

Organic Chemistry 212

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Notes: *Chapter Ten – Carboxylic Acids*

A carboxylic acid contains a carbonyl group attached to a hydroxyl group.

Write the structures for formic acid, acetic acid and benzoic acid:

Write the IUPAC name and the structure for the following commonly named acids:

butyric acid (butter):

capric acid (from the word for goat)

stearic acid (from solid fat)

Draw the dimer formed from two carboxylic acids through hydrogen bonding:

How does the solubility of a carboxylic acid compare to that of alcohols, aldehydes and ketones?

Aliphatic carboxylic acids from propanoic acid to decanoic acid are stinky liquids. These acids occur in sweat, rotting food and animal odors. Edible carboxylic acids are sour (acids are generally sour). Lactic acid makes pickles and sauerkraut sour.

Fatty Acids

Fatty acids are long, unbranched carboxylic acids having 12 to 20 carbons. They are derived from the hydrolysis of animal fats and vegetable oils. How many carbons are in the following acids:

oleic acid

linolenic acid

palmitic acid

Generalizations about fatty acids:

1. Nearly all fatty acids have an even number of carbon atoms, most between 12 and 20, in an unbranched chain.
2. The three most abundant fatty acids in nature are palmitic acid, stearic acid and oleic acid.
3. In most unsaturated fatty acids, the cis isomer predominates; the trans isomer is rare.
4. Unsaturated fatty acids have lower melting points than their saturated counterparts.

What is the difference between saturated and unsaturated fatty acids? How does the degree of unsaturation affect the melting point of these compounds?

There is an article in this chapter about trans fatty acids. Read the article and answer the following questions:

Why did the FDA require that the amount of trans fatty acids be listed on products?

What kinds of foods have the highest percentages of trans fatty acids?

What is an omega-3 fatty acid – draw the structure:

What does **partially hydrogenated** mean?

What does the penta in Eicosapentaenoic acid mean?

Soaps

Natural soap: tallow and coconut oil

What is tallow?

Saponification is the hydrolysis of an ester in aqueous sodium or potassium hydroxide to an alcohol and the sodium or potassium salt of the carboxylic acid:

Copy the saponification reaction from this chapter below:

What is a **triglyceride**? Draw one:

How is natural soap purified?

What is an **emulsifying agent**?

What is a **micelle**?

What is the biggest disadvantage of soap mentioned in this chapter?

Synthetic Detergents

Linear alkylbenzenesulfonates (LAS): sodium 4-dodecylbenzenesulfonate
(draw the structure below)

List some of the additives to detergents:

What is an optical bleach?

Characteristic reactions of carboxylic acids:

What is the typical range of K_a values for common carboxylic acids:

What is the effect on pK_a when a carboxylic acid contains more electronegative substituents?

Write the general form of the acid/base reaction between carboxylic acid and a strong hydroxide base:

What ending is given to the name of a carboxylic salt?

Reduction

What powerful reducing agent is used to convert a carboxylic acid to an alcohol?

Fischer Esterification

Treatment of a carboxylic acid with an alcohol in the presence of an acid catalyst – (sulfuric acid) gives an ester. This is similar to the reaction that produces a hemiacetal.

Decarboxylation

What condition causes decarboxylation to occur on mild heating?

Ketone Bodies: What causes the sweet smell on the breath of a severe diabetic?