

2020

Organic Chemistry

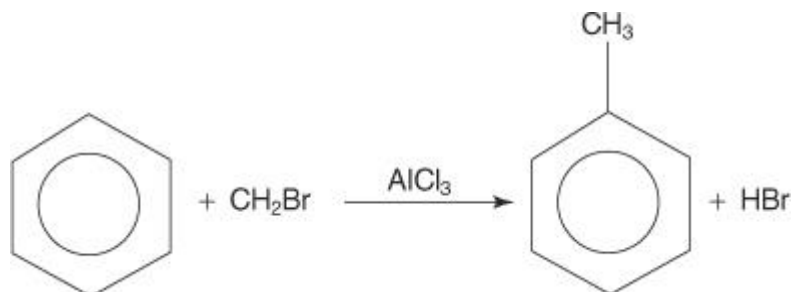
Friedal Craft Reaction

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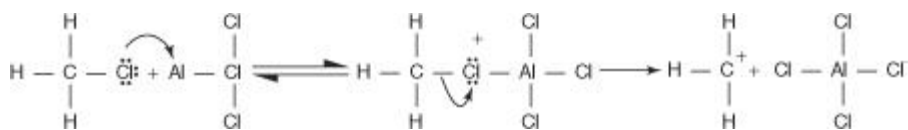
Friedel-Crafts Alkylation Reaction

An alkyl group can be added to a benzene molecule by an electrophile aromatic substitution reaction called the **Friedel-Crafts alkylation reaction**. One example is the addition of a methyl group to a benzene ring.

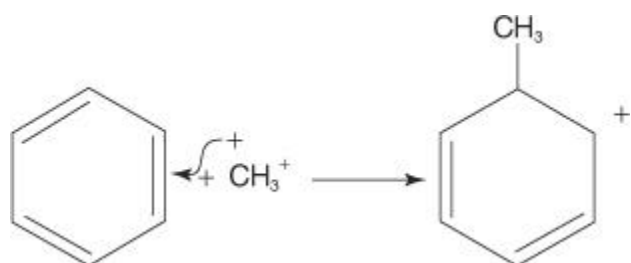


The mechanism for this reaction begins with the generation of a methyl carbocation from methylbromide. The carbocation then reacts with the π electron system of the benzene to form a nonaromatic carbocation that loses a proton to reestablish the aromaticity of the system.

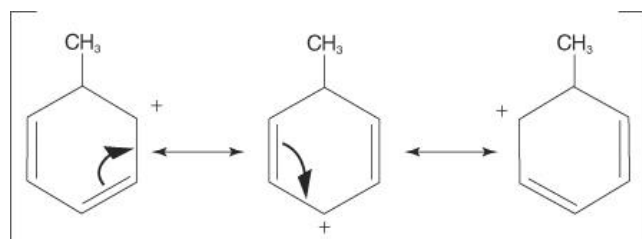
1. An electrophile is formed by the reaction of methylchloride with aluminum chloride.



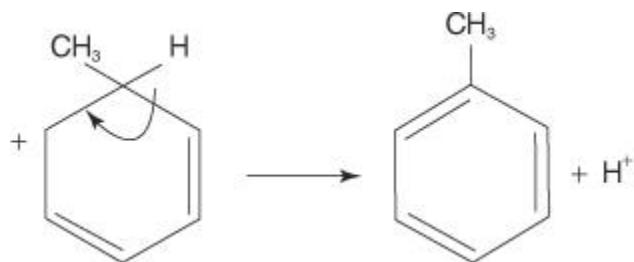
2. The electrophile attacks the π electron system of the benzene ring to form a nonaromatic carbocation.



3. The positive charge on the carbocation that is formed is delocalized throughout the molecule.



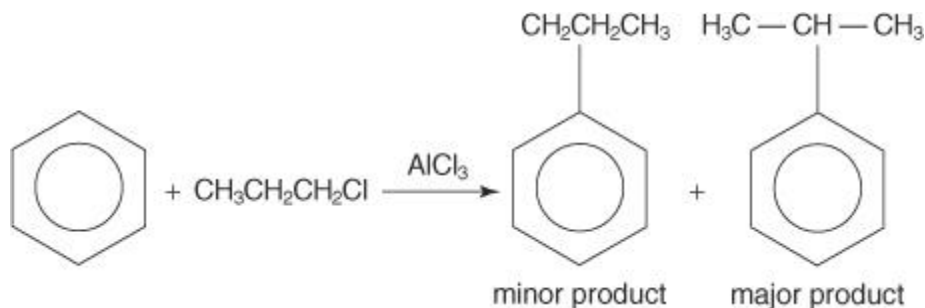
4. The aromaticity is restored by the loss of a proton from the atom to which the methyl group has bonded.



5. Finally, the proton reacts with the AlCl_4^- to regenerate the AlCl_3 catalyst and form the product HCl .



Carbocations can rearrange during the Friedel-Crafts alkylation reaction, leading to the formation of unpredicted products. One example is the formation of isopropyl benzene by the reaction of propyl chloride with benzene.



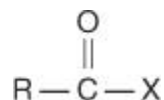
The isopropyl benzene results from a rearrangement of the initially formed propyl carbocation to the more stable isopropyl carbocation.



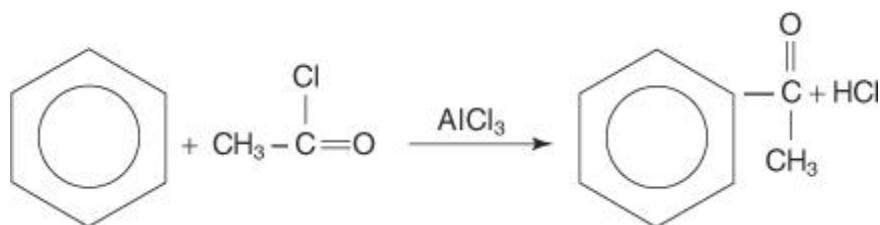
This rearrangement is called a 1,2-hydride ion shift. A hydride ion is H^- .

Friedel-Crafts Acylation Reaction

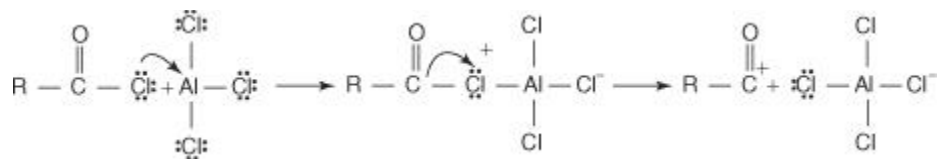
The **Friedel-Crafts acylation reaction**, another example of an electrophilic aromatic substitution reaction, is similar to the Friedel-Crafts alkylation reaction except that the substance that reacts with benzene is an acyl halide,



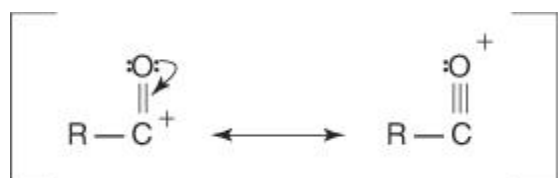
instead of an alkyl halide, R & bond; X. An acetyl chloride reaction appears as:



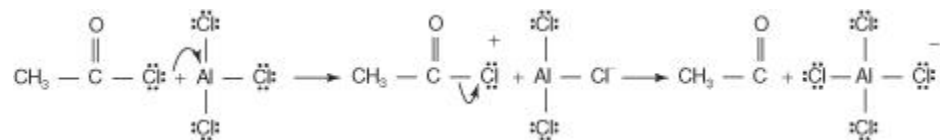
The mechanism for the generation of the acylium ion, $\text{R}-\overset{\text{O}}{\parallel}{\text{C}}^+$ is



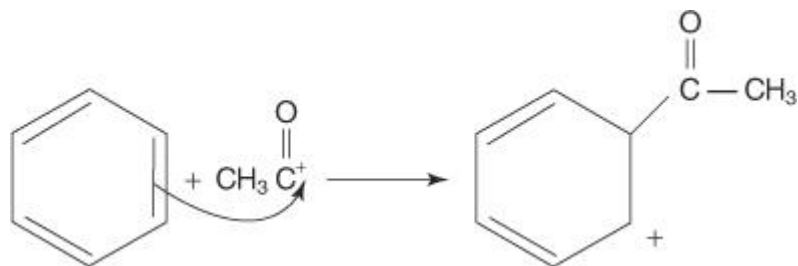
The remainder of the mechanism is identical to that of the alkylation of benzene. Because the acylium ion is resonance stabilized, no rearrangements occur.



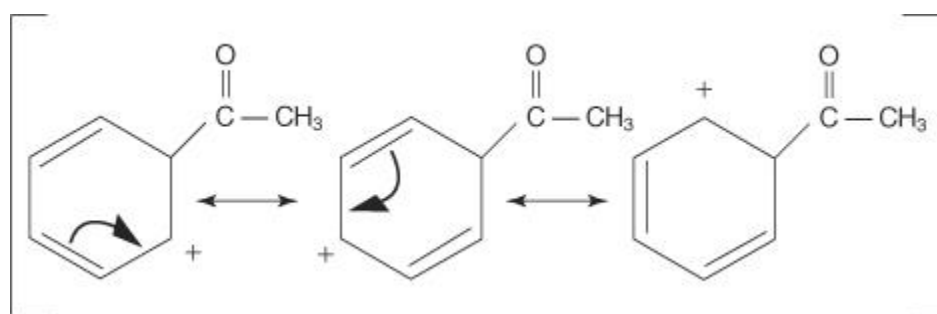
1. The reaction of acetyl chloride with aluminum chloride forms an electrophile.



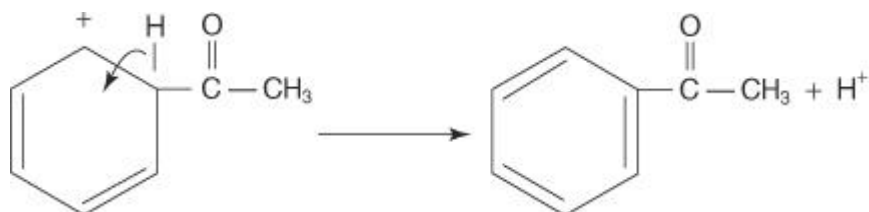
2. The electrophile attracts the π electron system of the benzene ring to form a nonaromatic carbocation.



3. The positive charge on the carbocation that is formed is delocalized throughout the molecule.



4. The loss of a proton from the atom to which the acetyl group has bonded restores the aromaticity.



5. The proton reacts with the AlCl_4^- to regenerate the AlCl_3 catalyst and form the product HCl .

