3055 BA SANGAM COLLEGE

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WORKSHEET 17

School: **Ba Sangam College** Subject: **Chemistry**
Year: **12** Name:_____

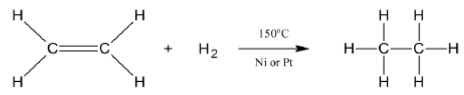
Strand	**4 Materials**
Sub strand	**12.4.1 Inorganic Chemistry**
Content Learning Outcome	**12.4.1.3** Investigate the different classes and reactions of hydrocarbons.

Alkynes

1. Hydrogenation

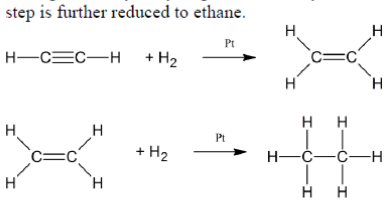
- Atoms of hydrogen add to the carbons in a double or triple bond to form alkanes.
- A catalyst such as platinum (Pt) or nickel (Ni) is added to catalyze the reaction.

Example 1: Hydrogenation of alkenes

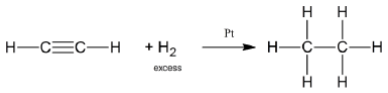


Example 2: Hydrogenation of alkynes

During the catalytic hydrogenation of ethyne, ethene is formed first which in the next step is further reduced to ethane.



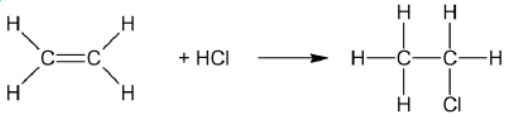
However if excess of H_2 is used, then ethyne is converted to ethane in a single step as shown below.



Hydrohalogenation (addition of hydrogen halides)

- Molecules such as HF, HCl, HBr and HI are added to alkenes.

Example:

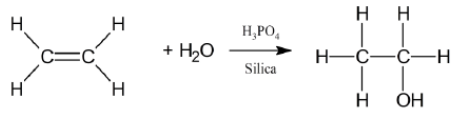


Chloroethane

2. Hydration

- Hydration is the addition of water molecules to alkenes to form alcohols.

Example: Ethene reacts with steam at 300°C and a pressure of 70 atm to form ethanol.

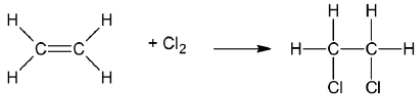


Ethanol

3. Halogenation

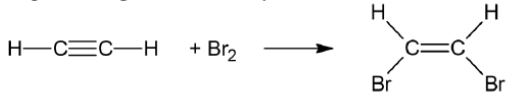
- Halogenation is the addition of halogens such as chlorine and bromine to alkenes and alkynes.
- Chlorine and bromine react with alkenes and alkynes at room temperature with addition of halogen atoms to the carbon atoms of the double bond or triple bond.

Example 1: Halogenation of an alkene

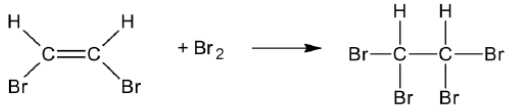


1,2-dichloroethane

Example 2: Halogenation of an alkyne

i 

1,2-dibromoethane

ii. 

1,1,2,2-tetrabromoethane

Note:

Addition of bromine is a useful qualitative test for unsaturation (presence of an alkene or an alkyne). When an alkene or alkyne is bubbled through red brown bromine water, the bromine water gets decolorized. The reaction is faster and more vigorous for alkynes then alkenes. The disappearance of the red color as bromine adds to the double bond or triple bond indicates that alkene or alkyne is present.

Isomerism

- Isomerism occurs where two or more compounds have the same molecular formula but different structural formulas.

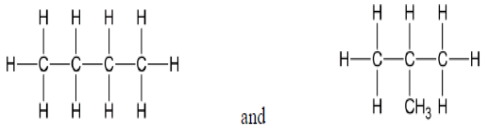
Two common types of isomers are:

1. Structural (also known as constitutional isomers)

- Structural isomerism occurs when the compounds have the same number and types of atoms but are arranged in different ways.
- The number of possible isomers increases rapidly as the length of the chain increases.

Example

The two structural isomers of the hydrocarbon with molecular formula C_4H_{10} are:

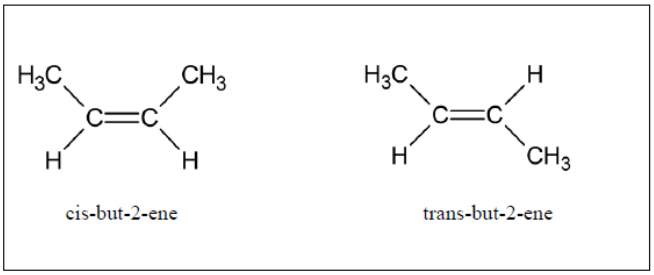


Butane and 2-methlypropane

2. Geometrical Isomers

- The double and triple bonds found in alkenes and alkynes are fixed and you will not be able to rotate it.
- This allows the atoms or the groups of atoms bonded to the carbons of the double bonds to have different arrangements.
- These different arrangements are called geometrical isomers. When the groups are on the same side of the double or triple bond, they area called **cis** isomers.
- When the groups are on opposite sides of the double or triple bond, they are called **trans** isomers.

Example



cis-but-2-ene trans-but-2-ene

4. Alcohols

- Alcohols are recognised by the presence of the hydroxyl functional group (–OH) bonded to a carbon atom of an alkyl or substituted alkyl group.
- The hydroxyl functional group strongly contributes to the physical properties of alcohols.
- The general formula of alcohol is $C_nH_{2n+1}OH$. Alcohols are represented as: R-OH, where R is the alkyl group and OH is the hydroxyl group.

Properties of alcohols

- Alcohols are colorless.
- Alcohols have much higher boiling points than other compounds of similar molecular weight.
- The boiling point of alcohols increases with the increasing number of carbon atoms.
- Small alcohols are miscible in water. However, once a certain number of carbons in the alkyl chain of the alcohol is reached, the alcohol is no longer soluble.
- The longer the carbon chains in an alcohol, the lower the solubility in polar solvents and the higher the solubility in nonpolar solvents.
- Alcohols with less than seven carbon atoms are liquid at room temperature.
- The smaller alcohols are more volatile than the larger ones.

IUPAC Naming of alcohols

- Naming alcohols is similar to alkenes and alkynes with some exceptions.
- Alcohols are named by replacing the terminal “e” of the corresponding alkane by ol”.
- Wherever necessary, a number is written in front of “ol” to indicate the position of the -OH functional group.
- While numbering the carbon atoms, priority should be given to the hydroxy group over the alkyl group.

Steps

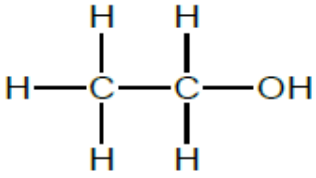
1. Select the longest carbon chain containing the functional group -OH.
2. Number the chain with the -OH group getting the lowest possible number.
3. Replace the "e" at the end of the suffix of the alkyl chain with -ol.
4. If necessary, add a prefix number to indicate which carbon the -OH group is bonded to.

The first six members of the alcohol series

Number of carbon atoms in the longest chain	Parent name
1	Methanol
2	Ethanol
3	Propanol
4	Butanol
5	Pentanol
6	Hexanol

Example

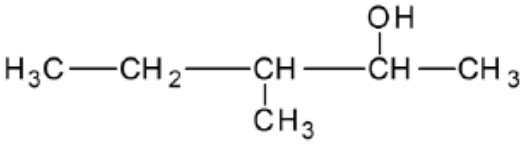
1. Name the alcohol given below.



Solution

i. The longest chain with the –OH group contain two carbon atoms, thus the parent name is ethanol.
ii. Since there are no other substituents, the name of the alcohol is **ethanol.**

2. Name the alcohol given below.



Solution

i. The longest chain with the –OH group contains five carbon atoms, thus parent name will be pentanol.
ii. While numbering the carbon atoms from the side which would give the –OH group a lower number (from right to left), it can be seen that the –OH group falls on carbon number two.
iii. Therefore, the parent name will be pentan-2-ol.
iv. There is one side branch on carbon number 3.
v. The side branch is an alkyl group containing one carbon atom, thus will be named methyl. The position and name of the side branch would be: 3-methyl.
vi. The name of the alcohol is therefore: **3-methylpentan-2-ol.**

Activity

1. Name the following alcohols.

A. CH_3-CH_2-CH(-CH_3)-CH_2-OH

B. CH_3-CH_2-CH(-OH)-CH_2-CH_2-CH_3

C. CH_3-CH_2-C(CH_3)(CH_3)-CH_2-OH

2. Draw the structure of the following alcohols.

i. 2-methylpentan-3-ol ii. 2,3-dimethylbutan-1-ol iii. 2-ethylhexan-3-ol

1A-_____

B-_____

C-_____ (3m)

2i)

ii)

iii)

iv)isopropyl alcohol