1. Draw a reaction coordinate and label it with all important energy levels. How does this help us explain reaction rates?

2. What is activation energy and how can it be decreased?

3. What are 3 ways to change the rate of a reaction?

4. Consider two reactions with identical rate constants – one of these reactions is 1$^{st}$ order and the other is 2$^{nd}$ order. Explain why the rate of the 2$^{nd}$ order reaction will decrease more quickly than the rate of the 1$^{st}$ order reaction.

5. Consider the following reactions. Determine the order of the reaction and write the simplest rate law possible (e.g. 3$^{rd}$ order would be rate=$k[A]^3$)

| **Reaction** | **$k_1$** |
|---|---|
| A | 1136 $s^{-1}$ |
| B | 83822 M $s^{-1}$ |
| C | 10.88 $M^{-2}s^{-1}$ |

*Hint: consider the units of the rate constant*

6. For the reaction below, use the method of initial rates to determine the rate constant and rate law. Make sure to use the correct units.

$$2\ NO\ (g) + O_2\ (g) \rightarrow 2\ NO_2$$

| Experiment | $[O_2]$ (M) | [NO] (M) | Rate ($M\ s^{-1}$) |
|---|---|---|---|
| **1** | 0.010 | 0.010 | $1.0 \times 10^{-6}$ |
| **2** | 0.005 | 0.010 | $0.5 \times 10^{-6}$ |
| **3** | 0.010 | 0.005 | $2.5 \times 10^{-7}$ |

*Strategy: The rate law will have the form rate = k* $[NO]^x [O_2]^y$. *Experiments 1 and 2 have equal [NO], so dividing the rate law of 1 by 2 will allow you to solve for y.*

7. For the reaction in problem 6, determine the **rate of the reaction** when the concentration of each reactant is 0.25 mM. *Strategy: this is plug and chug. Plug the 0.25 mM in for [NO] and* $[O_2]$. *Be careful with units.*

8. For the reaction below, use the method of initial rates to determine the rate constant and rate law. Make sure to use the correct units.

$$CO\ (g) + NO_2\ (g) \rightarrow NO\ (g) + CO_2\ (g)$$

| Experiment | $[NO_2]$ (mM) | [CO] (mM) | Rate (mM $s^{-1}$) |
|---|---|---|---|
| **1** | 0.15 | 0.15 | 0.011 |
| **2** | 0.30 | 0.15 | 0.045 |
| **3** | 0.60 | 0.30 | 0.18 |
| **4** | 0.60 | 0.60 | 0.18 |

9. For the reaction in problem 8, determine the **rate of the reaction** when the concentration of each reactant is 0.25 M.