A protein, A, dimerizes with the mechanism and rate constants:

\[ \frac{2A}{A_2} \begin{pmatrix} k_1 \\ k_{-1} \end{pmatrix} \]

1. What is the probability per unit time that a given \( A_2 \) dimer dissociates? What is the probability per unit time that a given A monomer dimerizes?

2. Give the rate equation for \( A \) and the rate equation for \( A_2 \). (Check that you did them right: by adding the two rate equations, you should be able to show that the rate at which \( A \) is consumed is twice the rate at which \( A_2 \) is produced.)

3. Solve the rate equation (you can use one of the methods discussed in lecture) to produce an algebraic expression for \([A]\) as a function of \( t \) and the rate constants.

4. Simplify the solution obtained in c for the special case \( k_{-1} = 0, [A]_{t=0} = A_0, \) and \([A_2]_{t=0} = 0\). Show that the simplified equation is a correct solution of the rate equation by differentiating it (with respect to \( t \)) and plugging the solution and its derivative back into the rate equation.

5. By numerical integration using a spreadsheet program, make two graphs that show the concentrations of \( A \) and \( A_2 \) as a function of time for the sets parameter values

   set 1: \( k_1 = 10^3 \text{ M}^{-1} \text{s}^{-1}, k_{-1} = 0, [A]_{t=0} = 5 \text{ mM, and [A}_2]_{t=0} = 0, \) and
   set 2: \( k_1 = 10^3 \text{ M}^{-1} \text{s}^{-1}, k_{-1} = 5 \text{ s}^{-1}, [A]_{t=0} = 5 \text{ mM, and [A}_2]_{t=0} = 0. \)

   Make certain that the decay times of the curves is of the correct order of magnitude, given the rate constants and initial concentrations. Explain your reasoning.

6. Using words, not equations, explain the differences in the final \( (t = 4) \) values and in the rate of approach to equilibrium in the two graphs.