find the rate constant for this reaction, and determine how long will the reaction take to reach 85.5% consumed?

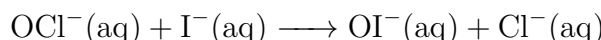
$$\ln\left(\frac{[A]_0}{[A]_t}\right) = kt \qquad \ln\left(\frac{[A]_0}{[A]_t}\right) = kt$$

$$24.0\% \text{ consumed} \implies [A]_t = 0.760[A]_0 \qquad 85.5\% \text{ consumed} \implies [A]_t = 0.145[A]_0$$

$$k = \frac{1}{19.7 \text{ min}} \ln\left(\frac{1}{0.760}\right) \qquad t = \frac{1}{0.0139 \frac{1}{\text{min}}} \ln\left(\frac{1}{0.145}\right)$$

$$k = 0.0139 \frac{1}{\text{min}} \qquad t = 139 \text{ min}$$

4. Determine the rate law for this base catalyzed reaction. Round orders to the nearest integer.



$[\text{OCl}^-]_0$ (M)	$[\text{I}^-]_0$ (M)	$[\text{OH}^-]_0$ (M)	v_0 ($\frac{\text{M}}{\text{s}}$)
1.62×10^{-3}	1.62×10^{-3}	0.52	3.06×10^{-4}
1.62×10^{-3}	2.88×10^{-3}	0.52	5.44×10^{-4}
2.71×10^{-3}	1.62×10^{-3}	0.84	3.16×10^{-4}
1.62×10^{-3}	2.88×10^{-3}	0.91	3.11×10^{-4}

$$v(t) = k[\text{OCl}^-]^m[\text{I}^-]^n[\text{OH}^-]^p$$

Compare 1 and 2, only $[\text{I}^-]$ changes

Compare 2 and 4, only $[\text{OH}^-]$ changes

$$\frac{v_2}{v_1} = \left(\frac{[\text{I}^-]_2}{[\text{I}^-]_1}\right)^n \qquad \frac{v_4}{v_2} = \left(\frac{[\text{OH}^-]_4}{[\text{OH}^-]_2}\right)^p$$

$$\frac{5.44 \times 10^{-4} \frac{\text{M}}{\text{s}}}{3.06 \times 10^{-4} \frac{\text{M}}{\text{s}}} = \left(\frac{2.88 \times 10^{-3} \text{ M}}{1.62 \times 10^{-3} \text{ M}}\right)^n \qquad \frac{3.11 \times 10^{-4} \frac{\text{M}}{\text{s}}}{5.44 \times 10^{-4} \frac{\text{M}}{\text{s}}} = \left(\frac{0.91 \text{ M}}{0.52 \text{ M}}\right)^p$$

$$1.778 = (1.778)^n \qquad 0.572 = (1.750)^p$$

$$n = \frac{\ln(1.778)}{\ln(1.778)} \approx 1 \qquad p = \frac{\ln(0.572)}{\ln(1.750)} \approx -1$$

Compare 1 and 3

$$\frac{v_3}{v_1} = \left(\frac{[\text{OCl}^-]_3}{[\text{OCl}^-]_1}\right)^m \left(\frac{[\text{I}^-]_3}{[\text{I}^-]_1}\right)^n \left(\frac{[\text{OH}^-]_3}{[\text{OH}^-]_1}\right)^p$$

$$\frac{3.16 \times 10^{-4} \frac{\text{M}}{\text{s}}}{3.06 \times 10^{-4} \frac{\text{M}}{\text{s}}} = \left(\frac{2.71 \times 10^{-3} \text{ M}}{1.62 \times 10^{-3} \text{ M}}\right)^m \left(\frac{1.62 \times 10^{-3} \text{ M}}{1.62 \times 10^{-3} \text{ M}}\right)^1 \left(\frac{0.84 \text{ M}}{0.52 \text{ M}}\right)^{-1}$$

$$1.033 = (1.673)^m (1)^1 (1.615)^{-1}$$

$$m = \frac{\ln(1.668)}{\ln(1.673)} \approx 1$$

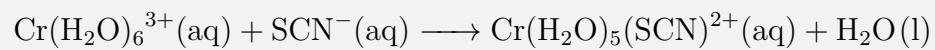
$$k = \frac{v[\text{OH}^-]}{[\text{OCl}^-][\text{I}^-]}$$

$$k = \frac{3.06 \times 10^{-4} \frac{\text{M}}{\text{s}} \cdot 0.52 \text{ M}}{(1.62 \times 10^{-3} \text{ M})(1.62 \times 10^{-3} \text{ M})} = 60.6 \frac{1}{\text{s}}$$

$$v(t) = 60.6 \frac{1}{\text{s}} [\text{OCl}^-][\text{I}^-][\text{OH}^-]^{-1}$$

Homework Problem 33

1. Determine the rate law for this reaction. Round orders to the nearest integer.



$[\text{Cr}(\text{H}_2\text{O})_6^{3+}]_0$ (M)	$[\text{SCN}^-]_0$ (M)	v_0 ($\frac{\text{M}}{\text{s}}$)
1.21×10^{-4}	1.05×10^{-5}	2.11×10^{-11}
1.46×10^{-4}	2.28×10^{-5}	5.53×10^{-11}
1.66×10^{-4}	1.05×10^{-5}	2.82×10^{-11}
1.83×10^{-4}	3.11×10^{-5}	9.44×10^{-11}