15.2 NITROBENZENE

Learning outcomes

Candidates should be able to:

- Show preparation of nitrobenzene from benzene.
- State physical properties of nitrobenzene.
- Explain chemical properties of nitrobenzene, i.e. reduction in
- different media and electrophilic substitution reactions (nitration, sulphonation & bromination).
- State important uses of nitrocompounds.

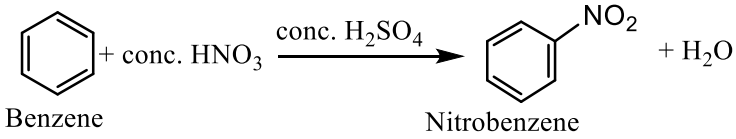
1. Compound that has smell of bitter almond is

   a. Aniline b. Phenol c. Nitrobenzene d. Benzene

Preparation of Nitrobenzene

Principle

Nitrobenzene is prepared in the laboratory by direct nitration of benzene with nitrating mixture i.e. a mixture of concentrated sulphuric acid and conc. HNO_3 at a **temperature about 60^0C.**



1. *Give a chemical reaction for the preparation of Nitrobenzene from benzene.* *1*

   1. *In the nitration of benzene, conc. HNO_3 acts as*

      a. Base b. acid c. Reducing agent d. oxidising agent

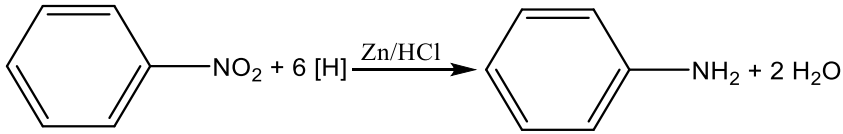
Physical Properties

1. Nitrobenzene is a pale-yellow oily liquid with a bitter almond smell.
2. It solidifies at 5.7°C and boils at 210^0C and its specific gravity is 1.2.
3. It is insoluble in water but soluble in organic solvents like Ether, Benzene, Chloroform, etc.

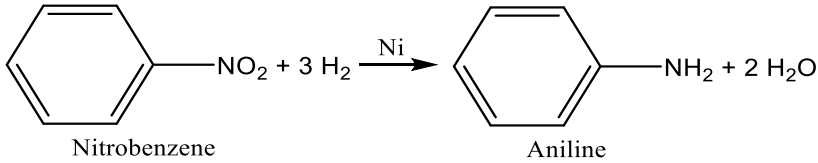
Chemical Properties

Reduction in different media

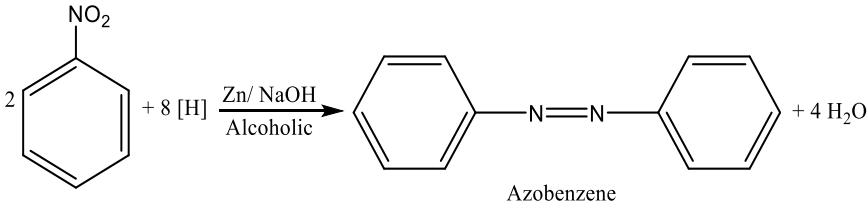
1. In acidic medium (Fe/HCl, Zn/HCl, or Sn/HCl)

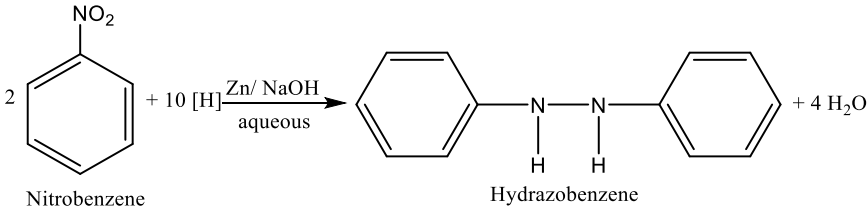


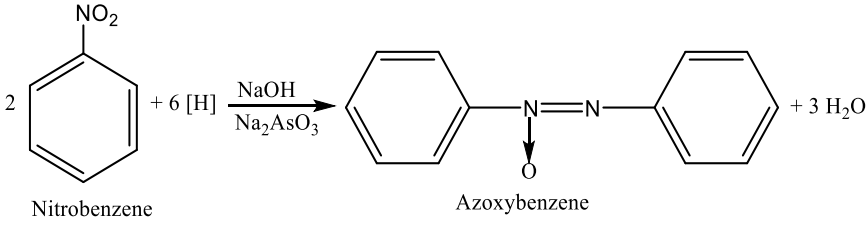
2. In catalytic medium (H_2 with Pd, Pt, or Ni)



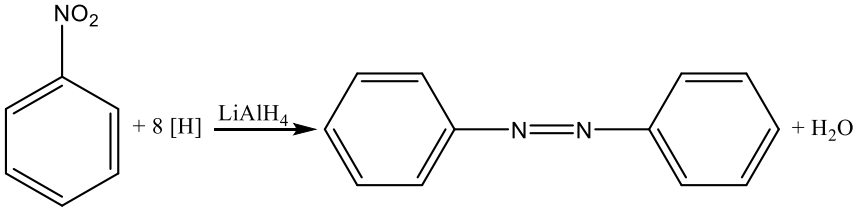
3. In Alkaline medium



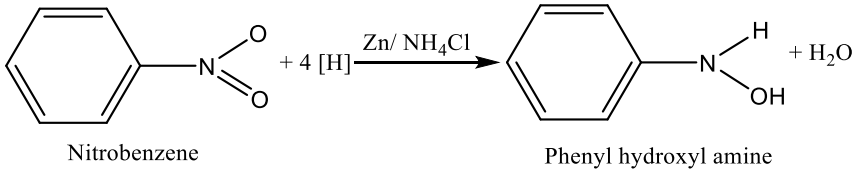




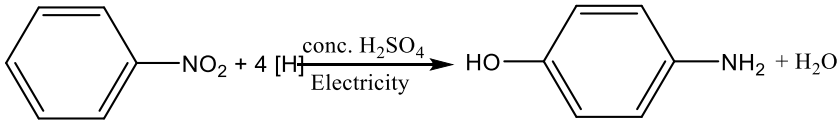
4. With Lithium aluminium hydride



5. In neutral medium



6. Electrolytic medium



Nitrobenzene

4-aminophenol
p-aminophenol

2. *What happens when Nitrobenzene is reduced in acidic, neutral, alkaline, and electrolytic conditions?* *5*
3. What happens when Nitrobenzene is subjected to reduction in an acidic medium?
4. *What happens when Nitrobenzene is subjected to reduction in a neutral medium?* *1*
5. *What products would you expect when Nitrobenzene is treated with Zn/ NaOH?* *1*
6. *Starting from nitrobenzene, how would you prepare aniline?* *1*
7. *Starting with Nitrobenzene, how would you prepare hydrazobenzene?* *1*
8. *Starting with Nitrobenzene, how would you prepare oxyazobenzene?* *1*
9. *What products would you expect when Nitrobenzene is subjected to electrolytic reduction?* *1*
10. *Starting from Nitrobenzene, how would you prepare Azobenzene?* *1*
11. *Convert Nitrobenzene into P-aminophenol.* *1*

2. Nitrobenzene on reduction with Sn/HCl gives
    a. o-dinitrobenzene
    b. 1,3-dinitrobenzene
    c. Aniline
    d. Nitrobenzene
3. Nitrobenzene on heating with zinc dust and aqueous NH_4Cl gives
    a. Aniline
    b. Phenylhydroxylamine
    c. Nitrosobenzene

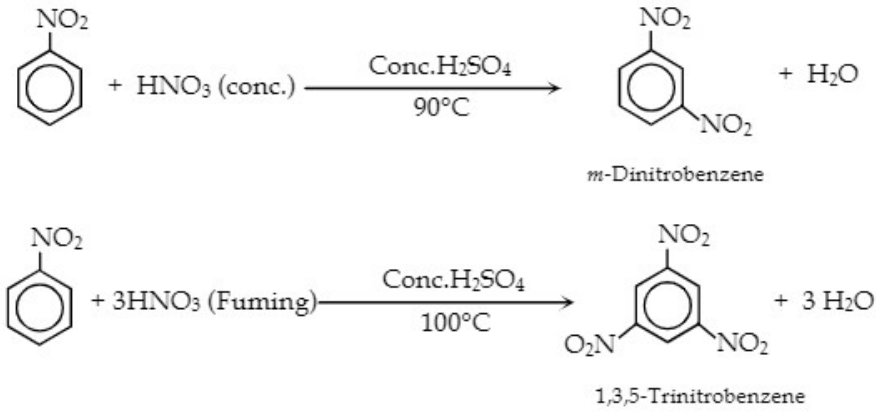
d. Hydrazobenzene

4. Reduction of nitrobenzene in zinc dust and aqueous NaOH gives
   a. Hydroxyl amine
   b. Azobenzene
   c. Hydrazobenzene
   d. Azoxybenzene
5. Reduction of nitrobenzene in alkaline medium gives
   a. Aniline
   b. P-aminoazobenzene
   c. Hydrazobenzene
   d. Nitrosobenzene
6. Reduction of nitrobenzene with lithium aluminum hydride gives
   a. Aniline
   b. Benzene diazonium chloride
   c. Phenol
   d. Azobenzene
7. Electrolytic reduction of nitrobenzene in weakly acidic medium gives
   a. N-phenylhydroxylamine
   b. Aniline
   c. Nitrosobenzene
   d. p-hydroxyaniline
8. Electrolytic reduction of nitrobenzene in a strongly acidic medium (e.g.-H_2SO_4) gives
   a. Aniline
   b. Azobenzene
   c. P-aminophenol
   d. Azoxybenzene
9. Which of the following product is obtained when nitrobenzene is electrolytically reduced?
   a. P-aminophenol
   b. Azobenzene
   c. Azoxybenzene
   d. Hydrazobenzene

Ring substitution

Nitro group is deactivating group in electrophilic aromatic substitution reaction, hence these reactions are slower than in Benzene.

Nitro group is meta directing group in electrophilic aromatic substitution reactions, hence meta substituted products are obtained. For example,



Nitrobenzene undergoes sulphonation with concentrated fuming sulphuric acid when heated. It also undergoes bromination with bromine in presence of $FeBr_3$ as a catalyst when heated. *(practice writing these reactions- check from book if u have written correctly*) Nitrobenzene does not undergo Friedel Craft reactions.

12. *Nitrobenzene prefers electrophilic substitution reaction at meta position. Explain.* *[2]*
13. *How would you predict nitro group in nitrobenzene is electron withdrawing?* *[2]*

10. Which of the following compounds is meta directing towards the electrophilic aromatic substitution reaction?

a. $C_6H_5NO_2$ b. C_6H_5OH c.$C_6H_5NH_2$ d. $C_6H_5CH_3$

11. Which of the following is least reactive in electrophilic aromatic substitution reaction?
    a. Chlorobenzene
    b. Phenol
    c. Nitrobenzene
    d. Aniline
12. Nitro group in nitrobenzene is
    a. Ring activator
    b. Ring deactivator
    c. Ortho/para director
    d. None of these
13. Nitration of nitrobenzene yields
    a. Picric acid
    b. Trinitrotoluene
    c. 1,4-dinitrobenzene
    d. 1,3-dinitrobenzene

Uses of nitro compounds.

1) Nitromethane can be used to produce chloropicrin which is used as a broad-spectrum antimicrobial, fungicide, herbicide, insecticide and a component of tear gas.
2) These can be used as a solvent.
3) Few nitroalkanes are used as explosives.
4) Nitrobenzene is used to prepare aniline and other dye stuff.
5) It is also used as a solvent in shoe polishes.

14. *Mention any one important use of Nitroalkane.*

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15. *Nitrobenzene is an industrial chemical*