

***Al-Mustaqbal University College***

***Department of Medical Physics***

***First Class***

***Organic Chemistry***

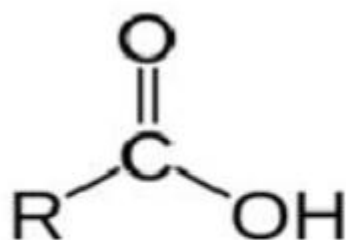
***Lec 8 Carboxylic Acid***

***MSc .Doaa Nassr***

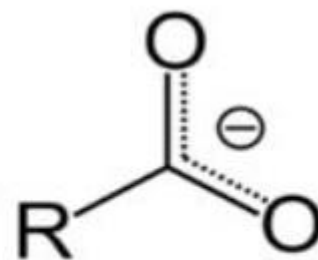
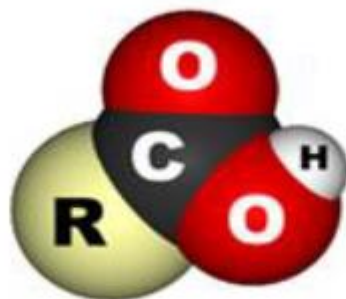
***MSc .Issa Farahan***

## Carboxylic acid

A carboxylic acid is an organic compound that contains a carboxyl group ( $\text{C}(=\text{O})\text{OH}$ ). The general formula of a carboxylic acid is  $\text{R}-\text{COOH}$ , with R referring to the rest of the molecule. Carboxylic acids occur widely. Important examples include the amino acids and acetic acid. Deprotonation of a carboxyl group gives a carboxylate anion.



Structure of a carboxylic acid



Structure of a Carboxylate Anion

# Nomenclature of Carboxylic Acids

The guidelines that must be followed in the IUPAC nomenclature of carboxylic acids are listed below.

1-The suffix ( e ) in the name of the corresponding alkane is replaced with ( oic acid ).

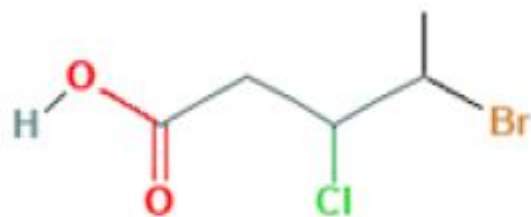
2-When the aliphatic chain contains only one carboxyl group, the carboxylic carbon is always numbered one. For example,  $\text{CH}_3\text{COOH}$  is named as ethanoic acid.

3-When the aliphatic chain contains more than one carboxyl group, the total number of carbon atoms is counted and the number of carboxyl groups is represented by Greek numeral prefixes such as ( di-, tri- , etc).

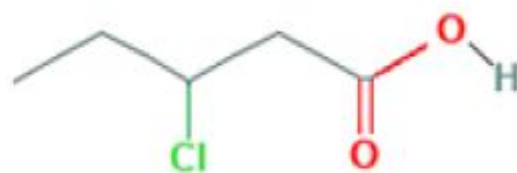
4-A carboxylic acid is named by adding these prefixes and suffixes to the parent alkyl chain. Arabic numerals are used for indicating the positions of the carboxyl group.

5-The name “**carboxylic acid**” assigned for a carboxyl substituent on a carbon chain. An example of such nomenclature is the name 2-carboxyfuran for the compound 2-Furoic acid  $C_5H_4O_3$  , 5-Methyl-3-heptenoic acid.

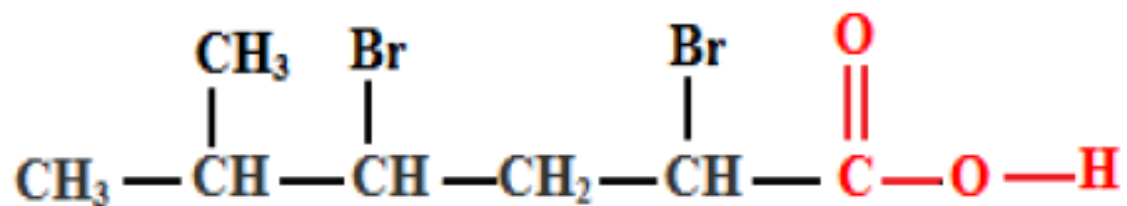
### Examples



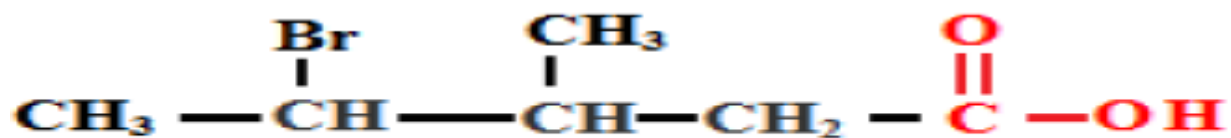
**4-Bromo-3-chloropentanoic acid**



**3-Chloropentanoic acid**



**2,4-Dibromo-5-methylhexanoic acid**



**4-Bromo-3-methylpentanoic acid**

<b>Common name</b>	<b>IUPAC name</b>	<b>Chemical formula</b>	<b>General formula</b>
<b>Formic acid</b>	<b>Methanoic acid</b>	<b>HCOOH</b>	<b>CH<sub>2</sub>O<sub>2</sub></b>
<b>Acetic acid</b>	<b>Ethanoic acid</b>	<b>CH<sub>3</sub>COOH</b>	<b>C<sub>2</sub>H<sub>4</sub>O<sub>2</sub></b>
<b>Propionic acid</b>	<b>Propanoic acid</b>	<b>CH<sub>3</sub>CH<sub>2</sub>COOH</b>	<b>C<sub>3</sub>H<sub>6</sub>O<sub>2</sub></b>
<b>Butyric acid</b>	<b>Butanoic acid</b>	<b>CH<sub>3</sub>(CH<sub>2</sub>)<sub>2</sub>COOH</b>	<b>C<sub>4</sub>H<sub>8</sub>O<sub>2</sub></b>
<b>Valeric acid</b>	<b>Pentanoic acid</b>	<b>CH<sub>3</sub>(CH<sub>2</sub>)<sub>3</sub>COOH</b>	<b>C<sub>5</sub>H<sub>10</sub>O<sub>2</sub></b>
<b>Caproic acid</b>	<b>Hexanoic acid</b>	<b>CH<sub>3</sub>(CH<sub>2</sub>)<sub>4</sub>COOH</b>	<b>C<sub>6</sub>H<sub>12</sub>O<sub>2</sub></b>
<b>Enanthic acid</b>	<b>Heptanoic acid</b>	<b>CH<sub>3</sub>(CH<sub>2</sub>)<sub>5</sub>COOH</b>	<b>C<sub>7</sub>H<sub>14</sub>O<sub>2</sub></b>
<b>Caprylic acid</b>	<b>Octanoic acid</b>	<b>CH<sub>3</sub>(CH<sub>2</sub>)<sub>6</sub>COOH</b>	<b>C<sub>8</sub>H<sub>16</sub>O<sub>2</sub></b>
<b>Pelargonic acid</b>	<b>Nonanoic acid</b>	<b>CH<sub>3</sub>(CH<sub>2</sub>)<sub>7</sub>COOH</b>	<b>C<sub>9</sub>H<sub>18</sub>O<sub>2</sub></b>
<b>Capric acid</b>	<b>Decanoic acid</b>	<b>CH<sub>3</sub>(CH<sub>2</sub>)<sub>8</sub>COOH</b>	<b>C<sub>10</sub>H<sub>20</sub>O<sub>2</sub></b>
<b>Undecylic acid</b>	<b>Undecanoic acid</b>	<b>CH<sub>3</sub>(CH<sub>2</sub>)<sub>9</sub>COOH</b>	<b>C<sub>11</sub>H<sub>22</sub>O<sub>2</sub></b>
<b>Lauric acid</b>	<b>Dodecanoic acid</b>	<b>CH<sub>3</sub>(CH<sub>2</sub>)<sub>10</sub>COOH</b>	<b>C<sub>12</sub>H<sub>24</sub>O<sub>2</sub></b>
<b>Myristic acid</b>	<b>Tetradecanoic acid</b>	<b>CH<sub>3</sub>(CH<sub>2</sub>)<sub>12</sub>COOH</b>	<b>C<sub>14</sub>H<sub>28</sub>O<sub>2</sub></b>
<b>Palmitic acid</b>	<b>Hexadecanoic acid</b>	<b>CH<sub>3</sub>(CH<sub>2</sub>)<sub>14</sub>COOH</b>	<b>C<sub>16</sub>H<sub>32</sub>O<sub>2</sub></b>

## Physical Properties of Carboxylic Acids

Carboxylic acid molecules are polar due to the presence of two electronegative oxygen atoms.

They also participate in hydrogen bonding due to the presence of the carbonyl group (C=O) and the hydroxyl group

The solubility of compounds containing the carboxyl functional group in water **depends on the size of the compound**. The smaller the compound (the shorter the R group), the higher the solubility.

The boiling point of a carboxylic acid is generally higher than that of water

Acidity :- Carboxylic acids are typically weak acids, meaning that they only partially dissociate into  $\text{H}_3\text{O}^+$  cations and  $\text{RCOO}^-$  anions in neutral aqueous solution