

Name _____

Period ____ Date ____/____/____

Chemical Kinetics

RATE LAWS

1. Consider the reaction: $2 \text{NO(g)} + \text{O}_2\text{(g)} \rightarrow 2 \text{NO}_2\text{(g)}$

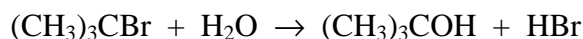
The following data were obtained from three experiments using the method of initial rates:

	Initial [NO] mol L ⁻¹	Initial [O ₂] mol L ⁻¹	Initial rate NO mol L ⁻¹ s ⁻¹
Experiment 1	0.010	0.010	2.5×10^{-5}
Experiment 2	0.020	0.010	1.0×10^{-4}
Experiment 3	0.010	0.020	5.0×10^{-5}

- Determine the order of the reaction for each reactant.
 - Write the rate equation for the reaction.
 - Calculate the rate constant.
 - Calculate the rate (in mol L⁻¹s⁻¹) at the instant when [NO] = 0.015 mol L⁻¹ and [O₂] = 0.0050 mol L⁻¹
 - At the instant when NO is reacting at the rate 1.0×10^{-4} mol L⁻¹s⁻¹, what is the rate at which O₂ is reactant and NO₂ is forming?
2. The reaction $2 \text{NO(g)} + 2 \text{H}_2\text{(g)} \rightarrow \text{N}_2\text{(g)} + 2 \text{H}_2\text{O(g)}$ was studied at 904 °C, and the data in the table were collected.

	Initial [NO] mol L ⁻¹	Initial [H ₂] mol L ⁻¹	Initial rate N ₂ mol L ⁻¹ s ⁻¹
Experiment 1	0.420	0.122	0.136
Experiment 2	0.210	0.122	0.0339
Experiment 3	0.210	0.244	0.0678
Experiment 4	0.105	0.488	0.0339

- Determine the order of the reaction for each reactant.
 - Write the rate equation for the reaction.
 - Calculate the rate constant at 904 °C.
 - Find the rate of appearance of N₂ at the instant when [NO] = 0.350 M and [H₂] = 0.205 M.
3. The reaction of ^tbutyl-bromide (CH₃)₃CBr with water is represented by the equation:

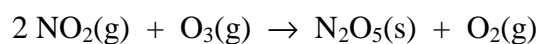


The following data were obtained from three experiments using the method of initial rates:

	Initial [(CH ₃) ₃ CBr] mol L ⁻¹	Initial [H ₂ O] mol L ⁻¹	Initial rate mol L ⁻¹ min ⁻¹
Experiment 1	5.0×10^{-2}	2.0×10^{-2}	2.0×10^{-6}
Experiment 2	5.0×10^{-2}	4.0×10^{-2}	2.0×10^{-6}
Experiment 3	1.0×10^{-1}	4.0×10^{-2}	4.0×10^{-6}

- What is the order with respect to (CH₃)₃CBr?
- What is the order with respect to H₂O?
- What is the overall order of the reaction?
- Write the rate equation.
- Calculate the rate constant, k, for the reaction.

4. The reaction:



$$\text{Rate Law: Rate} = k [\text{NO}_2]^a [\text{O}_3]^b$$

ON ANOTHER SHEET OF PAPER: Write your values for “a” (0, 1, 2), “b” (0, 1, 2), and “k”

The following data were obtained from three experiments using the method of initial rates:

	Initial $[\text{NO}_2]$ mol L^{-1}	Initial $[\text{O}_3]$ mol L^{-1}	Initial rate $\text{mol L}^{-1}\text{min}^{-1}$
Experiment 1	0.100	0.200	5.2×10^{-6}
Experiment 2	0.100	0.100	2.6×10^{-6}
Experiment 3	0.200	0.400	4.16×10^{-5}

- What is the order with respect to NO_2 ?
- What is the order with respect to O_3 ?
- Write the rate equation.
- Calculate the rate constant, k , for the reaction.