

Due: Please check the schedule.

Instructions: Answer the following questions showing all pertinent work (formulas, units, written explanations, etc.).

1. Given the reaction $2\text{NO} + \text{O}_2 \rightarrow 2\text{NO}_2$ and the following table, answer the following questions...

Experiment	[NO]	[O ₂]	Initial Rate
1	0.020	0.010	0.028
2	0.020	0.020	0.057
3	0.020	0.040	0.114
4	0.040	0.020	0.230

- Write the reaction rate of the above reaction in terms of all reactants and products.
- What is the order of each reactant and the order of the reaction?
- What are the rate law and rate constant for the above reaction?

2. Given the reaction $\text{CO} + \text{NO}_2 \rightarrow \text{CO}_2 + \text{NO}$, answer the following questions... (Assume this reaction is running at **high** temperatures, and thus, is a first-order reaction with respect to CO.)

$[\text{CO}]_0 = 3.8 \times 10^{-4} \text{ M}$ and $[\text{NO}_2]_0 = 0.650 \times 10^{-4} \text{ M}$ in a container of total volume of 2 L.

- The equation has a $k = 3.6 \times 10^{-3} \text{ 1/s}$ at 300°C . In order for the reaction to progress to products, it must be heated. If the reaction is heated for 150 seconds, how many grams of CO remain?
- How long must this sample be heated so that 99% of the sample has decomposed?

3. At **low** temperatures, the rate law for the reaction $\text{CO}(\text{g}) + \text{NO}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) + \text{NO}(\text{g})$ is as follows:
Rate = $k[\text{NO}_2]^2$

Show (by the method we discussed in class) which of the following mechanisms is correct.

- $2\text{NO}_2 \rightleftharpoons \text{N}_2\text{O}_4$ k_1 and k_{-1} (fast)
 $\text{N}_2\text{O}_4 + 2\text{CO} \rightarrow 2\text{CO}_2 + 2\text{NO}$ k_2 (slow)
- $2\text{NO}_2 \rightarrow \text{NO}_3 + \text{NO}$ k_1 (slow)
 $\text{NO}_3 + \text{CO} \rightarrow 2\text{NO}_2 + 2\text{CO}_2$ k_2 (fast)