

Ch 12 Kinetics #3 *Numeric values must be accompanied by units***Determining Order of Reaction from graphical analysis + Time/Concentration Problems****Determining Activation Energy,  $E_a$ , from graphical analysis**

1. Dinitrogen pentoxide decomposes to form nitrogen dioxide and oxygen.

t (s)	Dinitrogen pentoxide concentration, M
0	0.91
300	0.75
600	0.64
1200	0.44
3000	0.16

- Write the balanced equation of the reaction (include states).
  - Determine order of the reaction by linearizing and graphing the linearized the data. \_\_\_\_\_  
(No need to record data from the calculator here.)
  - Sketch a graph of the linearized data. Label axis.
  - What is the equation of the best fit line? \_\_\_\_\_ Indicate the  $r^2$  value:  $r^2 =$  \_\_\_\_\_
  - What is the rate constant? \_\_\_\_\_
2. The conversion of cyclopropane to propene in the gas phase is a first-order reaction with a rate constant of  $6.7 \times 10^{-4} \text{ s}^{-1}$  at  $500^\circ\text{C}$ . The initial concentration of cyclopropane was 0.25 M.
- Write the balanced equation of the reaction (include states).
  - What is the concentration after 8.8 min?
  - How many minutes will it take for the concentration to decrease from 0.25 M to 0.15 M?
  - How many minutes will it to convert 74% of the starting material?

3. A substance decomposes according to a first-order rate law, with a constant of  $3.65 \times 10^{-4} \text{ s}^{-1}$ .
- Calculate the half life of the substance.
  - The initial concentration is 0.482 M. Calculate the concentration after 1537 sec.
4. Strontium-90 is a radioactive product of nuclear fallout from weapons testing. The human danger, due to its chemical similarity to calcium, is the tendency for strontium to become incorporated into bones if ingested. The rate constant for the decay process is  $0.0247 \text{ yr}^{-1}$ .
- Calculate the time required for 0.774 g of Sr-90 to decay to 4.76 % of its original amount.
  - If 15.84 g of Sr-90 remain after 12.5 years, calculate the amount of materials that was present initially.

5. The rate constants for the decomposition of acetaldehyde  $\text{CH}_3\text{CHO}_{(g)} \rightarrow \text{CH}_4_{(g)} + \text{CO}_{(g)}$  were measured at five different temperatures. (The reaction has been determined to be 3/2 order; therefore, k has units of  $1/\text{M}^{1/2} \cdot \text{s}$ .)

K ( $1/\text{M}^{1/2} \cdot \text{s}$ )	T (K)
0.011	700
0.035	730
0.105	760
0.343	790
0.789	810

Determine the activation energy, in kJ/mol by plotting the appropriate data. Indicate the equation of the line of best fit and the  $r^2$  value.