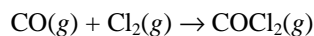


Chemical Kinetics: Rate Laws and Initial Rates (covering Topic 2, day 1)

1. The depletion of stratospheric ozone is a threat to life on Earth. Under certain conditions, the rate law for the decomposition

of ozone to oxygen by light, $2\text{O}_3 \xrightarrow{h\nu} 3\text{O}_2$, is $\text{Reaction Rate} = k \frac{[\text{O}_3]^2}{[\text{O}_2]}$.

- Give the individual reaction orders for O_3 and O_2 and the overall reaction order for the rate law.
 - What happens to the reaction rate if the concentration of O_3 is doubled?
 - What happens to the reaction rate if the concentration of O_3 is halved?
 - What happens to the reaction rate if the concentration of O_2 is halved?
2. Phosgene, COCl_2 , is a toxic gas formed by the chemical reaction of carbon monoxide and chlorine gas.



The initial rate of change in carbon monoxide concentration was monitored by infrared absorbance.

Experiment	Initial [CO] (mol/L)	Initial [Cl ₂] (mol/L)	Initial rate of change d[CO]/dt (mol/L-s)
1	0.200	0.500	-1.28E-06
2	0.200	0.100	-2.55E-07
3	0.100	0.100	-1.28E-07

- Write the rate law for this reaction.
 - Determine the rate constant.
3. For the reaction $2\text{A} + 2\text{B} + \text{C} \rightarrow \text{D}$ the following data were collected at constant temperature:

Experiment	Initial [A] (mol/L)	Initial [B] (mol/L)	Initial [C] (mol/L)	Initial rate of change d[A]/dt (mol/L-s)
1	0.050	0.100	0.200	-4.80E-05
2	0.200	0.100	0.200	-1.92E-04
3	0.200	0.100	0.100	-4.80E-05
4	0.200	0.050	0.200	-3.84E-04

- Write the rate law for this reaction.
 - Determine the rate constant.
4. Consider the reaction $3\text{A} + \text{B} \rightarrow \text{C}$. If B is in large excess compared to the concentration of A, we can assume the concentration of B changes very little during the reaction. We can just consider it constant and write

$$\text{Reaction Rate} = k[\text{A}]^x [\text{B}]^y = k'[\text{A}]^x$$

Here k' is called a *pseudo rate constant*. The graph on the right shows data for two experiments carried out for a reaction with equation $3\text{A} + \text{B} \rightarrow \text{C}$ where [B] is initially 2.2 M in both cases. Based on the graph:

- Construct a table like those above showing initial [A] and d[A]/dt for the two experiments.
- From your table, determine the reaction order of A.
- Determine the pseudo rate constant. (Watch those units!)

