NOTES #44

Kinetics II - Integrated Rate Laws

AP Chemistry

A. Relationship between [Reactant] and TIME (Integrated Rate Laws):

- The rate laws we have been writing allow us to calculate the rate of a reaction from _____ and _____.
  In other words, the rate laws express the rate as a function of _____.

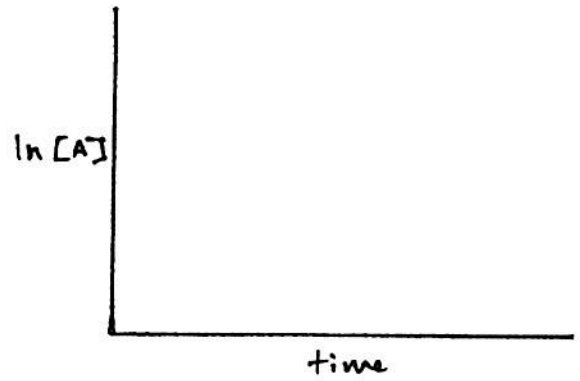
- The INTEGRATED rate laws can be used to determine the concentrations of reactants at <u>any time</u> during the course of the reaction. In other words, the integrated rate law express the rate as a function of _____.

** We are going to look at the integrated rate law for a zero, first and second order reaction.....okay?

B. FIRST ORDER: Ex: A ---------> products

1st ORDER PLOT

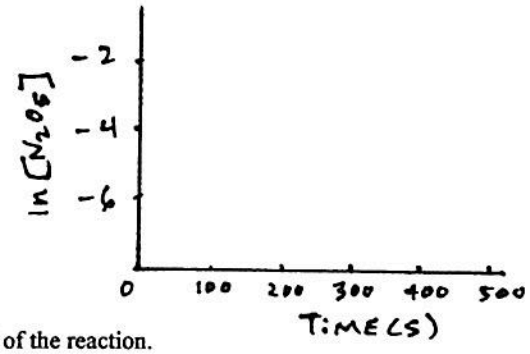
1. Determination of the integrated rate law.



EX: The decomposition of N_2O_5 in the gas phase was studies at constant temp. $2N_2O_5\ (g) \longrightarrow 4\ NO_2\ (g) + O_2\ (g)$

The following results were obtained:

$[N_2O_5]$ (M)	Time (s)
0.1000	0
0.0707	50
0.0500	100
0.0250	200
0.0125	300
0.00625	400



a) Using this data, verify that the rate law is first order in $[N_2O_5]$ and calculate the value of the rate constant.

b) Using the data given above, calculate $[N_2O_5]$ 2.5 minutes after the start of the reaction.

2. Half-life:

- What is it? The time required for a reactant to decreases to _____.

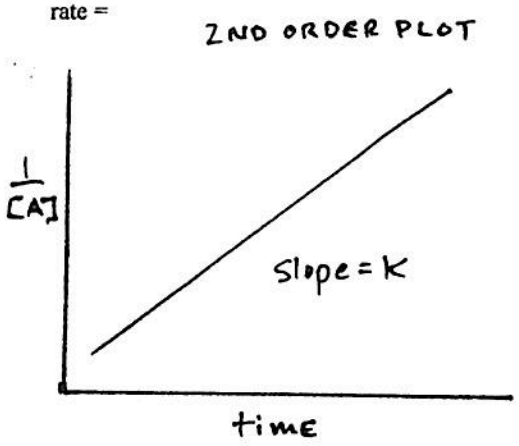
- How can we express the half-life of a 1st order process?

EX: Calculate the half-life of our decomposition of N_2O_5 from above. Assume $k = 6.93 \times 10^{-3} s^{-1}$.

EX: How long would it take in minutes for 95% of the N_2O_5 to decompose?

C. SECOND ORDER: Two possible scenarios: A ------> products rate =
A + B ------> products rate =

1. Determination of the INTEGRATED RATE LAW:



2. Determination of the half-life for a second order process:

EX: The reaction 2A------> B is second order with a rate constant of 51/M·min at 24°C.

a) Starting with [A] = 0.0092 M, how long will it take for [A] = 3.7×10^{-3} M?
b) Calculate the half-life of this reaction.