

Organic Reactions

Most organic compounds are hydrocarbons that come from petroleum...then how do we see such a wide variety of organic molecules? Chemical Reactions!

Types of Organic Reactions

1. Substitution
2. Elimination
3. Addition
4. Condensation



1. Substitution Reactions

A reaction in which one atom or a group of atoms in a molecule is replaced by another atom or groups of atoms.

Halogenation-a hydrogen atom is replaced by Chlorine, Fluorine or Bromine on an alkane (Iodine is less reactive and therefore doesn't substitute well)

In general, $\text{R-CH}_3 + \text{X}_2 \rightarrow \text{R-CH}_2\text{X} + \text{HX}$

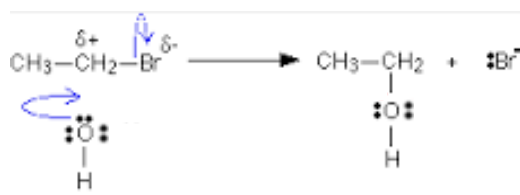
More specifically,



Once an alkane has been halogenated, the compound can undergo further substitutions

In general, $\text{R-CH}_2\text{X} + \text{OH}^- \rightarrow \text{R-OH} + \text{X}^-$

More specifically,



****This can also be accomplished by add water to the reaction; in this case an alcohol and a binary acid with form**



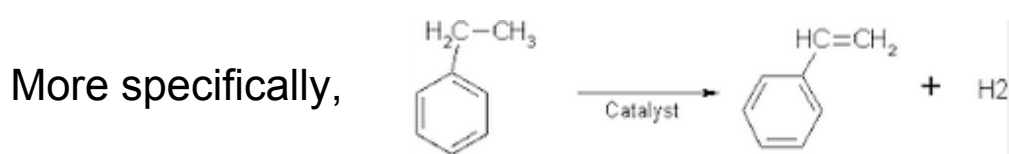
2. Elimination Reactions

A reaction in which a combination of atoms is removed from two adjacent C atoms forming an additional bond between the C atoms.

- eliminated atoms form stable compounds such as H_2O , HCl or H_2

Dehydrogenation-a reaction that eliminates two hydrogen atoms

In general, $\text{CH}_3\text{CH}_3 \rightarrow \text{CH}_2\text{CH}_2 + \text{H}_2$



Alkyl halides can undergo elimination reactions to produce an alkene and a binary acid

In general, $\text{R-CH}_2\text{-CH}_2\text{-X} \rightarrow \text{R-CH=CH}_2 + \text{HX}$

Alcohols can undergo elimination reactions by losing a H^+ and an OH^- to form water (dehydration reaction)

In general, $\text{R-CH}_2\text{-CH}_2\text{-OH} \rightarrow \text{R-CH=CH}_2 + \text{H}_2\text{O}$



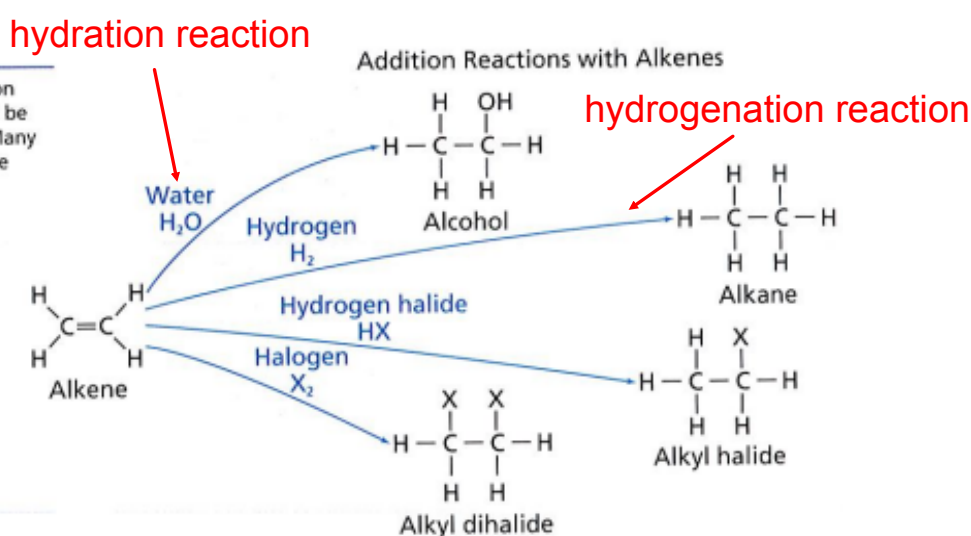
3. Addition Reaction

A reaction in which a other atoms bond to each of two atoms bonded by a double or triple bond

- reverse of an elimination reaction

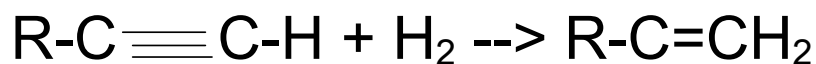
Figure 23-18

These examples are common addition reactions that can be carried out with alkenes. Many other addition reactions are possible.

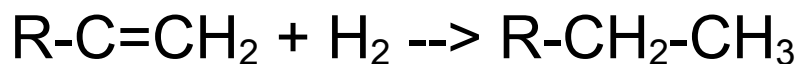


Alkynes can also be hydrogenated to produce alkenes or alkanes

1st H₂ molecule



1nd H₂ molecule





4. Condensation

A reaction in which two smaller organic molecules combine to form a more complex molecule accompanied by the loss of a small molecule such as water

Esterification is a type of condensation reaction:

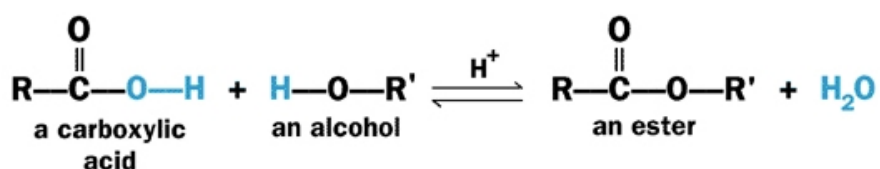
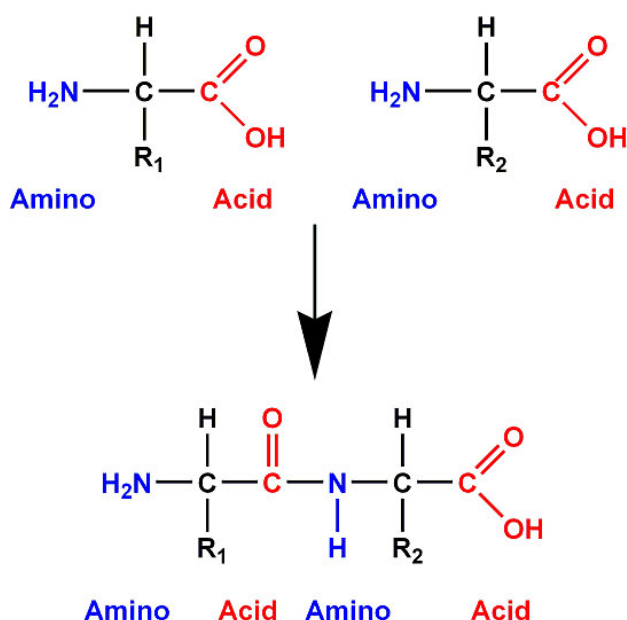


FIGURE A.

(Where R and R' are general hydrocarbon groups)

Condensation reactions are essential for living organisms:





Predicting Products of Organic Reactions

You can use the generic equations you have been provided to predict the products of specific organic reactions:

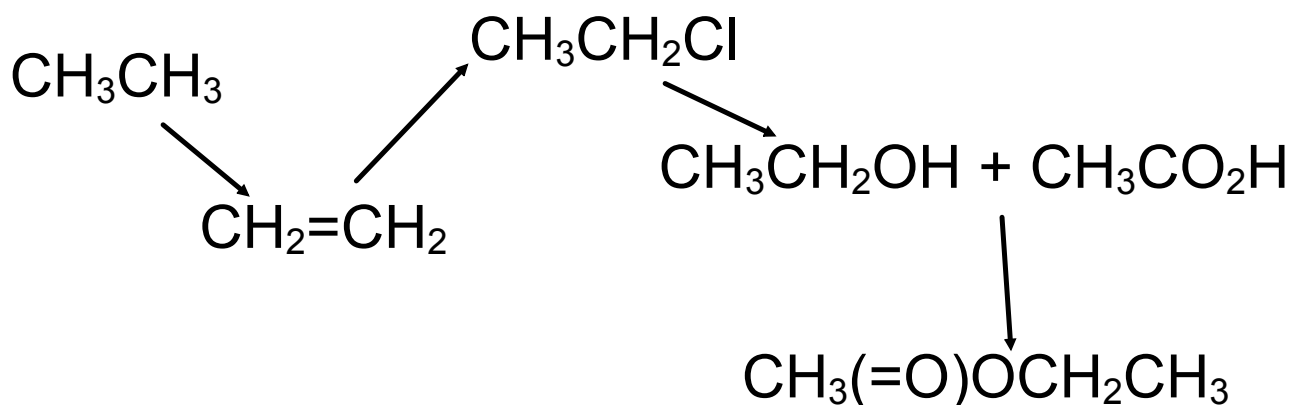
Steps:

1. Draw the structure of the reactant(s)
2. Use the generic equation as a model to see how the reactant(s) would react
3. Draw the structure of the likely product(s)

Example 1: Predict the product of the elimination of 1-butanol

Example 2: Predict the product of the reaction between cyclopentene and hydrogen bromide

Example 3: Label each reaction as a substitution, elimination, addition or condensation reaction





3.4 Assignment

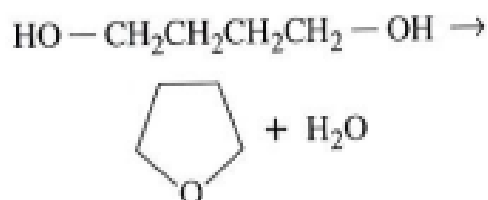
- Classify each of the following reactions as either substitution, elimination, addition, or condensation.
 - $$\text{CH}_3\text{CH}=\text{CHCH}_2\text{CH}_3 + \text{H}_2 \rightarrow \text{CH}_3\text{CH}_2-\text{CH}_2\text{CH}_2\text{CH}_3$$
 - $$\text{CH}_3\text{CH}_2\text{CH}_2\underset{\text{OH}}{\text{CH}}\text{CH}_3 \rightarrow \text{CH}_3\text{CH}_2\text{CH}=\text{CHCH}_3 + \text{H}_2\text{O}$$
- Identify the type of organic reaction that would best accomplish each of the following conversions.
 - alkyl halide \rightarrow alkene
 - alkene \rightarrow alcohol
 - alcohol + carboxylic acid \rightarrow ester
- Complete each of the following equations by writing the condensed structural formula for the product that is most likely to form.
 - $$\text{CH}_3\text{CH}=\text{CHCH}_2\text{CH}_3 + \text{H}_2 \rightarrow$$
 - $$\text{CH}_3\text{CH}_2\text{CHCH}_2\text{CH}_3 + \text{OH}^- \rightarrow$$
 - $$\text{CH}_3\text{CH}_2\text{C}=\text{CCH}_3 + 2\text{H}_2 \rightarrow$$
 - $$\text{CH}_3\text{CH}_2\underset{\text{OH}}{\text{CH}}\text{CH}_2\text{CH}_3 \xrightarrow{\text{Dehydration}}$$
- Identify the type of organic reaction seen below then predict the product(s).
 - ethene + HBr \rightarrow
 - 1-bromopropane + OH $^-$ \rightarrow
 - ethanol + propanoic acid \rightarrow
 - 2,3-dimethyl-1-butene + H $_2$ \rightarrow



3.4 Assignment KEY Cont...

5. Explain why the hydration reaction involving 1-butene may yield two distinct products whereas the hydration of 2-butene yields only 1 product.

6. Explain the difference between an elimination reaction and a condensation reaction. Which type of reaction best is best represented by the following equation?



7. Functional groups give organic compounds distinct properties that may be used to identify the type of compound present. Suppose to examined the properties of several compounds and made the following observations:

Compound 1-liquid that has a pungent odour. It is miscible with water and the solution is a weak electrolyte.

Compound 2-is a liquid that has a strong aroma resembling apricots.

Using your observations, classify the functional group in each compound.