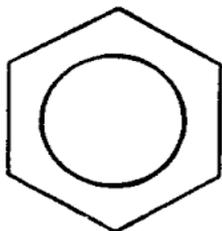


Benzene

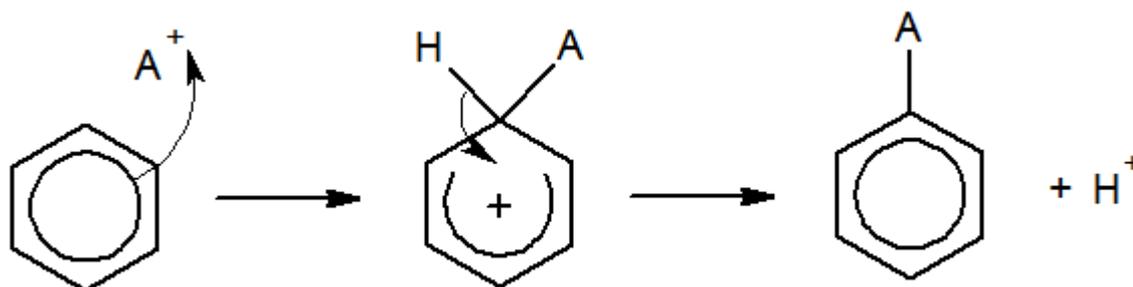
- Has the formula C_6H_6 . Benzene is an arene.



- Very stable; is a planar molecule. Bond angle is 120 degrees so it is trigonal planar.
- Delocalised pi system of electrons as there is one electron free on each carbon atom inside hexagonal structure.
- The p-orbitals overlap forming the delocalised pi bonds above and below the ring.
- The Kekule model with 3 alternating double and single bonds is incorrect because:
 - All the carbon – carbon bond lengths (139 pm) are the same in benzene. Shown by x-ray diffraction studies.
 - It cannot explain the extra stability shown by benzene based on the enthalpy of hydrogenation values.
 - Bond enthalpy values between the carbon-carbon bonds are all identical.
 - Benzene doesn't decolourise bromine water.
 - It doesn't react by addition reactions.
 - It can't explain the planar structure.
 - The bond angles in each carbon are identical.
- Colourless liquid at room temperature. Inflammable. Burns with a sooty flame. Soluble in organic solvents but insoluble in water.
- Boiling point of $80^\circ C$ and melting point of $5.5^\circ C$.
- Is a carcinogen and can cause cancer.
- Fairly unreactive due to its stability.
- Has VDW forces only.
- Reacts mainly by electrophilic substitution.

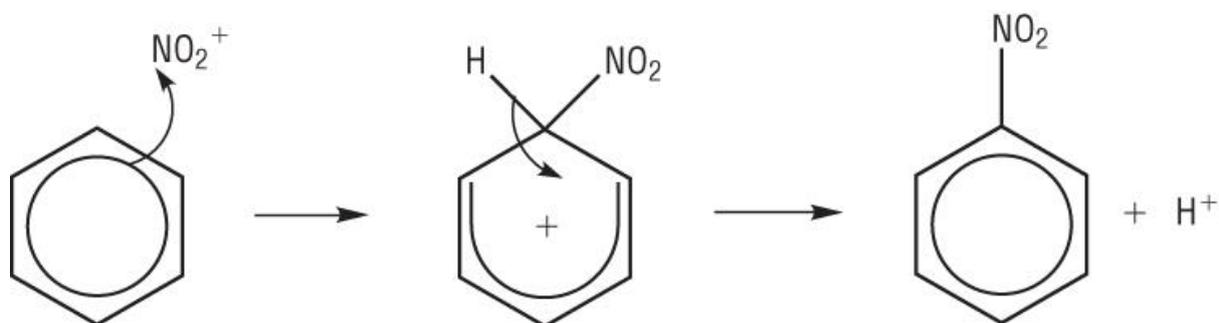
Reactions of benzene:

General electrophilic substitution mechanism:



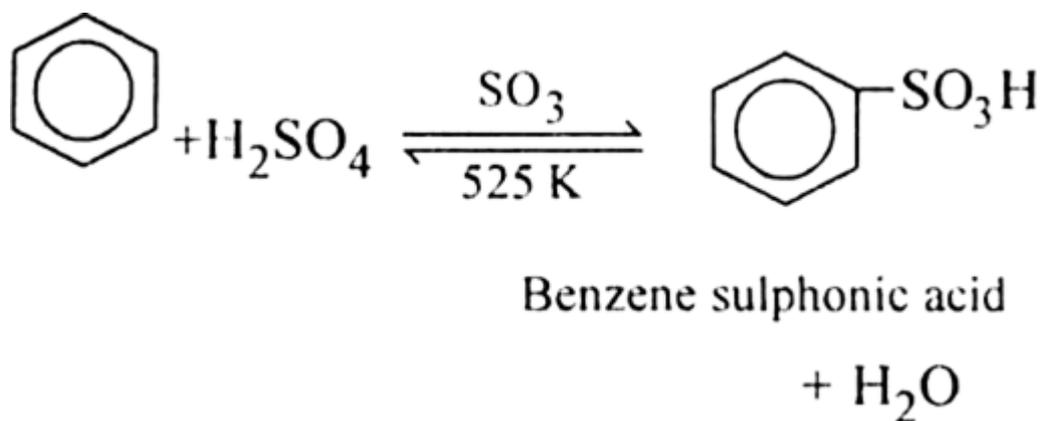
Nitration of benzene:

Use concentrated nitric acid and concentrated sulfuric acid which is the catalyst. At 50 to 55°C. The nitronium ion (NO_2^+) is the electrophile.



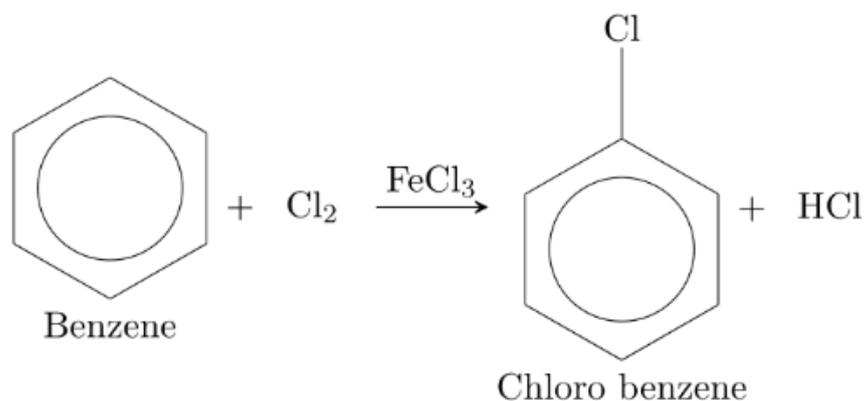
Sulfonation of benzene:

Fuming sulfuric acid is used. This is a mixture of SO_3 and H_2SO_4 .



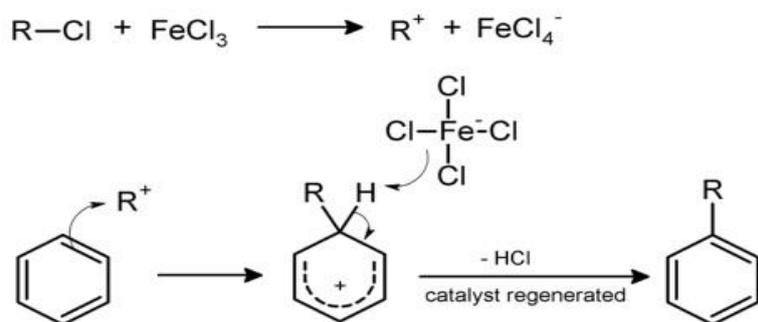
Halogenation of benzene:

Uses AlCl_3 or FeBr_3 catalyst.



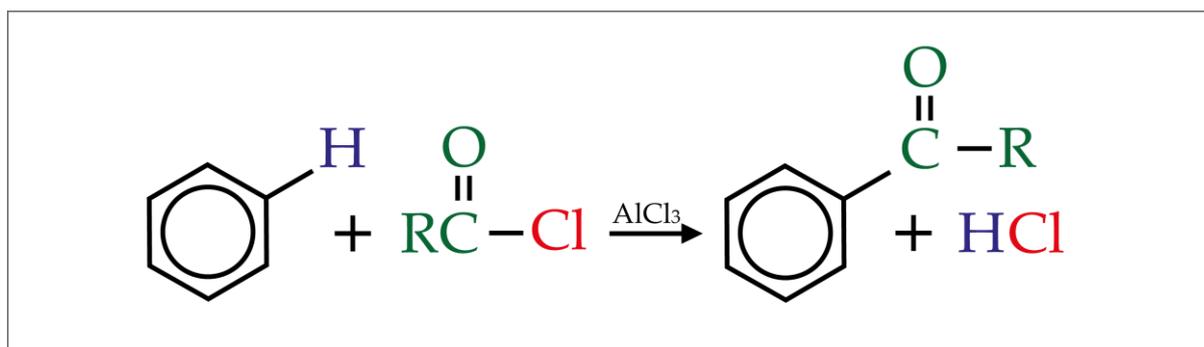
Friedal Craft's Alkylation of benzene:

Use AlCl_3 or FeCl_3 catalyst.



Friedal Craft's Acylation of benzene:

Anhydrous conditions. AlCl_3 catalyst.



Summary:

- Benzene is very stable and mainly reacts by electrophilic substitution, and usually a catalyst is needed.