

UNIT 12 - TOPIC 3
ORGANIC REACTIONS

Name: _____

ESSENTIALS: Know, Understand, and Be Able To...

Types of organic reactions include:

- addition
- substitution
- combustion
- polymerization
- esterification
- fermentation
- saponification

Identify organic reactions and fill in missing reactants/products.

TEXT REFERENCE: Addition – p. 733 – 34
Substitution – p. 728 – 29
Combustion – p. 336
Polymerization – p. 747 & 750
Esterification – p. 742
Fermentation – p. 733
Saponification – p. 776

EXPLORE

Activity: Organic Reactions

ELABORATE

Assignments

ENVISION

Moodle Assignment

EVALUATE

Quiz

Quiz Corrections

Activity: 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:

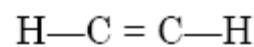
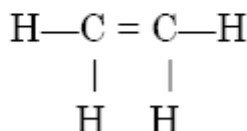
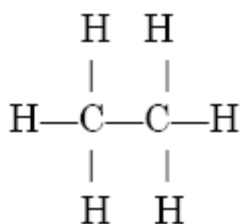
- Recognize organic reactions and predict the products formed from them:
 - Substitution
 - Addition
 - Esterification
 - Combustion
 - Fermentation
 - Saponification
 - Polymerization

Prerequisites:

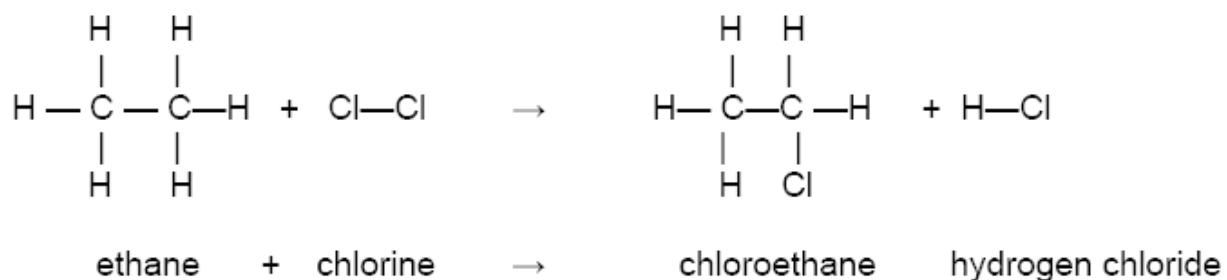
- Writing chemical equations.
- Ability to distinguish reactants and products in a reaction.
- Naming and identifying organic compounds.
- Ability to distinguish between saturated and unsaturated hydrocarbons.
- Naming and recognizing functional groups in organic compounds.

Warm Up Questions:

1. What element is found in all organic compounds?
2. What elements are found in hydrocarbons?
3. What are the names of the following simple hydrocarbons?



Model 1: Substitution

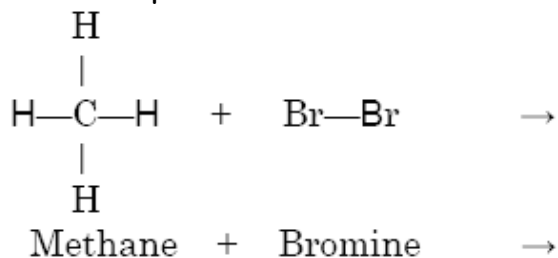


Key Questions:

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:

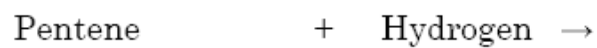
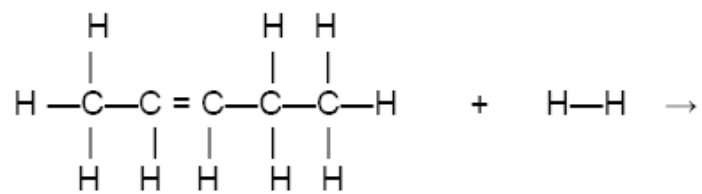
1. Draw and name the products of the substitution reaction between methane and bromine.



2. Describe what happens in the substitution reaction that involves methane and bromine molecules.
3. Describe a substitution reaction in general terms.

Exercises:

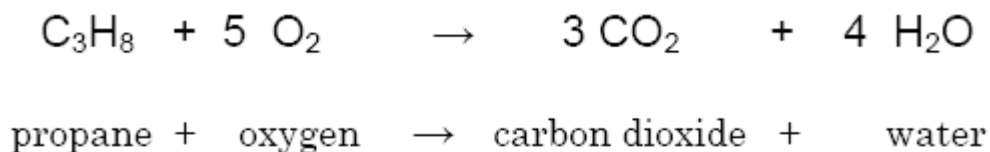
1. Draw and name the products of the addition reaction between pentene and hydrogen.



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.

Model 3: Combustion



Key Questions:

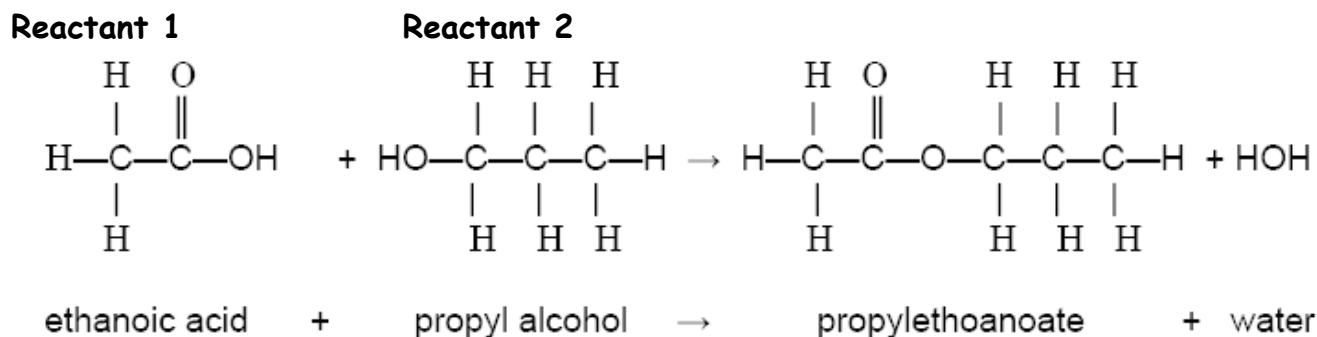
1. What are the reactants and products in this reaction?
2. Describe what happened in the combustion reaction.
3. What are the characteristic features of a combustion reaction?

Exercises:

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.

Model 4: Esterification

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

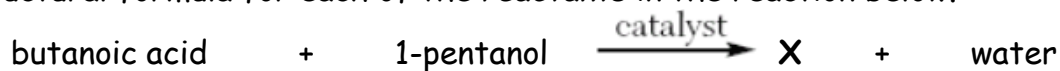


Key Questions:

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?

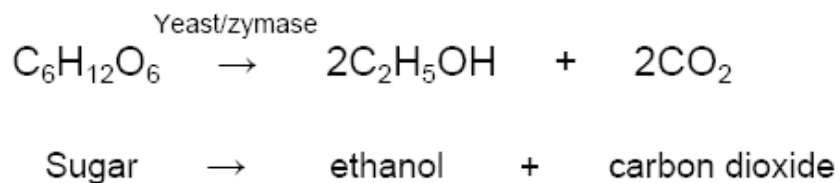
Exercises:

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



2. Identify and draw product X.
3. In general terms, describe an esterification equation.

Model 5: Fermentation



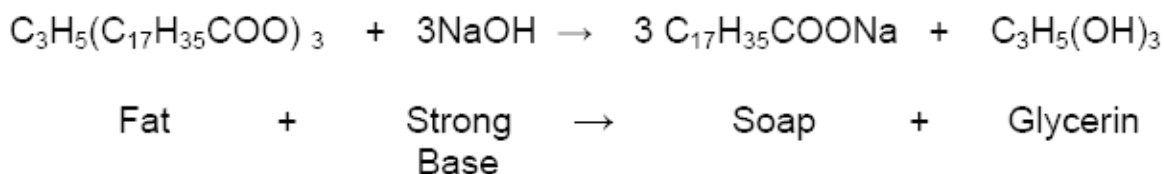
Key Questions:

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?

Model 6: Saponification



Exercises:

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?

****NOTE: SAPOnification looks like SOAP!!**

Model 7: Polymerization



MONOMER



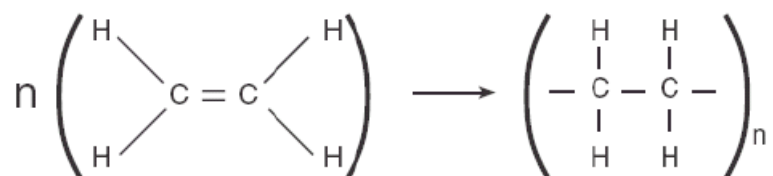
?

Using the paperclips to represent monomers, make a chain of 20 paperclips.

Key Questions:

1. If the single unit in the model is called a monomer, what would you call a chain of the units?
2. Describe the difference between a monomer of paperclips and the chain of paperclips that you made.
3. What is the relationship between a monomer and a polymer?

Exercises:



(n is a large number, generally > 2000)

Using the terms monomer, polymer, and polymerization, describe in your own words what is happening in this reaction.

BONUS: Polymer Research. Here are some examples to get you started.

Synthetic Polymers:

polyethylene (plastic containers)

polystyrene (styrofoam)

polyurethane (pillows, wood preservative)

polypropylene (stronger containers)

polyester (fibers)

polyvinyl chloride (PVC) piping, raincoats

Natural Polymers:

Polysaccharides (starch)

Proteins (poly amino acids)

Cellulose (wood)

Use the textbook or internet for additional help as needed.

1. Polymers are used to make many different materials. Name 5 parts of a car that are made using polymers.

2. Why is a polymer used in the windshields of airplanes and what kind of polymer is it?

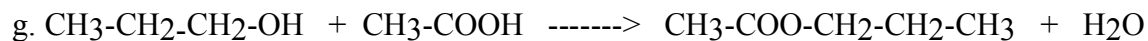
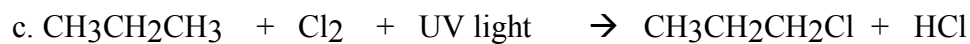
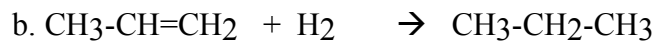
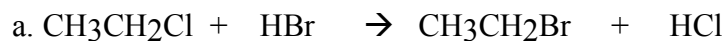
3. Many foods used to be packaged in glass bottles. What kind of polymer now is used instead of glass?

4. What might be some of the economic side effects of the increased use of polymers in automobiles?

5. While many of the polymers in use today are man-made, there are many naturally occurring polymers that are encountered every day. Name three common natural polymers and a source for each

Assignment: Organic Reactions Practice

What kind of reaction is shown (Addition, Substitution, or Esterification)



2. Draw the structure of the compound that results when

a. HBr is added to 2-butene

b. Ethyl alcohol is condensed with methanoic acid.

Assignment: Organic Reactions Practice



1. Fill in the missing information in the table below.

Row	Reaction	Name of Reaction
(1)	$ \begin{array}{c} \text{H} & \text{H} & \text{H} & \text{O} \\ & & & \\ \text{H}-\text{C}-\text{C}-\text{C}-\text{C}-\text{OH} \\ & & \\ \text{H} & \text{H} & \text{H} \end{array} + \text{X} \longrightarrow \begin{array}{c} \text{H} & \text{H} & \text{H} & \text{O} & \text{H} & \text{H} \\ & & & & & \\ \text{H}-\text{C}-\text{C}-\text{C}-\text{C}-\text{O}-\text{C}-\text{C}-\text{H} \\ & & & & & \\ \text{H} & \text{H} & \text{H} & & \text{H} & \text{H} \end{array} + \text{H}-\text{O}-\text{H} $	
(2)	$ \begin{array}{c} \text{H} & \text{H} & \text{H} \\ & & \\ & \text{C}=\text{C}-\text{C}-\text{H} \\ & & \\ & \text{H} & \text{H} \end{array} + \text{Br}_2 \longrightarrow \text{X} $	
(3)	$ \begin{array}{c} \text{CH}_2-\text{O}-\overset{\text{O}}{\parallel}{\text{C}}(\text{CH}_2)_{14}\text{CH}_3 \\ \\ \text{CH}-\text{O}-\overset{\text{O}}{\parallel}{\text{C}}(\text{CH}_2)_{14}\text{CH}_3 \\ \\ \text{CH}_2-\text{O}-\overset{\text{O}}{\parallel}{\text{C}}(\text{CH}_2)_{14}\text{CH}_3 \\ \text{a fat} \end{array} + 3 \text{NaOH} \begin{array}{l} \text{sodium hydroxide} \\ \text{(or KOH, potassium hydroxide)} \end{array} \downarrow \begin{array}{c} \text{CH}_2-\text{OH} \\ \\ \text{CH}-\text{OH} \\ \\ \text{CH}_2-\text{OH} \\ \text{glycerol} \end{array} + 3 \text{CH}_3(\text{CH}_2)_{14}\text{CO}_2\text{Na} \begin{array}{l} \text{a crude soap} \end{array} $	
(4)	$ \text{C}_6\text{H}_{12}\text{O}_6(\text{aq}) \xrightarrow{\text{enzyme}} 2\text{X} + 2\text{CO}_2(\text{g}) $	
(5)	$ \text{CH}_4(\text{g}) + 2\text{O}_2(\text{g}) \rightarrow 2\text{H}_2\text{O}(\text{g}) + \text{CO}_2(\text{g}) $	
(6)	$ n \left(\begin{array}{ccc} \text{H} & & \text{H} \\ & \diagdown & / \\ & \text{C}=\text{C} & \\ & / & \diagdown \\ \text{H} & & \text{H} \end{array} \right) \longrightarrow \left(\begin{array}{cc} \text{H} & \text{H} \\ & \\ -\text{C}- & \text{C}- \\ & \\ \text{H} & \text{H} \end{array} \right)_n $	
(7)	$ \text{C}_4\text{H}_{10} + \text{X}_2 \rightarrow \text{C}_4\text{H}_9\text{Cl} + \text{HCl} $	

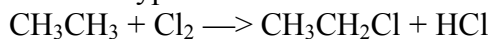
Questions:

- In row 1 of the table above, identify the missing reactant X. Draw a structural formula and write the name.
- In row 2 of the table above, identify the missing product X. Draw a structural formula and write the name.
- In row 4 of the table above, identify the missing product X.
- In row 7 of the table above, identify the missing reactant X.

Assignment: Organic Reactions Drill



1. What type of reaction is



1. an addition reaction
2. a substitution reaction
3. a saponification reaction
4. an esterification reaction

2. The products of the fermentation of a sugar are ethanol and

1. water
2. oxygen
3. carbon dioxide
4. sulfur dioxide

3. Which organic reaction produces rubber and plastics?

1. polymerization
2. esterification
3. saponification
4. fermentation

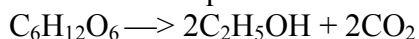
4. Which compound can undergo an addition reaction?

1. CH_4
2. C_2H_4
3. C_3H_8
4. C_4H_{10}

5. Which substance is a product of a fermentation reaction?

1. glucose
2. zymase
3. ethanol
4. water

6. Given the equation:



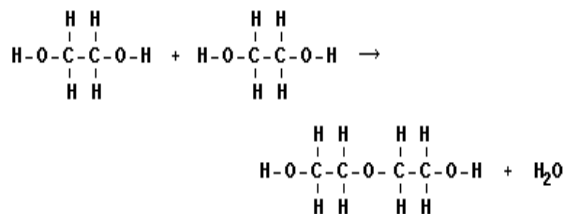
The chemical process illustrated by this equation is

1. fermentation
2. saponification
3. esterification

4. polymerization

7. The process of joining many small molecules into larger molecules is called

1. neutralization
2. polymerization
3. saponification
4. substitution



8. Which type of reaction is represented by the equation in the diagram?

1. condensation polymerization
2. addition polymerization
3. esterification
4. saponification

9. The reaction



1. substitution
2. addition
3. esterification
4. fermentation

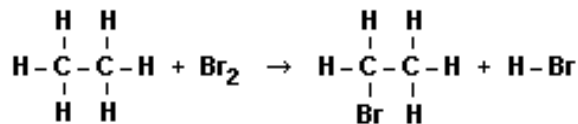
10. Which formula correctly represents the product of an addition reaction between ethene and chlorine?

1. CH_2Cl_2
2. CH_3Cl
3. $\text{C}_2\text{H}_4\text{Cl}_2$
4. $\text{C}_2\text{H}_3\text{Cl}$

11. When C_2H_4 molecules polymerize, the name of the polymer formed is

1. polymethylene

2. polyethylene
3. polypropylene
4. polybutylene



12. When butane burns in an excess of oxygen, the principal products are

1. CO₂ and H₂O
2. CO₂ and H₂
3. CO and H₂O
4. CO and H₂

13. Which reaction is used to produce polyethylene (C₂H₄)_n from ethylene?

1. polymerization
2. substitution
3. addition
4. combustion

14. Nylon, starch, and cellulose are products formed as a result of

1. oxidation
2. fermentation
3. substitution
4. polymerization

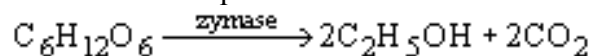
15. Which alcohol reacts with C₂H₅COOH to produce the ester C₂H₅COOC₄H₉?

1. CH₃OH
2. C₂H₅OH
3. C₃H₇OH
4. C₄H₉OH

16. Which organic product is formed in the reaction shown in the diagram?

1. bromoethane
2. bromoethene
3. bromoethyne
4. bromobenzene

17. Given the equation:



The reaction represented by this equation is called

1. esterification
2. saponification
3. fermentation
4. polymerization

18. Given the equation: CH₄ + Br₂ → CH₃Br + HBr
Which type of reaction does this equation represent?

1. addition
2. combustion
3. polymerization
4. substitution