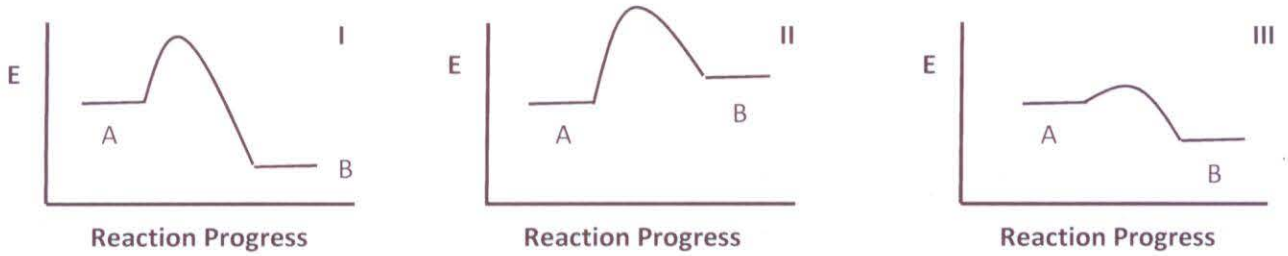
CHEM 105 – Dr. Lammi Name: _____

Quiz 7 – November 6, 2019

Integrated Rate Laws: $\ln [A]_t = -kt + \ln [A]_0$ **First Order** $\frac{1}{[A]_t} = kt + \frac{1}{[A]_0}$ **Second Order**

1. (6 pts) Consider the three reaction profiles below for the reaction: **A → B**



   a. Which profile(s) depict **spontaneous** reactions? (List all that apply.) I and III (negative ΔG)

   b. If the temperature and concentration of A are the same in each case, which reaction do you expect to be **fastest**? (Choose I, II, or III.)
   III (smallest Ea)

2. (4 pts) One of the reactions occurring in the catalytic converter of your car is: $2\ NO\ (g) \rightarrow N_2\ (g) + O_2\ (g)$

   Express the reaction rate in terms of: **(i) the disappearance of NO** and **(ii) the appearance of O_2**

   Rate = $-\frac{1}{2}\frac{\Delta[NO]}{\Delta t}$ = $\frac{\Delta[O_2]}{\Delta t}$

3. (6 pts) NO (g) reacts rapidly with unstable NO_3 (g) to form NO_2 (g): $NO\ (g) + NO_3\ (g) \rightarrow 2\ NO_2\ (g)$

   The reaction rate doubles when the concentration of NO doubles (at constant NO_3); the rate also doubles when the concentration of NO_3 doubles (at constant NO). **Write the rate law** for the reaction.

   Rate = $k[NO]^1[NO_3]^1$

4. (9 pts) The unstable molecule ClOO, rapidly decomposes: $2\ ClOO\ (g) \rightarrow Cl_2\ (g) + 2\ O_2\ (g)$. Suppose that you monitor the concentration of ClOO over time during this decomposition reaction, in order to determine the rate law.

   a. Referring to the integrated rate laws provided, **label each set of axes** to show what quantities you would graph to determine whether the reaction is first- or second-order in ClOO.

1st order

2nd order

([A] = [ClOO])

   b. Based on your graphs, **how will you know** whether the reaction is first- or second-order in ClOO?
   Look for the (more) linear graph to identify order

   c. Suppose that it is a **second-order** reaction. **How will you determine the rate constant (k)** from your graph?
   slope = k for 2nd-order graph.