

Exercise 12.7

Catalyzed Reaction Mechanisms

Name: _____

Date: _____ Per: _____

The rate law of a chemical reaction is a mathematical equation that describes how the reaction rate depends upon the concentration of each reactant.

The method of initial rates allows the values of these orders to be found by running the reaction multiple times under controlled conditions and measuring the rate of the reaction in each case. All variables are held constant from one run to the next, except for the concentration of one reactant. The order of that reactant concentration in the rate law can be determined by observing how the reaction rate varies as the concentration of that one reactant is varied.

Order of Reactant	Change in Initial Rate when Conc. is Doubled
First Order	Rate doubles
Second Order	Rate quadruples
Zero Order	Rate remains unchanged

The precise order of a reactant in a rate law may be calculated using the following formula:

$$\text{reactant order} = \frac{\log \left(\frac{\text{initial rate}_1}{\text{initial rate}_2} \right)}{\log \left(\frac{[X]_1}{[X]_2} \right)}$$

DIRECTIONS: Answer the following in the space provided.

- Draw a rough sketch of the energy profile for each of the cases:
 - $\Delta E = +10 \text{ kJ/mol}$, $E_a = 25 \text{ kJ/mol}$
 - $\Delta E = -10 \text{ kJ/mol}$, $E_a = 50 \text{ kJ/mol}$
 - $\Delta E = -50 \text{ kJ/mol}$, $E_a = 50 \text{ kJ/mol}$

a.	b.	c.
----	----	----

- The activation energy for the decomposition of HI(g) to $\text{H}_2\text{(g)}$ and $\text{I}_2\text{(g)}$ is 186 kJ/mol . The rate constant at 555 K is $3.52 \times 10^{-7} \text{ L/mol}\cdot\text{s}$. What is the rate constant at 645 K ?

- A certain reaction has an activation energy of 54.0 kJ/mol . At the temperature is increased from 22°C to a higher temperature, the rate constant increases by a factor of 7.00 . Calculate the higher temperature.

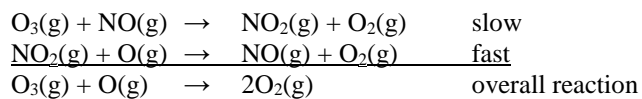
Exercise 12.7

Catalyzed Reaction Mechanisms

Name: _____

Date: _____ Per: _____

4. One mechanism for the destruction of ozone in the upper atmosphere is

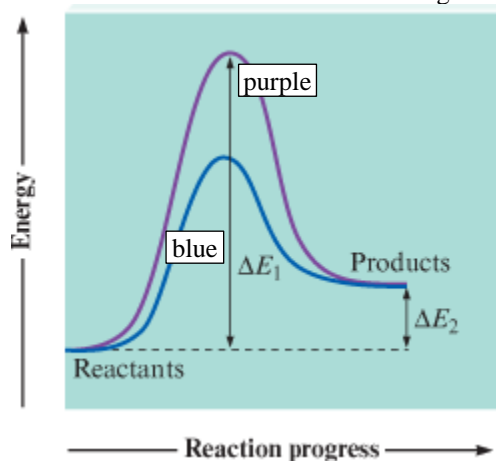


a. Which species is a catalyst?

b. Which species is an intermediate?

c. E_a for the uncatalyzed reaction $\text{O}_3(\text{g}) + \text{O}(\text{g}) \rightarrow 2\text{O}_2(\text{g})$ is 14.0 kJ. E_a for the same reaction when catalyzed is 11.9 kJ. What is the ratio of the rate constant for the catalyzed reaction to that for the uncatalyzed reaction at 25°C? Assume that the frequency factor A is the same for each reaction.

5. Consider the following energy plots for a chemical reaction when answering the questions below.



- Which plot (purple or blue) is catalyzed pathway? _____
- What does ΔE_1 represent? _____
- What does ΔE_2 represent? _____
- Is the reaction endothermic or exothermic? _____