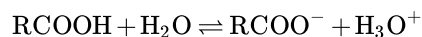


14.5: Chemical Properties of Carboxylic Acids- Ionization and Neutralization

Learning Objectives

- Name the typical reactions that take place with carboxylic acids.
- Describe how carboxylic acids react with basic compounds.

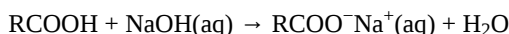
Water-soluble carboxylic acids ionize slightly in water to form moderately acidic solutions.



Their aqueous solutions exhibit the typical properties of acids, such as changing litmus from blue to red.

The anion formed when a carboxylic acid dissociates is called the *carboxylate* anion (RCOO^-).

Whether soluble in water or not, carboxylic acids react with aqueous solutions of sodium hydroxide (NaOH), sodium carbonate (Na_2CO_3), and sodium bicarbonate (NaHCO_3) to form salts:



In these reactions, the carboxylic acids act like inorganic acids: they neutralize basic compounds. With solutions of carbonate (CO_3^{2-}) and bicarbonate (HCO_3^-) ions, they also form carbon dioxide gas.

Carboxylic acid salts are named in the same manner as inorganic salts: the name of the cation is followed by the name of the organic anion. The name of the anion is obtained by dropping the *-ic* ending of the acid name and replacing it with the suffix *-ate*. This rule applies whether we are using common names or International Union of Pure and Applied Chemistry (IUPAC) names:

$\text{CH}_3\text{COO}^-\text{Li}^+$	$\text{CH}_3\text{CH}_2\text{CH}_2\text{COO}^-\text{K}^+$	$\text{C}_6\text{H}_5\text{COO}^-\text{Na}^+$
Lithium acetate (lithium ethanoate)	Potassium butyrate (potassium butanoate)	Sodium benzoate

The salts of long-chain carboxylic acids are called soaps. We discuss the chemistry of soaps elsewhere.



Sodium palmitate (a soap)

✓ Example 14.5.1

Write an equation for each reaction.

- the ionization of propionic acid in water (H_2O)
- the neutralization of propionic acid with aqueous sodium hydroxide (NaOH)

Solution

Propionic acid has three carbon atoms, so its formula is $\text{CH}_3\text{CH}_2\text{COOH}$.

- Propionic acid ionizes in water to form a propionate ion and a hydronium (H_3O^+) ion. $\text{CH}_3\text{CH}_2\text{COOH}(\text{aq}) + \text{H}_2\text{O}(\ell) \rightarrow \text{CH}_3\text{CH}_2\text{COO}^-(\text{aq}) + \text{H}_3\text{O}^+(\text{aq})$
- Propionic acid reacts with $\text{NaOH}(\text{aq})$ to form sodium propionate and water. $\text{CH}_3\text{CH}_2\text{COOH}(\text{aq}) + \text{NaOH}(\text{aq}) \rightarrow \text{CH}_3\text{CH}_2\text{COO}^-\text{Na}^+(\text{aq}) + \text{H}_2\text{O}(\ell)$

? Exercise 14.5.1

Write an equation for each reaction.

- the ionization of formic acid in water
- the ionization of *p*-chlorobenzoic acid in water

✓ Example 14.5.2

Write an equation for the reaction of decanoic acid with each compound.

- aqueous sodium hydroxide (NaOH)
- aqueous sodium bicarbonate (NaHCO₃)

Solution

- Decanoic acid has 10 carbon atoms. It reacts with NaOH to form a salt and water (H₂O). $\text{CH}_3(\text{CH}_2)_8\text{COOH} + \text{NaOH}(\text{aq}) \rightarrow \text{CH}_3(\text{CH}_2)_8\text{COO}^-\text{Na}^+(\text{aq}) + \text{H}_2\text{O}(\ell)$
- With NaHCO₃, the products are a salt, H₂O, and carbon dioxide (CO₂). $\text{CH}_3(\text{CH}_2)_8\text{COOH} + \text{NaHCO}_3(\text{aq}) \rightarrow \text{CH}_3(\text{CH}_2)_8\text{COO}^-\text{Na}^+(\text{aq}) + \text{H}_2\text{O}(\ell) + \text{CO}_2(\text{g})$

? Exercise 14.5.3

Write an equation for the reaction of benzoic acid with each compound.

- aqueous sodium hydroxide (NaOH)
- aqueous sodium bicarbonate (NaHCO₃)

📌 To Your Health: Organic Salts as Preservatives

Some organic salts are used as preservatives in food products. They prevent spoilage by inhibiting the growth of bacteria and fungi. Calcium and sodium propionate, for example, are added to processed cheese and bakery goods; sodium benzoate is added to cider, jellies, pickles, and syrups; and sodium sorbate and potassium sorbate are added to fruit juices, sauerkraut, soft drinks, and wine. Look for them on ingredient labels the next time you shop for groceries.



Calcium propionate



Potassium sorbate

Key Takeaways

- Soluble carboxylic acids are weak acids in aqueous solutions.
- Carboxylic acids neutralize bases to form salts.

This page titled [14.5: Chemical Properties of Carboxylic Acids- Ionization and Neutralization](#) is shared under a [CC BY-NC-SA 4.0](#) license and was authored, remixed, and/or curated by [Eden Francis](#) via [source content](#) that was edited to the style and standards of the LibreTexts platform.

- [15.4: Chemical Properties of Carboxylic Acids- Ionization and Neutralization](#) by Anonymous is licensed [CC BY-NC-SA 3.0](#). Original source: <https://2012books.lardbucket.org/books/introduction-to-chemistry-general-organic-and-biological>.