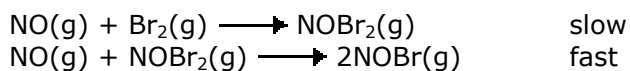


### Exercise 5.34 – Reaction mechanisms

**Q534-01** A proposed mechanism for the reaction  $2\text{NO}(\text{g}) + \text{Br}_2(\text{g}) \longrightarrow 2\text{NOBr}(\text{g})$  is as follows:



If this mechanism is correct then the rate law could be expected to be which of the following:

- A. rate =  $k[\text{NO}][\text{Br}_2]$
- B. rate =  $k[\text{NO}]^2[\text{Br}_2]$
- C. rate =  $k[\text{NO}][\text{NOBr}_2]$
- D. rate =  $k[\text{NO}]^2$

**Q534-02** The rate of the reaction  $2\text{A} + \text{B} \longrightarrow \text{Products}$ , is consistent with the rate equation, rate =  $k[\text{A}][\text{B}]$ .

Which reaction mechanism is consistent with this information?

- A.**  $\text{A} + \text{B} \longrightarrow \text{AB}$  (slow)  
 $\text{AB} + \text{A} \longrightarrow \text{Products}$  (fast)
- B.**  $\text{A} + \text{A} \longrightarrow \text{A}_2$  (slow)  
 $\text{A}_2 + \text{B} \longrightarrow \text{Products}$  (fast)
- C.**  $\text{A} + \text{B} \longrightarrow \text{AB}$  (fast)
- D.**  $\text{A} + \text{A} \longrightarrow \text{A}_2$  (fast)  
 $\text{A}_2 + \text{B} \longrightarrow \text{Products}$  (slow)

**Q534-03** The following reaction,  $\text{X}_2(\text{g}) + 2\text{Y}(\text{g}) \longrightarrow 2\text{XY}(\text{g})$  has the proposed mechanism:

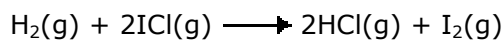


Based on this information the rate expression for this reaction is:

- A. rate =  $k[\text{XY}]$
- B. rate =  $k[\text{X}_2][\text{Y}]^2$
- C. rate =  $k[\text{X}_2]$
- D. rate =  $k[2\text{X}]$

### Exercise 5.34 – Reaction mechanisms

**Q534-04** The reaction of hydrogen and iodine monochloride is represented by this equation:



This reaction is first order in  $\text{H}_2(\text{g})$  and also first order in  $\text{ICl}(\text{g})$ . Which of these proposed mechanisms can be consistent with the given information about this reaction?

Mechanism 1	$\text{H}_2(\text{g}) + 2\text{ICl}(\text{g}) \longrightarrow 2\text{HCl}(\text{g}) + \text{I}_2(\text{g})$	
Mechanism 2	$\text{H}_2(\text{g}) + \text{ICl}(\text{g}) \longrightarrow \text{HCl}(\text{g}) + \text{HI}(\text{g})$	slow
	$\text{HI}(\text{g}) + \text{ICl}(\text{g}) \longrightarrow \text{HCl}(\text{g}) + \text{I}_2(\text{g})$	fast

- A. 1 only
- B. 2 only
- C. Both 1 and 2
- D. Neither 1 nor 2

**Q534-05** For the hypothetical reaction  $2\text{X} + 2\text{G} \longrightarrow \text{Q} + 2\text{M}$ , the rate expression is:

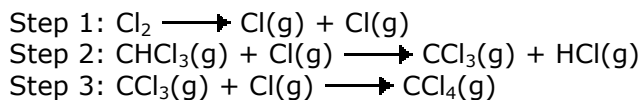
$$\text{Rate} = k[\text{X}]^2[\text{G}]$$

Which mechanism is most likely?

- A.**  $2\text{X} + \text{G} \rightleftharpoons 2\text{Q} + \text{R}$  (fast equilibrium)  
 $\text{Q} + \text{R} + \text{G} \longrightarrow 2\text{M}$  (slow, rate determining)
- B.**  $\text{X} + \text{G} \rightleftharpoons \text{Q} + \text{R}$  (fast equilibrium)  
 $\text{R} + \text{X} \longrightarrow 2\text{M}$  (slow, rate determining)
- C.**  $\text{X} + \text{X} \rightleftharpoons \text{X}_2$  (fast equilibrium)  
 $\text{X}_2 + \text{G} \longrightarrow \text{Q} + \text{T}$  (slow, rate determining)  
 $\text{T} + \text{G} \longrightarrow 2\text{M}$  (fast)
- D.**  $\text{G} + \text{G} \rightleftharpoons \text{G}_2$  (fast equilibrium)  
 $\text{G}_2 + \text{X} \longrightarrow \text{Q} + \text{T}$  (slow, rate determining)  
 $\text{T} + \text{X} \longrightarrow 2\text{M}$  (fast)

### Exercise 5.34 – Reaction mechanisms

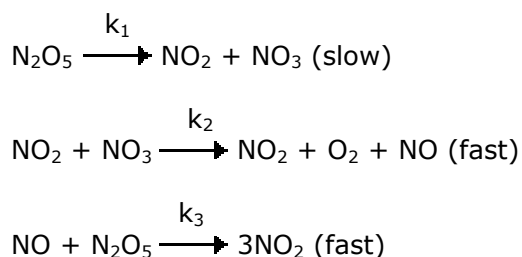
**Q534-06** The reaction between chloroform,  $\text{CHCl}_3(\text{g})$ , and chlorine,  $\text{Cl}_2(\text{g})$ , to form  $\text{CCl}_4(\text{g})$  and  $\text{HCl}(\text{g})$  is believed to occur by this series of steps.



If this reaction is first order in  $\text{CHCl}_3$  and half order in  $\text{Cl}_2$ , which statement about the relative rates of step 1, 2, and 3 is correct?

- A. Step 1 is the slowest.
- B. Steps 1 and 2 must both be slow.
- C. Step 2 must be slower than step 1.
- D. Step 3 must be the slowest

**Q534-07** The mechanism for the decomposition of nitrogen (V) oxide, has been identified as follows:



The stoichiometric equation for this decomposition is:

- A.  $\text{N}_2\text{O}_5 \longrightarrow \text{NO}_2 + \text{NO}_2$
- B.  $\text{N}_2\text{O}_5 \longrightarrow \text{NO}_2 + \text{O}_2 + \text{NO}$
- C.  $2 \text{N}_2\text{O}_5 \longrightarrow 4\text{NO}_2 + \text{O}_2$
- D.  $\text{N}_2\text{O}_5 + \text{NO} \longrightarrow 3\text{NO}_2$

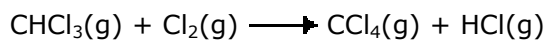
**Q534-08** The rate law consistent with the mechanism shown in question 07 above is:

- A.  $\text{rate} = k_1 [\text{N}_2\text{O}_5]$
- B.  $\text{rate} = k_3 [\text{NO}][\text{N}_2\text{O}_5]$
- C.  $\text{rate} = k_1 k_2 k_3 [\text{N}_2\text{O}_5]^2$
- D.  $\text{rate} = k_2 [\text{NO}_2][\text{NO}_3]$

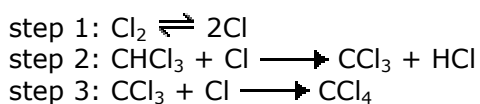
### Exercise 5.34 – Reaction mechanisms

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**Q534-09** For the stoichiometric reaction:



the rate law,  $\text{rate} = k[\text{CHCl}_3][\text{Cl}_2]^{1/2}$  has been determined. The mechanism given below has been proposed.



For this reaction, the rate determining step must be:

- A. step 1.
- B. step 2.
- C. step 3
- D. 1/2 times step 1

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**Q534-10** The ionic reaction:



is found to be described by the experimental rate equation,  $\text{rate} = k[\text{I}^-]^3[\text{S}_2\text{O}_8^{2-}]$ . This suggests that:

- A. the reaction occurs when three iodide ions collide simultaneous with one  $\text{S}_2\text{O}_8^{2-}$  ion
  - B. there must be only one step in the overall reaction since the rate is first-order in both reactants
  - C. the rate of reaction is inhibited by the presence of  $\text{I}_3^-$
  - D. a slow step in the overall reaction sequence may involve the collision of a single  $\text{I}^-$  ion with a single  $\text{S}_2\text{O}_8^{2-}$  ion.
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