B.Sc. II (H) PAPER - IIIC.

Friedel-craft Reaction

This reaction involves addition of alkyl group or acetyl group in benzene ring in presence of a Lewis acid. Two types of catalysis is used in Friedal craft reaction.

(i) Lewis acid in order of reactivity

$AlCl_3 > BF_3 > SbCl_5 > SnCl_4 > ZnCl_2$

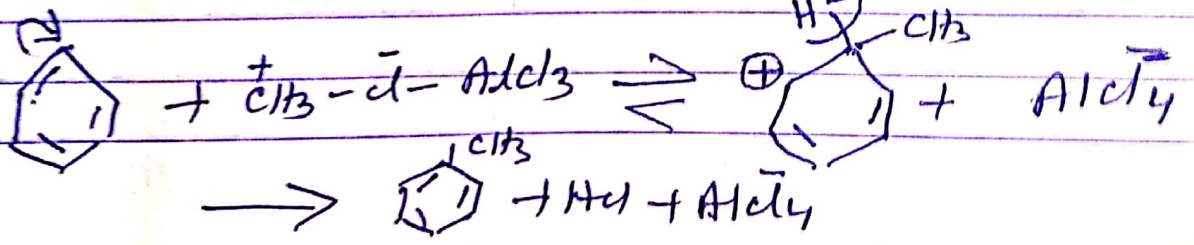
(ii) Proton acid catalysts :- HF, H_2SO_4, H_3PO_4.

Friedal craft reaction is divided in two parts i.e alkylation and acylation.

Alkylation:- The alkylation of benzene with primary halides takes place with formation of polar addition compound with lewis acid and alkyl halid. Thus function of Lewis acid is formation of electron deficient compound as given below. This electron deficient compound attack on benzene ring. Mechanism is given below.

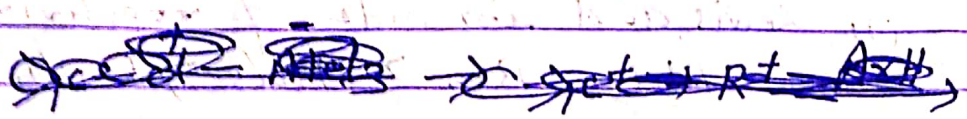
~~$CH_3Cl + AlCl_3 \rightleftharpoons CH_3Cl_2$~~

$CH_3Cl + AlCl_3 \rightleftharpoons \overset{+}{C}H_3 - \bar{C}l - AlCl_3$



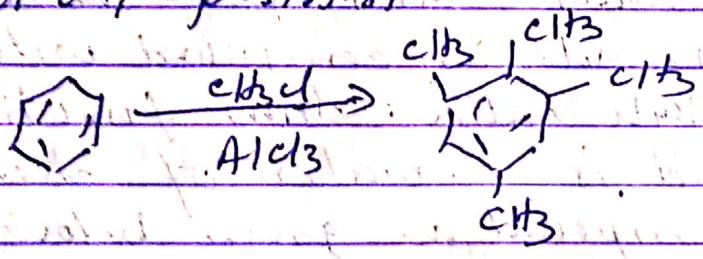
$\longrightarrow$ $+ HCl + AlCl_4$

In case of sec or tertiary alkyl halides carbon atom having the halogen more stable to accommodate the positive charge and therefore carbonium ion is formed.

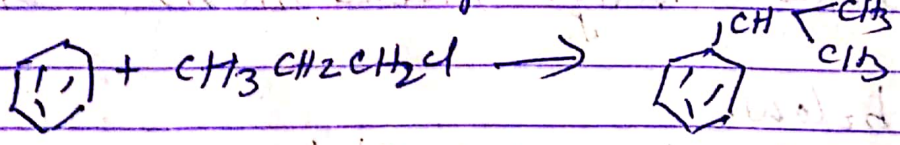


However the alkylation reaction suffers from following defects.

(i) As alkyl group is o, p directing and hence the reaction always leads poly alkylation at o-p position.



(ii) Some time rearrangement reaction occurs.



Isopropyl benzene.

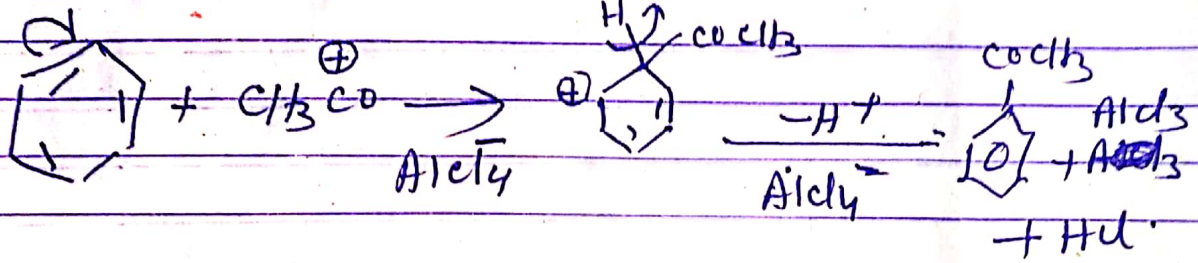
In presence of catalyst as protone, alkylation may also be done with alkene, alcohols, ether and ester.

$$CH_3 \cdot CH = CH_2 \xrightarrow{H^+} CH_3-\overset{\oplus}{C}H-CH_3$$

$$\xrightarrow[BF_3 \text{ or } HF]{C_6H_6} C_6H_5CH(CH_3)_2$$

Acylation :- Generaly acylation of benzene is done by acid chlorides or anhydride.

$$CH_3COCl + AlCl_3 \longrightarrow CH_3\overset{\oplus}{C}O + AlCl_4^-$$



Acylation is usually carried out in solvent nitrobenzene or carbon disulphide solvent.