

Quadrant II – Transcript and Related Materials

Programme: F.Y.B.Sc. (Chemistry)

Subject: Chemistry

Course Code: CHC 102 Section B

Course Title: Physical Chemistry and Organic Chemistry

Unit: 02- Alkyl and Aryl halides

Module Name: Aryl halides -Reactions (Chlorobenzene)-Nucleophilic Aromatic Substitution (replacement by -OH group)

Module No: 09

Name of the Presenter: Ms. Anuja B. Naik

Notes

Transcript of the video

Hello students, I am Ms. Anuja Naik from Ganpat Parsekar College of Education, Harmal, Pernem Goa and I will be dealing with Aryl halides -Reactions (Chlorobenzene)-Nucleophilic Aromatic Substitution (replacement by -OH group).

The lecture deals with,

- Nucleophilic Aromatic Substitution Reaction of Chlorobenzene with Sodium hydroxide.
- Bimolecular Displacement mechanism.
- Effect of Nitro substituent on the reactivity of Aryl Halides.

So, at the end of the lecture, the student will be able to:

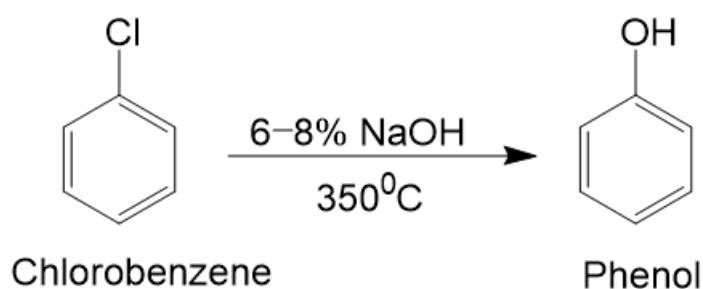
- Define Aromatic Nucleophilic Substitution reaction.
- Understand the Bimolecular Displacement mechanism.
- Explain the effect of Nitro substituent on the reaction.
- Predict the product of the reaction.

Now, what is a Nucleophilic Aromatic Substitution Reaction?

When a substitution reaction involves the attack by a nucleophile onto the aromatic ring, the reaction is referred to as a Nucleophilic Aromatic Substitution reaction. In this reaction, one nucleophile is substituted for another. Aryl halides undergo Nucleophilic Aromatic Substitution at higher temperature and pressure.

Next, Reaction of Chlorobenzene with aqueous NaOH.

Chlorobenzene is converted into phenol by aqueous sodium hydroxide only at temperatures over 300°C .



Bimolecular Displacement Mechanism for Nucleophilic Aromatic Substitution.

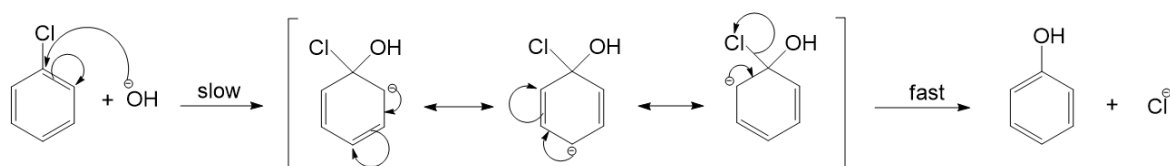
Nucleophilic Aromatic Substitution takes place by a two-step mechanism.

Step I - Attack of a nucleophilic reagent upon the ring to form a carbanion.

Step II - The expulsion of halide ion from this carbanion to yield the product.

As two molecular species participate in the slow and rate determining step, it is a bimolecular reaction.

In this mechanism, OH^- ion attacks electron-deficient carbon of aromatic ring and pi electrons are delocalized on the next carbon atom which gives carbanion. Other resonating structures are drawn by delocalizing the electrons. Finally, electrons on carbanion are delocalized thereby Cl is lost as Cl^- ion.



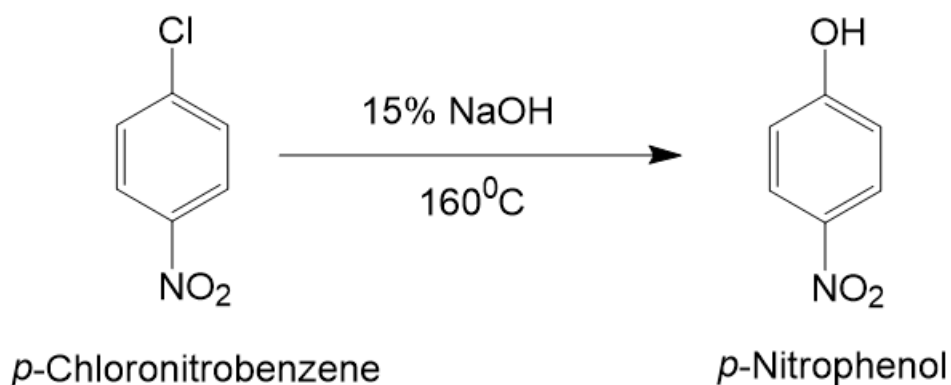
Next, we will see the Effect of Nitro substituent on aryl halides.

Aryl halides undergo Nucleophilic Aromatic Substitution at higher temperature and pressure.

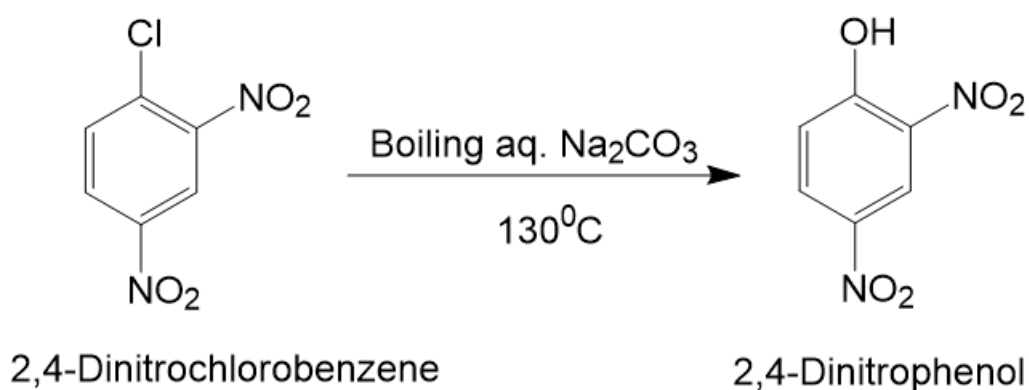
Electron withdrawing group like $-\text{NO}_2$ increases the reactivity of Aryl halides towards nucleophilic substitution reactions only when present at the ortho and para positions with respect to halogen.

As the number of ortho and para nitro groups on the ring is increased, the reactivity increases.

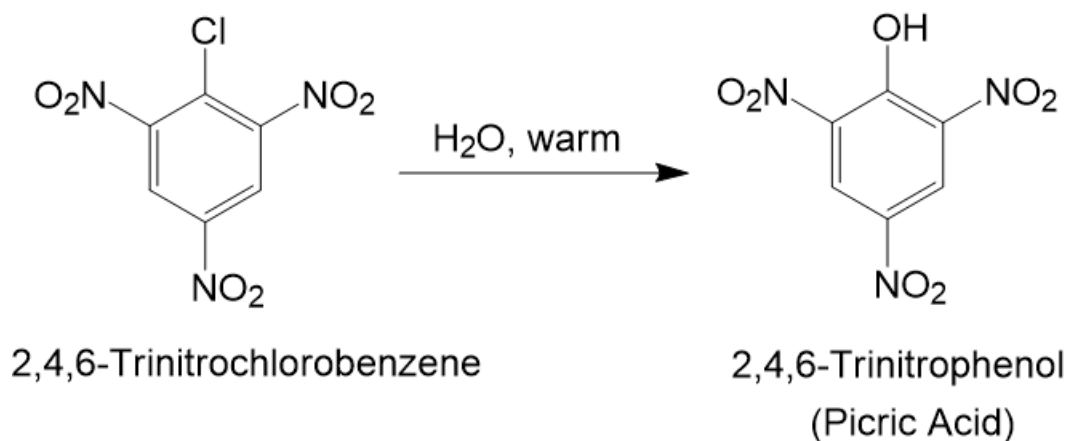
p-Chloronitrobenzene is converted into *p*-Nitrophenol by treatment with aqueous sodium hydroxide at 160°C .



2,4-Dinitrophenol is obtained from 2,4-Dinitrochlorobenzene by treatment with hot aqueous sodium carbonate.



2,4,6-Trinitrophenol is obtained from 2,4,6-Trinitrochlorobenzene by treatment with water.



Finally, these are the references.

Thank you.

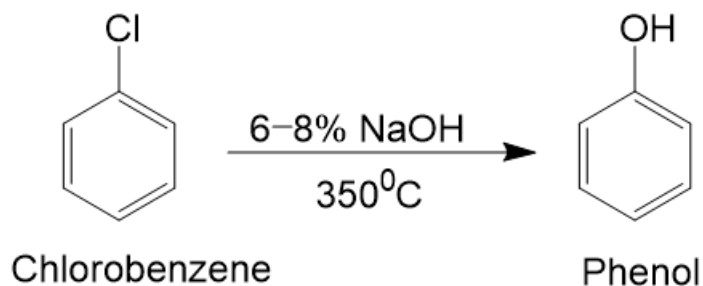
Summary of the video (Abstract of the transcript)

➤ **Nucleophilic Aromatic Substitution Reaction**

- When a substitution reaction involves the attack by a nucleophile on to the aromatic ring, the reaction is referred to as a Nucleophilic Aromatic Substitution reaction.
- In this reaction, one nucleophile is substituted for another.
- Aryl halides undergo Nucleophilic Aromatic Substitution at higher temperature and pressure.

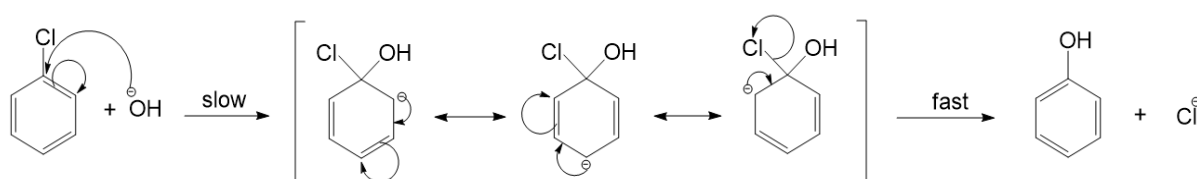
➤ **Reaction of Chlorobenzene with aqueous NaOH**

- Chlorobenzene is converted into phenol by aqueous sodium hydroxide only at temperatures over 300⁰ C.



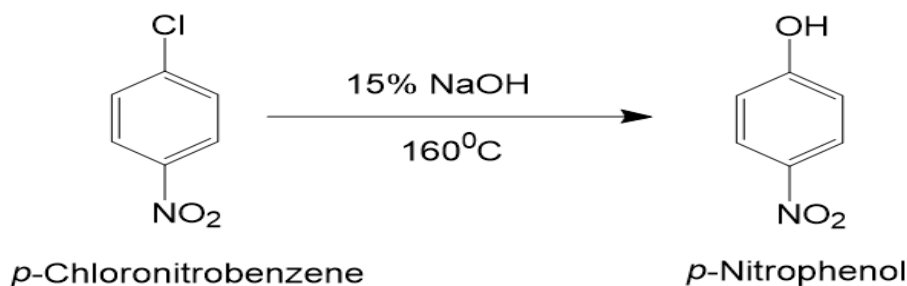
➤ **Bimolecular Displacement Mechanism for Nucleophilic Aromatic Substitution**

- Nucleophilic Aromatic Substitution takes place by a two-step mechanism.
- ✓ Step I - Attack of a nucleophilic reagent upon the ring to form a carbanion.
- ✓ Step II - The expulsion of halide ion from this carbanion to yield the product
- As two molecular species participate in the slow and rate determining step, it is a bimolecular reaction.

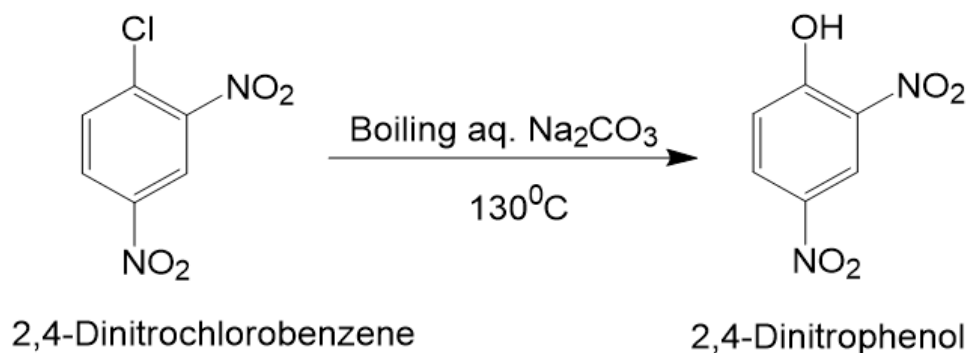


➤ **Effect of Nitro substituent**

- Aryl halides undergo Nucleophilic Aromatic Substitution at higher temperature and pressure.
 - Electron withdrawing group like -NO₂ increases the reactivity of Aryl halides towards nucleophilic substitution reactions only when present at the ortho and para positions with respect to halogen.
 - As the number of ortho and para nitro groups on the ring is increased, the reactivity increases.
- ✓ *p*-Chloronitrobenzene is converted into *p*-Nitrophenol by treatment with aqueous sodium hydroxide at 160^o C.



- ✓ 2,4-Dinitrophenol is obtained from 2,4-Dinitrochlorobenzene by treatment with hot aqueous sodium carbonate.



- ✓ 2,4,6-Trinitrophenol is obtained from 2,4,6-Trinitrochlorobenzene by treatment with water.

