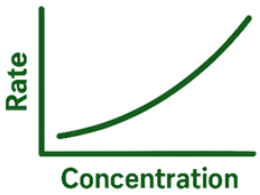
Kinetics and Equilibrium **Name**_____

Reaction Equations and Rate Laws

Read from **Lesson 1: Kinetics of Reactions** in the **Chemistry Tutorial Section, Chapter 14** of **The Physics Classroom**: Part d: Rate Equations Part e: Reaction Mechanisms

Rate Equations



In chemistry, understanding the speed of reactions and the molecular changes that occur during those processes is essential. **Rate equations** describe how the concentration of reactants influences the rate of a chemical reaction, allowing chemists to predict how changes in concentration affect the formation of products.

Questions

Use the **method of initial rates** to solve the following.

1. Clo Wrene is trying to determine the rate law equation for the following reaction and collects the following rate-concentration data.

$Br_2\,(g) + 2\,NO\,(g) \rightarrow 2NOBr\,(g)$

$[Br_2]_o$ (M)	$[NO]_o$ (M)	Initial Rate (M/min)
0.20	0.20	0.35
0.20	0.40	0.70
0.40	0.40	2.80

   a. Determine the order of the reaction for each reactant.

   b. Write the rate equation for the reaction.

   c. Calculate the rate constant and include the correct units.

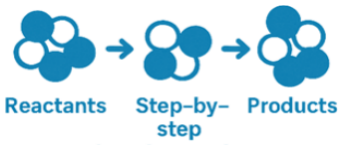
   d. Calculate the rate (in (M/min) at the instant when $[Br_2] = 0.30$ M and $[NO] = 0.30$ M.

   e. When the rate of change of concentration of Br_2 ($\Delta Br_2/\Delta t$) is changing at a rate of –1.00 M/min, what is the rate at which NOBr is forming?

   f. According to the rate law for the reaction, how will an increase in the concentration of bromine affect this reaction? Select all that apply.
      a. The rate of reaction increases.
      b. The rate of the reaction decreases.
      c. The value of the rate law constant increases.
      d. The value of the rate law constant decreases.
      e. Neither the rate nor the value of the rate law constant is changed.

Kinetics and Equilibrium

Reaction Mechanisms



Reaction mechanisms provide a step-by-step explanation of how a reaction actually takes place at the molecular level, showing the individual steps that lead from reactants to products.

Questions

1. Consider the following two step-reaction mechanism:

$$H_2O \rightarrow H_2 + O$$
$$H_2O + O \rightarrow H_2 + O_2$$

a. Write the overall balanced chemical equation.

b. Identify the intermediate (if present) and explain your reasoning.

c. Identify the catalyst (if present) and explain your reasoning.

d. If the rate law is $rate = k[H_2O]$, which step is the rate determining step? Explain your answer.

e. What is the molecularity of the rate determining step?

2. Match the correct term with the following descriptions.

_____ a. Catalyst

_____ b. Collision Model

_____ c. Enthalpy Change

_____ d. Rate-Determining step

_____ e. Reaction Mechanism

v. Amount of heat energy absorbed or released during a chemical reaction

w. Appears as both a reactant and a product, remaining unchanged throughout the reaction

x. Sequence of elementary steps that make up a chemical reaction.

y. Reactions occur when particles collide with sufficient energy and correct orientation.

z. The step of the reaction which governs the overall rate and is used to derive the rate law

3. Which of the following statements are true? If the statement is false, correct it so that it is true.

a. True or False. The sum of all elementary steps must match the overall chemical equation in terms of stoichiometry.

b. True or False. The rate-determining step must occur at the end of the mechanism.

c. True or False. If the temperature increases in both steps of question 1, the concentration of H_2O will decrease at a greater rate.