Compounds Containing Nitrogen

Question1

Which of the following reagents are suitable to differentiate Aniline and N-methylaniline chemical

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Options:

A. Acetic anhydride

B. Br_2 water

C. Conc. Hydrochloric acid and anhydrous zinc chloride

D. Chloroform and Alcoholic potassium hydroxide

Answer: D

Solution:

The only reagent that will "pick out" a primary aromatic amine (aniline) but not a secondary one (N-methylaniline) is the carbylamine test:

• Carbylamine test (Option D: $CHCl_3$ + alcoholic KOH)

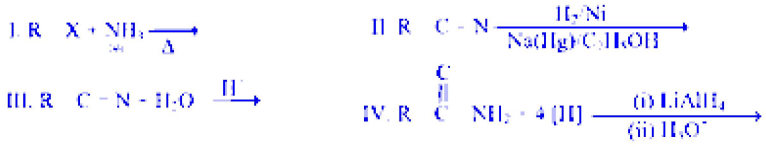
– $RNH_2 + CHCl_3 + 3\ KOH \rightarrow R–NC$ (isocyanide, foul smell) + 3 KCl + 3 H_2O

– Only primary amines give the isocyanide; secondary amines (like N-methylaniline) do not react.

Options A, B and C all react (or fail to react) with both aniline and N-methylaniline in essentially the same way, so they cannot be used to tell the two apart.

Question2

Which of the following reaction/s does not yield an amine?



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Options:

A. Both I and III

B. Only II

C. Only III

D. Both II and IV

Answer: C

Solution:

Cyanides on hydrolysis gives Carboxylic acids, where as rest all 3 cases amines can be prepared.

Question3

Match the compounds given in List - I with the items given in List - II.

List - I	List - II
(I) Benzenesulphonyl Chloride	(a) Zwitterioin
(II) Sulphanilic acid	(b) Hinsberg reagent
(III) Alkyl Diazonium salts	(c) Dyes
(IV) Aryl Diazonium salts	(d) Conversion to alcohols

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Options:

A. I - c, II - b, III - a, IV - d

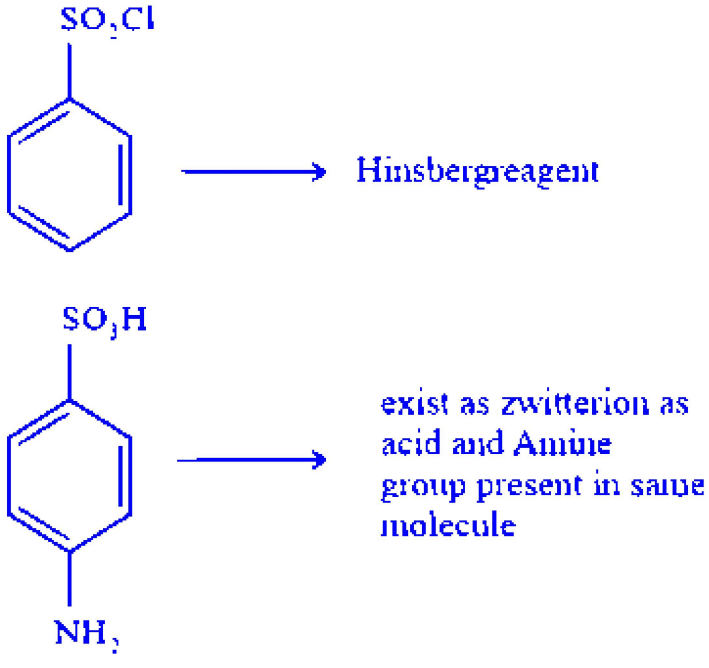
B. I - a, II - c, III - b, IV - d

C. I - c, II - a, III - d, IV - b

D. I - b, II - a, III - d, IV - c

Answer: D

Solution:



Alkyl diazonium Salts → Convert to alcohols as Carbocation intermediate formed is unstable.

Aryl diazonium Salts → Participate in dye test

Question4

Biologically active adrenaline and ephedrine used to increase blood pressure contain

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Options:

A. primary amino group

B. secondary amino group

C. tertiary amino group

D. quaternary ammonium salt

Answer: B

Solution:

Biologically active adrenaline and ephedrine used to increase blood pressure contains secondary amino group.

Question5

In the reaction,Aniline $\xrightarrow[\text{Dil. HCl}]{\text{NaNO}_2} P \xrightarrow[\text{NaOH}]{\text{Phenol}} Q$

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Options:

A. $C_6H_5N_2Cl$

B. ortho-hydroxyazobenzene

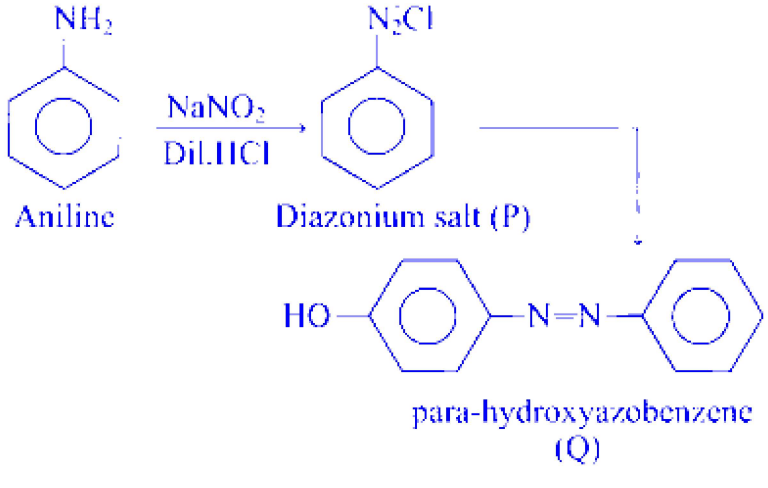
C. para-hydroxyazobenzene

D. meta-hydroxyazobenzene

Answer: C

Solution:

The complete reaction sequence proceeds as follows



Question6

In the reaction,

$$C_6H_5CN \xrightarrow[(ii)\ H_3O^+]{(i)\ SnCl_2+HCl} X \xrightarrow{conc.\ KOH} Y + Z$$

Formation of X, Y and Z are known by

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Options:

A. Rosenmund reduction, Cannizzaro reaction

B. Clemmensen reduction, Sandmeyer reaction

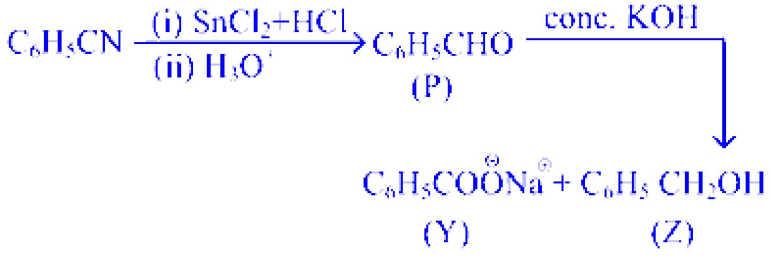
C. Wolff-Kishner reaction, Wurtz reaction

D. Stephen reaction, Canizzaro reaction

Answer: D

Solution:

The given reaction can be completed as follows.



Formation of 'X' involves Stephen reaction whereas the later part involves Cannizzaro reaction.

Question7

Aniline does not undergo

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Options:

A. nitration

B. sulphonation

C. Friedel-Craft's-reaction

D. bromination

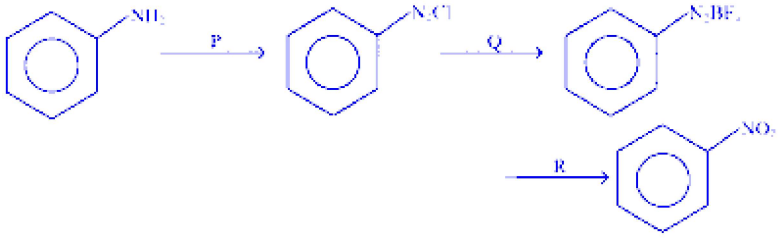
Answer: C

Solution:

Aniline does not undergoes Friedel-Craft's reaction due to the presence of an amino $(-NH_2)$ group attached to the aromatic ring. This amino group makes the aromatic ring highly nucleophilic and deactivates the ring towards electrophilic attack due to the electron donating nature of the lone pair on nitrogen.

Question8

In the reaction,



P, Q and R respectively are

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Options:

A. $NaNO_2$+ dil. $HCl, HBF_4, Cu + NaNO_2$

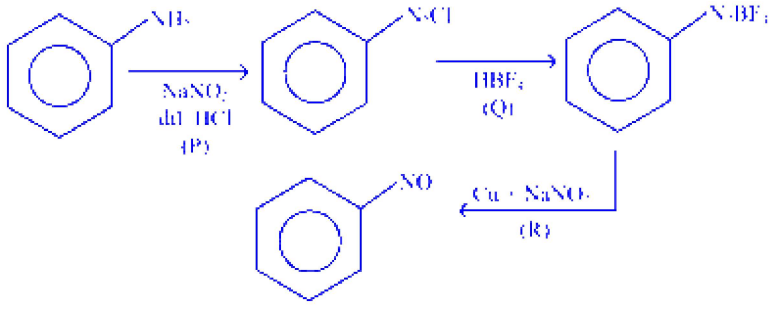
B. $NaNO_2$+ conc. $HCl, F_2, Cu + NaNO_3$

C. $NaNO_2$+ dil. HCl, BF_3, Cu + $NaNO_2$

D. $NaNO_2$+ dil. HCl, F_2, Cu + $NaNO_3$

Answer: A

Solution:



Thus P, Q and R are $NaNO_2$+ dil HCl, HBF_4, Cu + $NaNO_2$ respectively.

Question9

Identify the products A and B in the reactions :

$$R - X + \text{AgCN} \longrightarrow A + \text{Ag}X$$
$$R - X + \text{KCN} \longrightarrow B + \text{KX}$$

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Options:

A. $A = RCN; B = RNC$

B. $A = RNC; B = RCN$

C. $A = RNC; B = RNC$

D. $A = R - \text{CN}; B = R\text{CN}$

Answer: B

Solution:

$R - X + \mathrm{AgCN} \longrightarrow R\mathrm{NC} + \mathrm{AgX}$
$R - X + \mathrm{KCN} \longrightarrow R\mathrm{CN} + \mathrm{KX}$

KCN is predominantly ionic in nature, its C – C bond is more stable than C – N bond. Therefore, in this case attack takes place through carbon atom. On other hand, AgCN is predominantly covalent in nature, hence only nitrogen is available for bonding result in formation of RNC.

Question10

In carbylamine test for primary amines the resulting foul smelling product is

KCET 2022

Options:

A. $\mathrm{CH_3CN}$

B. $\mathrm{CH_3NC}$

C. $\mathrm{COCl_2}$

D. $\mathrm{CH_3NCl_2}$

Answer: B

Solution:

In carbylamine test for primary amines the resulting foul smelling product is $\mathrm{CH_3NC}$.

$$\text{e.g. } \underset{\text{Ethylamine}}{\mathrm{CH_3CH_2NH_2}} + \mathrm{CHCl_3} + \underset{\text{Alcoholic}}{3\mathrm{KOH}} \longrightarrow \underset{\text{Ethyl isocyanide}}{\mathrm{CH_3CH_2NC}} + 3\mathrm{KCl} + 3\mathrm{H_2}$$

Question11

A secondary amine is

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Options:

A. a compound with two carbon atoms and an NH_2 group

B. a compound with an NH_2 group on the carbon atom in number 2 position

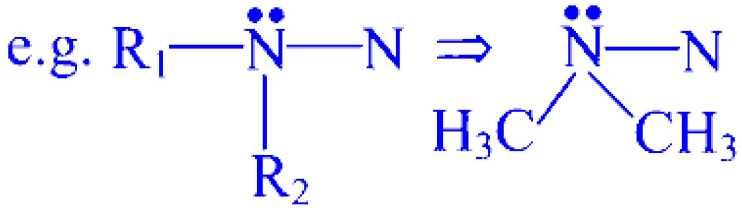
C. a compound in which 2 of the hydrogen of NH_3 have been replaced by organic group

D. an organic compound with two NH_2 groups

Answer: C

Solution:

A secondary amine is a compound in which 2 of the hydrogen of NH_3 have been replaced by organic group.



Question12

$C_6H_5CH_2Cl \xrightarrow{\text{Alc. } NH_3} A \xrightarrow{2CH_3Cl} B$. **The product B is**

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Options:

A. N, N-dimethylphenylmethanamine

B. N, N-dimethylbenzenamine

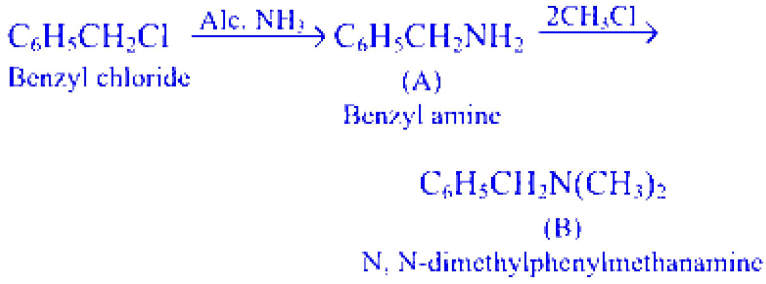
C. N-benzyl-N-methylmethanamine

D. phynyl-N-N-dimethylmethanamine

Answer: A

Solution:

Benzyl chloride on reaction with alc. NH_3 gives benzyl amine (A) which further on reaction with two moles of CH_3Cl give N, N-dimethyl phenylmethanamine (B).



Question13

The method by which aniline cannot be prepared is

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Options:

A. nitration of benzene followed by reduction with Sn and conc. HCl

B. degradation of benzamide with bromine in alkaline solution

C. reduction of nitrobenzene with H_2/Pd is ethanol

D. potassium salt of phthalimide treated with chlorobenzene followed by the hydrolysis with aqueous NaOH solution

Answer: D

Solution:

Aryl halides do not undergo nucleophilic substitution with potassium phthalimide under ordinary conditions. Thus, method (d) cannot be used for preparation of aniline.

Question14

A hydrocarbon $A\,(C_4H_8)$ on reaction with HCl gives a compound $B\,(C_4H_9Cl)$ which on reaction with 1 mol of NH_3 gives compound $C\,(C_4H_{10}N)$. On reacting with $NaNO_2$ and HCl followed by treatment with water, compound C yields an optically active compound D. The compound D is

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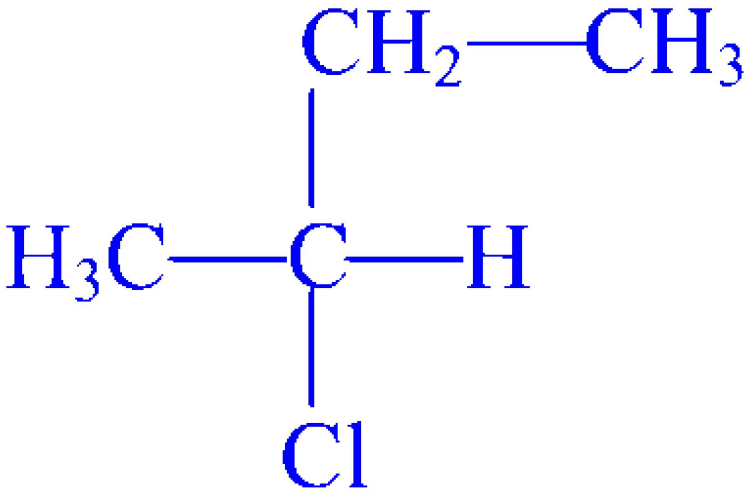
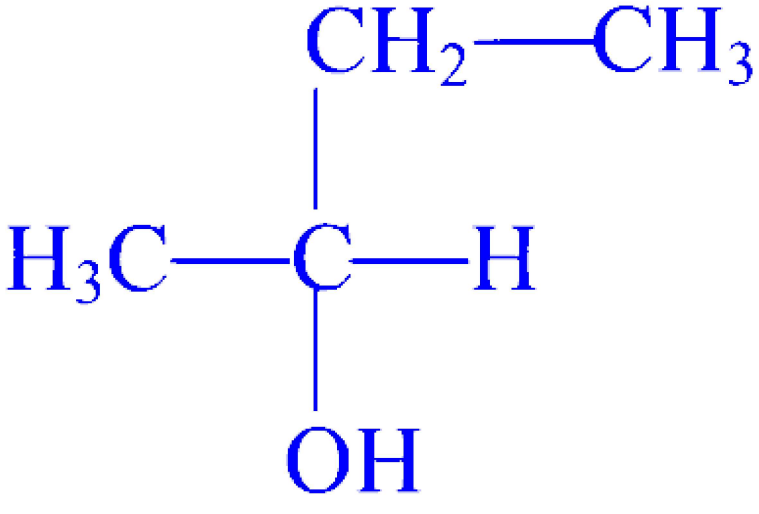
Options:

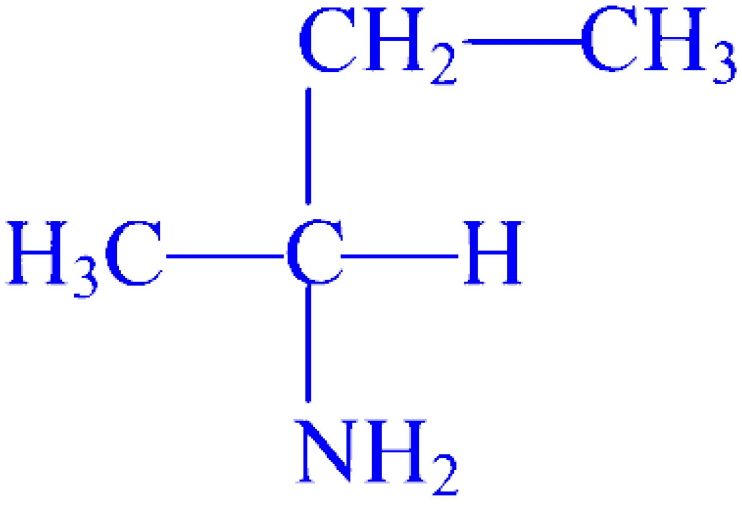
A.

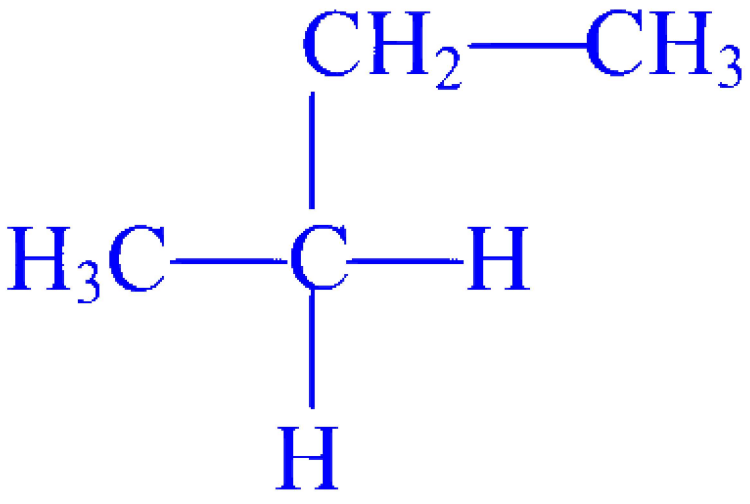


B.



C.



D. 

Answer: B

Solution:

From the given information question, addition of HCl occured on A. That means A is an alkene.

$$\underset{(A)}{C_4H_8} \xrightarrow{HCl} \underset{(B)}{C_4H_9Cl}$$

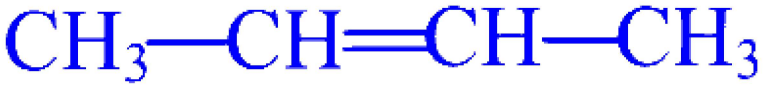
Cl in compound B is substituted by NH_2 to give compound C ($C_4H_{11}N$).

$$\underset{(B)}{C_4H_9Cl} \xrightarrow{NH_3} \underset{(C)}{C_4H_{11}N}$$

C gives a diazonium salt with $NaNO_2/HCl$ which on further treatment with water give an optically active alcohol. That means C is an aliphatic amine.

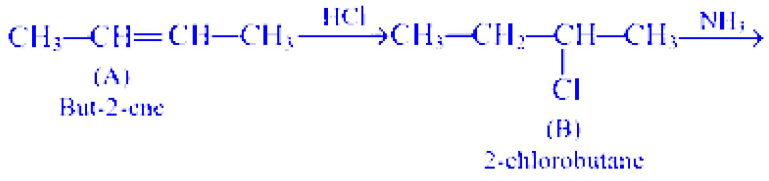
$$C \xrightarrow[(ii)\ H_2O]{(i)\ NaNO_2/HCl} D \text{ [Alcohol (optically active)]}$$

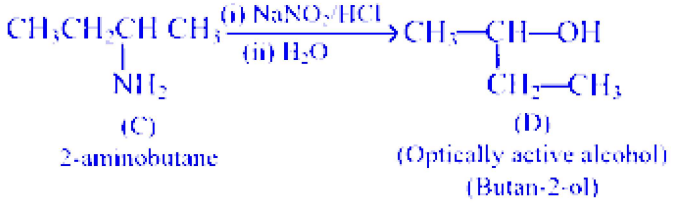
From the given information it is concluded that the most probable structure of A is



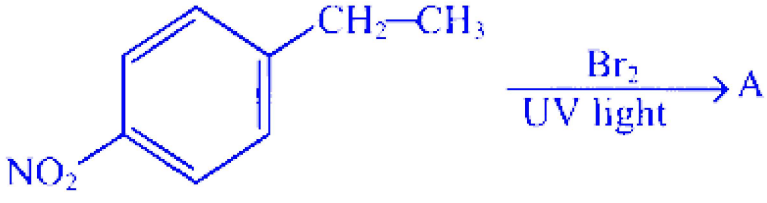
. As only but-2-ene gives optically active alcohol (D) as final product.

The reactions involves are as follows.





Question15



The compound A (major product) is

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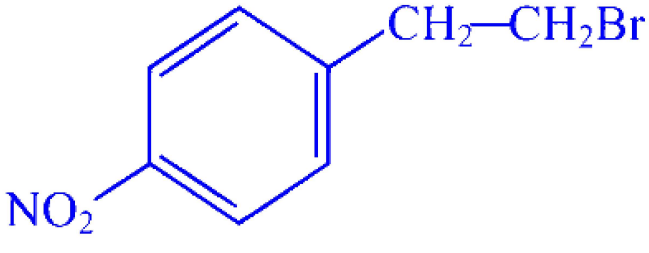
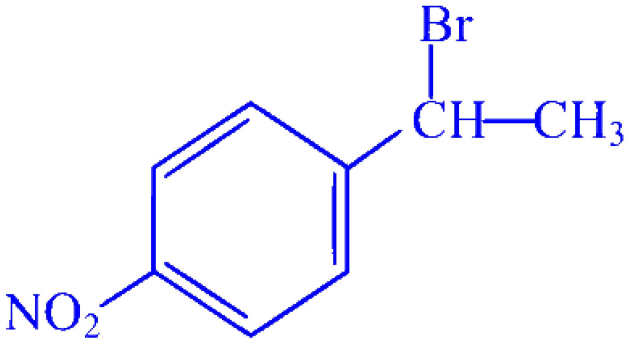
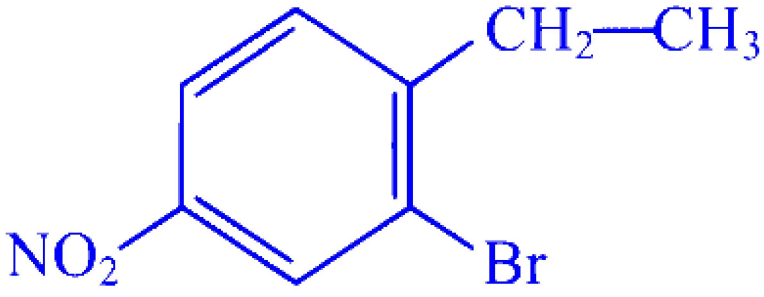
Options:

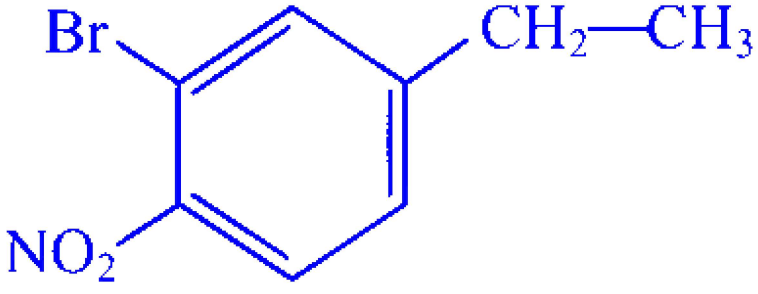
A.



B.



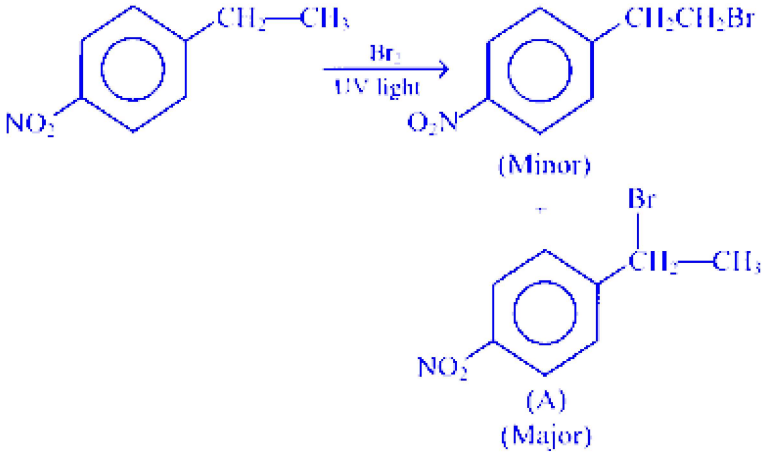
C. 

D. 

Answer: B

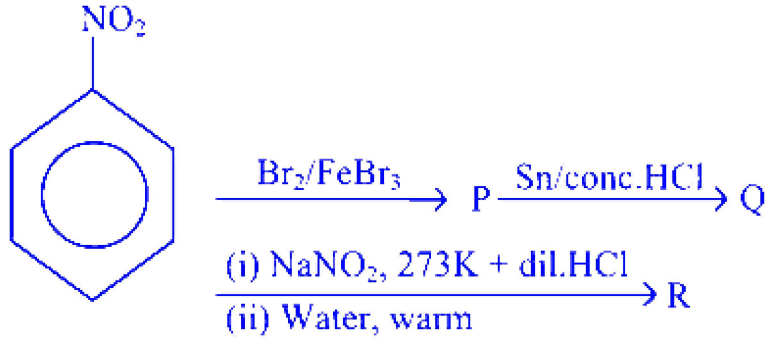
Solution:

In the presence of UV light free radicals substitution of alkane of the given compound take place in the following way.



Question16

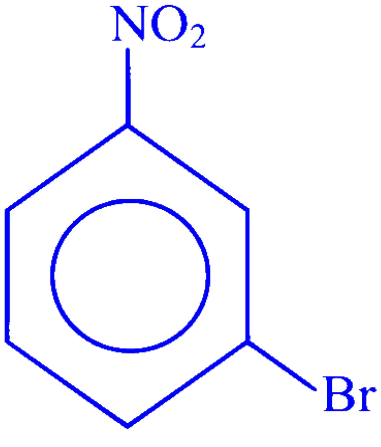
The final product for the reaction is



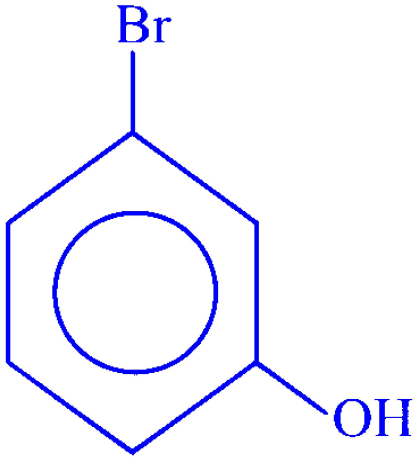
KCET 2020

Options:

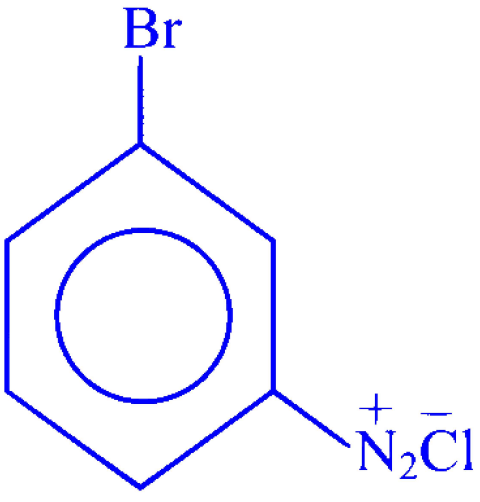
A.



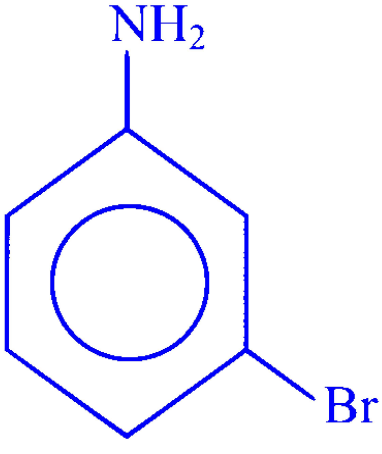
B.



C.

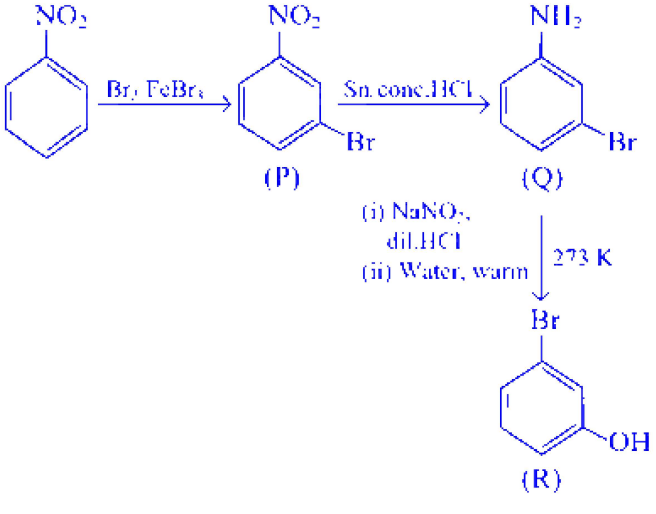


D.



Answer: B

Solution:



Question17

Hinsberg's reagent is

KCET 2020

Options:

A. $(CH_3CO)_2O$/pyridine

B. $C_6H_5SO_2Cl$

C. $C_6H_5SO_2NH_2$

D. CH_3COCl/pyridine

Answer: B

Solution:

Hinsberg reagent is $C_6H_5SO_2Cl$, (benzene sulphonyl chloride) which is used for detection and confirmation of primary, secondary and tertiary amines.

Question18

Which of the following is least soluble in water at 298 K ?

KCET 2019

Options:

A. CH_3NH_2

B. $(CH_3)_3N$

C. $(CH_3)_2NH$

D. $C_6H_5NH_2$

Answer: D

Solution:

Aniline $(C_6H_5NH_2)$ is least soluble in water at 298 K due to the presence of high molecular mass benzene ring present in ring. Lower aliphatic amines such as CH_3NH_2, $(CH_3)_3$ N and $(CH_3)_2NH$ can form intermolecular

hydrogen bonds with water molecules and hence soluble in water. Solubility of amines decreases with increase in molar mass due to increase in the hydrophobic part which retard the formation of H-bonds.

Question19

If aniline is treated with $1:1$ mixture of conc. HNO_3 and conc. H_2SO_4, p-nitroaniline and m-nitroaniline are formed nearly in equal amounts. This is due to

KCET 2019

Options:

A. m-directing property of $-NH_2$ group

B. protonation of $-NH_2$ which causes deactivation of benzene ring

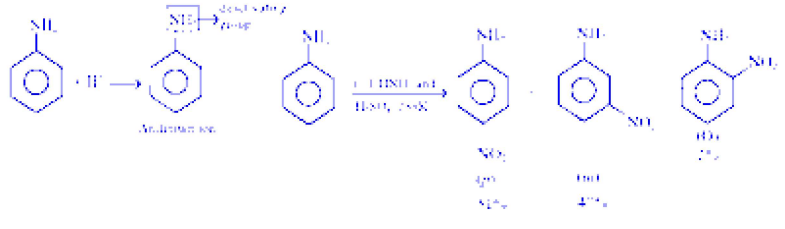
C. m and p directing property of $-NH_2$ group

D. isomerisation of some p-nitroaniline into m-nitroaniline

Answer: B

Solution:

On treatment of aniline with $1:1$ mixture of conc. HNO_3 and conc. H_2SO_4, p-nitro aniline and m-nitro aniline are formed nearly in equal amounts. This is due to protonation of $-NH_2$ which causes deactivation of benzene ring. Under strongly acidic medium, aniline is protonated to form anilinium ion which in m-directing.



Question20

During the fusion of organic compound with sodium metal, nitrogen present in the organic compound is converted into

KCET 2018

Options:

A. $NaNO_2$

B. $NaNH_2$

C. NaCN

D. NaNC

Answer: C

Solution:

When an organic compound containing nitrogen is fused with sodium metal—a procedure known as the sodium fusion test or Lassaigne's test—the nitrogen is transformed into a water-soluble salt. In this test, the conditions favor the formation of the cyanide ion. When the fused mass is dissolved in water, the nitrogen present is converted into sodium cyanide, which is written as:

NaCN

This is the basis for subsequent confirmatory tests (such as the formation of Prussian blue when the solution is treated with ferrous sulfate).

Thus, the correct answer is:

Option C: NaCN.

Question21

Which of the following will be the most stable diazonium salt $\left(R\,N_2^+X^-\right)$?

KCET 2018

Options:

A. $CH_3\,N_2^+X^-$

B. $CH_3CH_2\,N_2^+X^-$

C. $C_6H_5\,N_2^+X^-$

D. $C_6H_5CH_2\,N_2^+X^-$

Answer: C

Solution:

Understanding Diazonium Salts: Diazonium salts have the general formula $R - N_2^+X^-$, where R is an organic group and X is a counterion (like a halogen). The key to their stability is the nature of the R group attached to the diazonium ion (N_2^+).

Stability Factors: Aromatic diazonium salts are generally more stable than aliphatic ones because the aromatic ring can help delocalize the positive charge.

Now let's look at the options:

Option A: $CH_3\ N_2^+X^-$ (Methyl diazonium) - Aliphatic

Option B: $CH_3CH_2\ N_2^+X^-$ (Ethyl diazonium) - Aliphatic

Option C: $C_6H_5\ N_2^+X^-$ (Phenyl diazonium) - Aromatic

Option D: $C_6H_5CH_2\ N_2^+X^-$ (Benzyl diazonium) - Although it contains a benzene ring, it's considered aliphatic because the N_2^+ group is attached to the $-CH_2$ group, not directly to the benzene ring.

Given this, the most stable diazonium salt is the one where the N_2^+ group is directly attached to a benzene ring, allowing for charge delocalization.

So, the correct answer is:

Option C: $C_6H_5\ N_2^+X^-$

Question22

The reaction of benzenediazonium chloride with aniline yields yellow dye. The name of the yellow dye is

KCET 2018

Options:

A. *p*-hydroxya: henzene

B. *p*-aminoazoLanzene

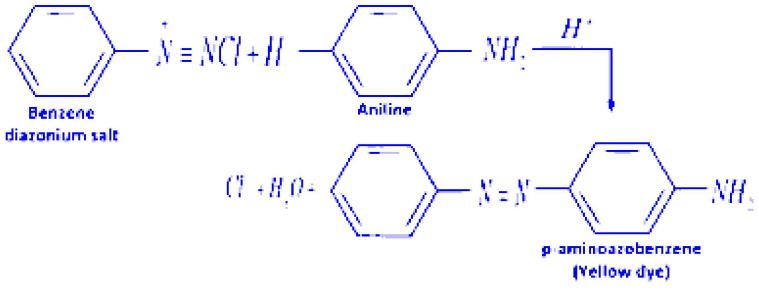
C. *p*-nitroazobenzene

D. o-nitroazobenzene

Answer: B

Solution:

Benzene diazonium chloride with aniline yield p-aminoazobenzene (yellow dye).



Question23

The correct order of increasing basic nature for the bases NH_3, CH_3NH_2 and $(CH_3)_2NH$ in aqueous solutions

KCET 2017

Options:

A. $CH_3NH_2 < NH_3 < (CH_3)_2NH$

B. $NH_3 < CH_3NH_2 < (CH_3)_2NH$

C. $CH_3NH_2 < (CH_3)_2NH < NH_3$

D. $(CH_3)_2NH < NH_3 < CH_3NH_2$

Answer: B

Solution:

If the alkyl group is bigger than CH_3 group, there is steric hindrance to H -bonding and hence $+I$ effect predominates over H -bonding. $2 > 3 > 1$. There is an important role of the inductive effect, solvation effect and steric hindrane of alkyl group. Which decide the basic strength of alkyl amine in the aqueous state.

$(CH_3)_2NH > CH_3OlH_2 > NH_3$

Question24

Galbriel phthalimide synthesis is used in the preparation of primary amine from phthalimide, which of the following reagent is not used during the process?

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Options:

A. KOH

B. NaOH

C. HCl

D. Alkyl halides

Answer: C

Solution:

In the synthesis of primary amines from phthalimide, hydrochloric acid (HCl) is not utilized. During this process, the reagents typically involved include phthalimide, a base (such as KOH or NaOH), and a primary alkyl halide (1° R-X).
