Chemical Kinetics: Integrated Rate Law (Covering Topic 2, Day 2)

1. The irreversible reaction A → B has the rate law *Reaction Rate* $= k$ = 0.002 mol/L·hr. If the concentration of A is 1.0 M initially, how long before the concentration of A drops to zero?
2. Nuclear decay follows first order kinetics. Sodium-24 has a half-life of 14.96 hours and is used to monitor blood circulation. (The equation for this nuclear decay is show below.)

$$^{24}_{11}Na \rightarrow ^{24}_{12}Mg + ^{0}_{-1}\beta \text{ (a beta particle)}$$

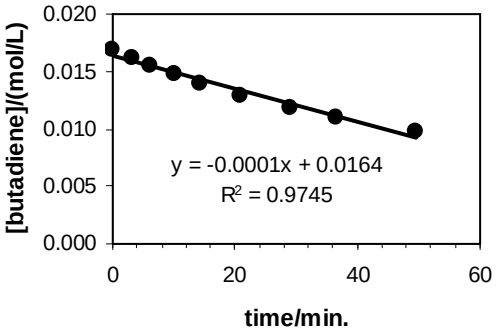
   a.) What is the rate constant for this reaction?
   b.) How long will it be before sodium-24 has dropped to 10% of its original level after being ingested by a patient?

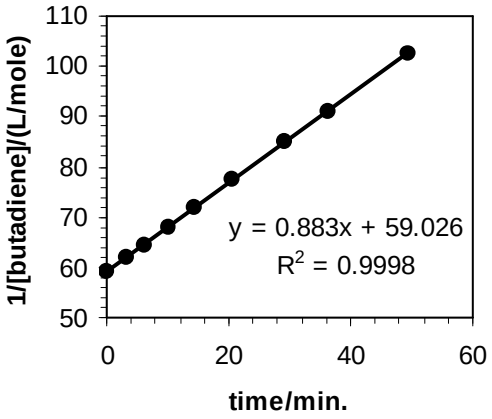
3. The reaction HI(*g*) →½ I_2 (*g*) + ½ H_2 (*g*) follows the rate law *Reaction Rate* = $k[HI]^2$ with *k*=0.02L/mol·s. What is the concentration of HI after 12 seconds starting with an initial concentration of HI of 0.2 *M*?
4. The dimerization of butadiene (CH_2=CH–CH=CH_2) involves the following chemical equation:

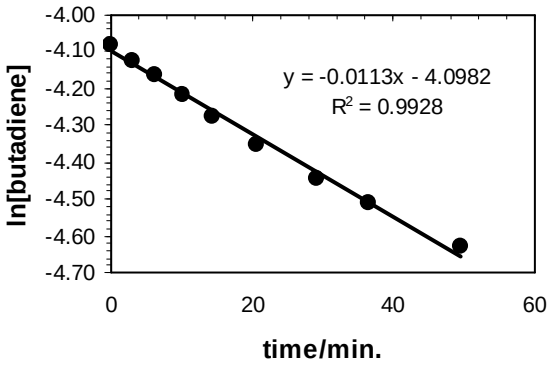
   2 butadiene → dimer

   This gas-phase reaction has been studied by Vaughan (*J. Am. Chem. Soc.*, **1932**, *54*, 3863) at 599 K. In lab you repeat Vaughan's study and obtain the following data.

   a.) What is the reaction order according to your data?
   b.) Calculate the rate constant from the data. (Don't forget the units! Watch out for those coefficients!)
   c.) How much time must pass before 50% of the butadiene is consumed (i.e., what's the half life of this reaction?)







5. Given in http://www.stolaf.edu/depts/chemistry/courses/toolkits/126/hw/hwprob5.xls are data that were collected by students in lab. Determine the order of the reaction with respect to $HCrO_4^-$ by graphing $[HCrO_4^-]$, $\ln[HCrO_4^-]$, and $1/[HCrO_4^-]$ vs. time and checking the trend lines.