CHM 1046 Chapter 13 Homework

1. Review Examples 13.03 and 13.04. Suppose two experiments are done with reaction $A \rightarrow 2C$.
In the first experiment, $rate_1 = 0.00170$ M/s at t= 0 when initially $[A]_1 = 1.50$ M,
In the second experiment, $rate_2 = 0.00680$ M/s at t = 0 when initially $[A]_2 = 3.00$ M.
Determine the order of reaction with respect to [A], that is the exponent for [A] in the rate law.
Write the rate law with the rate constant (k) along with [A] and the exponent number value.
Then, determine the value of the rate constant (k) by rearranging the rate law. (2 pts)

2. Review OpenStax Examples 12.6, 12.7, and 12.11. Suppose a 1^{st} order reaction has $k = 0.000770\ s^{-1}$. Use $[A] = [A]_0(e^{-kt})$ to find [A] when $[A]_0 = 1.50$ M and t = 1800 s.
The half-life ($t_{½}$) is when $[A] = (½)[A]_0$. Describe what the term half-life means in a complete sentence and find the half-life ($t_{½}$) for this reaction. (2 pts)

3. Review the section on Graphing Concentration-Time Equations in the chapter 13 notes.
For the reaction in problem 2, write the form of the concentration-time equation which results in a straight-line graph. Determine the number values for the slope and the y-intercept. (1 pt)

4. Review Figure 12.9 in OpenStax. Draw the straight-line on graph paper or in Excel for the results of the numerical data in problems 2 and 3. Include both axis labels and number the axes consistently. Include the locations and values (x,y) for the y-intercept and at least one other point on the line. (1 pt)

5. Review catalysis on the last page of the chapter 13 notes. Define catalyst.
Explain how the catalyst is in the mechanism, yet cancels out of the net chemical equation.
Describe how the catalyst affects the activation energy. (1 pt)

6. Review Example 12.14 in OpenStax. Also, review mechanism on last page of chapter 13 notes.
Suppose a reaction has the following mechanism:

1. $2B \rightleftharpoons B_2$ fast equilibrium, rate constants are k_{1F} forward and k_{1R} reverse
2. $B_2 + C \rightarrow B_2C$ slow, rate constant is k_2
3. $B_2C \rightarrow X + C$ fast, rate constant is k_3

First, write the rate equation for the rate-determining step. Next, write the rate equation for the equilibrium step by setting its forward rate equal to its reverse rate. Then, obtain an equation for $[B_2]$ by rearranging the equilibrium rate equation. Now, substitute that result for $[B_2]$ into the rate equation for the rate-determining step. The result should simplify to rate = $k[B]^2[C]$. Find what k equals in terms of the other rate constants. (1 pt)

7. Review Figure 12.14 in OpenStax. Define activated complex and activation energy.
Show both on a potential energy diagram. Explain how the two terms are related. (2 pts)