

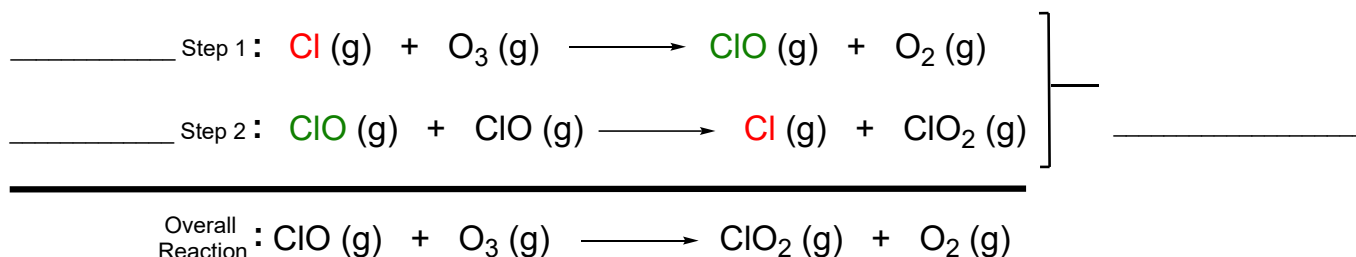
CONCEPT: REACTION MECHANISM

Reaction Mechanism Overview

- A **Reaction Mechanism** is a step-by-step sequence of *elementary steps* by which an overall _____ change occurs.

□ **Elementary Step**: ____ step in a series of reactions that show the progress of a reaction at the molecular level.

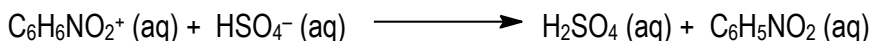
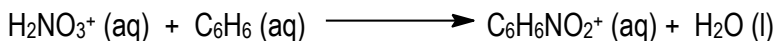
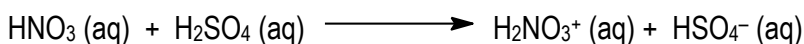
Reaction Mechanism Overview



□ **Catalyst**: Compound shown as a _____ in the 1st step and then as a _____ in the final step.

□ **Reaction Intermediate**: Compound that first appears as a _____ then later as a _____.

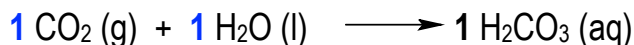
EXAMPLE: Consider the following reaction mechanism for the formation of nitrobenzene:



Identify the reaction intermediate(s) and catalyst(s).

Molecularity

- Associated with the number of moles for _____ molecules within an elementary step.



□ **1 mole** = _____ molecular

□ **2 moles** = _____ molecular

□ **3 moles** = _____ molecular

EXAMPLE: The elementary reaction, $2 \text{ NO}_2 \text{ (g)} + \text{F}_2 \text{ (g)} \longrightarrow 2 \text{ NO}_2\text{F (g)}$, is an example of a _____ reaction.

a) Unimolecular

b) Trimolecular

c) Bimolecular

d) Termolecular

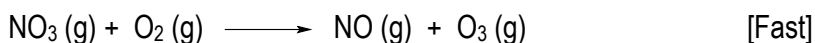
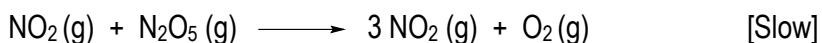
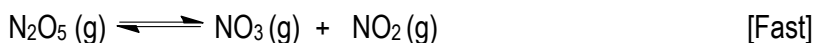
e) Tetramolecular

CONCEPT: REACTION MECHANISM

Rate Law Determination

- In a reaction mechanism, one of the elementary steps is classified as a *slow step*.
 - **Slow Step:** The _____-determining step that limits the overall rate of a chemical reaction.
 - For a slow step, the _____ of the reactants are equal to the reaction orders of the rate law.

EXAMPLE: Consider the following elementary steps. What is the rate law of the reaction mechanism?



STEP 1: Locate the _____ step of the reaction mechanism.

- As long as the reactants are not _____, their _____ = the reaction orders of the rate law.

$$\text{Rate} = ___ \left[\quad \right]^{\square} \left[\quad \right]^{\square}$$

STEP 2: If a reactant is an _____ cancel it out with the product intermediate.

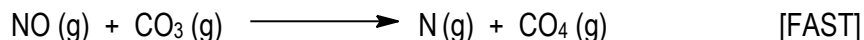
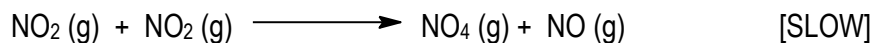
STEP 3: If Step 2 happens, use the elementary step possessing the product intermediate.

- For that elementary step the _____ of the reactants still equal the reaction order.
- For that elementary step the _____ of the products = the _____ of the reaction orders.

$$\text{Rate} = ___ \left[\quad \right]^{\square} \left[\quad \right]^{\square}$$

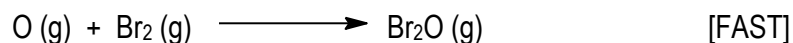
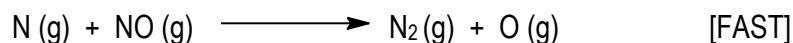
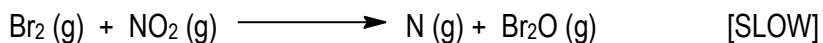
CONCEPT: REACTION MECHANISM

PRACTICE: Consider the following elementary steps:



What is the rate law of the reaction mechanism?

PRACTICE: The following reaction of $2 \text{Br}_2 (\text{g}) + 2 \text{NO} (\text{g}) \longrightarrow \text{N}_2 (\text{g}) + 2 \text{Br}_2\text{O} (\text{g})$ has the following rate law: Rate = $k [\text{Br}_2][\text{NO}]^2$. The proposed mechanism for the reaction is:



Which of the following statements is/are **false**?

- a) The rate determining step is bimolecular.
- b) There are three elementary steps in the reaction mechanism.
- c) The mechanism possesses a catalyst.
- d) O is the only reaction intermediate in this reaction mechanism.
- e) This is not a valid mechanism for the reaction.