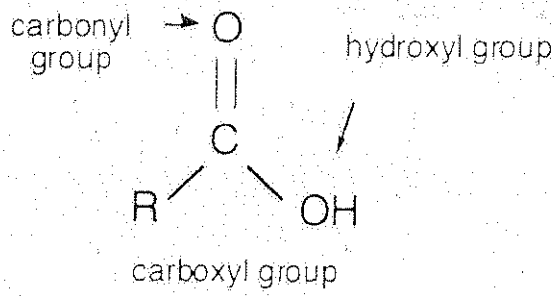
Name_____ Block_____

Organic Lab 7: Carboxylic Acids and Esters

A **carboxyl group** is really a combination of two other functional groups, a hydroxyl group and a carbonyl group:



Carboxyl groups are also written as – **COOH** or, less commonly, CO_2H.

The combination of these two polar groups produces an extremely polar side group, the **organic acid**. In an acid, the hydrogen atom can lose its share of the electron pair completely to the oxygen atom, and is cast off into the surrounding water molecules:

$$R\text{-}COOH \rightarrow R\text{-}COO^- + H^+$$

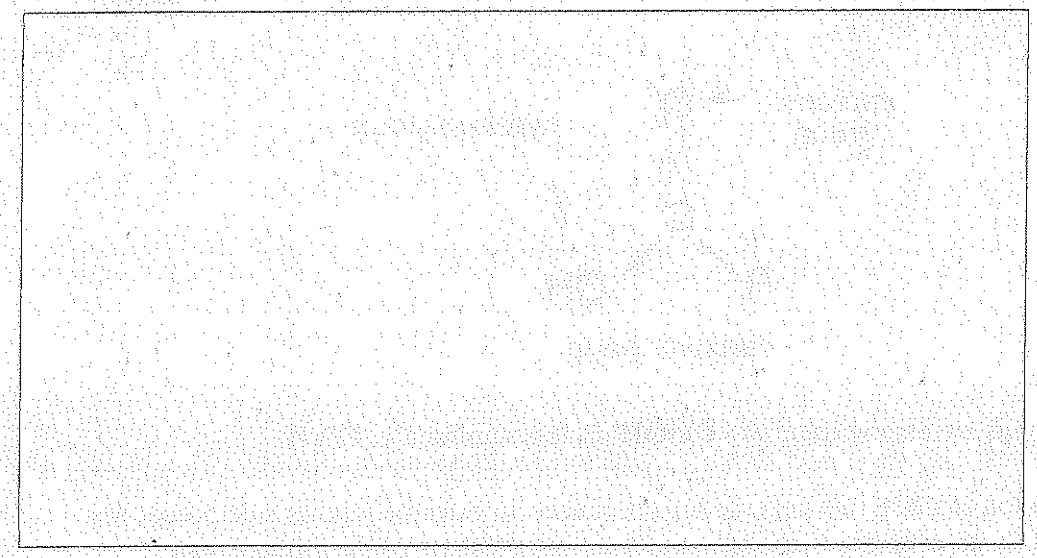
The hydrogen becomes associated with a water molecule, which becomes a **hydronium ion** (H_3O^+) and the acid group becomes a negative ion, $RCOO^-$. The presence of the hydronium ion in water makes the mixture an **acidic solution**. How often does this happen? Not very. Between one in a thousand and one in 100,000 organic acid molecules are dissociated at any given time, depending on the acid. Is this small amount of acid significant? Yes! Weak acids have many important functions in living systems, some of which we will study in regular chemistry class in the spring. For now we will concentrate on building and naming these compounds.

1. Naming acids

Naming is easy for acids. Take the parent chain name, and add the suffix –oic plus the word acid. Since carboxylic acids are usually at the end of molecules, they rarely appear with numbers. Draw the structural formula for **pentanoic acid** below:

2. Formic Acid and Acetic Acid

These are the common names for the first two organic acids. Build models of these, write structural formulas, and name them in the IUPAC system below. Write their chemical formulas next to the structural formulas.



Multiple carboxylic acids are also common in living systems. Among the most common are oxalic acid and citric acid (vitamin C). Oxalic acid has two organic acid groups, while vitamin C has three. The chemical formula for oxalic acid is $C_2O_4H_2$. Draw the structural formula for this molecule below. Try to name it using the IUPAC rules.

3. The physical properties of organic compounds

Consider the following table of the boiling points of various organic molecules containing three carbons.

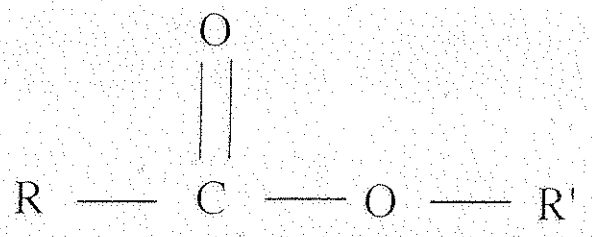
Which compounds will dissolve in vegetable oil?_____

4. Esters

Esters are products of **condensation reactions** of carboxylic acids and alcohols. In the presence of acid, a molecule of water is removed:

$$CH_3CH_2CH_2CH_2OH + CH_3COOH \rightarrow CH_3CH_2CH_2CH_2OOCCH_3 + H_2O$$

In this reaction, the product is known as **butyl ethanoate**. Name the reactants!

All esters have the general formula 

Esters are renowned for their great smells. Flowering plants produce them to attract pollinating insects, and later to get animals to eat fruit, distributing their seeds everywhere. This one is found in apples.

The committee that creates the chemistry regents likes to have students name esters. Based on the example above, see if you can come up with a few rules to name these compounds.

1. _____

_____

2. _____

_____

Make models and draw structural formulas of the following:

a) methyl ethanoate
c) ethyl methanoate
c) methyl propanoate
d) propyl ethanoate (pears)

Rank	*Compound*	*Boiling Point (°C)*
	Propanone	56.2°
	Propyne	-23.2°
	Propane	-42.1°
	Propanoic acid	141.0°
	Propanal	48.0°
	Propene	-47.4°
	Propanol	97.0°
	Methyl Propyl Ether	39°

Rank each compound from 1-8 based the following scale: 1= least polar, 8=most polar.

Draw the structural formulas for each compound below.

Which compound has the least attractive forces between its molecules? _____

Which compound is the most polar, and why? _____

_____

Which compounds will dissolve in water? _____