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WORKSHEET 18

School: **Ba Sangam College**

Subject: **Chemistry**

Year: **12**

Name: _____

Strand	4 Materials
Sub strand	4.2 Organic Chemistry
Content Learning Outcome	CH 12.4.2.2 Investigate the preparations and reactions of alcohols and carboxylic acids.

Chemical reactions of alcohols

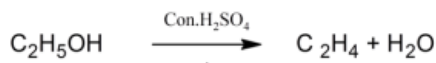
1. Combustion reaction Alcohols burn with blue flame releasing heat and light energy and producing carbon dioxide and water.

Complete Combustion	Incomplete Combustion
$\text{C}_2\text{H}_5\text{OH}_{(l)} + 6\text{O}_{2(g)} \rightarrow 2\text{CO}_{2(g)} + 3\text{H}_2\text{O}_{(l)}$	$\text{C}_2\text{H}_5\text{OH}_{(l)} + 2\text{O}_{2(g)} \rightarrow 2\text{CO}_{(g)} + 3\text{H}_2\text{O}_{(l)}$

2. Dehydration

Dehydration is done by heating the alcohol with concentrated sulfuric acid (which acts as a dehydrating agent). In this reaction, alcohols are used to produce the corresponding alkenes and water.

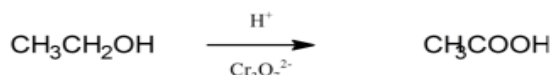
Example



3. Oxidation of alcohol

Alcohols can be oxidized to carboxylic acid by oxidizing agents such as acidified potassium dichromate ($\text{Cr}_2\text{O}_7^{2-}/\text{H}^+$).

Example



Oxidation of alcohol is used commonly in the breathalyzer test. The breathalyzer test determines the amount of alcohol in a person's breath. Acidified potassium dichromate is placed in glass tubing which is attached to a plastic bag. The person is allowed to blow air into the glass tubing. The alcohol in the breath changes the orange dichromate ions ($\text{Cr}_2\text{O}_7^{2-}$) to green chromium ions (Cr^{3+}). The time in which the orange crystals turn green indicates the concentration of alcohol in the person's breath.

Carboxylic Acids

- Carboxylic acids are recognised by the presence of a carboxyl ($-\text{COOH}$) functional group bonded to a carbon atom of an alkyl or substituted alkyl group.
- The general formula for carboxylic acids is $\text{C}_n\text{H}_{2n}\text{O}_2$. Carboxylic acids are represented as: $\text{R}-\text{COOH}$, where R is the alkyl group and COOH is the carboxyl group.

Properties of carboxylic acids

- Carboxylic acids are weak acids which react in the same way as dilute mineral acids. The solubility of acids decreases as the number of carbon atoms increases. Small carboxylic acids are readily soluble in water. They only partially dissociate into H^+ and $\text{R}-\text{COO}^-$ in aqueous solutions. They have a higher melting and boiling points compared to the relative

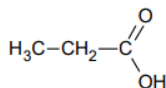
hydrocarbons and alcohols. Most often have strong odors of its derivative.

IUPAC naming of carboxylic acids

- Carboxylic acids are named like alcohols, with some exceptions.
- The parent chain is the one with the greatest number of carbon atoms and includes the functional group (-COOH).
- Carboxylic acids are named by replacing the terminal “e” of the corresponding alkane with “oic acid”.
- While numbering the carbon atoms, priority should be given to the carboxyl group over the alkyl group and ensure that a lower number is given to the carbon which contains the -COOH group.

Number of carbon atoms in longest chain	Parent name
1	Methanoic acid
2	Ethanoic acid
3	Propanoic acid
4	Butanoic acid
5	Pentanoic acid
6	Hexanoic acid

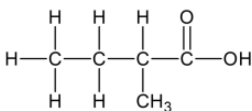
The first six members of the carboxylic acid series Example 1. Name the carboxylic acid shown below.



Solution

The longest continuous carbon chain which includes the -COOH functional group has three carbon atoms. It has no side branches. Therefore the name is **propanoic acid**.

2. Name the carboxylic acid shown below.



Solution

i. The longest chain with the -COOH group contains four carbon atoms, thus parent name will be butanoic acid. ii. There is one side branch on carbon number 2. iii. The side branch is an alkyl group containing one carbon atom, thus will be named methyl. The position and name of the side branch will be 2-methyl. iv. Thus, the name of the carboxylic acid would be 2-methylbutanoic acid

Activity

(6m)

Alcohols						
General Formula	$C_nH_{2n+1}OH$					
Alcohol	Methanol	Ethanol	Propanol	Butanol	Pentanol	Hexanol
Molecular Formula	CH_4O	C_2H_6O	C_3H_8O	C_4H_9OH	$C_5H_{11}OH$	$C_6H_{13}OH$
Expanded structural formula		$ \begin{array}{c} H & H \\ & \\ H-C & -C-OH \\ & \\ H & H \end{array} $				
Condensed structural formula	CH_3OH	CH_3CH_2OH or CH_3-CH_2-OH	$CH_3CH_2CH_2OH$ or $CH_3-CH_2-CH_2-OH$	$CH_3CH_2CH_2CH_2OH$ or $CH_3(CH_2)_2CH_2OH$ or $CH_3-CH_2-CH_2-CH_2-OH$		