

Lecture 3-27: Integrated Rate Law

rate = $k[A]^x$ M/s = 0th order
 M/s ? M^x

BE ABLE TO:
 * match up order w/ rate constant orders

+ higher conc = faster rxn rate.

+ b/c conc. is changing, the rate is also changing.

INTEGRATED RATE LAWS

• only one reactant is changing.

ACTIVITY II

* assumed no back rxn.

	0 order	1st order	2nd order
rate law	$= k$	$= k[A]$	$= k[A]^2$
integrated	$[A] = [A_0] - kt$	$[A]_t = [A]_0 e^{-kt}$	$\frac{1}{[A]} = \frac{1}{[A_0]} + kt$
1/2 life	$t_{1/2} = \frac{[A]_0}{2k}$	$t_{1/2} = \frac{\ln(2)}{k}$	$t_{1/2} = \frac{1}{[A_0]k}$ <small>set initial conc</small>

conc will be 1/2 of initial conc.

$$[A] = [A_0] - kt$$

$$0.5[A_0] = [A_0] - kt_{1/2}$$

* 1/2 life depends initial conc.

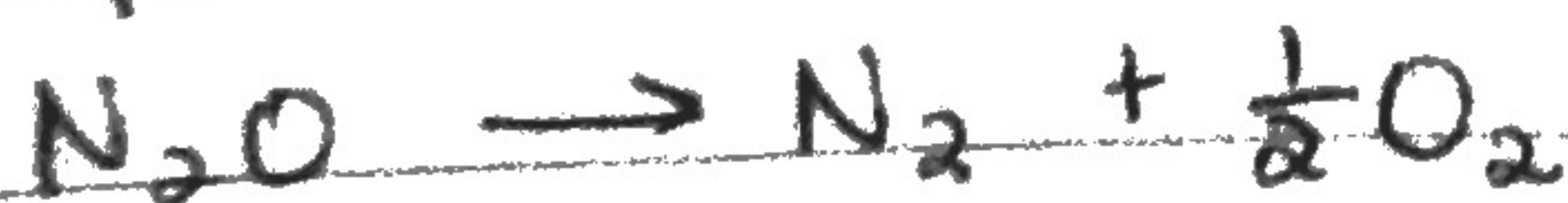
No initial conc!!!!

	0 th order	1 st order	2 nd order
To make straight line plot.	$[A]$ vs. time	$\ln[A]$ vs. time	$\frac{1}{[A]}$ vs. time
slope of line equals?	$-k$	$-k$	$+k$

* k is always a positive #.

EXAMPLE

① decomposition of N_2O follows 1st order kinetics.



$$\text{rate} = k[N_2O]$$

$$(.20)e^{(-3.4)(.100)} = \boxed{.142 M}$$

⑤ $[A]_t = [A]_0 e^{-kt}$ $[A] = [A]_0 e^{-kt}$

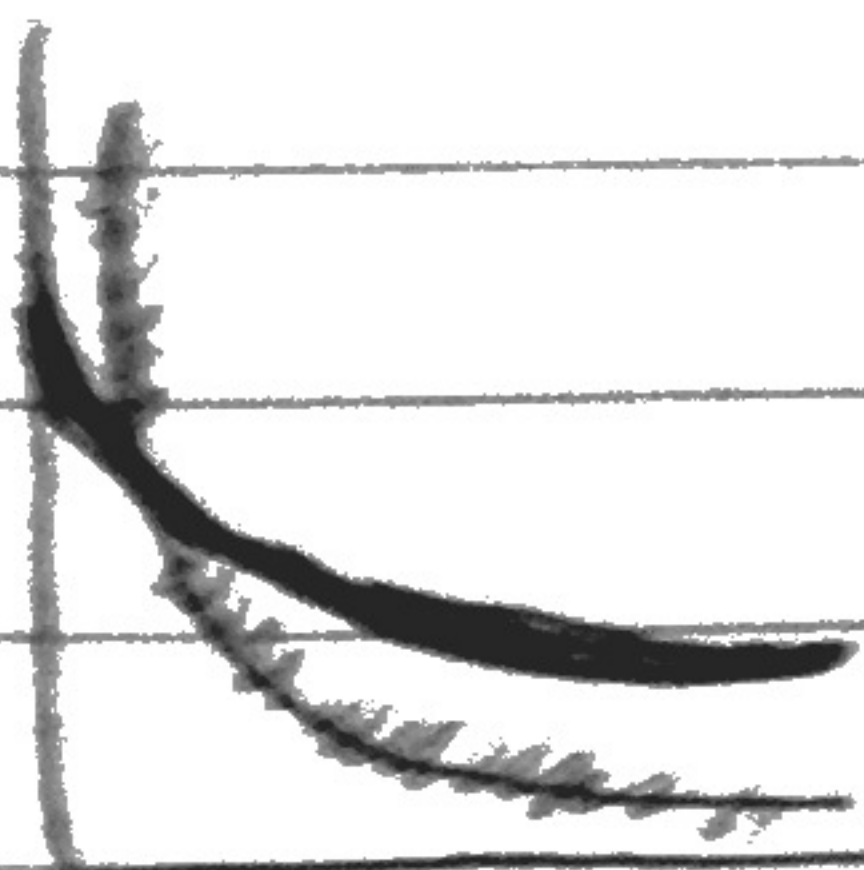
$\cdot \ln[A]_t =$

$\frac{[A]}{[A]_0} = 0.01 = e^{-kt}$ * solve for t or k
 $t = \frac{1}{k} \ln \frac{[A]_0}{[A]}$



\cdot rate law: $k[CO][H_2O]$

$[CO]_0 = 0.01M$
 $[H_2O]_0 = 0.01M$



Why is plot of $\ln[CO]$ not a straight line?

Both $[CO]$ and $[H_2O]$ are changing, so rate depends on both conc.

If you have multiple things changing, won't make a straight line.

Now if you do...

$[CO]_0 = 0.01M$
 $[H_2O]_0 = \underline{\underline{2M}}$



Why is plot of $\ln[CO]$ now a steep straight line?

Rate for water rate is same as CO .
 Conc of H_2O is almost constant because it's so much larger.

For the initial conditions of:

$[CO]_0 = 0.01M$
 $[H_2O]_0 = 2M$

What's the conc of H_2O at very long times. What's limiting reactant?

$[H_2O]$ will be 1.99

$[CO] \sim 0$ (LR)

$[H_2O] \sim 1.99M$ left (over)

If water is constant, can do

rate = $k'[CO]$; pseudofirst order

If know $[H_2O]$ can get back to

2nd order