

# Compounds Containing Nitrogen

## Question1

Which of the following sets of reagents convert aniline to chlorobenzene?

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Options:

A.

$\text{NaNO}_2/\text{HCl}$ , 273 – 278 K;  $\text{Cu}_2\text{Cl}_2/\text{HCl}$

B.

$\text{NaNO}_2/\text{HCl}$ , 293 – 298 K;  $\text{Cu}_2\text{Cl}_2/\text{HCl}$

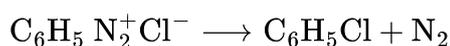
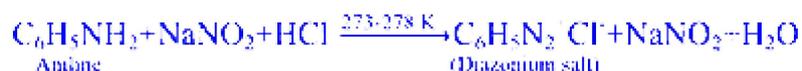
C.  $\text{NaNO}_2/\text{HCl}$ , 273 – 278 K;  $\text{SOCl}_2$

D.  $\text{NaNO}_2/\text{HCl}$ , 273 – 278 K;  $\text{Cl}_2$

**Answer: A**

**Solution:**

The complete reaction is

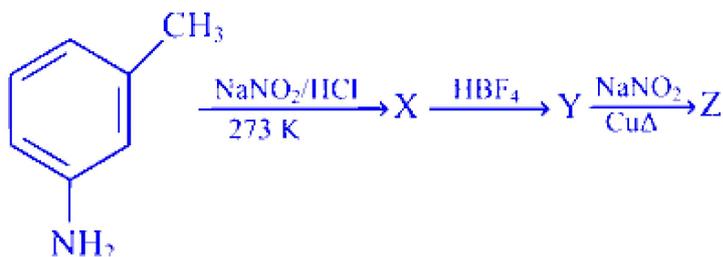


Hence, reagents are:  $\text{NaNO}_2/\text{HCl}$ , 273 – 278 K;  $\text{Cu}_2\text{Cl}_2/\text{HCl}$ .

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## Question2

The % of carbon in ' Z ' is (At.wt. C=12u,H=1u,N=14u O = 16u)



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Options:

A.

71.3

B.

51.3

C.

61.3

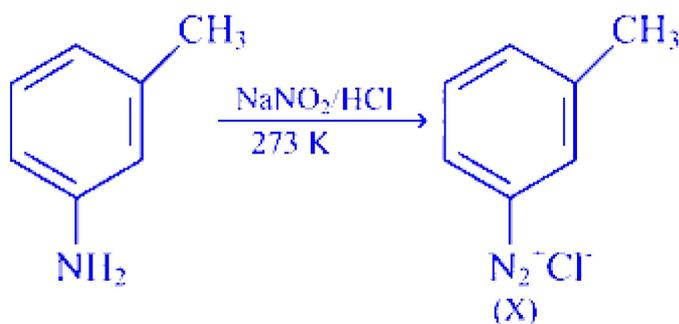
D.

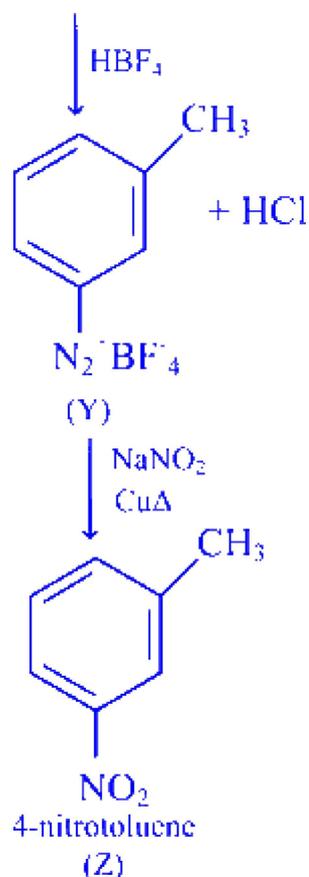
48.3

**Answer: C**

**Solution:**

The complete reaction sequence is as follows





Molar mass of  $Z$  i.e.,

$$\text{C}_7\text{H}_7\text{NO}_2 = (7 \times 12) + (7 \times 1) + (1 \times 14) = 137\text{u}$$

Now \% of carbon in  $Z$

$$\begin{aligned}
 &= \frac{\text{Mass of carbon}}{\text{Molar mass of } Z} \times 100 \\
 &= \frac{84}{137} \times 100 = 61.3\%
 \end{aligned}$$

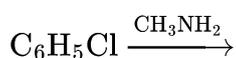
### Question3

**Benzyl amine can be prepared from which of the following reactions?**

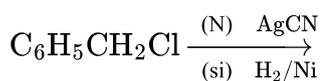
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**Options:**

A.



B.



C.



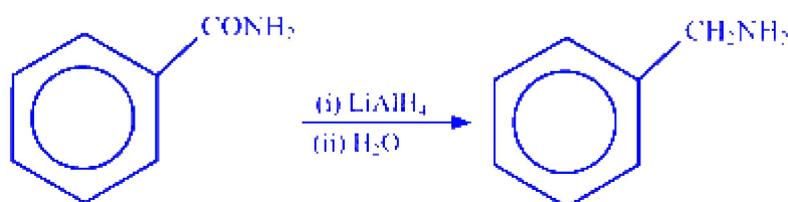
D.



**Answer: D**

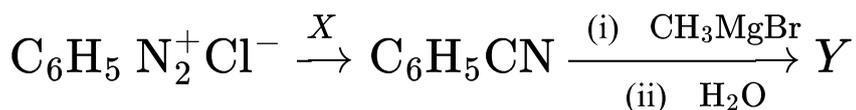
**Solution:**

Among the given options, Benzylamine can be prepared by reaction given in option (d)



## Question4

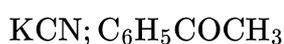
What are  $X$  and  $Y$  in the following reaction sequence?



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**Options:**

A.



C.



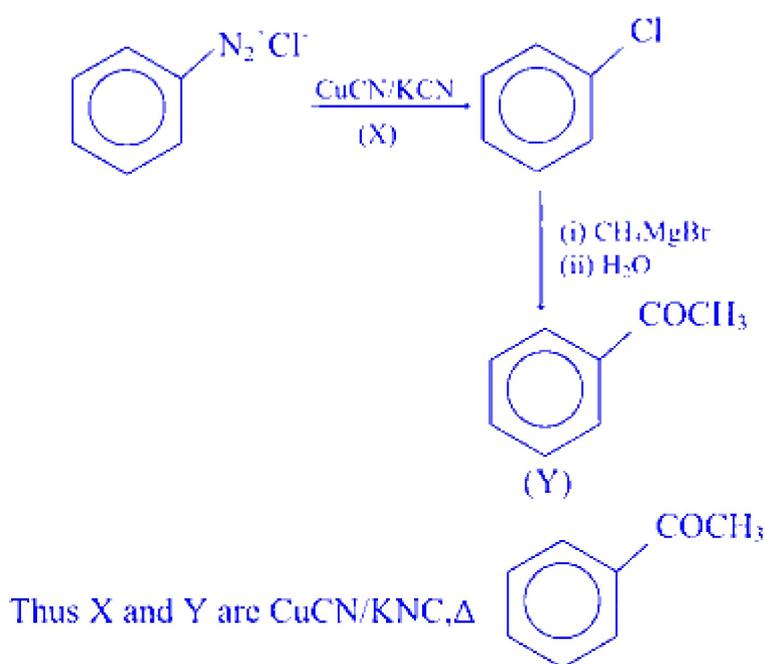
D.



**Answer: D**

**Solution:**

The complete reaction sequence is as follows



## Question 5

What is *A* in the following reaction?



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**Options:**

A.



B.



C.



D.



**Answer: C**

**Solution:**

The complete reaction sequence is as follows



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## Question6

Consider the following

**Statement-I** In the nitration of aniline, more amount of *m*-nitroaniline is formed than expected.

**Statement-II** In the presence of a strongly acidic medium, aniline is protonated to form anilinium ion, which is meta-directing.

The correct answer is

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Options:

A.

Both statement-I and statement-II are correct.

B.



Both statement-I and statement-II are not correct.

C.

Statement-I is correct, but statement-II is not correct.

D.

Statement-I is not correct, but statement-II is correct.

**Answer: A**

## Solution:

### Statement I

In the nitration of aniline, more amount of *m*-nitroaniline is formed than expected.

Normally,  $-\text{NH}_2$  is an activating, **ortho/para-directing** group.

Hence, we expect **mainly o- and p-nitroaniline**.

However, nitration is carried out in *strongly acidic* medium ( $\text{H}_2\text{SO}_4/\text{HNO}_3$ ), and under these conditions, **aniline gets protonated** to form the **anilinium ion** ( $\text{C}_6\text{H}_5\text{NH}_3^+$ ).

The  $-\text{NH}_3^+$  group is an **electron-withdrawing, deactivating, meta-directing** group.

So the nitration mixture now contains protonated aniline, which gives **meta nitro product**.

As a result, the actual nitration product mixture contains a **higher proportion of *m*-nitroaniline** than we would expect based on the activating nature of  $-\text{NH}_2$  alone.

✔ Hence, **Statement I is correct**.

### Statement II

In the presence of a strongly acidic medium, aniline is protonated to form anilinium ion, which is meta-directing.

As discussed above, this is **true** — in a strongly acidic medium, aniline is converted to the anilinium ion ( $\text{C}_6\text{H}_5\text{NH}_3^+$ ).

The anilinium ion is **meta-directing** because the positively charged nitrogen withdraws electrons from the ring, deactivating it, especially at ortho and para positions.

✔ Hence, **Statement II is also correct**.

✔ **Final Answer**

**Option A:** *Both Statement I and Statement II are correct.*

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## Question7

The reaction of benzene diazonium chloride with Cu and HCl is known as

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Options:

A.

Sandmeyer reaction

B.

Etard reaction

C.

Finkelstein reaction

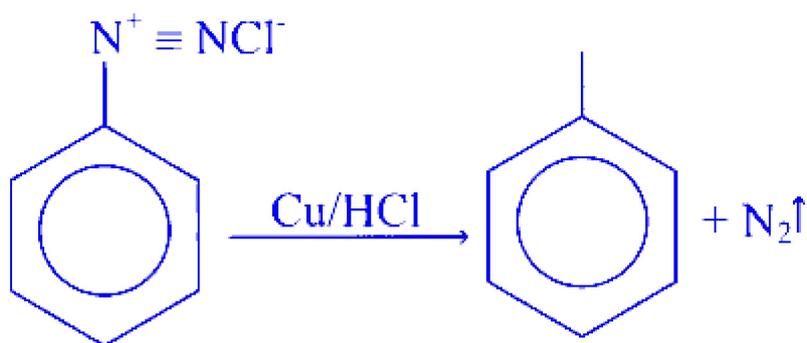
D.

Gattermann reaction

**Answer: D**

**Solution:**

The reaction of benzene diazonium chloride with Cu and HCl is called as Gattermann reaction to form chlorobenzene.



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## Question8

The sequence of reagents required to convert aniline to benzoic acid is



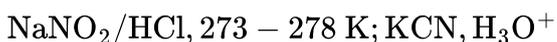
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Options:

A.



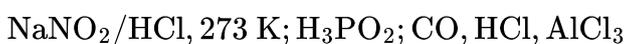
B.



C.



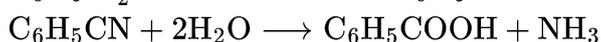
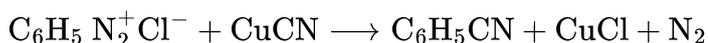
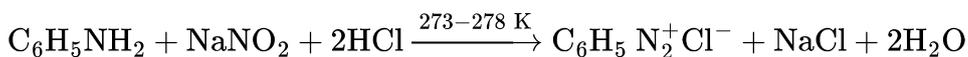
D.



**Answer: C**

**Solution:**

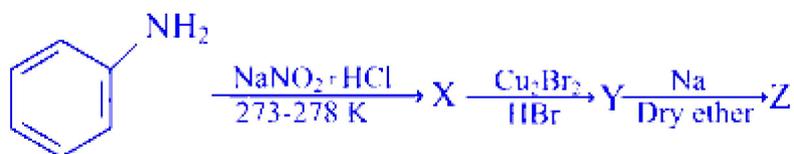
The sequence of reagent required is,  $\text{NaNO}_2/\text{HCl}/273 - 278 \text{ K}; \text{CuCN}/\text{KCN}; \text{H}_3\text{O}^+$  The reaction is,



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## Question9

In the given reaction sequence conversion of Y to Z is



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### Options:

A.

Wurtz reaction

B.

Wurtz-Fittig reaction

C.

Fitting reaction

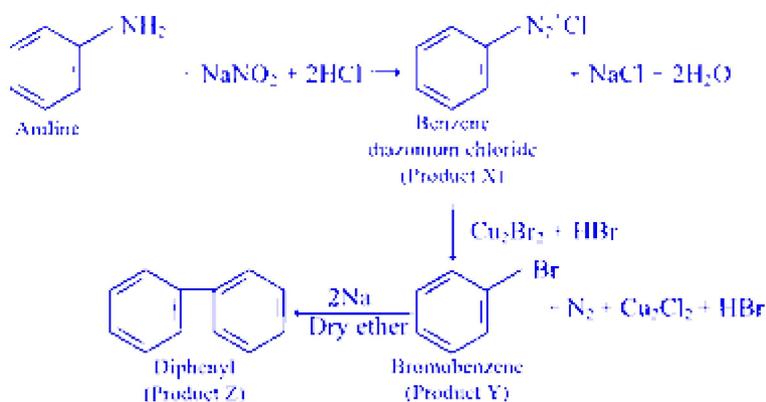
D.

Swarts reaction

**Answer: C**

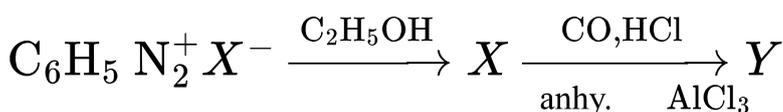
### Solution:

The reaction mentioned is a Fitting reaction, The complete reaction is as follow,



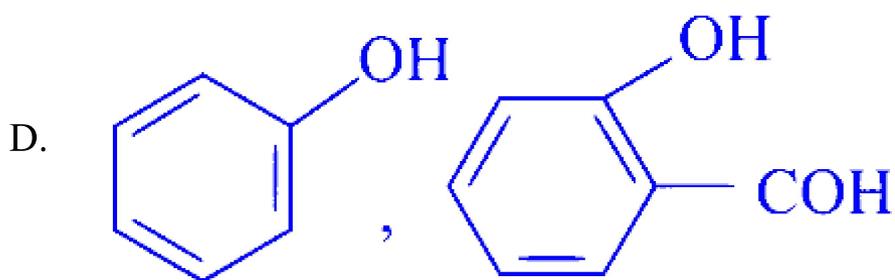
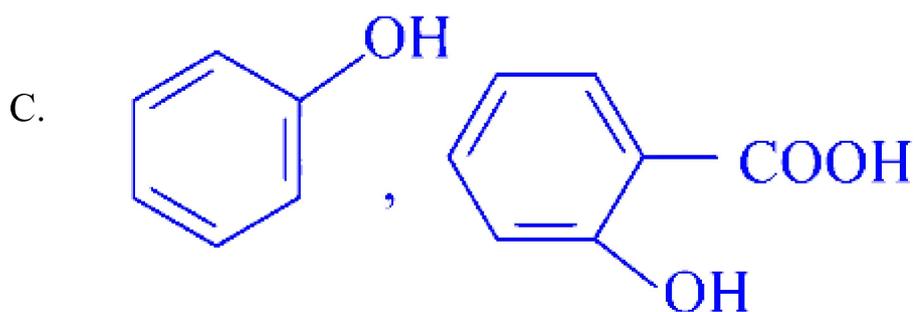
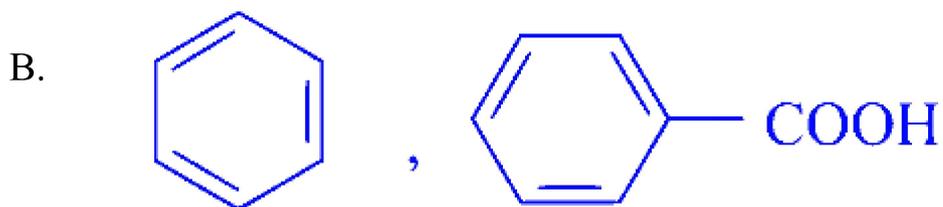
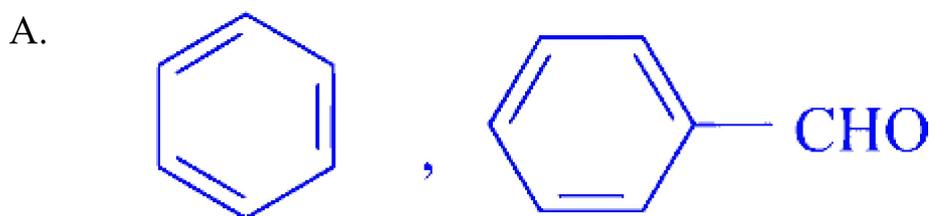
## Question 10

What are  $X$  and  $Y$  respectively in the following reaction sequence?



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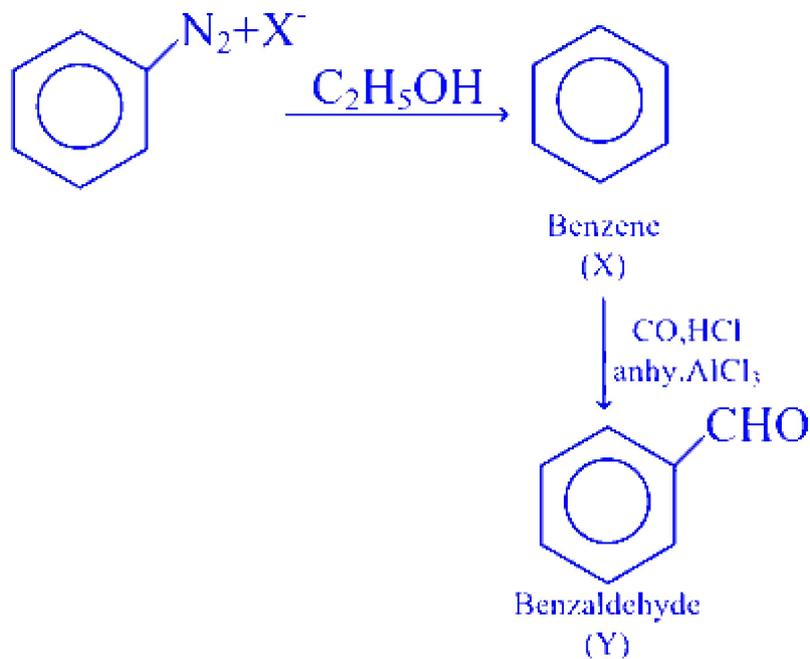
**Options:**



**Answer: A**

**Solution:**

The complete reaction sequence is as follow



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## Question11

How many amines with molecular formula  $\text{C}_3\text{H}_9\text{N}$  can react with benzenE sulphonyl chloride?

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Options:

A.

2

B.

3

C.

4

D.

1

**Answer: B**



## Solution:

Total three amines with formula  $C_3H_9N$  can react with benzene sulphonyl chloride.

(i)  $CH_3CH_2CH_2NH_2$  : Propylamine

(ii)  $(CH_3)_2CHNH_2$  : Isopropylamine

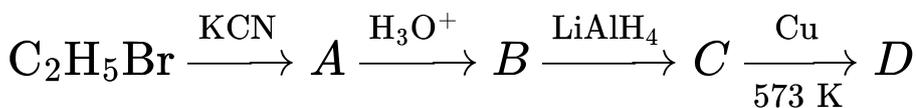
(iii)  $CH_3CH_2NHCH_3$  :

N -methylethylamine

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## Question12

In the following sequence of reactions, what is the end product (*D*) ?



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Options:

A.

Acetaldehyde

B.

Acetone

C.

Propionaldehyde

D.

Propanol-1

**Answer: C**

## Solution:

The complete reaction is as follows



## Solution:

### Statement I:

$\text{CH}_3\text{NH}_2$  is more basic than  $\text{NH}_3$  but  $\text{C}_6\text{H}_5\text{NH}_2$  is less basic than  $\text{NH}_3$ .

### Explanation:

- **Methylamine ( $\text{CH}_3\text{NH}_2$ ):**

The  $-\text{CH}_3$  group is **electron donating** (+I effect), which **increases the electron density** on nitrogen, making it **more basic** than ammonia.

- **Aniline ( $\text{C}_6\text{H}_5\text{NH}_2$ ):**

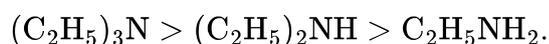
The lone pair on nitrogen gets **delocalized** into the **benzene ring** through **resonance**, reducing its availability to accept a proton.

So aniline is **less basic** than ammonia.

✔ Hence, Statement I is correct.

### Statement II:

The order of basic strength of amines in aqueous phase follows the order



### Let's check this:

In the **aqueous phase**, basic strength is influenced by two factors:

1. **+I effect** (electron donating alkyl groups increase basicity)
  2. **Solvation effect** (stabilization of the conjugate ammonium ion)
- In aqueous solution, the **solvation effect** is strong for **primary > secondary > tertiary amines**, because primary amines can form more hydrogen bonds.
  - However, the **+I effect** increases as we move from primary  $\rightarrow$  secondary  $\rightarrow$  tertiary.

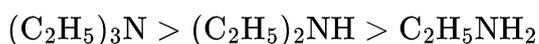
The combined effect in aqueous phase gives the **observed order**:

**Secondary amine > Primary amine > Tertiary amine**

That is:



But the statement says the order is:



✗ **This is incorrect** in aqueous medium.

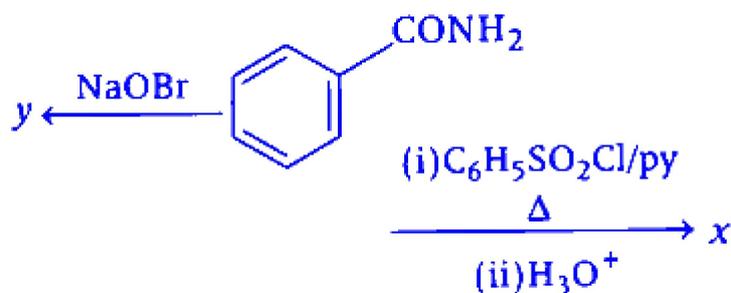
✔ **Correct Answer:**

**Statement I is correct but Statement II is not correct.**

✔ Option C

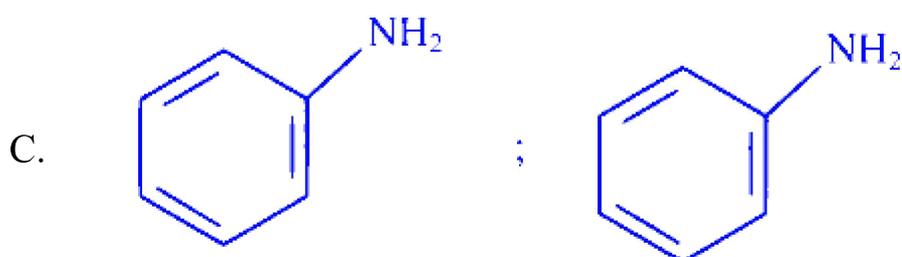
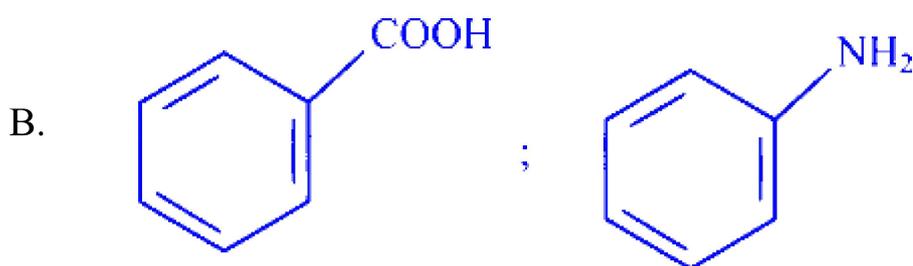
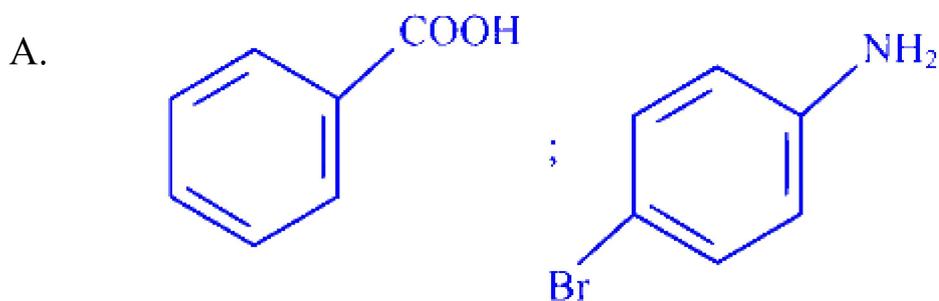
## Question 14

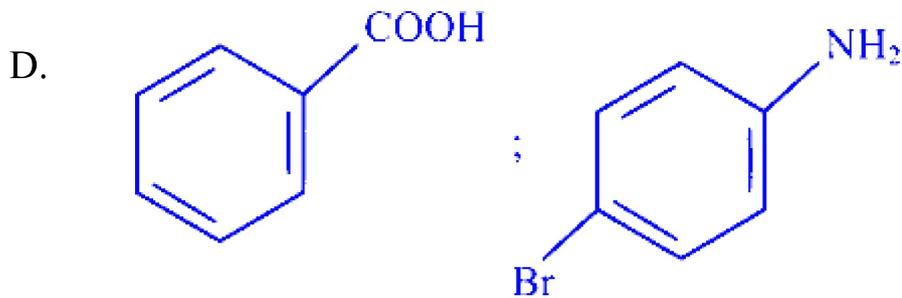
What are  $x$  and  $y$  in the following set of reactions?



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Options:

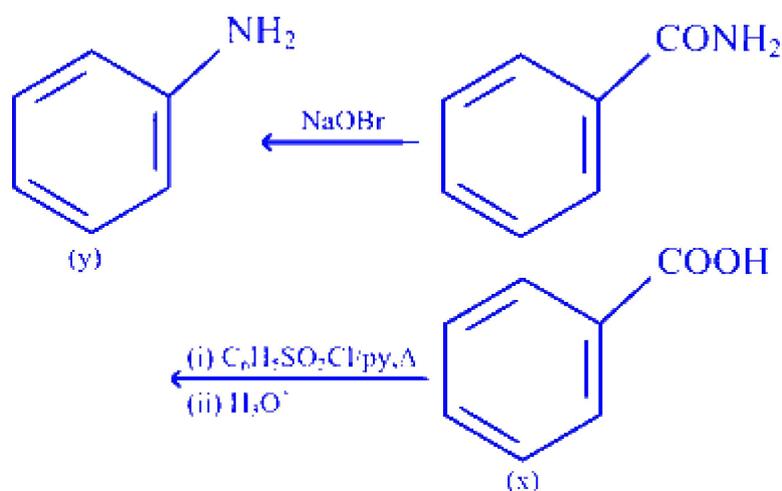




**Answer: B**

**Solution:**

The complete reaction sequence is as follows

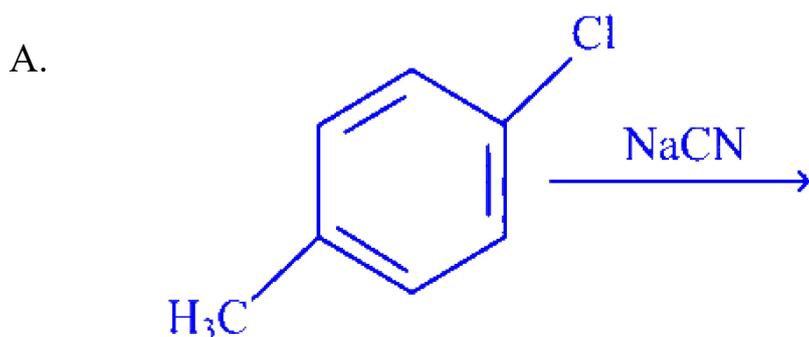


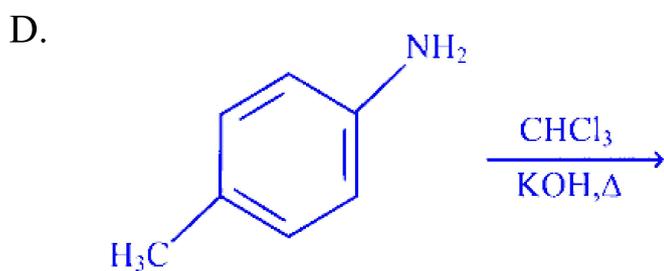
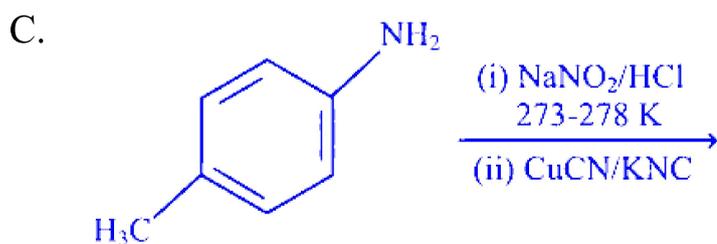
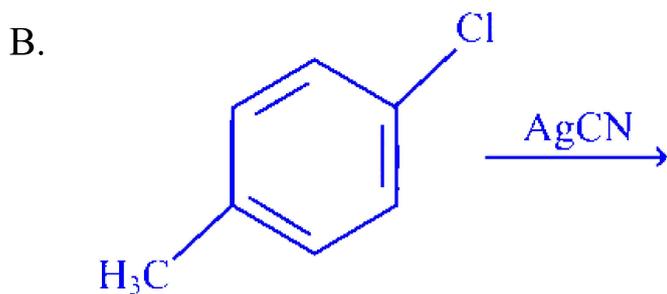
## Question15

*p*-methyl benzene nitrile can be prepared from which of the following?

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Options:

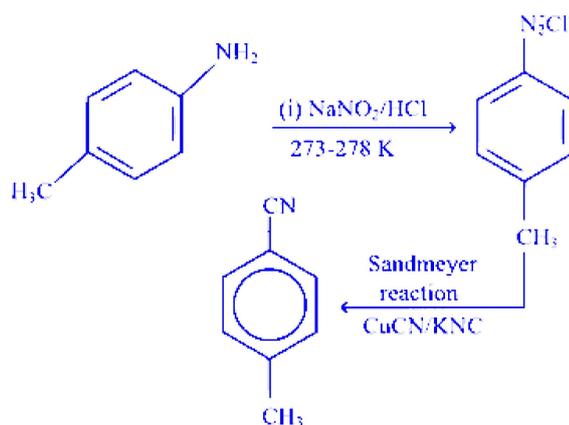




**Answer: C**

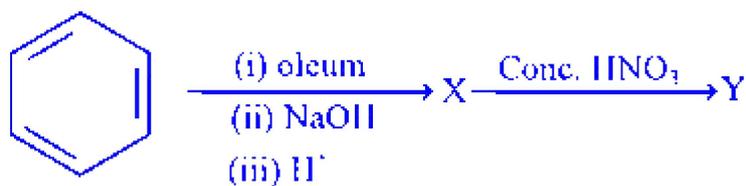
**Solution:**

Among the given options, *p*-methyl benzene nitrile can be prepared by



## Question16

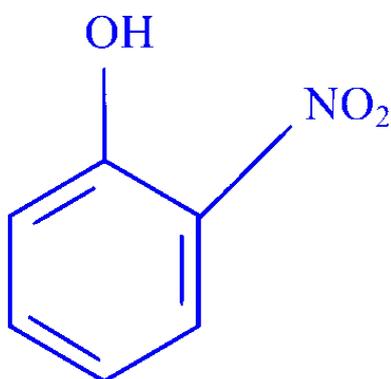
What is  $Y$  in the given sequence?



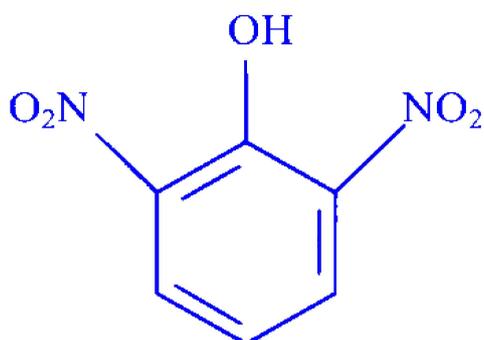
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Options:

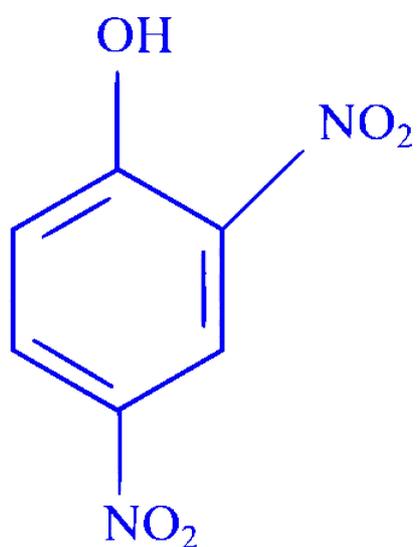
A.



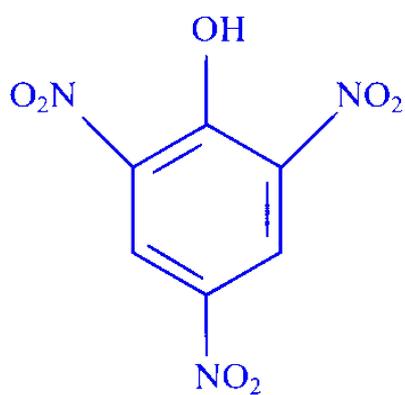
B.



C.

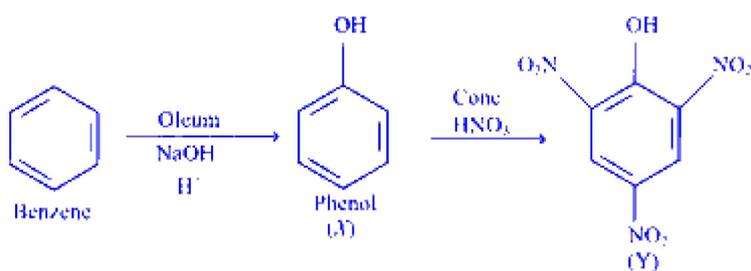


D.



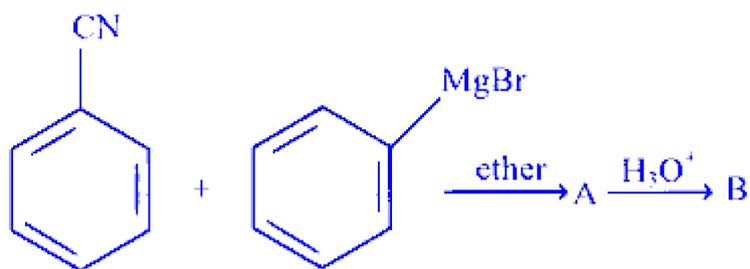
**Answer: D**

**Solution:**



## Question17

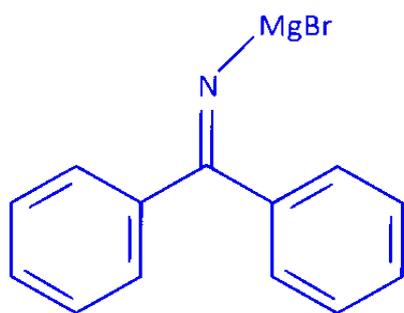
Identify *B* in the given reaction sequence.



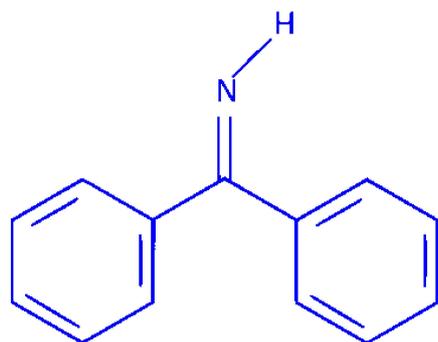
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Options:

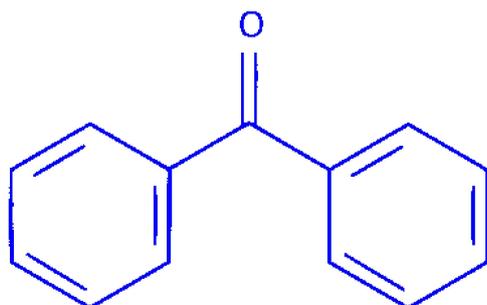
A.



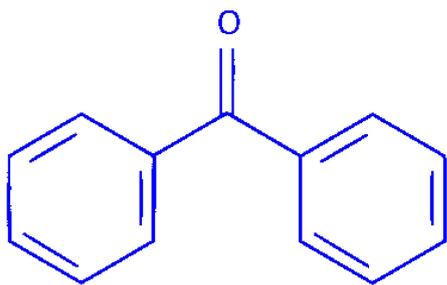
B.



C.



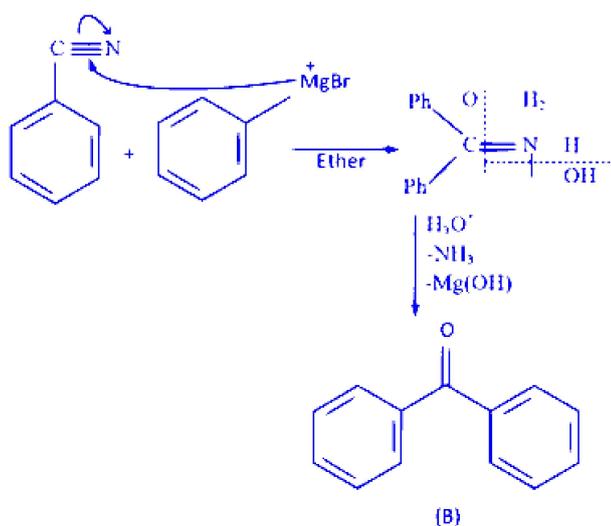
D.



**Answer: C**

**Solution:**

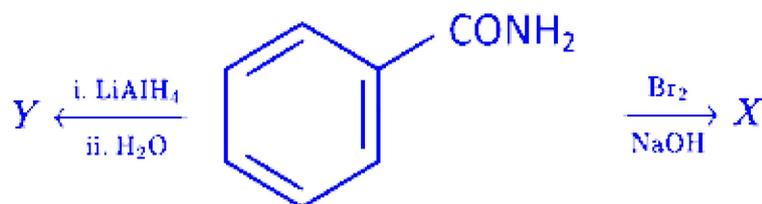
The reaction involved is



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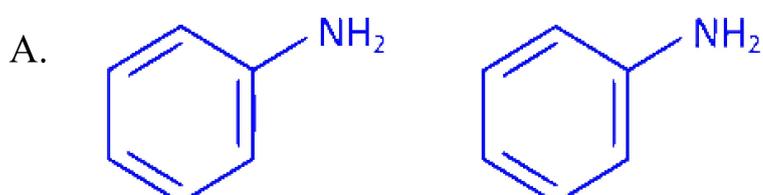
## Question18

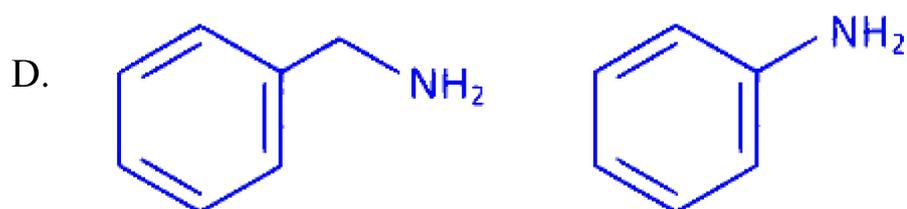
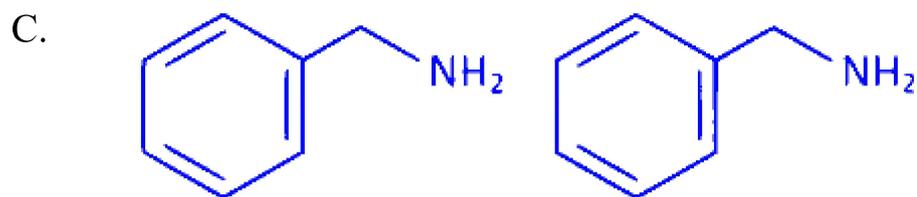
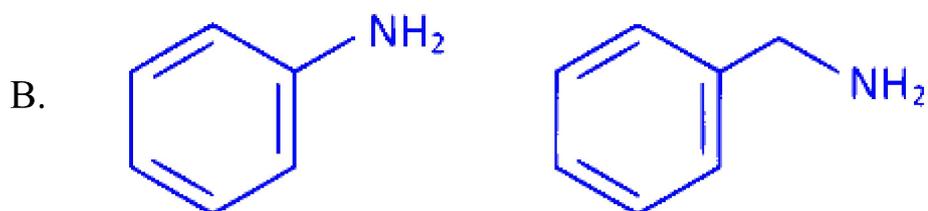
What are *X* and *Y* respectively in the following reactions?



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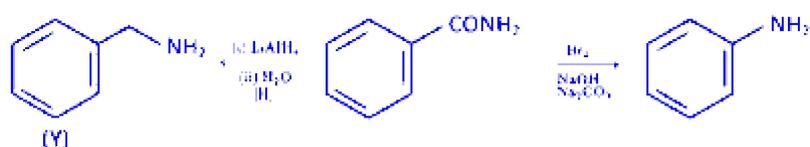
**Options:**





**Answer: B**

**Solution:**



## Question19

The two reactions involved in the conversion of benzene diazonium chloride to diphenyl are respectively

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**Options:**

A. Swarts, Fittig

B. Gatterman, Swarts



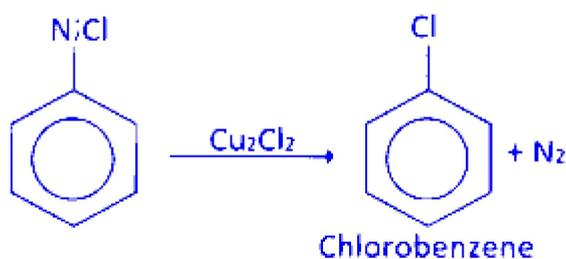
C. Sandmeyer, Wurtz

D. Sandmeyer, Fittig

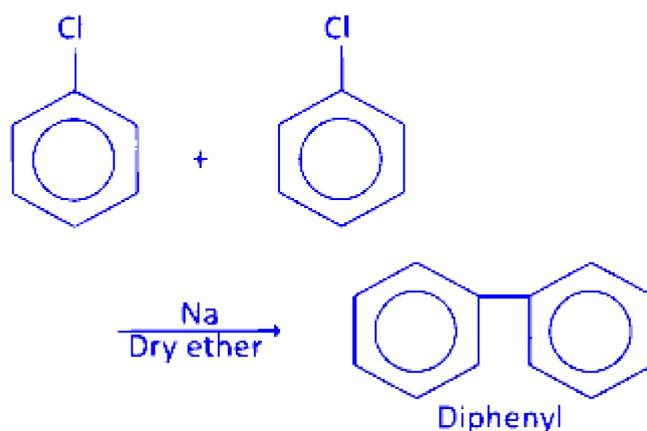
**Answer: D**

### Solution:

Conversion of benzene diazonium chloride to chlorobenzene is called as Sandmeyer reaction.



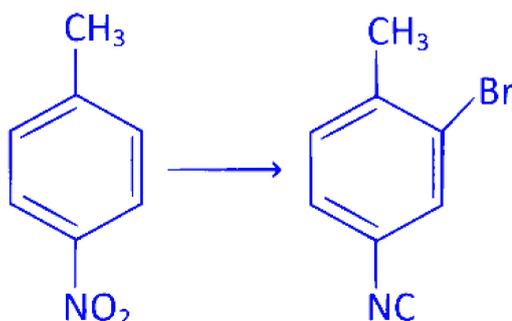
Now chlorobenzene to diphenyl reaction is called as Fittig reaction.



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## Question20

The correct sequence of reactions involved in the following conversion is



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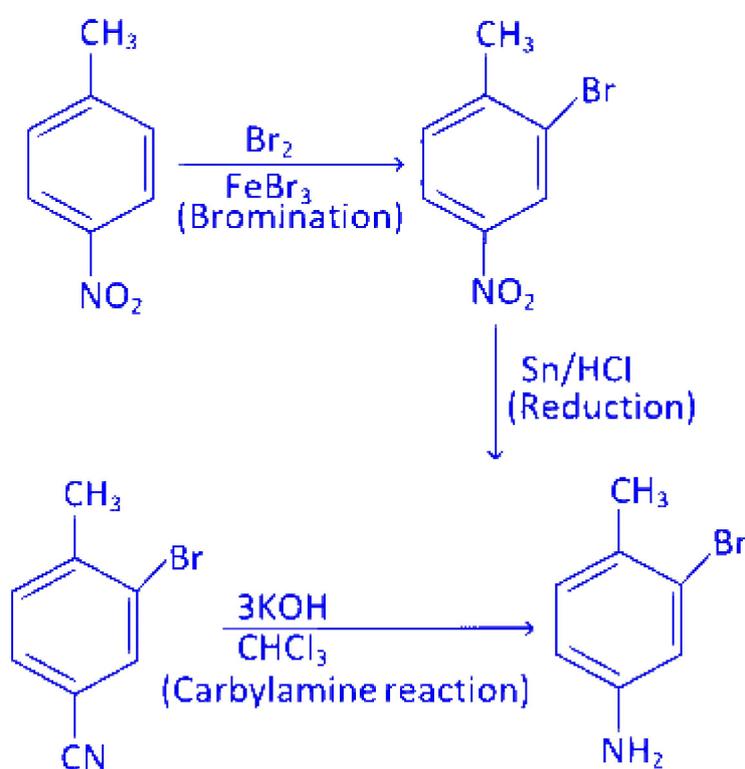
### Options:

- A. Bromination, reduction, carbylamine reaction
- B. Reduction, bromination, carbylamine reaction
- C. Bromination, reduction, oxidation
- D. Reduction, bromination, oxidation

**Answer: A**

### Solution:

Image The correct sequence of reaction involved is the given conversion is



So, the processes involved in given sequence are bromination, reduction and carbylamine reaction.

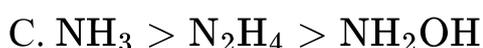
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## Question21

The relative basic strength of the compounds is correctly shown in the option.

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Options:



Answer: C

Solution:

The correct order of relative basic strength will be



In  $\text{NH}_3$ , the lone pair is completely available for donation, hence is most basic whereas  $\text{NH}_2 - \text{NH}_2$  and  $\text{NH}_2 - \text{OH}$  can be considered as derivatives of  $\text{NH}_3$ . Here, H is replaced by  $-\text{NH}_2$  forming  $\text{NH}_2 - \text{NH}_2$  and  $-\text{OH}$  forming  $\text{NH}_2 - \text{OH}$  being highly electron withdrawing due to  $-\text{O}$  will decrease the electron density most on  $-\text{N}$ .

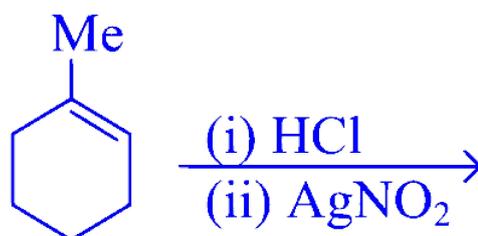
∴ Least basic electron withdrawing  $-I$ -effect of  $-\text{NH}_2$  is less as compared to  $-\text{OH}$ .

Hence correct order of basic strength is



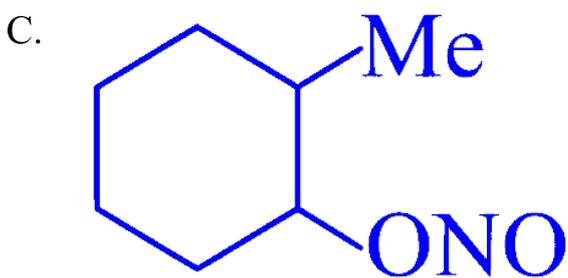
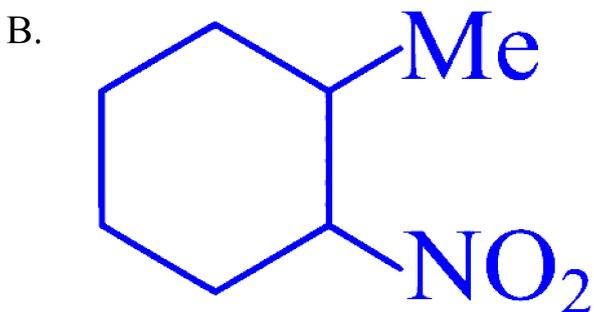
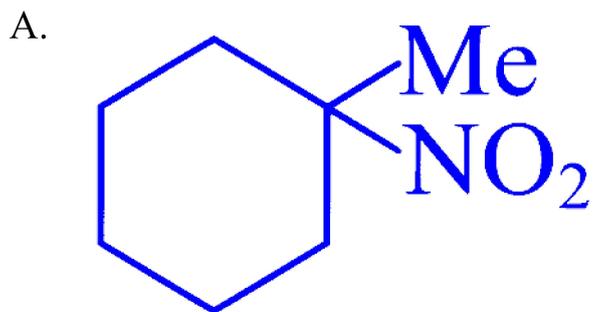
## Question22

Identify the major product formed from the following reaction.



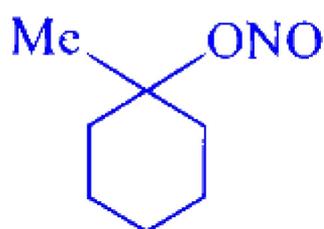
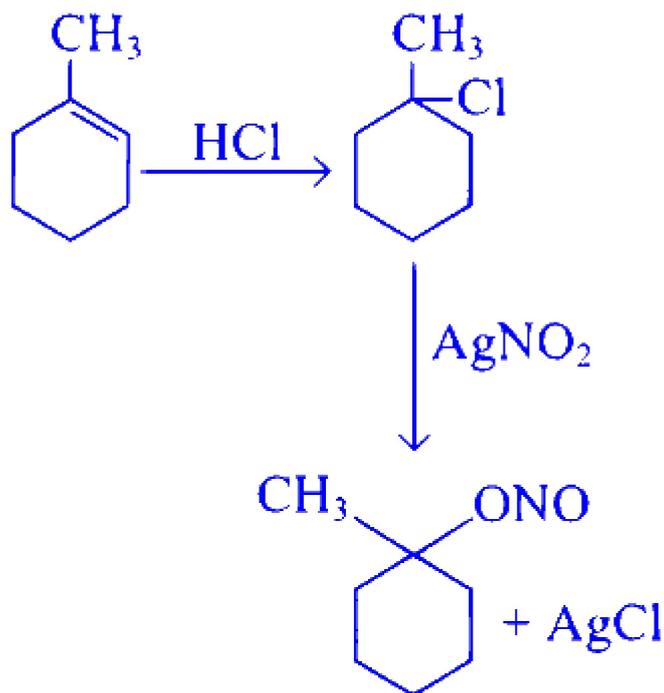
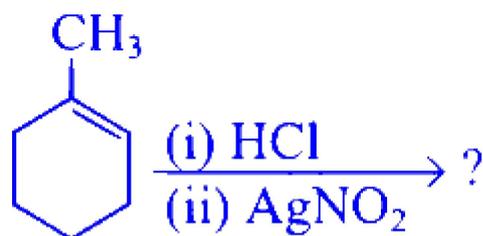
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Options:



Answer: D

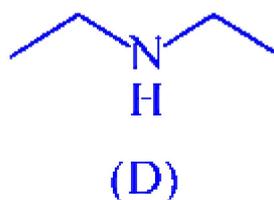
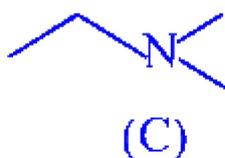
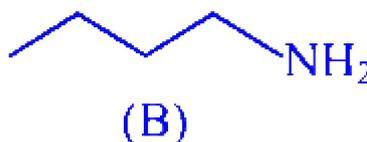
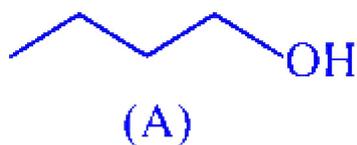
Solution:



is correct option.

## Question23

Arrange the following in decreasing order of their boiling points.



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Options:

A.  $A > B > D > C$

B.  $A > C > D > B$

C.  $B > C > D > A$

D.  $C > A > B > D$

Answer: A

Solution:



The boiling point of (A) alcohol is highest due to H-bonding.

Out of primary (B), secondary (D) and tertiary amines (C), the boiling point in decreasing order is Primary amine > Secondary amine > Tertiary amine

as intermolecular association decreases in same order, being highest in primary amine and least in tertiary amine due to steric hindrance.

∴ The correct decreasing order of boiling point in given compound is

$A > B > D > C$ .

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## Question24

Arrange the following bases in decreasing order of basicity.

1. Aniline

2. o-nitroaniline

3. m-nitroaniline

4. p-nitroaniline

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**Options:**

A.  $1 > 2 > 4 > 3$

B.  $1 > 3 > 4 > 2$

C.  $4 > 3 > 2 > 1$

D.  $3 > 2 > 1 > 4$

**Answer: B**

**Solution:**

Due to presence of electron withdrawing nitro group, delocalisation of lone pair of electron is improved. This effect observed in para and ortho position.

In ortho position, very close inductive effect of nitro group is also observed. Hence, o-nitroaniline is less basic than p-nitroaniline. In m-nitroaniline, only inductive effect is present.

Order of basicity is as follows:

aniline > m-nitroaniline > p-nitroaniline > o-nitroaniline.

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## Question25

Using Kjeldahl's method over 1g of a soil sample, the ammonia evolved could neutralise 25 mL of 1 M  $\text{H}_2\text{SO}_4$ . Then, the percentage of nitrogen present in the sample is

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Options:

- A. 100%
- B. 60%
- C. 70%
- D. 25%

**Answer: C**

**Solution:**

25 mL of 1M  $\text{H}_2\text{SO}_4$  corresponds to 25 m mol.

It will neutralise 50 mol of  $\text{NH}_3$ .

$$\text{weight of N} = \frac{14 \times 50}{1000} \text{ g} = 0.70 \text{ g}$$

Thus 1g of sample of organic compound contains 0.70 g of nitrogen.

$$\% \text{ of nitrogen in organic sample is } \frac{0.70}{1} \times 100 = 70\%$$

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