Example: Identifying overall reaction and intermediates/catalysts
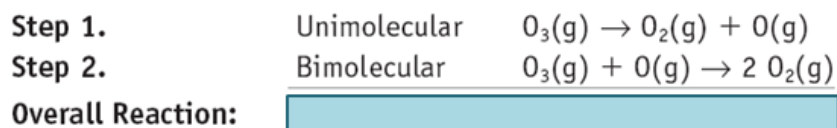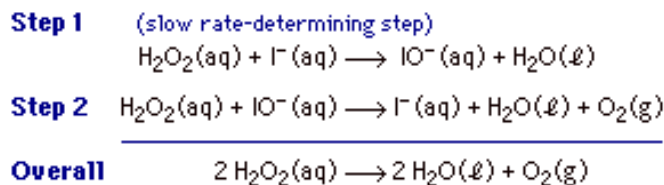
Step 1.	Unimolecular	$O_3(g) \rightarrow O_2(g) + O(g)$
Step 2.	Bimolecular	$O_3(g) + O(g) \rightarrow 2\,O_2(g)$
Overall Reaction:		

CLICKER QUESTION

$$2\,NO(g) \rightarrow N_2O_2(g)$$

$$N_2O_2(g) + H_2(g) \rightarrow N_2O(g) + H_2O(g)$$

$$N_2O(g) + H_2(g) \rightarrow N_2(g) + H_2O(g)$$
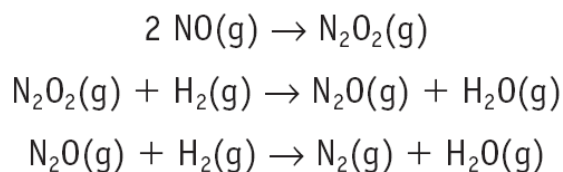
Overall Reaction:

Intermediates?

Catalysts?

Step 1 (slow rate-determining step)

$H_2O_2(aq) + I^-(aq) \longrightarrow IO^-(aq) + H_2O(\ell)$

Step 2 $H_2O_2(aq) + IO^-(aq) \longrightarrow I^-(aq) + H_2O(\ell) + O_2(g)$

Overall $2\,H_2O_2(aq) \longrightarrow 2\,H_2O(\ell) + O_2(g)$

Elementary Step	Molecularity	Rate Equation
A $\rightarrow$ product	Unimolecular	Rate= k[A]
A + B $\rightarrow$ product	Biomolecular	Rate= k[A][B]
A + A $\rightarrow$ product	Bimolecular	Rate= $k[A]^2$
2A + B $\rightarrow$ product	Termolecular	Rate= $k[A]^2[B]$

Molecularity of each step?

What is the overall reaction?

Step 1.	$Br_2(g) + NO(g) \longrightarrow Br_2NO(g)$
Step 2.	$Br_2NO(g) + NO(g) \longrightarrow 2 BrNO(g)$

Overall Reaction:

If Step 1 is slow, what is the rate law?

Elementary Step 1 Slow, rate-determining $2 NO_2(g) \longrightarrow NO_3(g) + NO(g)$

Elementary Step 2 Fast $NO_3(g) + CO(g) \longrightarrow NO_2(g) + CO_2(g)$

Overall Reaction $NO_2(g) + CO(g) \longrightarrow NO(g) + CO_2(g)$

- **Proposed mechanism 1:**

Step 1:

$H_2 + ICl \rightarrow HI + HCl$ *(slow)*

Step 2:

$ICl + HCl \rightarrow HI + Cl_2$

Sum

Rate
  Step 1
  Step 2
  Overall

- **Proposed mechanism 2:**

Step 1:

$H_2 + ICl \rightarrow HCl + HI$ *(slow)*

Step 2:

$HI + ICl \rightarrow HCl + I_2$

Sum

Rate
  Step 1
  Step 2
  Overall

How to determine if a proposed reaction mechanism is "reasonable" $H_2 + 2ICl \rightarrow 2HCl + I_2$