

## Experiment 8: Reactions of Functional Group – 1

### Some Reactions of Hydrocarbons

#### SEE THE VEDIO:

Reactions Of Aliphatic And Aromatic Compounds:

<https://youtu.be/uzME70Ubt40>

#### INTRODUCTION

#### Hydrocarbons

HCs are organic compounds containing carbon and hydrogen atoms in their structure.

Hydrocarbons themselves are separated into two types: aliphatic hydrocarbons and aromatic hydrocarbons.

**a) Aliphatic hydrocarbons atoms** (مركبات خطية مسلسلة) are hydrocarbons based on chains of C.

**There are three types of aliphatic hydrocarbons:**

- ✓ **Alkanes** are aliphatic hydrocarbons with only single covalent bonds between carbon-carbon atoms, they are relatively unreactive, because they have strong C-C single bond.
- ✓ **Alkenes** are hydrocarbons that contain at least one C=C double bond, more reactive than alkanes.
- ✓ **Alkynes** are hydrocarbons that contain a C

✓ **alicyclic hydrocarbons**. Occasionally, we find an aliphatic hydrocarbon with a ring of C atoms; these hydrocarbons are called **cycloalkanes (or cycloalkenes or cycloalkynes)**

✓ In general **the reactivity of alicyclic hydrocarbons** are similar to that of linear alkanes and alkenes.

▶ Because alkanes have the maximum number of H atoms possible according to the rules of covalent bonds, alkanes are referred to **as saturated hydrocarbons**.

### **b) Aromatic Hydrocarbons**

▶ "Aromatic hydrocarbons are sometimes known as "arenes" or "aryl hydrocarbons.

▶ Most aromatic hydrocarbons contain a **benzene** ring in their structure; but there are non-benzene aromatic hydrocarbons called heteroarenes, which follow the "Huckle's rule" (Cyclic rings which follow the Huckle's rule have  $4n+2$  number of  $\pi$ -electrons; where  $n = 0,1,2,3,4,5,6$ ).

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## Reactions of Aliphatic and Aromatic Hydrocarbons

### ❖ Aliphatic Hydrocarbons :

- ▶ **Saturated hydrocarbons** undergo substitution reactions
- ▶ **Unsaturated hydrocarbons** attain the stability by addition reaction. But, some reactions happen under controlled conditions without breaking multiple bonds.

### ❖ Aromatic Hydrocarbons:

Aromatic hydrocarbons are unsaturated, but have a stable conjugated electron system, so that they are more liable to substitution reactions rather than addition reactions.

## ● ● ● | Properties of Aliphatic hydrocarbons

- **STRUCTURE AFFECTS MOLECULAR PROPERTIES**
- **Alkanes** are not polar and are good solvents for other nonpolar molecules
- **Alkanes** have low reactivity because they are nonpolar and have no charge, and because they have strong single bonds between carbon atoms.
- **Alkenes** are nonpolar and have low solubility in water. Alkenes are more reactive than alkanes because the double bond increases electron density between the two carbon atoms, providing a good site for chemical reactivity
- **Alkynes** have physical and chemical properties similar to alkenes but are generally more reactive because the triple bonds cause even larger electron densities than double bonds

### Uses of Hydrocarbons

- Hydrocarbons are widely used as fuels. For example LPG (liquefied petroleum gas), CNG (Liquefied natural gas).
- They are used in the manufacturing of polymers such as polyethene, polystyrene etc.
- These organic compounds find their application in the manufacturing of drugs and dyes as a starting material.
- They serve as lubricating oil and grease.

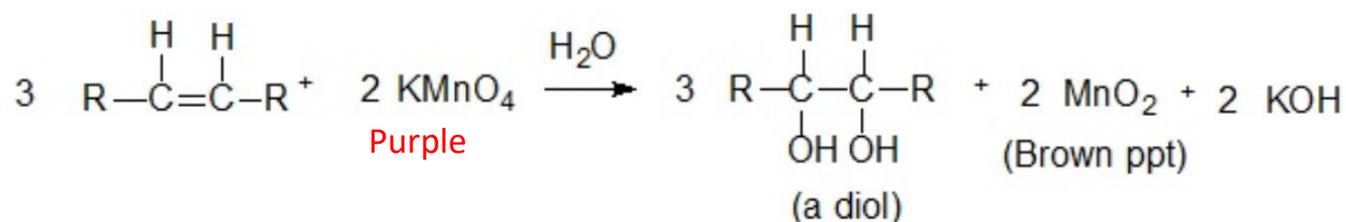
**Materials:** Test tubes, hexane, cyclohexane, hexene, cyclohexene, m-xylene, dilute  $\text{KMnO}_4$ , aluminum chloride, chloroform, bromine in carbon tetrachloride.

**WEAR SAFETY GLASSES AT ALL TIMES IN LAB**

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**Part A. Baeyers Test: Reaction of Alkenes with Aqueous Potassium Permanganate**

Potassium permanganate is an oxidizing agent that reacts with unsaturated aliphatic hydrocarbons, but does not react with alkanes or aromatic hydrocarbons. The dilute  $\text{KMnO}_4$  solution has a deep purple color, if there is no reaction you should see no color change. When it reacts with unsaturated aliphatics it produces  $\text{MnO}_2$ , a brown precipitate. This reaction is useful as a test for the presence of a multiple bond, if there is no other easily oxidizable group, such as an alcohol or aldehyde.



For Experimental Procedure; See the following YouTubes:

<https://youtu.be/B1hqWTKXIQg>

$\text{KMnO}_4$  test

[https://youtu.be/pv\\_zMbf7Tc](https://youtu.be/pv_zMbf7Tc)

Benzene and Toluene with  $\text{KMnO}_4$

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**Caution.**

- Bromine is highly toxic and can cause severe skin burns. Wear disposable gloves to avoid skin contact with the bromine solution, and do not breathe the vapors. Work in a hood, if possible Sulfuric acid is a corrosive liquid. Avoid skin contact.

**Procedure:**

1. Place 5 drops of the following HC in clean separate test tubes: Hexane, Hexene, and Toluene
2. Add 2 drops of bromine solution to each test tube and observe the disappearance of red color of Br<sub>2</sub>.
3. Record your observations.

For Experimental Procedure; See the :following YouTubes

[https://youtu.be/2C\\_6ax2TsV8](https://youtu.be/2C_6ax2TsV8)

BROMINE TEST HEXANE & HEXENE

<https://youtu.be/qEm-CaqhcOs>

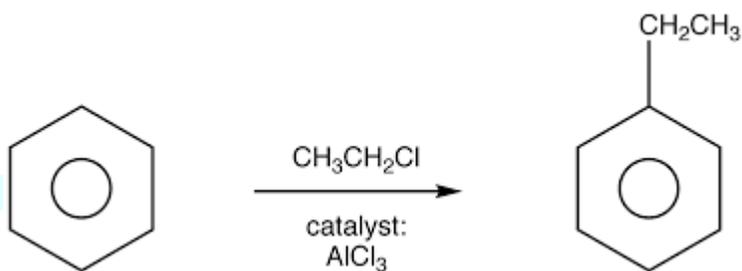
Br<sub>2</sub> test

**Note:** It is essential that the aluminum chloride be anhydrous (water free). Be sure your test tubes and other materials are clean and dry before performing this test.

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### C. Electrophilic Aromatic Substitution Reactions

1. Friedel – Crafts Alkylation Reaction.
2. Friedel – Crafts Acylation Reaction.



For Experimental Procedure; See the following YouTubes:

<https://youtu.be/33D7IYfuEq8>

Alkylation and acylation of benzene

<https://youtu.be/mCTHFpwrOKg>

Alkylation of m-xylene

### D. Reaction of Hydrocarbons with Sulfuric Acid

For Experimental Procedure; See the following YouTubes:

<https://youtu.be/oNbwlfqNUD4>

H<sub>2</sub>SO<sub>4</sub> solubility test cyclohexene, cyclohexane, and benzene

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### E. Combustion of Hydrocarbon in Presence of O<sub>2</sub>

Saturated compounds burn cleanly, while unsaturated ones tend to produce soot.

For Experimental Procedure; See the following YouTube:

<https://youtu.be/EaGbYoZ-6W0> Rxns of Hexane & 1-Hexene: 1. Combustion. 2. Br<sub>2</sub> 3. KMnO<sub>4</sub>

### Caution.

1. Sulfuric is extremely corrosive liquids. Avoid contact of these acids with your skin or clothing. Wear disposable gloves. If you have an accidental spill, wash immediately with a large amount of water.
2. Cyclohexane and cyclohexene are flammable. Do not use an open flame as a heating source during this experiment

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