

5.111 Principles of Chemical Science: Week 12

Logan Pachulski

September 9th, 2019

Progress Update

Over the past week I have been introduced to:

- 1 Nuclear decay as a first order process
- 2 Second order rate laws
- 3 More on chemical kinetics

Nuclear decay

In lecture 31, we discussed nuclear decay as a first order process; we define activity A as

$$A = kN \quad (1)$$

where k is the rate constant and N is the number of nuclei present. Then by the first order integrated rate law,

$$A = A_0 e^{-kt} \text{ and } t_{1/2} = \frac{0.6931}{k} \quad (2)$$

Second order processes

In the latter part of lecture 31, we discussed the second order integrated rate law and its associated half life:

$$\frac{1}{[A]_t} = kt + \frac{1}{[A]_0} \text{ and } t_{1/2} = \frac{1}{k[A]_0} \quad (3)$$

Further into chemical kinetics

Most reactions can be broken into a series of *elementary reactions*. Elementary reactions occur exactly as written, and almost always only have 1 or 2 reactants. Consider the following elementary reaction:



It has a predicted forwards rate

$$r = k[\text{NO}]^2. \quad (5)$$

By chaining together elementary reactions and their rates, we can get an overall predicted reaction rate.

Example problem

Consider the following example problem from lecture 31:

4. If the equilibrium constant for a reaction is 5.2×10^3 at 25°C , would you expect the rate constant for the forward reaction to be greater than or less than the rate constant for the reverse reaction at 25°C .