CAIE Chemistry A-level

31: Halogen Compounds

(A-level only)

Notes

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Halogen Compounds

Substitution with Chlorine

The reaction of benzene with chlorine requires an **aluminium chloride catalyst**.

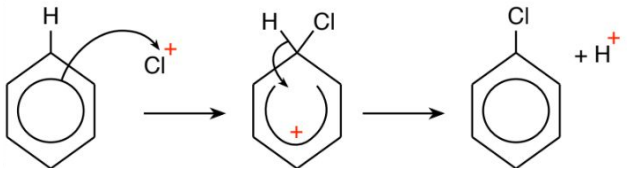
$$C_6H_6 + Cl_2 \rightarrow C_6H_5Cl + HCl$$

The mechanism for the electrophilic substitution reaction:

Stage 1: The aluminium chloride catalyst generates the electrophile from chlorine.

$$Cl_2 + AlCl_3 \rightarrow AlCl_4^- + Cl^+$$

Stage 2: The electrophile reacts with the benzene molecule.



Stage 3: The hydrogen ion reacts with the $AlCl_4^-$, reforming the $AlCl_3$ catalyst.

$$AlCl_4^- + H^+ \rightarrow AlCl_3 + HCl$$

Difference in Reactivity between Chlorobenzene and Chloroalkane

Chlorobenzene is much less reactive than chloroalkane. This is because the C-Cl bond in chlorobenzene is much stronger than in an halogenoalkane.

The aromatic C-Cl bond is stronger due to one of the lone pairs on the chlorine atom interacting with the delocalised electron system, strengthening the bond. For reactions, like nucleophilic substitution, the C-Cl bond would require breaking. Since the chlorobenzene bond requires more energy to break, chlorobenzene is less reactive.