

15 • Chemical Kinetics**RATE LAWS**

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

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 $2 \text{NO}(\text{g}) + 2 \text{H}_2(\text{g}) \rightarrow \text{N}_2(\text{g}) + 2 \text{H}_2\text{O}(\text{g})$ 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.