Reaction Mechanism

- A reaction mechanism summarizes the individual steps a reaction follows
- Each individual step is called an elementary step or elementary process

Example

- $2\ NO_{(g)} + O_{2(g)} \rightarrow 2\ NO_{2(g)}$
- Experimental data shows that the NO_2 is not formed directly from the collision of NO and O_2
  - N_2O_2 particles can be detected during the reaction

- A more likely scenario for the reaction is a two step reaction mechanism

Step 1		2 NO	→	N_2O_2
Step 2	N_2O_2	+ O_2	→	2 NO
Net Reaction	2 NO	+ O_2	→	2 NO_2

- As N_2O_2 appears in the reaction mechanism but not in the overall reaction, it is called an **intermediate**

- Catalysts, as well as intermediates, do not appear in the overall reaction
- The decomposition of ozone with a chlorine catalyst illustrates this

$$Cl + O_3 \rightarrow O_2 + ClO$$

Step 1	Cl	$+ O_3$	$\rightarrow$	ClO	$+ O_2$
Step 2		O_3	$\rightarrow$	O_2	$+ O$
Step 3	ClO	$+ O$	$\rightarrow$	Cl	$+ O_2$
Net Reaction		$2\ O_3$	$\rightarrow$	$3\ O_2$	

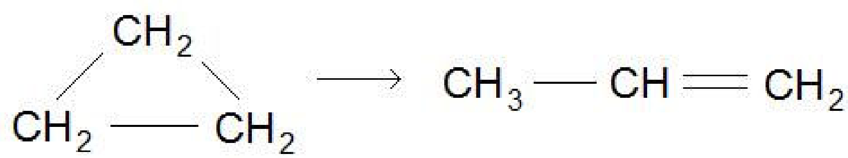
- Cl is a catalyst
- ClO is an intermediate

- The slowest of the elementary processes will determine the rate of the reaction
- It is called the **rate determining step**

- The **molecularity** of a reaction refers to the number of particles involved in an elementary step
- The molecules may be of the same type or different types
- The elementary step may involve one particle, two particles, or three particles
- It is possible to use the elementary steps of a reaction to deduce a rate law

One Particle, Unimolecular

- Conversion of cyclopropane to propene



Two Particles, Bimolecular

- Production of nitrogen dioxide
- Both elementary steps involve two particles

Step 1 $2\,NO \rightarrow N_2O_2$

Step 2 $N_2O_2 + O_2 \rightarrow 2\,NO$

Three Particles, Termolecular

- There are very few reactions that require three particles to react simultaneously in an elementary step