



Chem 341 • Organic Chemistry I

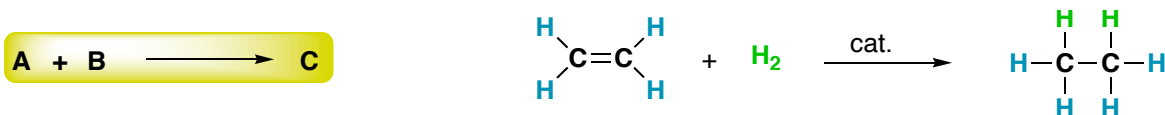
Lecture Summary 12 • September 19, 2007

Chapter 5 - Overview of Organic Reactions

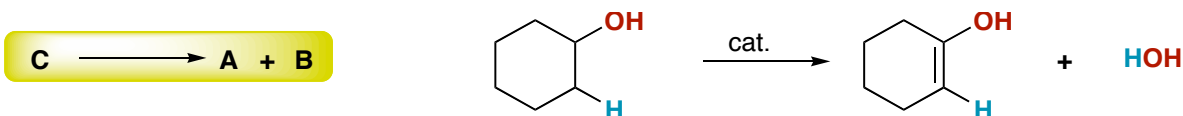
General Reaction Classes

All reaction steps can be classified as one of the following four general reactions.

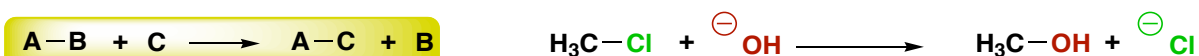
Additions Reactions - two or more molecules combine to form a new product



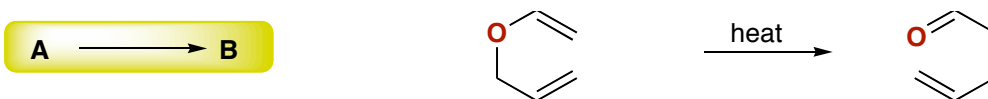
Elimination Reactions - a molecule breaks apart into two or more molecules



Substitution Reactions - part of a molecule is substituted for another group



Rearrangement Reactions - A molecule does not gain or lose atoms, but reorganizes its bonds or groups. Also called isomerization.



Reaction Mechanisms

A mechanism is a detailed step by step description of a chemical transformation. Chemical reactions involve bond breaking and bond making. Bonds can break in two different ways.

Homolytic Bond Cleavage - the atoms separate and each takes one electron from the bond to form free radicals. Note that radicals are neutral and have one unpaired electron.

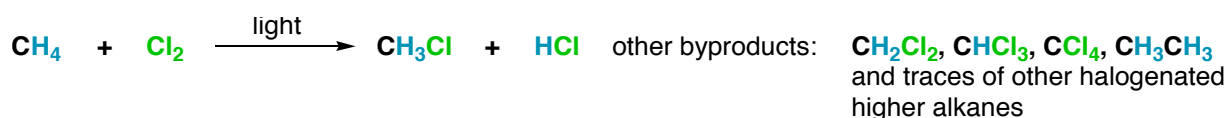


Heterolytic Bond Cleavage - the atoms separate and the more electronegative atom takes both electrons from the bond. This usually leaves one atom electron deficient and positive and one atom electron rich and negatively charged. Most organic reactions occur via heterolytic bond cleavages.



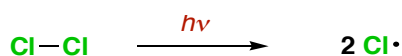
Free Radical Halogenation of Alkanes

Alkanes are generally inert to most reactions because they are not polar. However, when highly reactive free radicals are present, alkanes can react. Consider the following reaction where methane becomes chlorinated with chlorine in the presence of light.

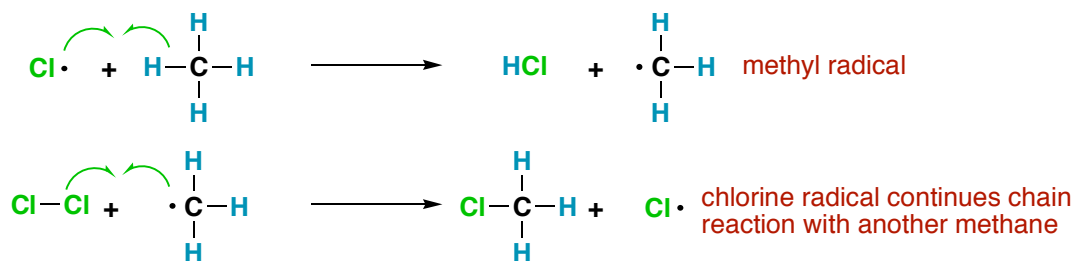


A mechanism that accounts for the formation of all these products is shown below. Notice there are three different kinds of radical steps in this mechanism; Initiation, Propagation and Termination. Initiation steps always involves a stable molecule breaking into two or more radicals. Propagation involves the reaction of a radical species with a stable molecule generating another stable molecule plus a different reactive radical. Termination of radical processes occurs when two radicals combine to form a stable molecule and no other reactive species.

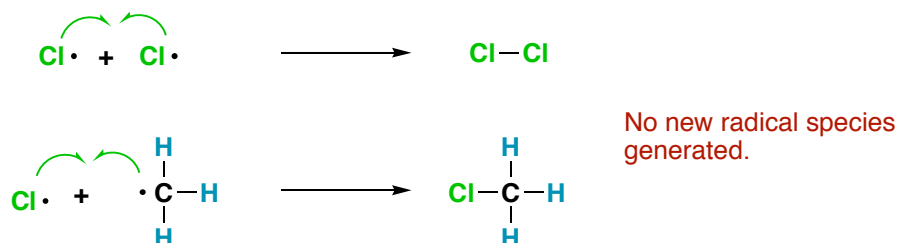
Initiation - Chlorine absorbs a photon of light and homolytically breaks apart.



Propagation - Chlorine radical abstracts a hydrogen (with one electron) from methane leaving behind a methyl free radical. The methyl free radical reacts with a chlorine molecule to put one chlorine on the carbon leaving the other as a reactive radical. The resulting Cl radical is then able to continue the chain reaction by reacting with another molecule of methane.



Termination - This reaction comes to a halt when two chlorine radicals come together to form chlorine molecule or a methyl radical combines with a chlorine radical.



Note that there could be other propagation and termination reactions that occur. For example, CH_2Cl_2 could form by reacting chlorine radical with the first product CH_3Cl to make a different radical which grabs chlorine. Ethane could be formed if two methyl radicals combine in a termination process. Generally free radical halogenation of alkanes is not a very useful reaction as there are many products that result and it is not clean or selective.

Polar Reactions

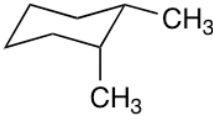
Most reactions occur through polar heterolytic bond breaking and making. They occur due to the attraction between positive and negatively charged parts of a molecule. Thus, it is important to remember how electronegative atoms influence the polarization of bonds. In any polar reaction there is an electron deficient species and an electron rich species. We have special terms to refer to their role in a reaction.

Nucleophile (loves the nucleus) - these are electron rich and seek out positive charges.

Electrophile (loves electrons) - these are electron deficient and are seeking electrons.

A nucleophile will attack (push its electron density or electron pair towards) an electrophile.

Quiz of the day

Q: Note: Please make sure your student ID in your PRS unit does not have the leading 0. Which of the statements is true about the following molecule? 	<input type="checkbox"/> 1:	The boat conformation would be lower in energy.
	<input type="checkbox"/> 2:	The ring flip conformer is higher in energy.
	<input type="checkbox"/> 3:	The ring flip conformer is lower in energy.
	<input checked="" type="checkbox"/> 4:	The ring flip conformer is equal in energy.