

1.10: Carboxylic acids and Esters

Learning Objective

- How to name carboxylic acids and esters.

A **carbonyl group** consists of a carbon atom double-bonded to an oxygen atom, written as $\text{C}=\text{O}$. When a **hydroxy (-OH) group** is also bound to the carbonyl carbon, the resulting group is known as a **carboxy group**. **Carboxylic acids** contain the **carboxy group**, and one type of carboxylic acid derivative is an **ester**.



Figure 1.10.1: carboxylic acid



Figure 1.10.2: ester

Carboxylic acids are often abbreviated as **R-COOH** or **R-CO₂H**. Some simple carboxylic acids, such as acetic acid and benzoic acid, are referred to primarily by their common names.

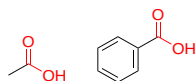


Figure 1.10.3: acetic acid and benzoic acid

The common name of this molecule is valeric acid. Its formal name is pentanoic acid.

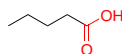


Figure 1.10.4: pentanoic acid

Practice Questions

- The common name of Molecule A is caprylic acid. What is the formal name of Molecule A?

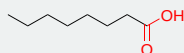


Figure 1.10.5: Molecule A

- The name of this molecule is hexanedioic acid.

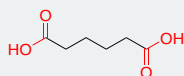


Figure 1.10.6: hexanedioic acid

What is the name of Molecule B?

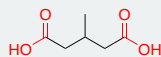


Figure 1.10.7: Molecule B

- The name of this molecule is cyclohexanecarboxylic acid.

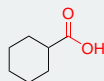


Figure 1.10.8: cyclohexanecarboxylic acid

What is the name of Molecule C?



Figure 1.10.9: Molecule C

4. The name of this molecule is 1,2-benzenedicarboxylic acid.

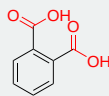


Figure 1.10.10: 1,2-benzenedicarboxylic acid

What is the name of Molecule D?

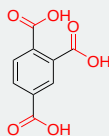


Figure 1.10.11: Molecule D

5. The name of this molecule is 4-bromopentanoic acid. Number the carbons.

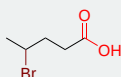


Figure 1.10.12: 4-bromopentanoic acid

6. Number the carbons. What is the name of Molecule E?

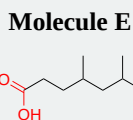


Figure 1.10.13.

7. This molecule is named 2-hydroxybutanoic acid (also known as lactic acid).

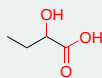


Figure 1.10.14: 2-hydroxybutanoic acid

What is the name of Molecule F?

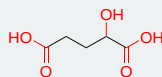


Figure 1.10.15: Molecule F

8. This molecule is named 3,6-dioxo-4-hydroxyhexanoic acid.

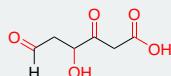


Figure 1.10.16: 3,6-dioxo-4-hydroxyhexanoic acid

What is the name of Molecule G?

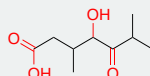


Figure 1.10.17: Molecule G

Esters are often manufactured to provide fragrance. One example is isobutyl methanoate, which smells like raspberries.

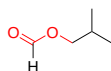


Figure 1.10.18: isobutyl methanoate

The process of **esterification** involves adding an alcohol to a carboxylic acid in the presence of hydrogen ions.

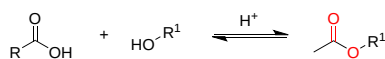


Figure 1.10.19: esterification

To name an ester, first we name the alcohol used, and then the carboxylic acid. Below is shown the esterification reaction of ethanol and propanoic acid to create ethyl propanoate.

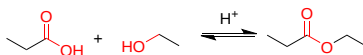


Figure 1.10.20: synthesis of ethyl propanoate

Practice Questions

1. What is the name of Molecule H?



Figure 1.10.21: Molecule H

2. What is the name of Molecule I?

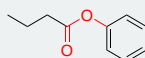


Figure 1.10.22: Molecule I

3. This molecule is named dimethylbutanedioate.

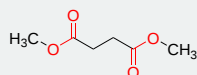


Figure 1.10.23: dimethylbutanedioate

What is the name of Molecule J?

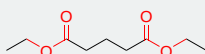


Figure 1.10.24: Molecule J

4. This molecule is named 2-chloroethyl propanoate.

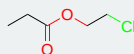


Figure 1.10.25: 2-chloroethyl propanoate

What is the name of Molecule K?

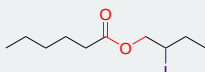


Figure 1.10.26: Molecule K

5. This molecule is named 2-bromopropyl 4-chlorobutanoate. Number the carbons.

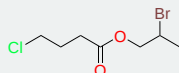


Figure 1.10.27: 2-bromopropyl 4-chlorobutanoate

6. Number the carbons. What is the name of Molecule L?

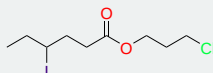


Figure 1.10.28: Molecule L

7. What additions do we make to our existing naming rules to name carboxylic acids and esters?

8. Write the steps that you use to name a carboxylic acid in order, as instructions for a student who doesn't know how to do it.

9. Draw any carboxylic acid and go through the steps in naming your molecule.

10. Write the steps that you use to name an ester in order, as instructions for a student who doesn't know how to do it.
11. Draw any ester and go through the steps in naming your molecule.

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