

Chemical Kinetics

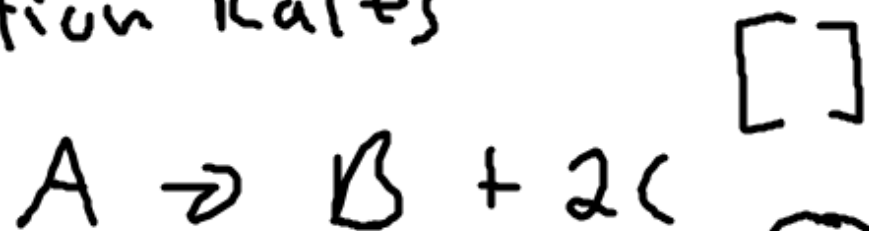
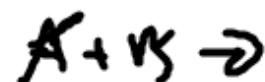
- rate of the reaction

Spontaneous - does not mean fast

something that just happens

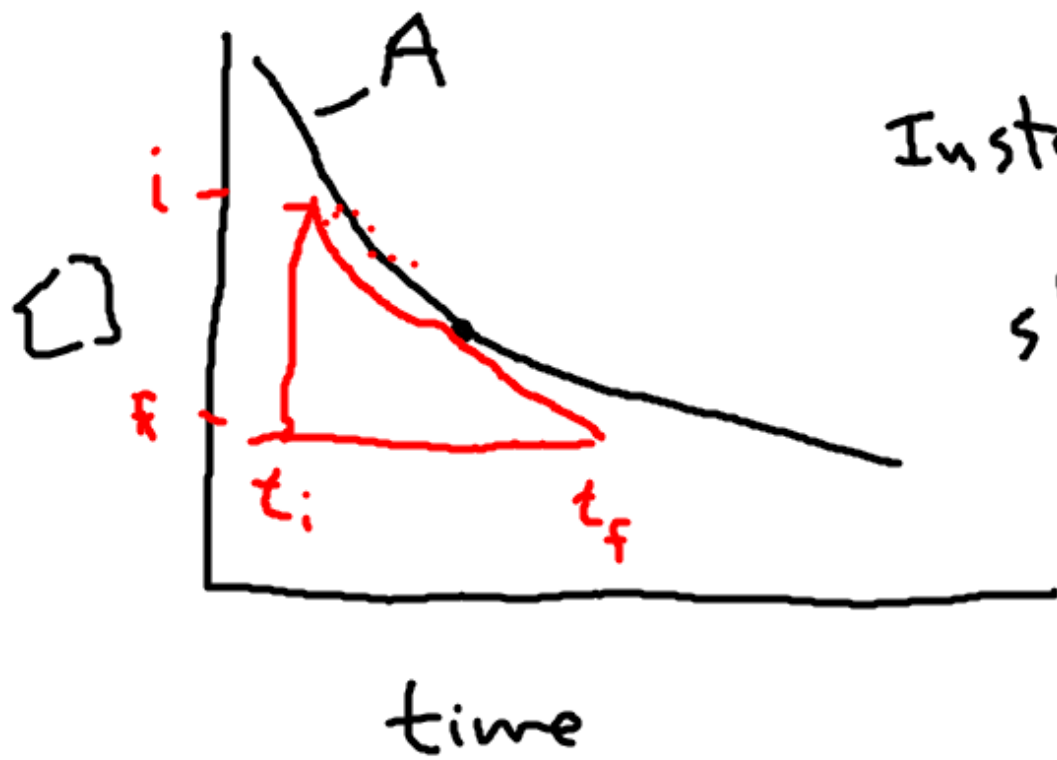
nail rusting

Reaction Rates



$$\frac{[A]_f - [A]_i}{t_f - t_i} = \frac{-\Delta[A]}{\Delta t} = \text{rate}$$

t	[A]	[B]	[C]	rate
0	1	0	0	0-50 $\text{rate} = \frac{+.21}{50} = .0042$
50	.79	.21	.42	
100	.65	.35	.70	
400	.31	.69	1.38	0-400 $\text{rate} = \frac{.69}{400} = .0017$ Slower?



Instantaneous rate
slope of the tangent
line

Rate Laws



only care about reactants

why? the reverse rxn is very small

$$4 = 2^2$$

rate = $k [\text{NO}_2]^n$ → order of the rxn

$\frac{\text{M}}{\text{sec}}$ ↓
rate constant

$n=1$ $1^1 = 1$
 $n=2$ $2^2 = 4$

by experiment

Types of Rate Laws $[A]_0$

differential Law (rate Law)

- Σ only

integrated rate Law

- Σ over time

$$y = mx + b$$



$$[A] = kt + [A]_0$$

Determining the form of the rate law



$[\text{N}_2\text{O}_5]_0$	rate ($\frac{\text{mol}}{\text{L}\cdot\text{s}}$)	$\frac{\text{M}}{\text{s}}$
0.90	5.4×10^{-4}	
0.45	2.7×10^{-4}	

$$\frac{\text{rate}_1}{\text{rate}_2} = \frac{k[\text{N}_2\text{O}_5]^n}{k[\text{N}_2\text{O}_5]^n}$$

$$\frac{5.4 \times 10^{-4}}{2.7 \times 10^{-4}} = \left(\frac{.90}{.45}\right)^n$$

$$\text{rate} = k [\text{N}_2\text{O}_5]^n$$

$$\text{rate} = k [\text{N}_2\text{O}_5]^1$$

$$k = \frac{\text{rate}}{[\text{N}_2\text{O}_5]} = \frac{5.4 \times 10^{-4} \frac{\text{mol}}{\text{L}\cdot\text{s}}}{.90 \frac{\text{mol}}{\text{L}}} = 6 \times 10^{-4} \text{ s}^{-1}$$

$$2 = 2^n$$

565
 $[NH_4^+]^n [NO_2^-]^m$ rate

x	1			
	2	.005	2	1.35×10^{-7}
	3	.01		2.70×10^{-7}
		.01		5.40×10^{-7}

$$\text{rate} = k[NH_4^+]^n [NO_2^-]^m = k[NH_4^+]^1 [NO_2^-]^1$$

n use 2+3

m use 1+2

$$k = \frac{2.7 \times 10^{-7}}{(.1)(.01)}$$

$$2 = 2^n$$

$$2 = 2^m$$

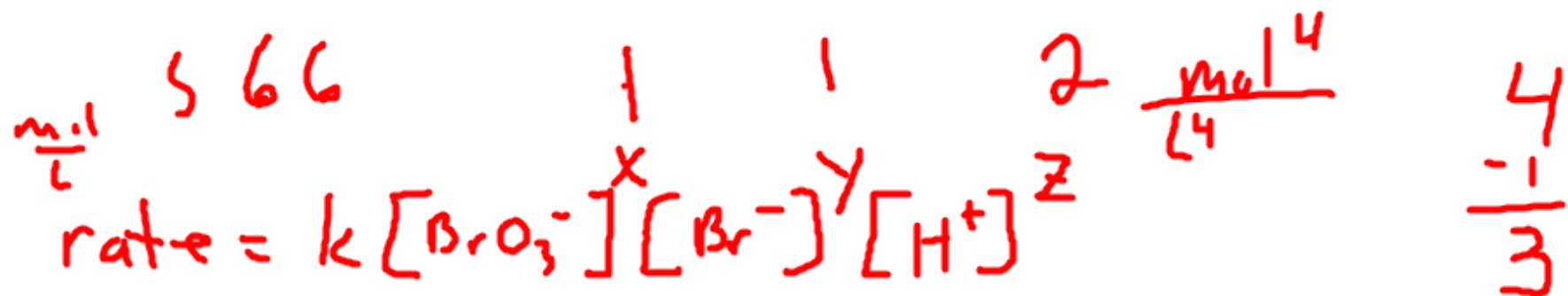
$$n = 1$$

$$m = 1$$

$$2.70 \times 10^{-4} \frac{L}{mol \cdot s}$$

$$\frac{mol}{L \cdot s} = \left(\frac{L}{mol \cdot s} \right) \left(\frac{mol}{L} \right) \left(\frac{mol}{L} \right)^2$$

order rxn = 2



$$x \quad 1+2 \quad \quad \quad y \quad 2+3 \quad \quad \quad z \quad 1+4$$

$$2 = 2^x \quad \quad \quad 2 = 2^y \quad \quad \quad 4 = 2^z$$

$$x=1 \quad \quad \quad y=1 \quad \quad \quad z=2$$

$$k = \frac{8.0 \times 10^{-4}}{(0.1)(0.1)(0.1)^2} = 8.0 \frac{\text{L}^3}{\text{mol}^3 \cdot \text{s}}$$

$$5 \quad .30 \quad \frac{.0015}{.4} \quad 5.7 \times 10^{-4}$$

$$[\text{Br}^-] = \frac{k_2 a t e}{k_1 [\text{BrO}_3^-] [\text{H}^+]^2}$$

rxn rates
rate laws
forms of rate law