MINISTRY OF EDUCATION

SECONDARY ENGAGEMENT PROGRAMME

GRADE 11

CHEMISTRY

WEEK 8 **LESSON 1**

Topic: Organic Compounds

Sub-topic: Carboxylic acids (Organic acids)

Objective: Given structures students will:

- Identify carboxylic acids by their functional group
- Relate the properties of carboxylic acids to their functional group

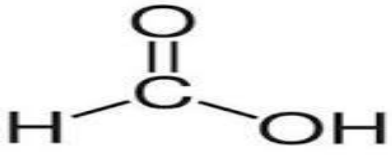
Content

Carboxylic acids are weak acids that only partially ionize in water to produce a small number of hydrogen ions. These organic compounds have the carboxylic acid functional group -COOH

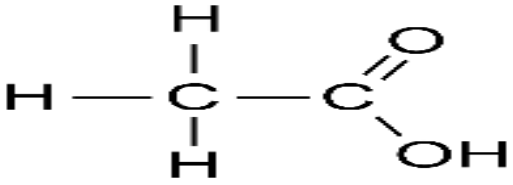
consisting of a carbonyl group (C=O) with a hydroxyl group (O-H) attached to the same carbon atom. They have the general formula $C_n H_{2n+1} COOH$. Carboxylic acids are derivatives of hydrocarbons in which one or more of the hydrogen atoms in the hydrocarbon have been replaced by a carboxyl group. Their names end in -anoic acid and the structures of the first four members are shown below.

Structures of the first four members

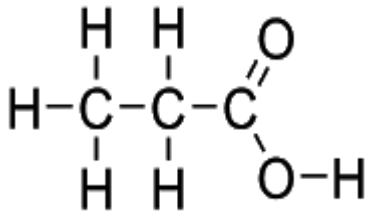
1. Methanoic acid



2. Ethanoic acid



3. Propanoic Acid



4. Butanoic Acid

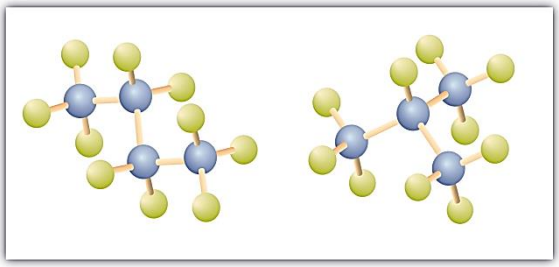


Table showing the names structure and uses of the carboxylic acids

Carbon atoms	Common name	IUPAC name	Chemical formula	Common location or use
1	Formic acid	Methanoic acid	HCOOH	Insect stings
2	Acetic acid	Ethanoic acid	CH_3COOH	Vinegar
3	Propionic acid	Propanoic acid	CH_3CH_2COOH	Preservative for stored grains
4	Butyric acid	Butanoic acid	$CH_3(CH_2)_2COOH$	Rancid butter
5	Valeric acid	Pentanoic acid	$CH_3(CH_2)_3COOH$	Valerian
6	Caproic acid	Hexanoic acid	$CH_3(CH_2)_4COOH$	Goat fat
7	Enanthic acid	Heptanoic acid	$CH_3(CH_2)_5COOH$	
8	Caprylic acid	Octanoic acid	$CH_3(CH_2)_6COOH$	Coconuts and breast milk

9	Pelargonic acid	Nonanoic acid	$CH_3(CH_2)_7COOH$	Pelargonium
10	Capric acid	Decanoic acid	$CH_3(CH_2)_8COOH$	
12	Lauric acid	Dodecanoic acid	$CH_3(CH_2)_{10}COOH$	Coconut oil and hand wash soaps.
14	Myristic acid	Tetradecanoic acid	$CH_3(CH_2)_{12}COOH$	Nutmeg
16	Palmitic acid	Hexadecanoic acid	$CH_3(CH_2)_{14}COOH$	Palm oil
18	Stearic acid	Octadecanoic acid	$CH_3(CH_2)_{16}COOH$	Chocolate, waxes, soaps, and oils
20	Arachidic acid	Icosanoic acid	$CH_3(CH_2)_{18}COOH$	Peanut oil

Note: You only need to know the names of the first 4 members, the others are given for information purposes only.

Properties of carboxylic acids

1. The carboxylic acids have the typical properties of acids. For example, they:
    - dissolve in water to form acidic solutions with pH values less than 7
    - react with metals to form a salt and hydrogen
    - react with bases to form a salt and water
    - react with carbonates to form a salt, water and carbon dioxide

    These properties are due to the –COOH functional group which has a replaceable hydrogen ion.

2. They are solids or liquids at r.t.p. The presence of the -COOH group makes carboxylic acids polar allowing for a relatively strong force of attraction between carboxylic acid molecules.
3. They are soluble in water. This is because the polar functional group (-COOH) attracts water molecules with a relatively strong force of attraction. However, their solubility decreases as the length of the carbon chain increases.
4. They have high melting and boiling points when compared to organic compounds of similar molar mass. The presence of the -OH group in acids allows them to form hydrogen bonds that require large amounts of energy to break.

References

https://sites.google.com/site/chemistryolp/what-are-carboxylic-acids

https://2012books.lardbucket.org/books/introduction-to-chemistry-general-organic-and-biological/s18-01-functional-groups-of-the-carbo.html

https://byjus.com/chemistry/ethanoic-acid/