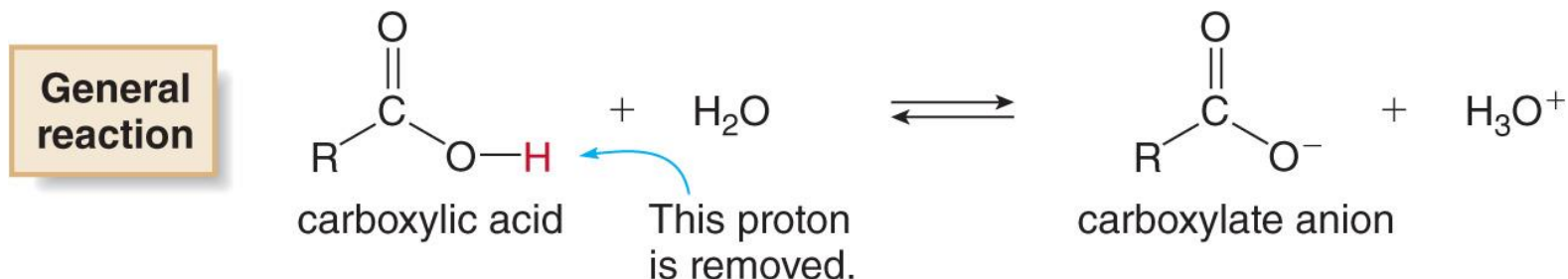


The Acidity of Carboxylic Acids

- Carboxylic acids are **proton (H⁺) donors**:

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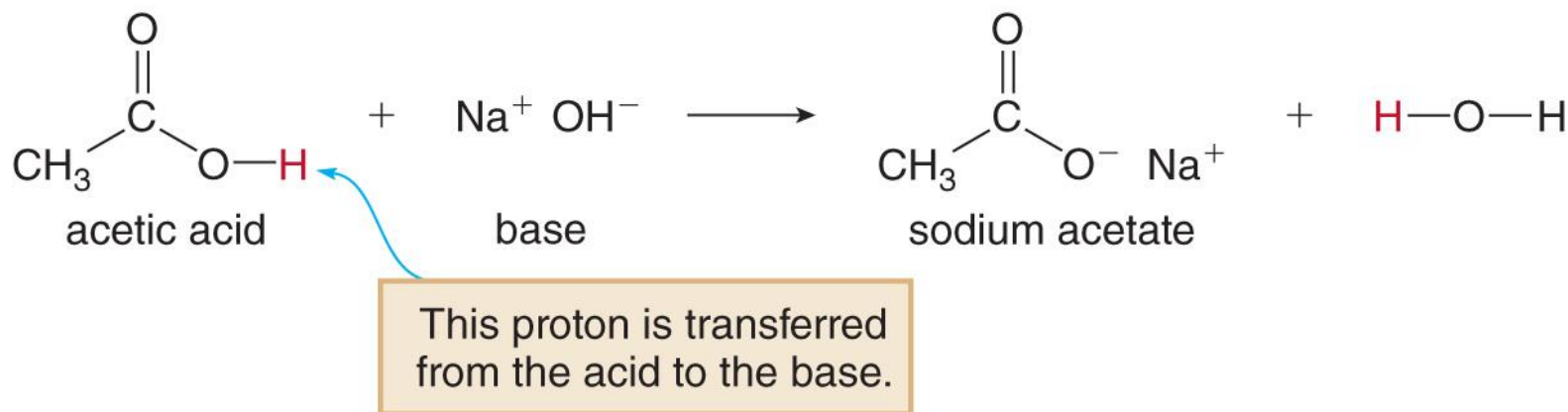
- They are **weak acids** compared to inorganic acids like HCl or H₂SO₄.
- Only a **small percentage** of a carboxylic acid is ionized in aqueous solution.

The Acidity of Carboxylic Acids

A. Reaction with Bases

- Carboxylic acids react with bases such as NaOH to form **water-soluble salts**.

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- The carboxylic acid **donates the proton** to the base, OH⁻, which accepts it.

The Acidity of Carboxylic Acids

B. Carboxylate Anions—Salts of Carboxylic Acids

- To name the metal salts of carboxylate ions, put the three pieces below together:

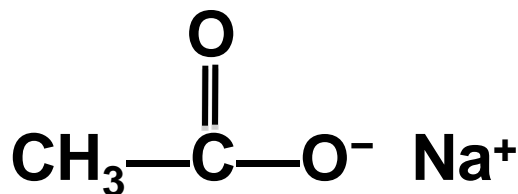
name of the metal cation

+

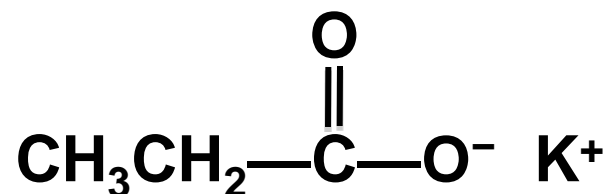
parent

+

-ate (suffix)



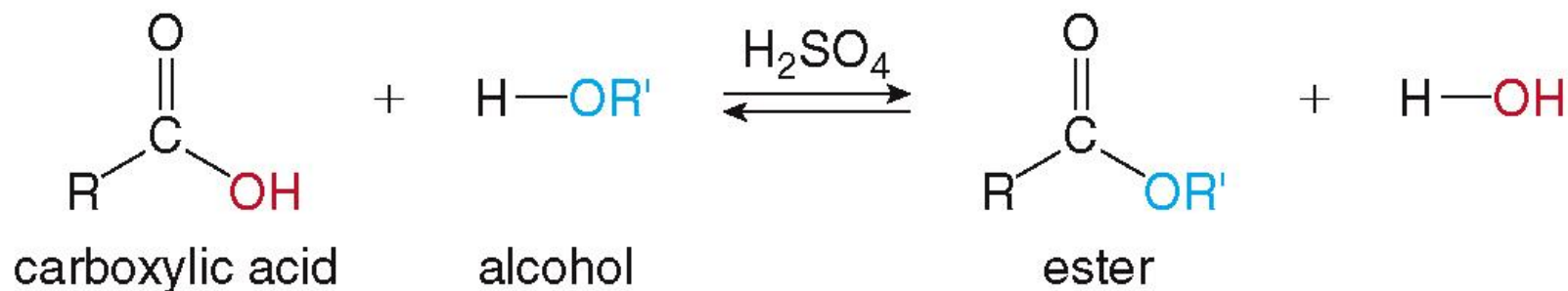
sodium acetate



potassium propanoate

The Conversion of Carboxylic Acids to Esters and Amides

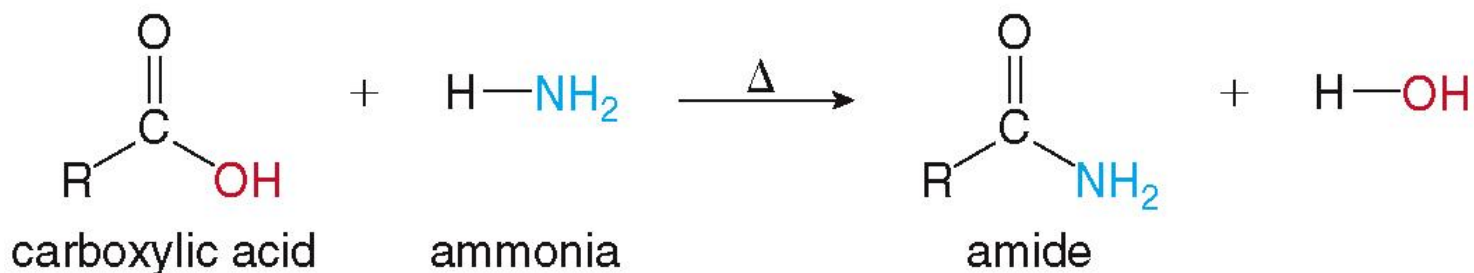
Carboxylic acids react with **alcohols** to form **esters**.



The **OR'** group replaces the **OH** group.

The Conversion of Carboxylic Acids to Esters and Amides

Carboxylic acids react with ammonia to form **amides**.

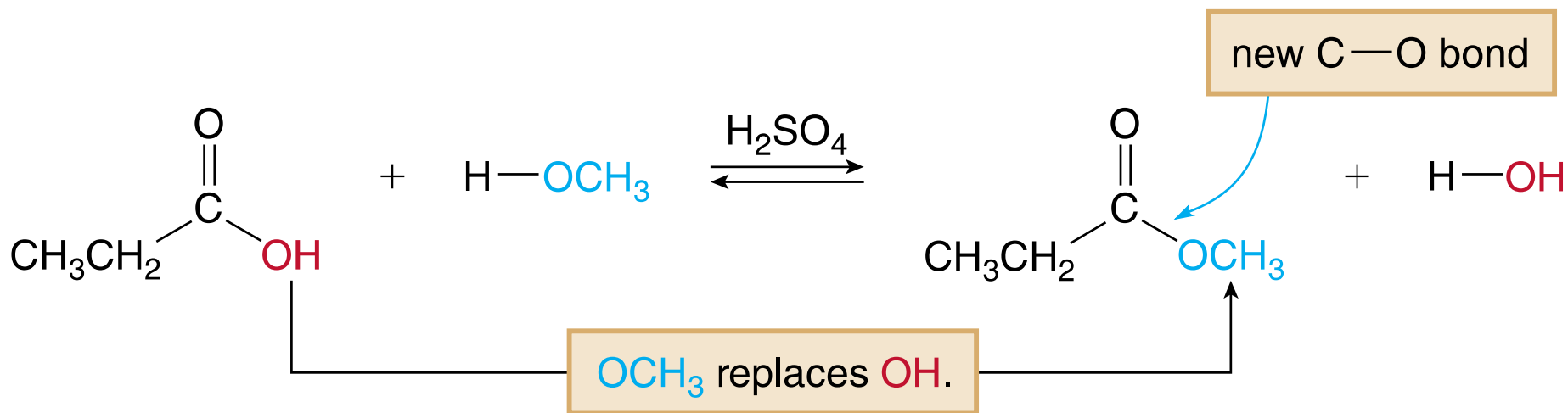


The **NH₂** group replaces the **OH** group.

The Conversion of Carboxylic Acids

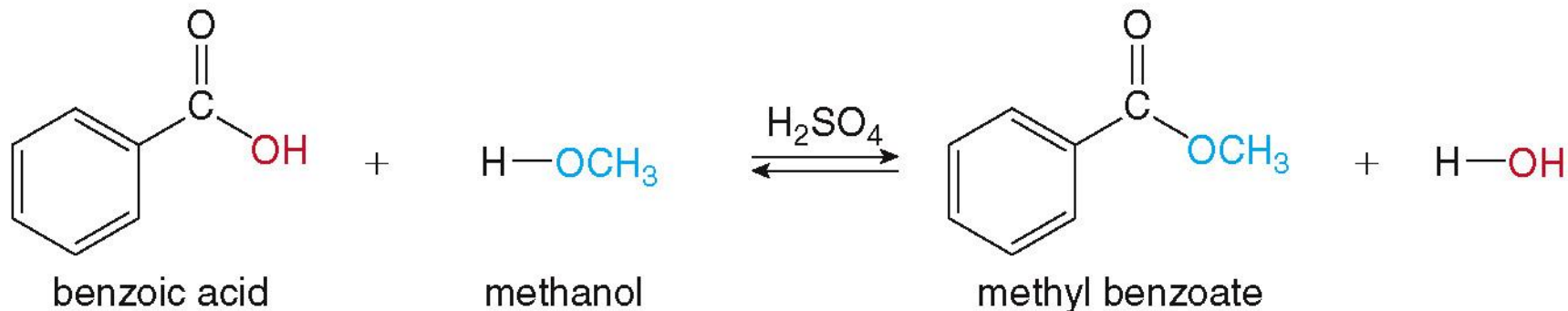
A. Ester Formation

Formation of an ester is done by the **Fisher esterification**:



The Conversion of Carboxylic Acids

A. Ester Formation

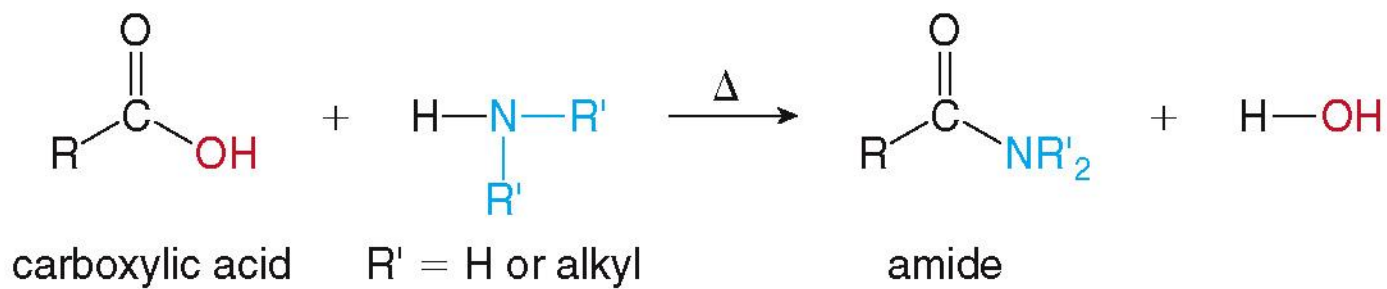


- The Fisher esterification is an **equilibrium process**.
- According to **Le Châtelier's principle**, the reaction is driven to the right by:
 1. using **excess alcohol**
 2. **removing the water** as it is formed

The Conversion of Carboxylic Acids

B. Amide Formation

Heating a carboxylic acid with ammonia (NH₃) or an amine (R'NH₂ or R'₂NH) forms an **amide**.

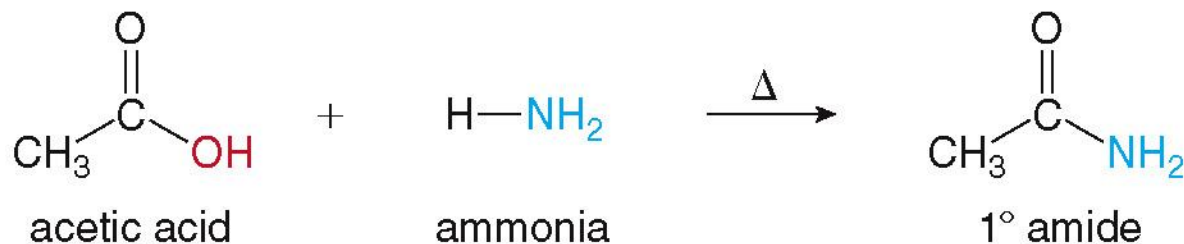


The Conversion of Carboxylic Acids

B. Amide Formation

The identity of the N-compound determines the **type of amide** formed.

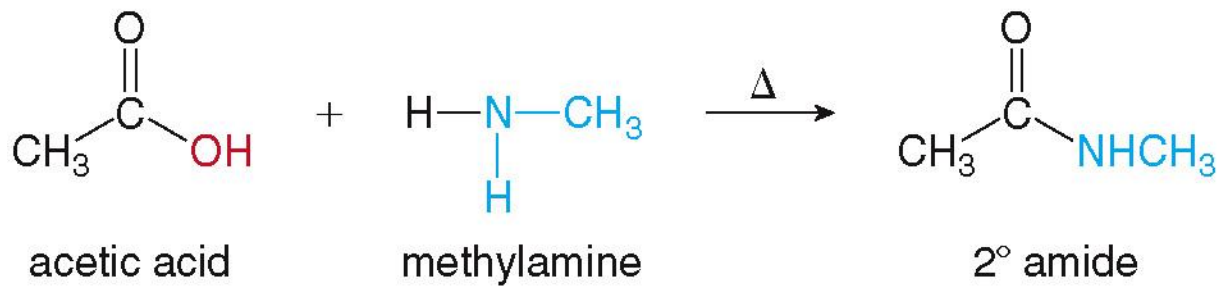
- Reaction with **NH₃** forms a **1° amide** (RCONH₂).



The Conversion of Carboxylic Acids

B. Amide Formation

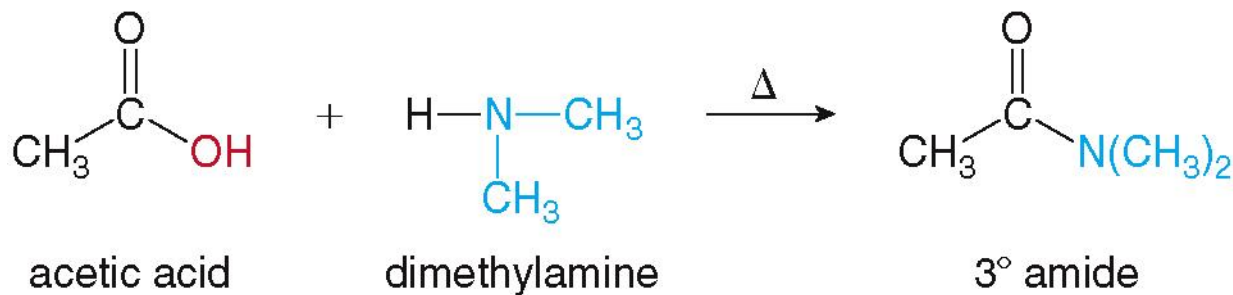
Reaction with $R'NH_2$ forms a 2° amide ($RCONHR'$).



The Conversion of Carboxylic Acids

B. Amide Formation

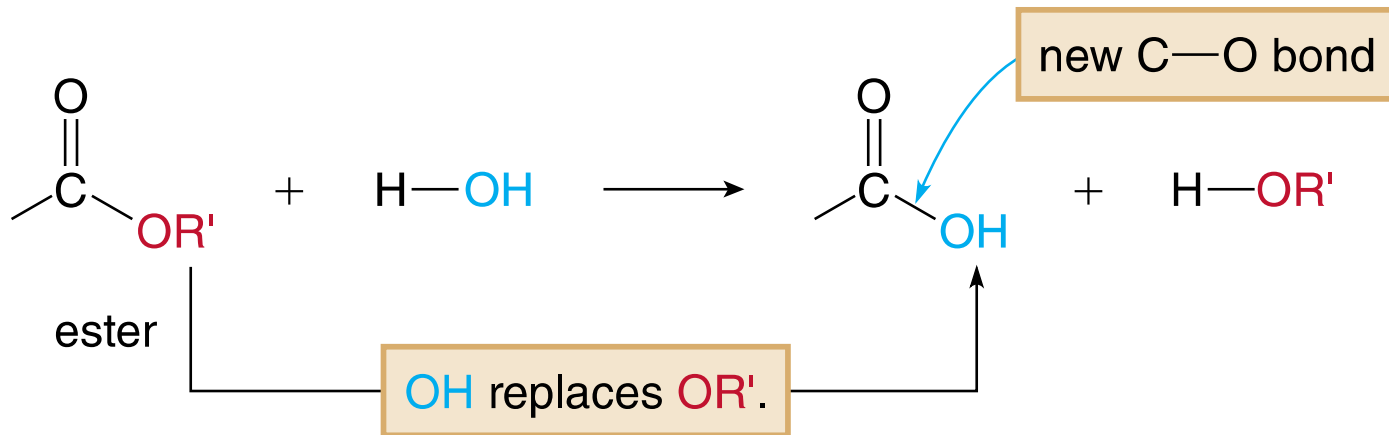
Reaction with R'_2NH forms a 3° amide ($RCONR'_2$).



Hydrolysis of Esters and Amides

A. Ester Hydrolysis

An ester reacts with **water** to form a carboxylic acid and an alcohol; this is a **hydrolysis reaction**.

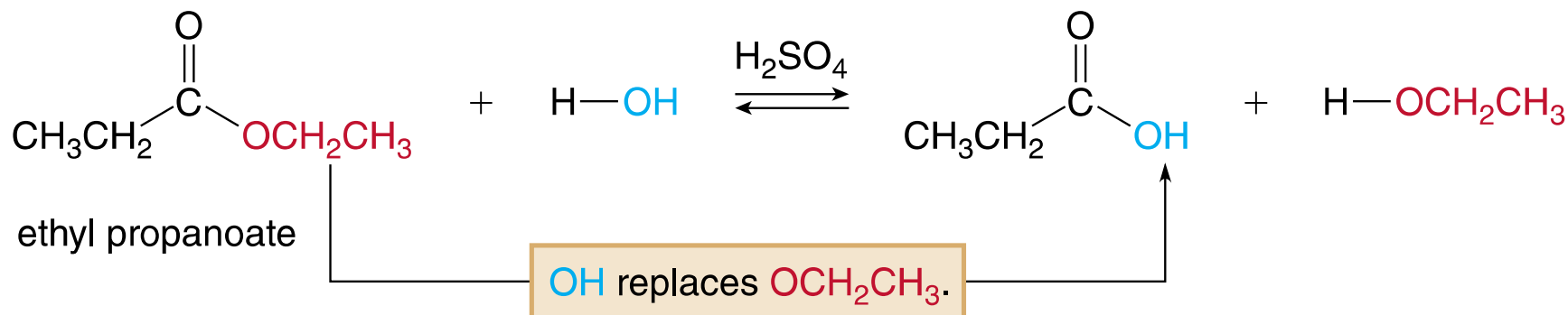


The **OH** group replaces the **OR'** group.

Hydrolysis of Esters and Amides

A. Ester Hydrolysis

An example of ester hydrolysis using an **acid catalyst**:

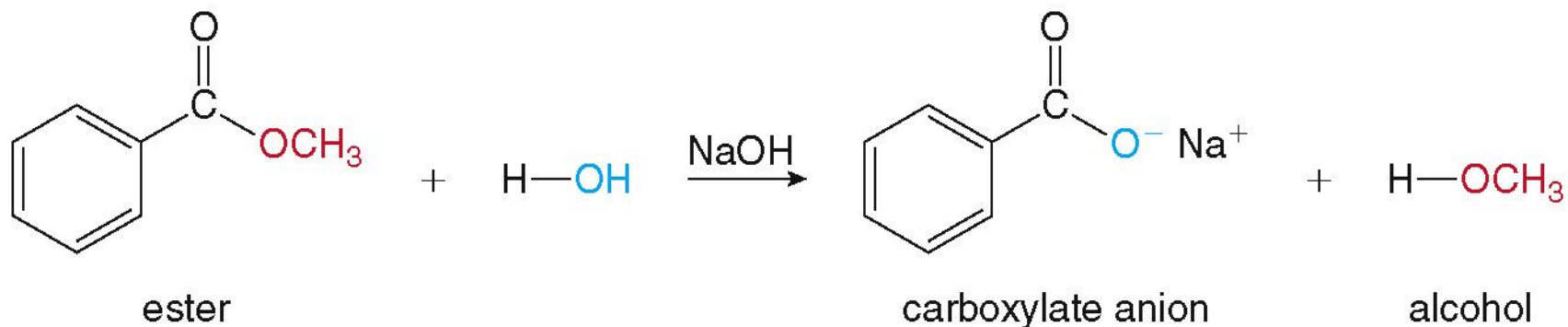


The equilibrium is driven to the **right** by using a **large amount of water**.

Hydrolysis of Esters and Amides

A. Ester Hydrolysis

An example of ester **hydrolysis** using an aqueous **base**, called **saponification**:



This basic hydrolysis forms the **carboxylate anion** rather than the carboxylic acid product.