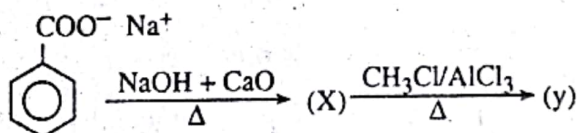


Organic Chemistry

Unit 8: Aromatic hydrocarbon

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Organic Chemistry

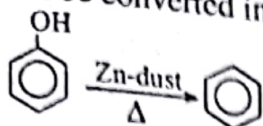
Unit 8: Aromatic hydrocarbon

Syllabus

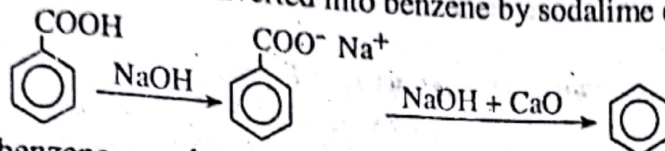
- ☐ Definition, characteristics of aromatic compounds, Huckel's rule, structure of benzene, isomerism and orientation of benzene derivatives
- ☐ Preparation of benzenes from
 - i. decarboxylation ii. phenol iii. ethyne iv. chlorobenzene
- ☐ Physical properties of benzene
- ☐ Chemical properties of benzene
 - i. Addition reaction: hydrogen, halogen and ozone
 - ii. Electrophilic substitution reactions: nitration, sulphonation, halogenation
Friedal craft's alkylation and acylation
 - iii. Combustion of benzene and uses

Some important terms, concepts and formulae

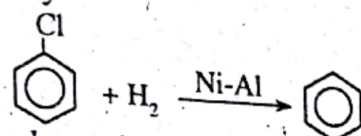
1. Benzene or compounds containing benzene type nucleus are called aromatic hydrocarbon.
2. Phenol can be converted into benzene by distilling with Zn-dust.



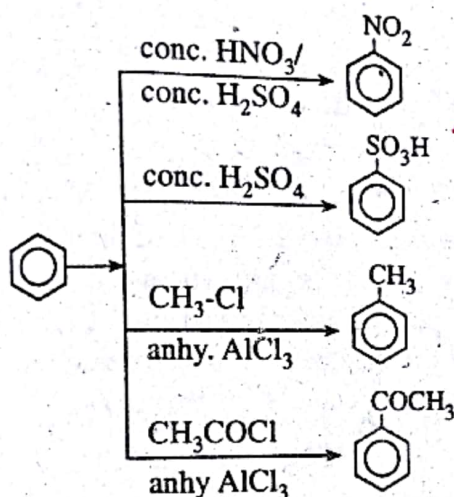
3. Benzoic acid can be converted into benzene by sodalime decarboxylation.



4. Chlorobenzene can be converted into benzene by reducing in presence of Ni-Al alloy.



5. Benzene burns in presence of oxygen to give huge amount of energy.
- 6.



7. Benzene is used as a solvent for fats and carbohydrates.

Read the above mentioned various definitions, explanations and formulae carefully. Then go through the following solved examples. After doing the solved examples, try to solve the other similar questions independently.

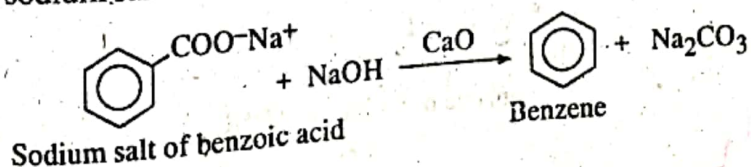
Subject Matter

Very Short Questions-Answers

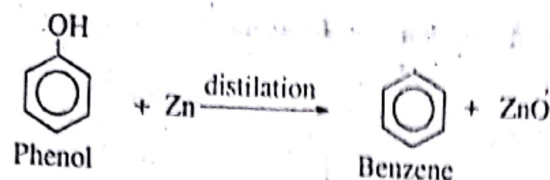
Q.1. Give any two methods of preparation of benzene.

Ans: The following two methods can be used to prepare benzene:

(a) **Sodalime decarboxylation:** Benzene can be obtained by decarboxylating sodium salt of benzoic acid with sodalime.



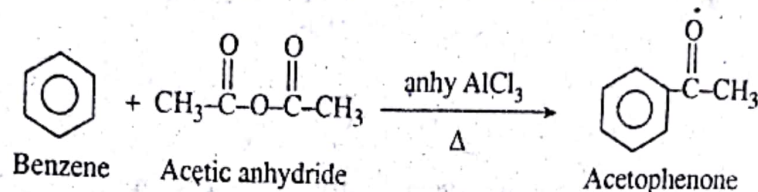
(b) Similarly, benzene can also be prepared by distilling phenol with zinc dust.



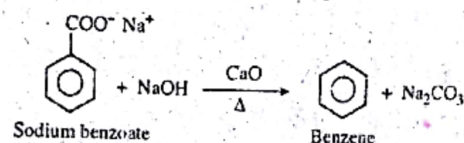
Q.2. What happens when:

- i. Benzene is heated with acetic anhydride in presence of anhydrous AlCl_3 .
- ii. Sodium benzoate is heated with sodalime.

Ans: (i) When benzene is heated with acetic anhydride in presence of anhydrous AlCl_3 , acetophenone is obtained.

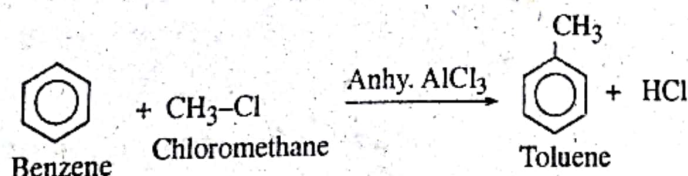


(ii) Benzene is obtained as product:



Q.3. Define electrophilic substitution reaction with one example.

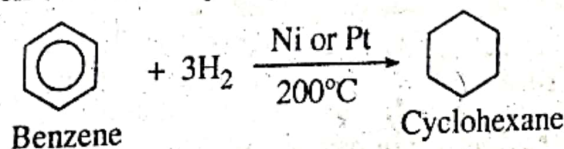
Ans: The attack of an electrophile on benzene to give substituted benzene with subsequent displacement of electrofuge (H^+) is known as electrophilic substitution reaction. One good example of such reaction is attack of chloromethane on benzene nucleus in presence of anhydrous aluminium chloride to give toluene.



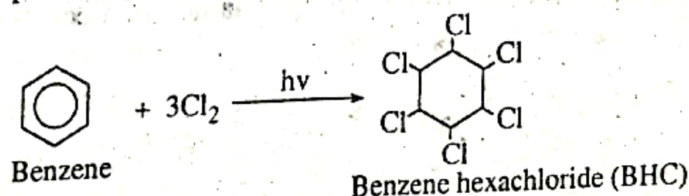
Q.4. What are the products obtained when

- (a) Benzene is hydrogenated catalytically?
- (b) Benzene is chlorinated in presence of sunlight.

Ans: (a) When benzene is hydrogenated catalytically, it is reduced to cyclohexane.

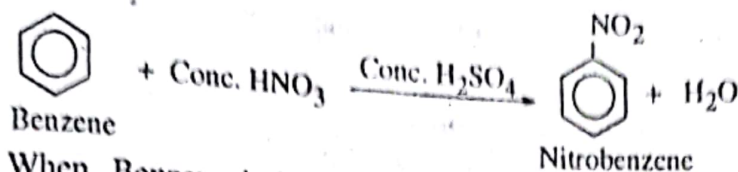


(b) Similarly, Benzene gives Benzene hexachloride (BHC) with chlorine in presence of sunlight.

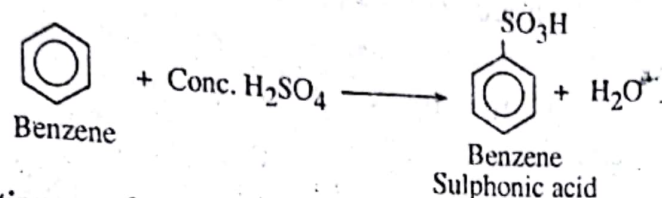


Q.5. Write the action of Benzene with (a) Conc. HNO_3 in presence of conc. H_2SO_4 and (b) Conc. H_2SO_4 alone.

Ans: (a) Benzene reacts with conc. HNO_3 upon refluxing in presence of conc. H_2SO_4 to give Nitrobenzene. This reaction is also known as nitration.



(b) When, Benzene is heated with conc. H_2SO_4 for a few hours, benzene sulphonic acid is obtained. This is a type of sulphonation reaction.



Q.6. Mention any four important uses of Benzene.

Ans: The important uses of Benzene are:

- It is used as a good solvent for extraction of fats and oils.
- It is used as a fuel for automobiles under the name benzole. It is also added in gasoline to increase their octane rating.
- It is used to prepare styrene, cyclohexane which are raw materials for plastic.
- It is used to prepare various industrial products such as dyes, drugs and perfumes.

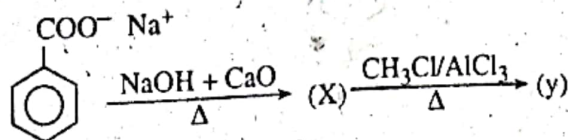
Q.7. What is aromaticity?

Ans: The stabilization of aromatic compounds due to delocalization of conjugated π -electron system in them is called as aromatic stabilization or aromaticity. For instance the aromaticity of benzene is 36 Kcal/mole i.e. it is stabilized by 36 Kcal/mole than supposed cyclohexatriene.

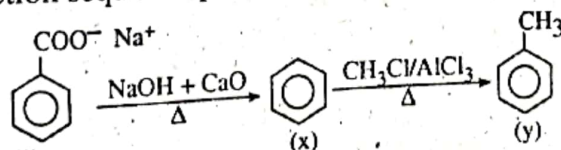
Q.8. State Hukels rule.

Ans: Huckel's rule is used to predict the structural requirement for a compound to be aromatic. According to this rule, "for a compound to be aromatic it should have flat or nearly flat cyclic structure possessing $(4n + 2)$ delocalized π -electrons where $n = 1, 2, 3, 4$ etc. i.e. number of closed ring".

Q.9. Identify (X) and (Y) in the following reaction and give their names.



Ans: The reaction sequence proceeds as



Hence, $x = \text{C}_6\text{H}_6$ (Benzene)

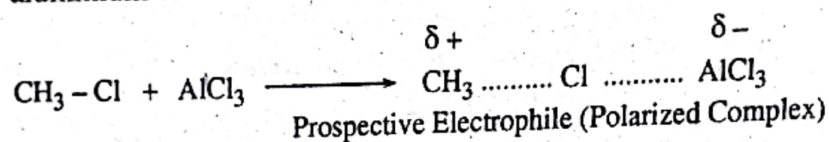
$y = \text{C}_6\text{H}_5\text{CH}_3$ Toluene

Short Question-Answers

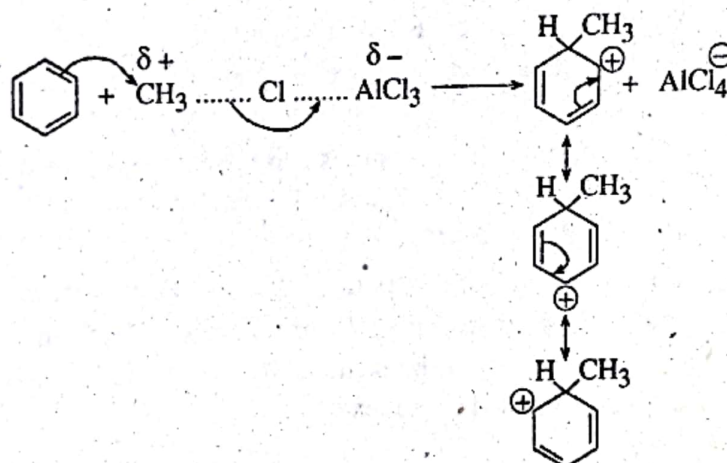
Q.10. Write a short note on Friedel-craft's reaction.

Ans: The reaction of alkylhalide or acylhalide with benzene in presence of anhydrous metal chloride, more frequently aluminium chloride to give substituted benzene is collectively known as **Friedel-craft's reaction**. It is an electrophilic substitution reaction since the rate determining step is the attack of electrophile on benzene. It can be classified into the following two types:

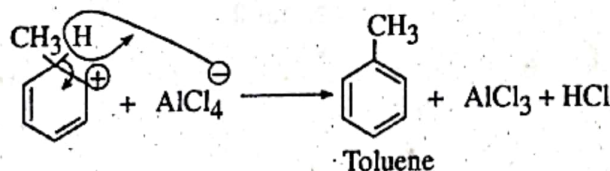
- (a) **Friedel-craft's alkylation:** In this type of reaction, the electrophile is alkyl group which are generated by using alkylhalide and anhydrous aluminium chloride. For instance, the methyl electrophile can be generated as follows by using chloromethane and anhydrous aluminium chloride:



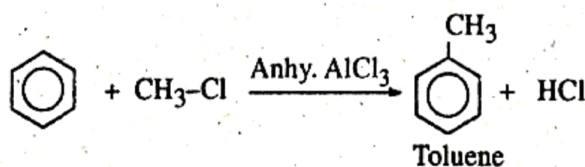
The prospective electrophile then attack benzene nucleus.



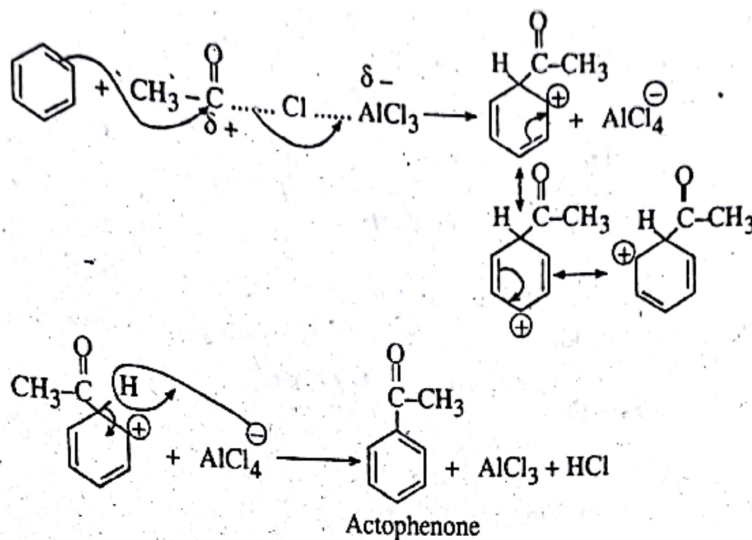
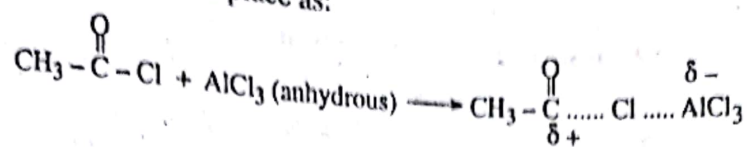
Finally, the electrofuge H^+ is eliminated to regain the benzene nucleus.



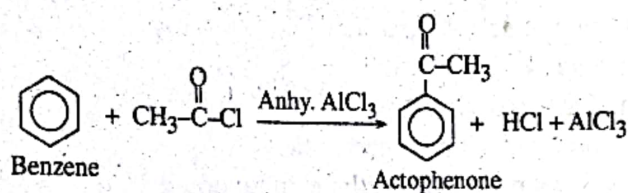
The reaction can be simply represented as:



- (b) **Friedel-craft's acylation:** Here, the electrophile is acyl group which is generated by using acylchloride and anhydrous aluminium chloride. The reaction takes place as:



This reaction can be represented in a single step as follows:



This reaction is a good method to introduce carbonyl group in benzene ring.