

## Organic Chemical Reactions Lecture Guide

### Purpose

The purpose of this lecture guide is to guide you through the lecture and highlight important topics. This assignment will help to increase your knowledge and familiarity with organic chemical reactions.

**Student Learning Outcomes:** After completing this lecture guide, you will be able to:

- Distinguish between oxidation and reduction.
- Determine components of redox reactions involving organic molecules.
- Construct products of condensation and hydrolysis reactions.
- Identify common types of organic reactions.
- Identify common types of alkene addition reactions.
- Predict products of alkene addition reactions.
- Construct products of dehydration reactions.

### Criteria

This worksheet is optional and will not count as a grade.

1. If a process results in the change of the chemical composition of a substance, this is referred to as a \_\_\_\_\_.
2. In a chemical reaction, \_\_\_\_\_ bonds break so that \_\_\_\_\_ bonds are formed. The bonds that are broken are located in the \_\_\_\_\_ and the bonds that are formed are located in the newly formed \_\_\_\_\_.
3. Chemical equations can be shown to provide details about a chemical reaction. In the chemical equation, the \_\_\_\_\_ are shown to the left of the reaction arrow. These substances are also referred to as starting material and react to form \_\_\_\_\_, which are shown to the right of the reaction arrow. If the chemical equation has the  $\rightleftharpoons$  reaction arrow, this indicates that the reaction is \_\_\_\_\_. If the equation has the  $\rightarrow$  reaction arrow, the process is \_\_\_\_\_.
4. Chemical reactions involving organic compounds generally show structures of all components since many organic compounds can exist as various \_\_\_\_\_ (molecules with the same molecular formula but different atom connectivity). Reactions involving organic compounds typically occur at the \_\_\_\_\_.

5. Biochemical often refer to reactants as \_\_\_\_\_. Many of these equations can involve reactions that are \_\_\_\_\_. These are reactions that occur together where the energy released from one reaction provides the energy needed for the other reaction.
6. Reactions that involve a transfer of electrons are called \_\_\_\_\_ reactions. The substance that loses electrons is said to undergo \_\_\_\_\_ and the substance that gains electrons undergoes \_\_\_\_\_. A mnemonic that can help distinguish between the loss or gain of electrons is \_\_\_\_\_.
7. When a substance loses electrons, it becomes possible for another substance to gain electrons. Therefore, the substance that loses electrons is the \_\_\_\_\_. The substance that gained electrons is known as the \_\_\_\_\_.
8. Redox reactions involving organic compounds can be observed by identifying changes in the number of bonds to \_\_\_\_\_ and/or \_\_\_\_\_.
9. If an organic compound has a decrease in the number of bonds to hydrogen, this indicates that the substance undergoes \_\_\_\_\_.
10. If an organic compound has an increase in the number of bonds to hydrogen, this indicates that the substance undergoes \_\_\_\_\_.
11. If an organic compound has a decrease in the number of bonds to oxygen, this indicates that the substance undergoes \_\_\_\_\_.
12. If an organic compound has an increase in the number of bonds to oxygen, this indicates that the substance undergoes \_\_\_\_\_.

13. Redox reactions involving organic compounds result in the change in the functional group that is present. The most saturated hydrocarbon, the \_\_\_\_\_, can be oxidized to form the \_\_\_\_\_. These molecules can be further oxidized to produce \_\_\_\_\_.
14. \_\_\_\_\_ alcohols can be oxidized to produce carbonyl-containing molecules, but \_\_\_\_\_ alcohols cannot be oxidized. When a primary alcohol is oxidized, it is converted to a \_\_\_\_\_. This substance can be further oxidized to produce a \_\_\_\_\_. A secondary alcohol can be oxidized to produce a \_\_\_\_\_.
15. Chemical reactions that involve multiple smaller compounds combining to form one larger organic compound are called \_\_\_\_\_ reactions. Water is a \_\_\_\_\_ in these types of reactions.
16. During \_\_\_\_\_ a carbonyl-containing group is present and results in the formation of a carboxylic acid derivative. The reaction that occurs between a carboxylic acid and an alcohol is known as a(n) \_\_\_\_\_ reaction and results in the formation of a(n) \_\_\_\_\_ functional group. The reaction that occurs between a carboxylic acid and a thiol is known as a(n) \_\_\_\_\_ reaction and results in the formation of a thioester. The condensation reaction that occurs between a carboxylic acid and an amine is known as a(n) \_\_\_\_\_ reaction and results in the formation of a(n) \_\_\_\_\_ functional group. This type of reaction will only occur with a \_\_\_\_\_ or \_\_\_\_\_ amine and will not occur if a \_\_\_\_\_ amine is present.

17. In a condensation reaction that occurs between a carboxylic acid and an amine, water is produced by the carboxylic acid losing the \_\_\_\_\_ and the amine losing the \_\_\_\_\_.
18. Chemical reactions that involve one organic compound that is broken down to form multiple smaller organic compounds are called \_\_\_\_\_ reactions. Water is a \_\_\_\_\_ in these types of reactions.
19. When a strong base is used to catalyze the breakdown of organic compounds, the reaction is referred to as a \_\_\_\_\_ reaction.
20. When an ester undergoes hydrolysis, the products are a \_\_\_\_\_ and \_\_\_\_\_. When a \_\_\_\_\_ undergoes hydrolysis, the products are a carboxylic acid and thiol. During the hydrolysis of an amide, a \_\_\_\_\_ and \_\_\_\_\_ are formed. However, due to the presence of this acid and base, further reactions will occur. Following the acid-base reactions, the final products of the hydrolysis of amines are \_\_\_\_\_ and \_\_\_\_\_.
21. In an \_\_\_\_\_ reaction, an atom or group of atoms is added to each carbon of the double bond.
22. In the \_\_\_\_\_ reaction, hydrogen is added to an alkene in the presence of a metal catalyst. This reaction can also be classified as a \_\_\_\_\_ reaction due to the increase of hydrogen to the organic molecule and it results in the alkene being converted to an \_\_\_\_\_.

23. In the \_\_\_\_\_ reaction, a molecular halogen is added to an alkene. This reaction does not require the addition of a catalyst and results in the alkene being converted to a(n) \_\_\_\_\_. In a \_\_\_\_\_ reaction, a hydrogen halide is added to an alkene.
24. Water can be involved in different parts of alkene reactions. In a \_\_\_\_\_ reaction, water is a product. This reaction involves an \_\_\_\_\_ being converted to an \_\_\_\_\_. During the reaction, the hydrogen and hydroxyl (from the alcohol) are removed from \_\_\_\_\_ carbon atoms. The major product that forms has the double bond between the carbon that the hydroxyl group was attached to and the carbon with \_\_\_\_\_ hydrogen atoms. If the compound has a carbonyl group, the double bond forms between the -H from the carbon \_\_\_\_\_ to the carbonyl group and the -OH group \_\_\_\_\_ carbons away from the carbonyl group.
25. In a \_\_\_\_\_ reaction, water is a reactant. This reaction involves an alkene, water, and an acid catalyst reacting to convert the alkene to an \_\_\_\_\_. When water is added to an asymmetric alkene, \_\_\_\_\_ rule is used to predict the major product of the reaction. This rule indicates that the \_\_\_\_\_ from the water molecule is added to the carbon of the double bond (in the alkene) that had the \_\_\_\_\_ hydrogen. The other group of atoms would then add to the opposite carbon. If the compound involves a carbonyl group adjacent to the alkene, the hydroxyl (-OH) group is added to the carbon of the double bond \_\_\_\_\_ from the carbonyl group.