Organic Reactions

Why?

Many organic reactions lead to products we use everyday. Organic reactions can be categorized by looking at the reactants used and the products formed. Soap, alcohol, fragrances, flavors, and flames in your gas barbeque are all products of organic reactions.

Learning Objectives

- Recognize organic reactions: substitution, addition, esterification, combustion, fermentation, and saponification.

Success Criteria

- Predict the products of organic reactions.

Vocabulary

- Substitution
- Addition
- Fermentation
- Saponification
- Combustion
- Esterification

Prerequisites

- Writing chemical equations
- Ability to distinguish reactants and products in a reaction
- Naming and identifying organic compounds
- Ability to distinguishing between saturated and unsaturated hydrocarbons
- Naming and recognizing functional groups in organic compounds

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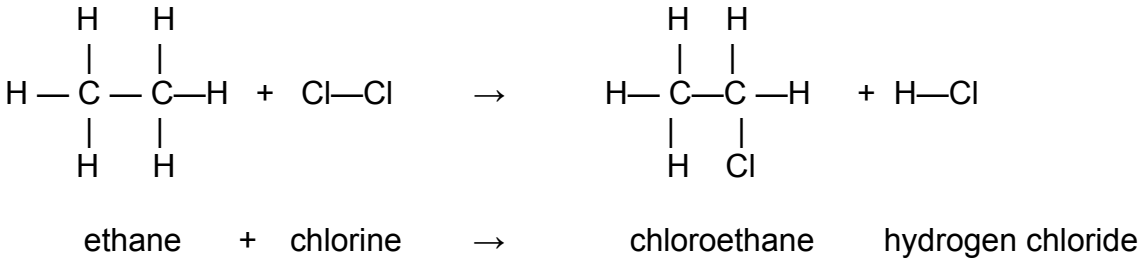
Edited by Linda Padwa and David Hanson, Stony Brook University

Model #1: Substitution



Key Questions

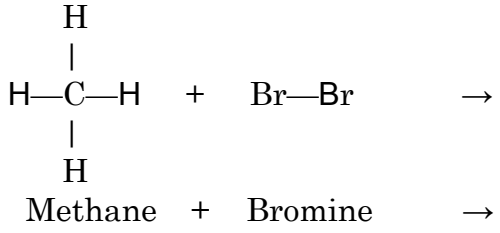
1. What are the reactants and products in this reaction?

2. Describe what happened in the substitution reaction.

3. What are the characteristic features of a substitution reaction?

Exercises

1. Draw and name the products of the substitution reaction between methane and bromine.



2. Describe what happens in the substitution reaction that involves methane and bromine molecules.

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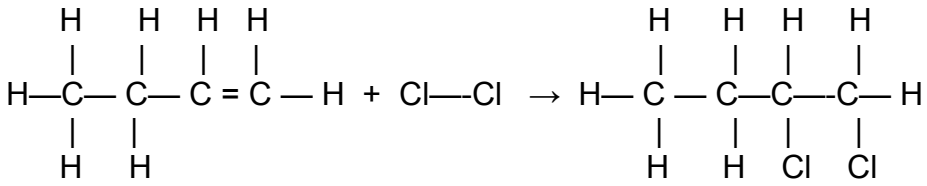
3. Describe a substitution reaction in general terms.

Model # 2: Addition



Key Questions

1. How are the reactants in this reaction the similar to those in the substitution reaction?

2. How are the reactants in this reaction different from those in the substitution reaction?

3. What *type* of organic compound is the reactant in the addition reaction?

4. Describe what happens in the addition reaction.

5. What are the characteristic features of an addition reaction?

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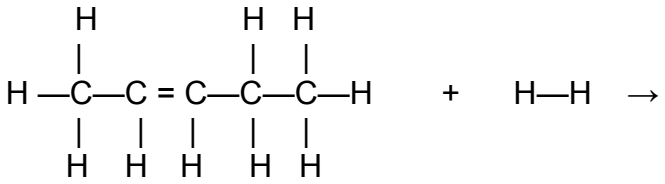
6. Suggest at least two other diatomic elements be could replace chlorine in an addition reaction.

Exercises

1. Draw and name the products of the addition reaction between pentene and hydrogen.



Pentene + Hydrogen →

2. Describe what is going on between the molecules of pentene and hydrogen in this addition reaction.

3. Describe an addition reaction in general terms.

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Model 3: Combustion

$$C_3H_8 + 5\ O_2 \rightarrow 3\ CO_2 + 4\ H_2O$$

pentane + oxygen → carbon dioxide + water

Key Questions

1. What are the reactants and products in this reaction?

2. Describe what happened in the combustion reaction.

3. What are the characteristic features of a combustion reaction?

Exercise

1. Propane is an alkane, hexene is an alkene, and butyne is an alkyne. What would be the products of the combustion equation for each of these compounds? Explain your answer.

2. Write the balanced equation for the complete combustion of hexene (C_6H_{12}).

3. Describe a combustion equation in general terms.

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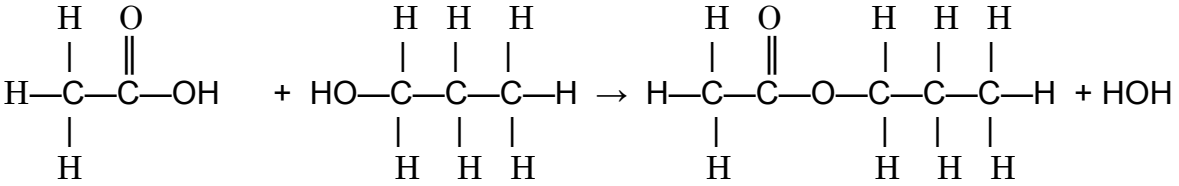
Model 4: Esterification

Many compounds found in fruits can be prepared in the laboratory using an esterification reaction.



ethanoic acid + propyl alcohol → propylethoanoate + water

Key Questions

1. To what class of organic compounds does reactant 1 belong?

2. To what class of organic compounds does reactant 2 belong?

3. To what class of organic compounds does the product (not water) belong?

4. Based on the information in the model, what are the characteristic features of an esterification reaction?

Exercise

1. Draw a structural formula for each of the *reactants* in the reaction below.

2. Identify and draw product X.

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3. In general terms, describe an esterification equation.

Model #5: Fermentation

$$C_6H_{12}O_6 \xrightarrow{\text{Yeast/zymase}} 2C_2H_5OH + 2CO_2$$

Sugar ethanol carbon dioxide

Key Questions

1. Ethanol is an example of what type of organic compound?

2. What is the role of the "yeast/zymase" in the fermentation reaction?

Exercise

1. What are the characteristic features of a fermentation reaction?

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Model #6: Saponification

$C_3H_5(C_{17}H_{35}COO)_3 + 3NaOH \rightarrow 3\ C_{17}H_{35}COONa + C_3H_5(OH)_3$

Fat	Strong Base	Soap	Glycerin

Key Questions

1. Draw the structural formula for one soap molecule.

2. Draw the structural formula for glycerin.

Exercise

1. What are the characteristic features of a saponification reaction?

2. If the Na in the soap molecule were to be replaced with H, what would be the classification of the organic compound that forms?

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