

2. Organic Reactions

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Abstract:

The chemistry of carbon compounds is now referred to as organic chemistry. When the majority of the substances identified in this discipline of chemistry came from living organisms, the word "organic" was first used to characterize it.

The greatest component of chemistry is organic chemistry, which also ranks among the most popular disciplines in terms of both its factual base and its audience size. There are currently more than a million known organic compounds, and thousands more are constantly being found in nature or created in laboratories.¹

Chemical processes involving organic molecules are known as organic reactions. Functional groups have a strong relationship with several of these reactions. Analysis of features including bond strength, steric hindrance, and the electron affinities of important atoms are all carefully considered in the general theory of these processes.

Covalent bonds found in organic compounds change most frequently during organic processes. These modifications could include bond cleavage, electric bond displacement, energy modifications associated with covalent bond formation, etc. We must.²

Keywords:

Covalent bond, steric hindrance, electron affinities, bond strength, energy modifications.

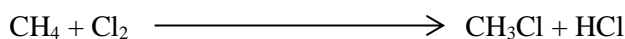
2.1 Types of Organic reactions:

- A. Substitution reactions
- B. Addition reactions
- C. Elimination reactions
- D. Rearrangement reactions

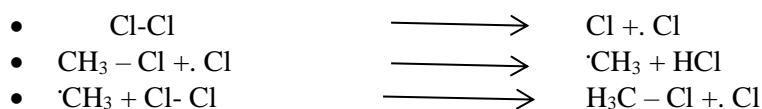
2.1.1 Substitution Reactions:

In a substitution reaction, an atom or group of atoms from a molecule are exchanged out for new ones while maintaining the molecule's original structural integrity. Free radical, nucleophilic, and electrophilic substitution reactions are those in which free radicals, nucleophiles, and electrophiles serve as reactive intermediates.³

A. Free Radical Substitution Reactions: For instance, methyl chloride is created when methane combines with chlorine in the presence of sunlight by replacing one hydrogen atom with a chlorine atom in a free radical substitution reaction. This reaction is known as a free radical substitution reaction because it uses free radicals as intermediates.

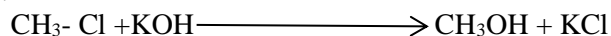


This reaction involves the following steps:



This reaction may proceed further to replace remaining hydrogen atoms by chlorine to form CH_2Cl_2 , CHCl_3 and CCl_4 by similar mechanisms.

B. Nucleophilic Substitution Reactions: A nucleophilic substitution process is one in which methyl chloride and aqueous potassium hydroxide react to produce methyl alcohol.

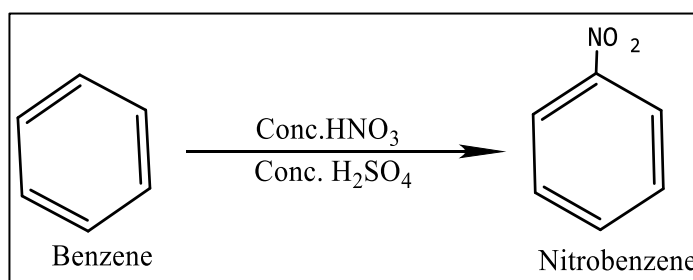


In this reaction replacement of Cl by a nucleophile ($:\text{OH}^-$) take place. Substitution reactions of alkyl halide involve nucleophilic substitution reactions.

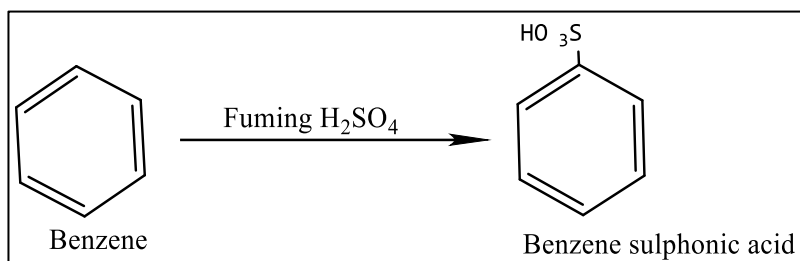
C. Electrophilic Substitution Reactions: Electrophilic substitution reactions include aromatic substitution processes like nitration, sulphonation, Friedel craft reactions, etc. These reactions involve replacement of nuclear hydrogen by an electrophile (Ex- NO_2 , R^+ etc)⁴

Example: -

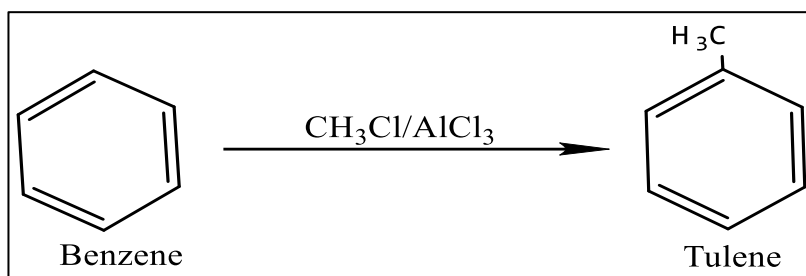
- Nitration



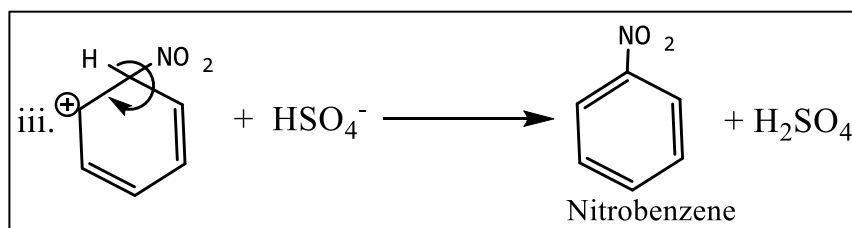
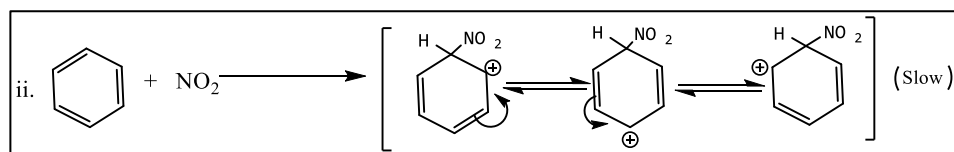
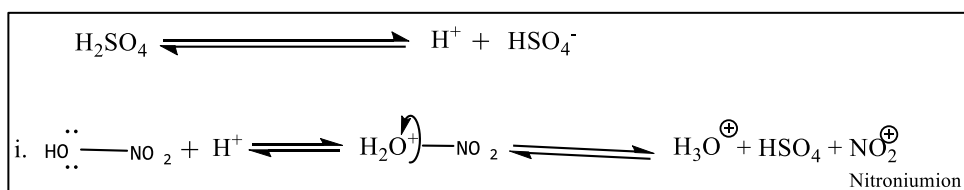
- Sulphonation



- Friedel craft reaction

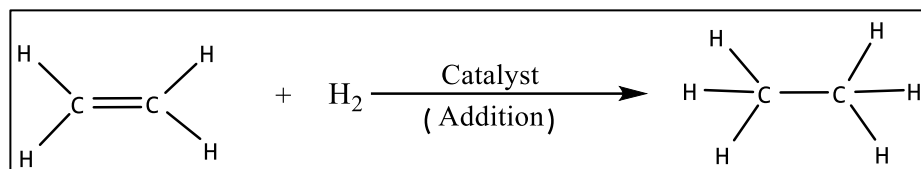


- Mechanism of Nitration:



2.1.2 Addition Reactions:

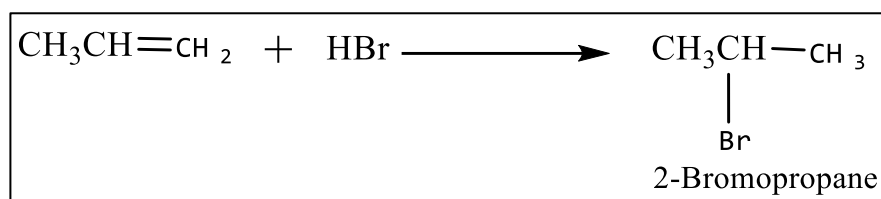
The chemical molecules with double or triple bonds that cause these reactions (unsaturated compounds). These substances easily incorporate hydrogen, haloacids, halogens, etc. into the end product while altering the molecule's shape. For example,



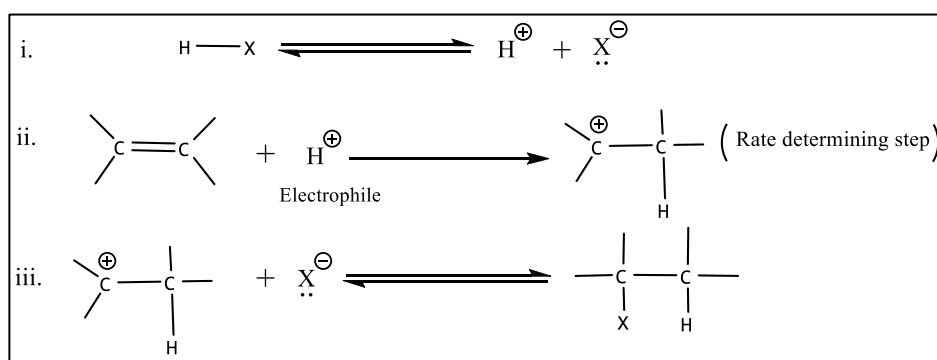
In these reactions, one pi bond, which is weaker than an alpha bond, breaks to produce two new sigma bonds, one on each carbon, which satisfy the valency criteria in the end product.

These reactions are of three types:

A. Electrophilic Additions: These reactions are known as electrophilic addition reactions because they are started by the addition of an electrophile during the rate-determining step. For example,



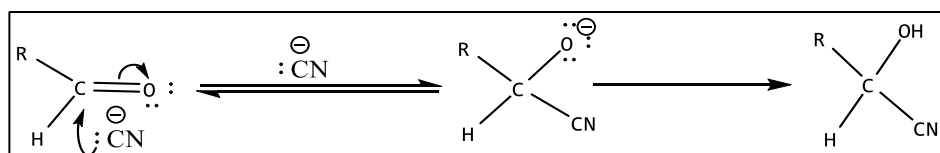
B. Mechanism: It is an electrophilic addition reaction, initiated by the electrophile (H^+) released from the HX. This reaction involves the following steps:



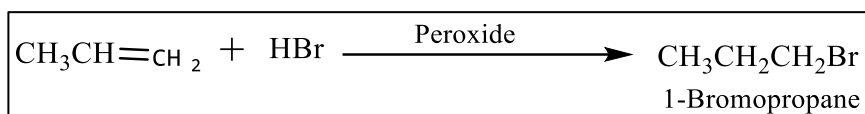
The rate determining step is step (ii) leading to the formation of a **carbocation**.

C. Nucleophilic Additions: Simple aldehydes and ketones' carbon-oxygen double bonds give rise to addition reactions that are typically nucleophilic in nature.

For example, addition of HCN to aldehydes

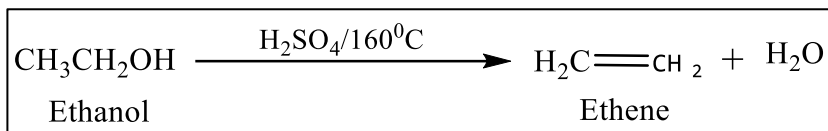


A. Free radical additions: - Free radical mechanism controls the addition reaction of HBr to unsymmetric alkenes (like propene) in the presence of peroxides to produce an anti-Markownikoffs product. Free radical addition reaction is the name given to this process.

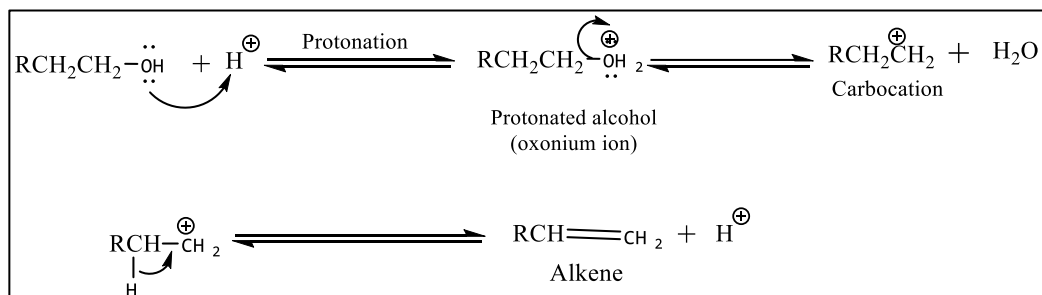


2.1.3 Elimination Reactions:

This reaction is the opposite of the addition reaction. A reactant molecule loses atoms or groups during an elimination process. These reactions result in compounds with many bonds.⁵ For example,



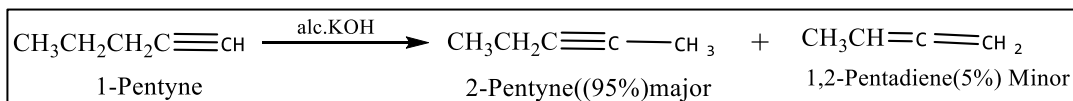
A. Mechanism: It involves protonation of alcoholic group followed by elimination of water and deprotonation.



2.1.4 Rearrangement Reactions:

An atom or a group of atoms may move from one area of a molecule to another area of the same molecule during a rearrangement reaction. Triple bond migration may also be involved.⁶

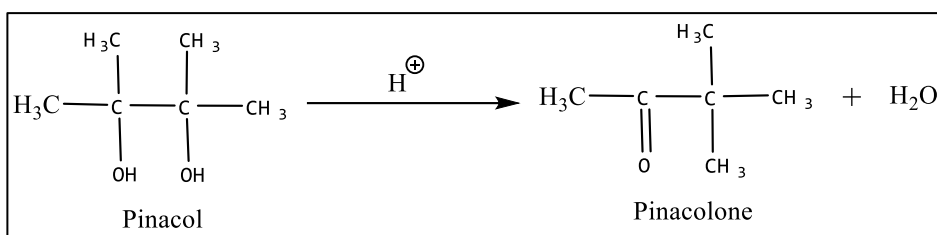
For example, 1-pentyne with alcoholic KOH tend to rearrange with migration of triple bond to form 2-pentyne as major product:



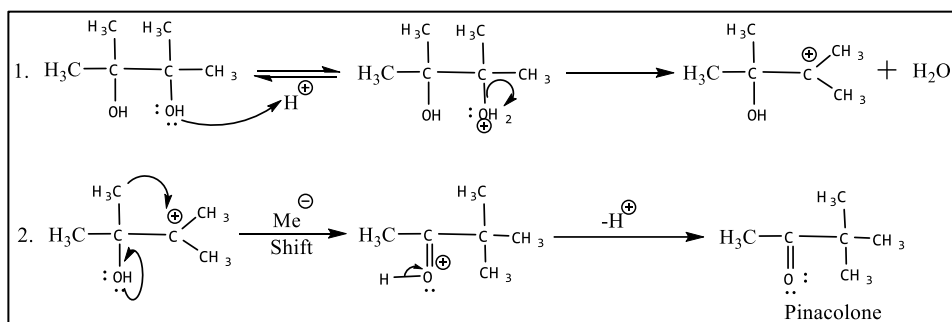
Some of examples of Rearrangement reactions,

A. Pinacol Pinacolone Rearrangement: It involves the dehydration of substituted vicinal diols (pinacols) under acid catalysis, followed by rearranging the carbon skeleton to produce ketones.⁷

For example,



Mechanism:

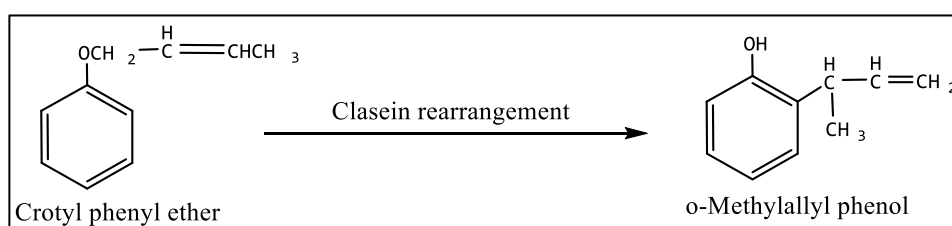


Step 1 involves protonation of that -OH group, which on elimination of water molecule gives most stable carbocation.

Step 2, carbocation undergoes a 1,2-methyl shift to the electron deficient carbon to generate protonated ketone.

B. Claisen Rearrangement: O-allyl ether of phenol undergoes a rearrangement to become o-allylphenol at a temperature of about 200°C in the absence of any catalyst. The Claisen rearrangement of phenolic allyl ethers is the name of this thermal process.⁸

For Example,



2.2 References:

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