12.6: Oxygen-Containing Organic Compounds

Learning Objectives

- Classify oxygen-containing organic compounds based on the structure of the functional group that is present.
- Identify hydroxyl groups, carbonyl groups, and carboxyl groups within oxygen-containing organic compounds.

Oxygen-containing organic compounds may be classified based on the structural arrangement of oxygen atoms in relation to the carbon and hydrogen atoms within a molecule. Such structural arrangements often allow oxygen-containing compounds to function in a similar manner chemically and physically from molecule-to-molecule and are called **functional groups**. Figure 12.6.1 shows three common oxygen-containing functional groups found in organic molecules.

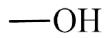
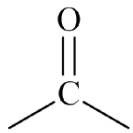
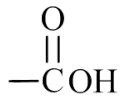
hydroxyl group	
carbonyl group	
carboxyl group	

Figure 12.6.1: Common oxygen-containing functional groups.

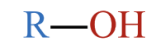
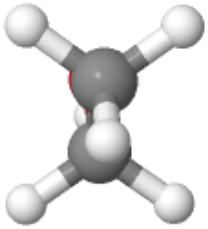
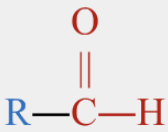
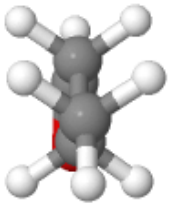
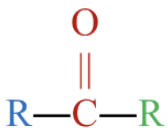
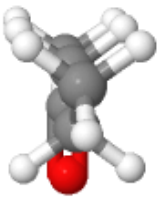
Classifying Oxygen-Containing Organic Compounds

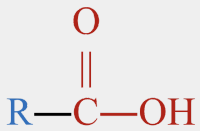
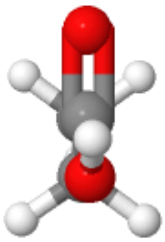
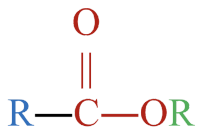
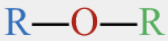
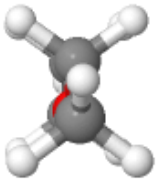
The functional groups shown in Figure 12.6.1 are just three of many different functional groups. However, the presence and location of functional groups in organic molecules allows us to lump them together into different classes that function similarly, both chemically and physically. Table 12.6.1 shows the classification of several types of oxygen-containing organic compounds. Though the list is not complete, it provides some perspective as to the wide variety of oxygen-containing organic compounds that are possible.

Notice the presence of the functional groups shown above in the different families of compounds. The letter **R** represents an alkyl group (or more generally, a hydrocarbon group). As a reminder, molecular models rendered with JSmol may be manipulated by grabbing the molecules and rotating it to your desired orientation.

Table 12.6.1: Classification of Oxygen-Containing Organic Molecules

Family	Structure	Example

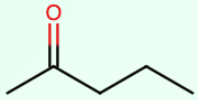
Family	Structure	Example
alcohol		
aldehyde		
ketone		

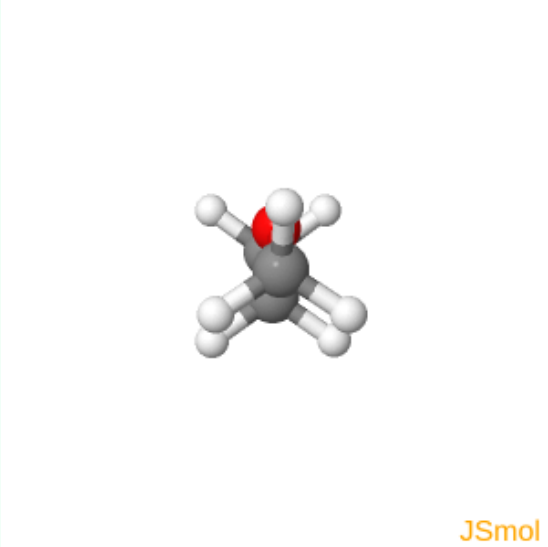
Family	Structure	Example
carboxylic acid		
ester		
ether		

✅ Example 12.6.1

Classify each molecule as an alcohol, aldehyde, ketone, carboxylic acid, ether, or ester.

A. $CH_3CH_2CH_2\overset{\overset{\displaystyle O}{\|}}{C}H$

B. 

C. 

D. CH_3OH

Solution

A. This molecule has an alkyl group that is bonded to a carbon atom that is double bonded to an oxygen atom and single bonded to a hydrogen atom. This gives it a general formula that fits an aldehyde, $R-\overset{\overset{\displaystyle O}{\|}}{C}-H$.

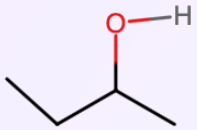
B. This molecule has an alkyl group attached to each side of a carbonyl group, $\overset{\overset{\displaystyle O}{\|}}{C}$. This gives it a general formula that fits a ketone, $R-\overset{\overset{\displaystyle O}{\|}}{C}-R$.

C. This molecule has an alkyl group attached to each side of an oxygen atom. This gives it a general formula that fits an ether, $R-O-R$.

D. This molecule has an alkyl group attached to a hydroxyl group, $-OH$. This gives it a general formula that fits an alcohol, $R-OH$.

✏️ Exercise 12.6.1

Classify each molecule as an alcohol, aldehyde, ketone, carboxylic acid, ether, or ester.

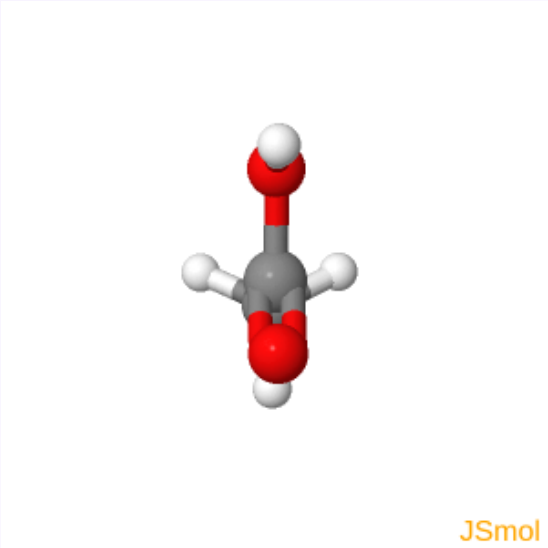


A.

B. $CH_3CH_2\overset{\overset{\displaystyle O}{||}}{C}OCH_3$

C. $CH_3OCH_2CH_2CH_2CH_3$

D.



Answer A

alcohol

Answer B

ester

Answer C

ether

Answer D

carboxylic acid

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