11/(24) Rate= $K[A]^1[B]^0[C]^2$

$(3^1)(3^0)(3)^2$

$27 = 3 \quad 1 \quad 9$

Feb 3-8:08 AM

14/(26) (a) Rate= $K[NO]^2[H_2]^1$

$(0.035)^2 \; (0.015)$

$K = 6*10^4 \frac{1}{M^2 \cdot sec}$

Feb 3-8:19 AM

14/32 CHART

Expt	NO	O_2	Rate
1	0.0126	0.0125	1.41×10^{-2}
2	0.0252	0.0125	5.64×10^{-2}
3	0.0252	0.0250	1.13×10^{-1} (11.3×10^{-2})

NO: ×2 (1 → 2); O_2: ×2 (2 → 3); Rate: ×4 (1 → 2)

$$Rate = K[NO]^{2}[O_2]^{1}$$

Expt 1→2: $2^{2} = 4$

2→3: $2^{1} = 2$

Feb 3-8:22 AM

14.32 b

$$Rate = K[NO]^{2}[O_2]^{1}$$

3rd order rxn overall

$$\frac{M}{sec} = K(M^{2})(M^{1})$$

$$\frac{\frac{M}{sec}}{M^{3}} = K\frac{M^{3}}{M^{3}}$$

$$\frac{M}{sec} \div \frac{M^{3}}{1}$$

$$\frac{M}{sec} \times \frac{1}{M^{3}} = \frac{1}{M^{2} \cdot sec}$$

Feb 3-8:29 AM

$$2NO + O_2 \rightarrow 2NO_2$$

$$-\frac{1}{2}\frac{\Delta[NO]}{\Delta t} = -\frac{1}{1}\frac{\Delta[O_2]}{\Delta t} = \frac{1}{2}\frac{\Delta[NO_2]}{\Delta t}$$

Feb 3-8:37 AM

Units of Rate Constant (k) → rxn order

Zero order Rxn

$$Rate = k[A]^0$$

$$\frac{M}{sec} = k\, M^0$$

$$\frac{M}{sec} = k$$

$$\frac{1}{M^{-1}\,sec} = k$$

First order

$$Rate = k[A]^1$$

$$\frac{\frac{M}{sec}}{M^1} = \frac{k \cdot M^1}{M^1}$$

$$\frac{M}{sec} \div \frac{M}{1} = \frac{M}{sec} \cdot \frac{1}{M}$$

$$\frac{1}{M^0 \cdot sec} = k$$

just for show.

Second order

$$Rate = k[A]^2$$

$$\frac{M}{sec} = k\, M^2$$

$$\frac{M}{sec} \div \frac{M^2}{1} = \frac{M}{sec} \cdot \frac{1}{M^2} = \frac{1}{M \cdot sec}$$

$$\frac{1}{M^1 \cdot sec} = k$$

Feb 3-8:40 AM

4th order $\frac{1}{M^4 \cdot sec}$

$Rate = K[A]^4$

$\frac{M}{sec} = K \frac{M^4}{M^4}$ → $\frac{1}{M^3 \cdot sec} = K$

Units for rate constant → order of the rxn is

$\frac{1}{M^{\#-1} \cdot sec}$ ← order

Feb 3-8:52 AM

(14.31) $Rate = K[BF_3]^1[NH_3]^1$ (0.1) (0.5)

5 → 4 / [ ] / Rate: $2^1 = 2$

2 → 1: $2^1 = 2$

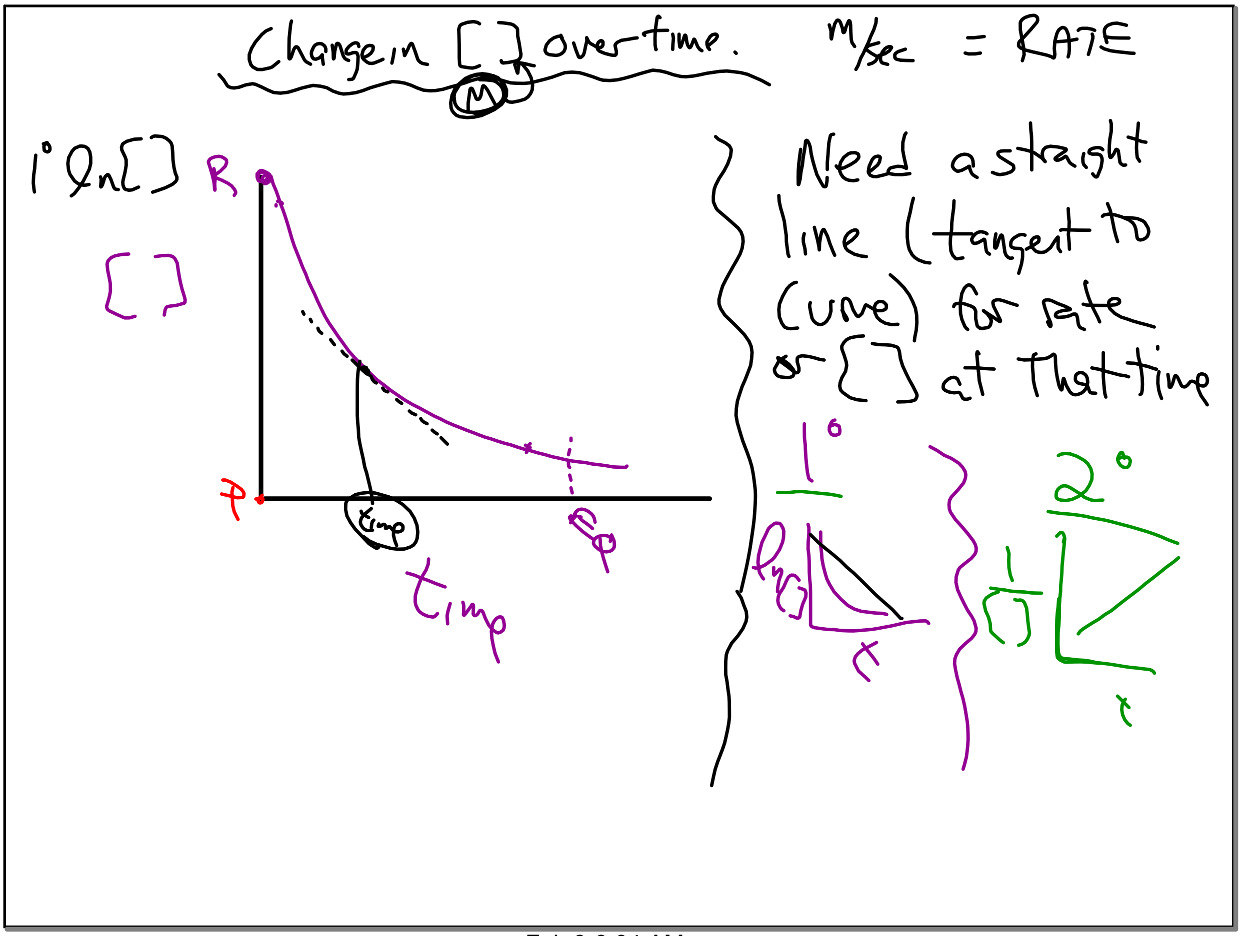
$K = \frac{1}{M^1 * sec}$

$\frac{1}{2}^1 \quad \frac{1}{2}$

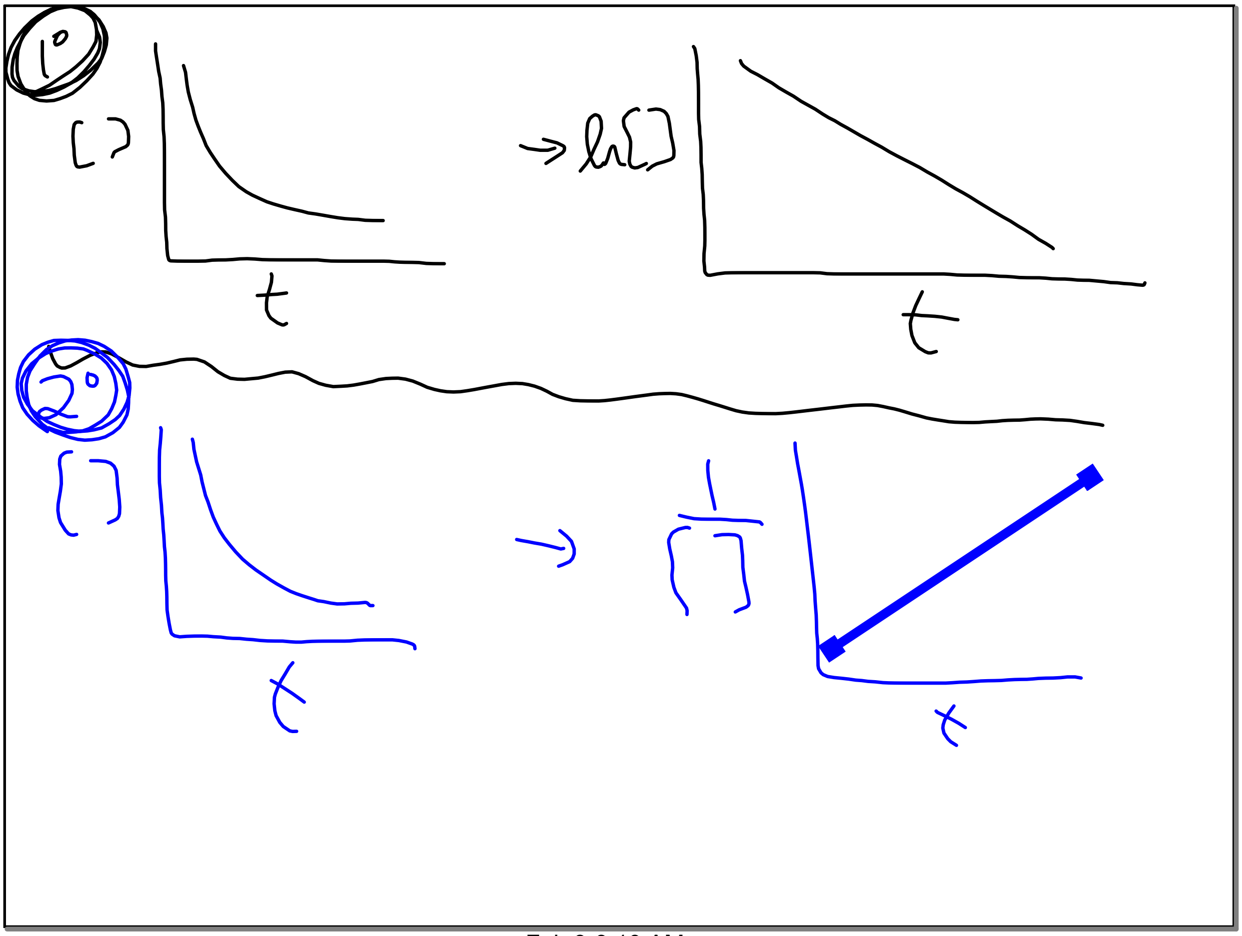
Exp 1: $Rate = K(BF_3)^1(NH_3)^1$

$0.2130 = K(0.25)^1(0.25)^1$

Feb 3-8:55 AM

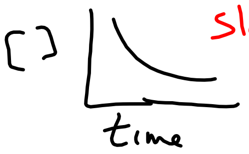


Feb 3-9:04 AM

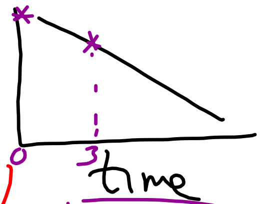


Feb 3-9:10 AM

First order rxns [concentration] vs. time



slope = $-K$ ⟹ $\ln[\,]$



At time Ø (start) $[A_0]$

At some time (t) down the road $[A_t]$

$A \rightarrow B$ (react)

$$y = mx + b$$

$$\ln[A_t] = -Kt + \ln[A_0]$$

Feb 3-9:14 AM

1° $K = 1.45\ yr^{-1}$ $1.45 \frac{1}{M^0 * yr}$

$T = 12°C$

$A_0 = 5 \times 10^{-7}\ g/cm^3$ insecticide

(a) How much remains after 1yr?

$$\ln A_t = -Kt + \ln A_0$$

(same units)

$$\ln A_t = (-1.45)(1) + \ln(5 \times 10^{-7})$$

$$e^{\ln A_t} = e^{-15.96}$$

$$A_t = 1.17 \times 10^{-7}\ g/cm^3$$

Feb 3-9:19 AM

Half Life

$$A_t = \frac{1}{2}[A_0]$$

$$\ln A_t = -Kt + \ln A_0$$

$$-\ln A_0 \qquad\qquad -\ln A_0$$

$$\ln A_t - \ln A_0 = -Kt$$

$$\ln \frac{A_t}{A_0} = -Kt$$

$$\ln \frac{\frac{1}{2}A_0}{A_0} = -Kt$$

$\log A - \log B = \log \frac{A}{B}$

$$\ln 1/2 = -Kt$$

$$-0.693 = -Kt_{1/2}$$

$$0.693 = Kt_{1/2}$$

1°

$$t_{1/2} = \frac{0.693}{K}$$

1° half life
only dependent on K
Rate constant

Feb 3-9:25 AM

14 / 38 + 40

Feb 3-9:30 AM