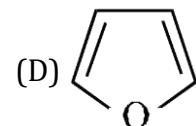
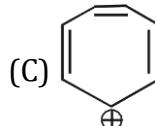
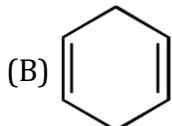
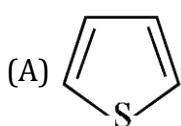


## EXERCISE # I

**Q.1** Which of the following is not an aromatic compound:



**Q.2** Which of the following group is divalent:

(A) Benzoyl

(B) Benzyl

(C) Benzal

(D) p-Tolyl

**Q.3** Benzene is a resonance hybrid mainly of two Kekule structures. Hence:

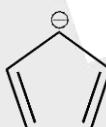
(A) Half of the molecules correspond to one structure, and half of the second structure

(B) At low temperatures benzene can be separated into two structures

(C) Two structures make equal contribution to resonance hybrid

(D) An individual benzene molecule changes back and forth between two structures

**Q.4** How many  $\pi$  electron are there in the following species:



(A) 2

(B) 4

(C) 6

(D) 8

**Q.5** The number of benzylic hydrogen atoms in ethylbenzene is:

(A) 3

(B) 5

(C) 2

(D) 7

**Q.6** Which one of the following is the most basic compound in water :

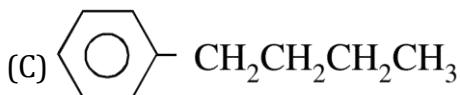
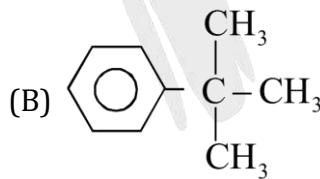
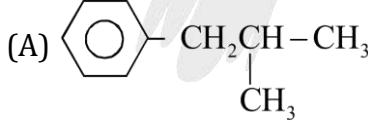
(A)  $C_6H_5 - NH_2$

(B)  $C_6H_5 - NHCH_3$

(C)  $C_6H_5 - N(CH_3)_2$

(D)  $C_6H_5 N(C_2H_5)_2$

**Q.7**  +  $CH_3CH_2CH_2CH_2Cl \xrightarrow{AlCl_3}$  hydrocarbon (X) major product X is:



(D) None is correct

**Q.8** In the sulphonation, acetylation and formylation of benzene the group of effective electrophiles would be :

(A)  $SO_3^+$ ,  $CH_3C \equiv O$ ,  $HO$

(B)  $SO_3$ ,  $CH_3 - C \equiv O$ ,  $HO$

(C)  $SO_3$ ,  $CH_3CHO$ ,  $CO + HCl$

(D)  $HSO_3$ ,  $CH_3CO$ ,  $HCO$

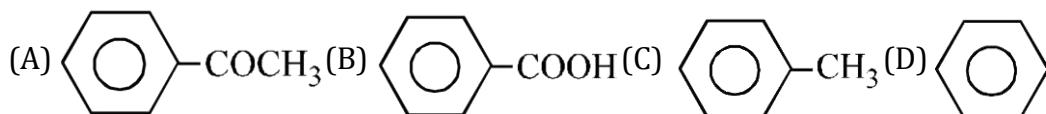
**Q.9** o/p ratio in highest for nitration of which of the following compound?

(A) Ethyl benzene    (B) Toluene    (C) Isopropyl benzene    (D) Tertiarybutyl benzene

**Q.10** Which can be used to generate  $\text{NO}_2^+$  in nitration of benzene ring

(A)  $\text{HNO}_3 + \text{H}_2\text{SO}_4$     (B)  $\text{HNO}_3 + \text{HClO}_4$     (C)  $\text{N}_2\text{O}_5$     (D) All

**Q.11** Product obtained when benzoyl acetic acid is heated with soda-lime is:

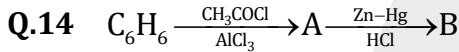


**Q.12** For the electrophilic substitution reaction involving nitration, which of the following sequence regarding the rate of reaction is true?

- (A)  $k_{\text{C}_6\text{H}_6} > k_{\text{C}_6\text{D}_6} > k_{\text{C}_6\text{T}_6}$     (B)  $k_{\text{C}_6\text{H}_6} < k_{\text{C}_6\text{D}_6} < k_{\text{C}_6\text{T}_6}$   
 (C)  $k_{\text{C}_6\text{H}_6} = k_{\text{C}_6\text{D}_6} = k_{\text{C}_6\text{T}_6}$     (D)  $k_{\text{C}_6\text{H}_6} > k_{\text{C}_6\text{D}_6} < k_{\text{C}_6\text{T}_6}$

**Q.13** For the electrophilic substitution reaction involving sulphonation, which of the following sequence regarding the rate of reaction is true?

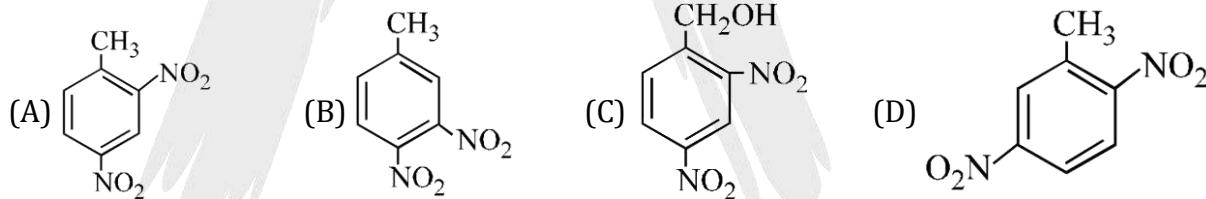
- (A)  $k_{\text{C}_6\text{H}_6} > k_{\text{C}_6\text{D}_6} > k_{\text{C}_6\text{T}_6}$     (B)  $k_{\text{C}_6\text{H}_6} < k_{\text{C}_6\text{D}_6} < k_{\text{C}_6\text{T}_6}$   
 (C)  $k_{\text{C}_6\text{H}_6} = k_{\text{C}_6\text{D}_6} = k_{\text{C}_6\text{T}_6}$     (D)  $k_{\text{C}_6\text{H}_6} > k_{\text{C}_6\text{D}_6} < k_{\text{C}_6\text{T}_6}$



The end product in the above sequence is:

- (A) Toluene    (B) Ethyl benzene    (C) Both the above    (D) None

**Q.15** p-Nitrotoluene on further nitration gives:



**Q.16** Reaction of  $\text{SO}_3$  is easier in:

- (A) Benzene    (B) Toluene    (C) Nitrobenzene    (D) chlorobenzene

**Q.17** Which order is correct for the decreasing reactivity to ring monobromination of the following compounds:

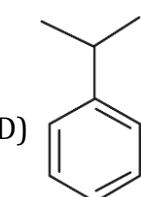
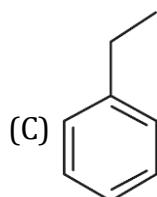
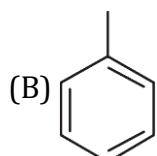
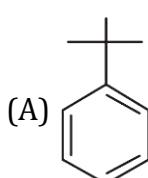
- (I)  $\text{C}_6\text{H}_5\text{CH}_3$     (II)  $\text{C}_6\text{H}_5\text{COOH}$     (III)  $\text{C}_6\text{H}_6$     (IV)  $\text{C}_6\text{H}_5\text{NO}_2$

- (A) I > II > III > IV    (B) I > III > II > IV    (C) II > III > IV > I    (D) III > I > II > IV

**Q.18** The highest yield of m-product is possible by the electrophilic substitution of the following:

- (A)  $\text{C}_6\text{H}_5\text{CH}_3$     (B)  $\text{C}_6\text{H}_5\text{CH}_2\text{COOC}_2\text{H}_5$   
 (C)  $\text{C}_6\text{H}_5\text{CH}(\text{COOC}_2\text{H}_5)_2$     (D)  $\text{C}_6\text{H}_5\text{C}(\text{COOC}_2\text{H}_5)_3$

**Q.19** Which of the following will undergo sulphonation at fastest rate?



**Q.20** Aniline under acidic medium, when chlorinated, produces:

(A) o-Chloro aniline

(B) m-Chloro aniline

(C) p-Chloro aniline

(D) Mixture of ortho and para-chloro aniline

**Q.21** When sulphonilic acid ( $p - \text{H}_2\text{NC}_6\text{H}_4\text{SO}_3\text{H}$ ) is treated with excess of bromine water, the product is:

(A) Tribromo product

(B) Dibromo product

(C) Monobromo product

(D) Tetrabromo product

**Q.22** In a reaction of  $\text{C}_6\text{H}_5\text{Y}$ , the major product (> 60%) is m-isomer, so the group Y is:

(A)  $-\text{COOH}$

(B)  $-\text{Cl}$

(C)  $-\text{OH}$

(D)  $-\text{NH}_2$

**Q.23** An aromatic compound of molecular formula  $\text{C}_6\text{H}_4\text{Br}_2$  was nitrated then three isomers of formula  $\text{C}_6\text{H}_3\text{Br}_2\text{NO}_2$  were obtained. The original compound is:

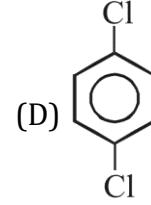
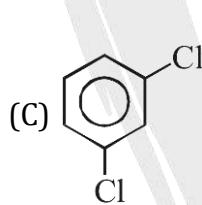
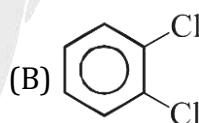
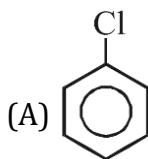
(A) o-Dibromobenzene

(B) m-Dibromobenzene

(C) p-Dibromobenzene

(D) Both A & C

**Q.24** Which of the following substituted benzene derivatives would furnish only three isomers in significant amount when one more substituent is introduced:



**Q.25** Which of the following is most reactive towards sulphonation?

(A) m-Xylene

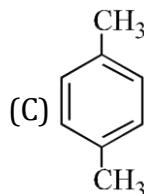
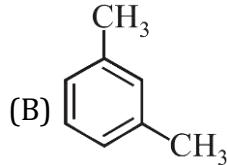
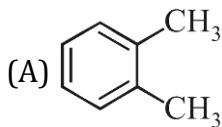
(B) o-Xylene

(C) Toluene

(D) p-Xylene

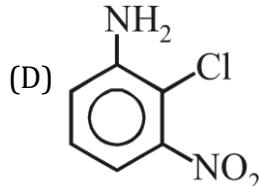
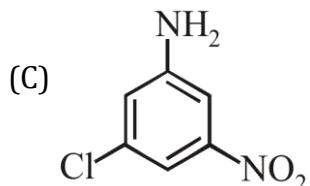
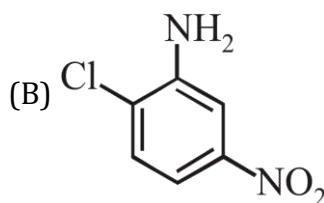
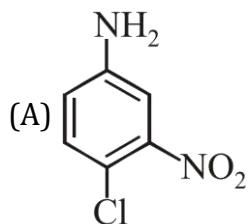
**Q.26** Ring nitration of dimethyl benzene results in the formation of only one nitro dimethyl benzene.

The dimethyl benzene is:

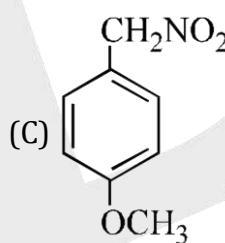
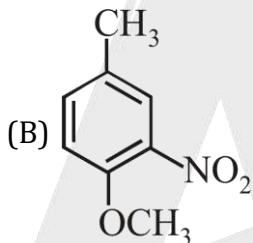
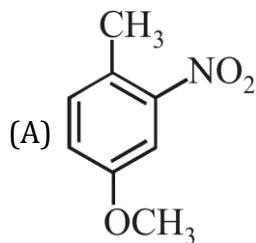


(D) None of these

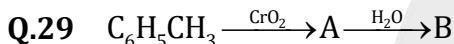
**Q.27** If meta-nitroaniline is chlorinated, the major product is:



**Q.28** If p-methoxy toluene is nitrated, the major product is:



(D) No reaction

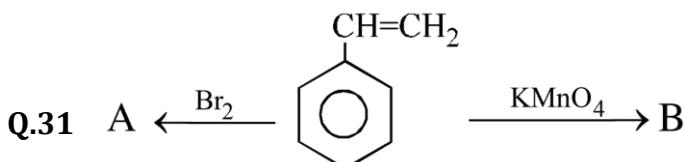


The functional group present in B and name of the reaction would be

- (A) - CHO, Gattermann aldehyde synthesis
- (B) - CHO, Etard reaction
- (C) -COCH<sub>3</sub>, Friedel Crafts reaction
- (D) -CHO, Oxo reaction

**Q.30** Etard reaction in the following is:

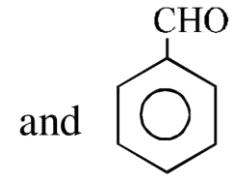
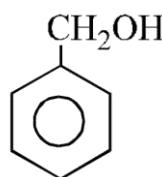
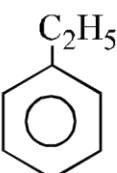
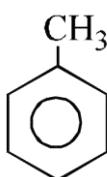
- (A) Oxidation of toluene to benzaldehyde by chromylchloride
- (B) Oxidation of toluene to benzaldehyde by alkaline KMnO<sub>4</sub>
- (C) Dry distillation of calcium benzoate
- (D) Reaction of benzene with Cl<sub>2</sub> in the presence of UV light



Compound A and B respectively are:

- |                                  |                                     |
|----------------------------------|-------------------------------------|
| (A) o-Bromostyrene, benzoic acid | (B) p-Bromostyrene, benzaldehyde    |
| (C) m-Bromostyrene, benzaldehyde | (D) Styrene dibromide, benzoic acid |

**Q.32** If the mixture of the following four aromatic compounds on oxidation by strong oxidising agent gives:



- (A) Mixture of  $C_6H_5CH_2OH + C_6H_5COOH$  (B) Mixture of  $C_6H_5CHO + C_6H_5COOH$   
 (C) Only  $C_6H_5COOH$  (D) None of the above

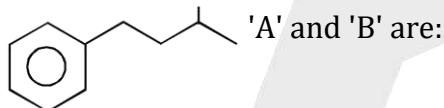
**Q.33** Methyl group attached to benzene can be oxidised to carboxyl group by reacting with:

- (A)  $Fe_2O_3$  (B)  $AgNO_3$  (C)  $KMnO_4$  (D)  $CrO_3$

**Q.34** Which of the following is/are produced when a mixture of benzene vapour and oxygen is passed over  $V_2O_5$  catalyst at 775 K ?

- (A) Oxalic acid (B) Glyoxal (C) Fumaric acid (D) Maleic anhydride

**Q.35** Benzene on reaction with 'A' forms



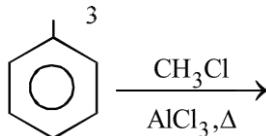
- 'A' and 'B' are: (A)  $Zn(Hg) + conc. HCl$ ,

- (B)
- (C)
- (D)

**Q.36** Which chloroderivative of benzene among the following would undergo-hydrolysis most readily with aq. NaOH to furnish the corresponding hydroxy derivative.

- (A)
- (B)
- (C)
- (D)

**Q.37** Major product of this reaction will be :



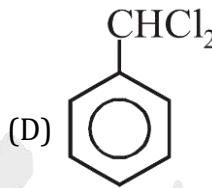
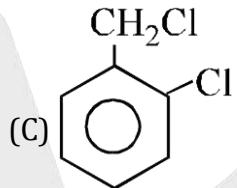
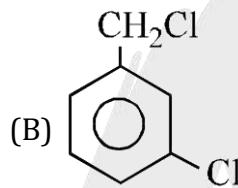
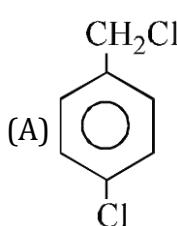
- (A) o-Xylene (B) p-Xylene (C) Both (D) m-Xylene

- Q.38** For preparing monoalkyl benzene, acylation process is preferred than direct alkylation because  
 (A) In alkylation, a poisonous gas is evolved  
 (B) In alkylation, large amount of heat is evolved  
 (C) In alkylation, polyalkylated product is formed  
 (D) Alkylation is very costly

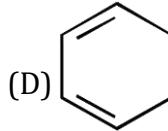
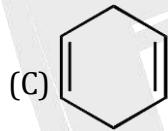
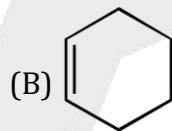
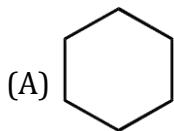
- Q.39** Phenol and ethanol are distinguished by the reaction with

(A) Red litmus      (B)  $\text{NaHCO}_3$       (C)  $\text{FeCl}_3$       (D) Na

- Q.40** An aromatic compound ' $\text{A}'$ '  $\text{C}_7\text{H}_6\text{Cl}_2$ , gives  $\text{AgCl}$  on bonding with alcoholic  $\text{AgNO}_3$  solution, and yields  $\text{C}_7\text{H}_7\text{OCl}$  on treatment with sodium hydroxide. ' $\text{A}'$  on oxidation gives a mono chlorobenzoic acid which affords only one mononitro derivative. The compound A is:



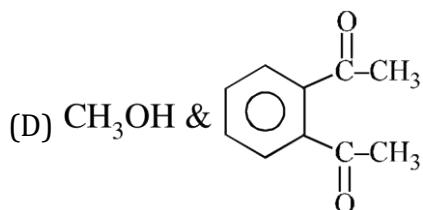
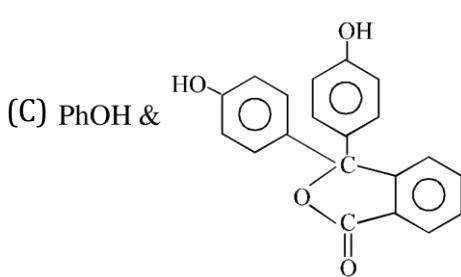
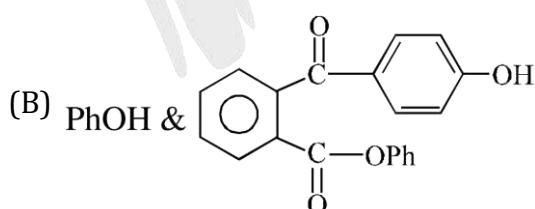
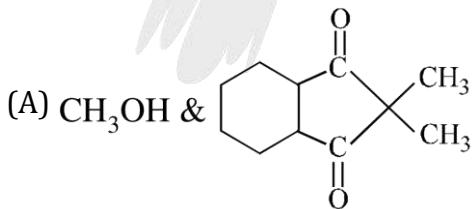
- Q.41** +  $\text{H}_2 \xrightarrow[\text{High pressure}]{\text{Ni, high temp.}}$  (A). Which of the following can be isolated as the product of this



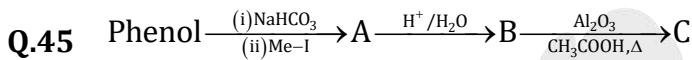
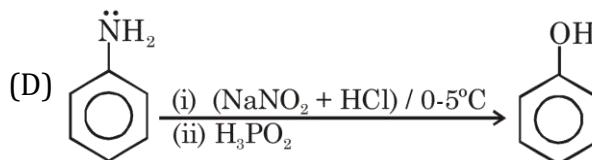
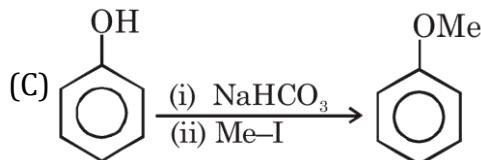
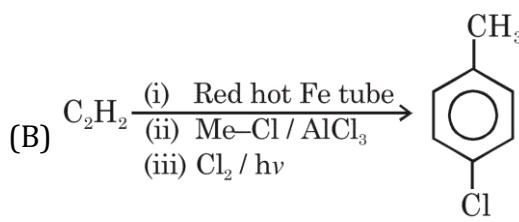
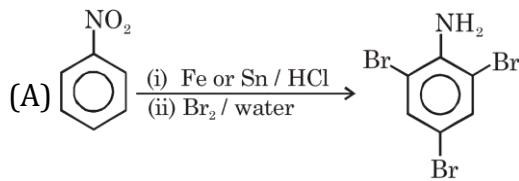
- Q.42** Chloral +
- $$\xrightarrow{\text{Conc. H}_2\text{SO}_4}$$
- product. The product is:



- Q.43** Acetophenone  $\xrightarrow{\text{HCO}_3\text{H}}$  A  $\xrightarrow{\text{H}_3\text{O}^+}$  B + C  $\xrightarrow[\text{H}^+]{\text{Phthalic Anhydride}}$  Indicator (D); C & D are

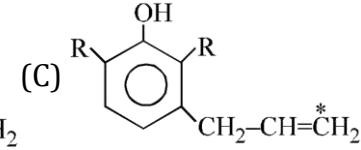
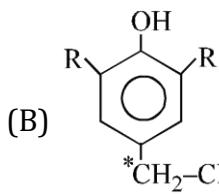
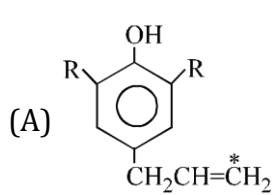
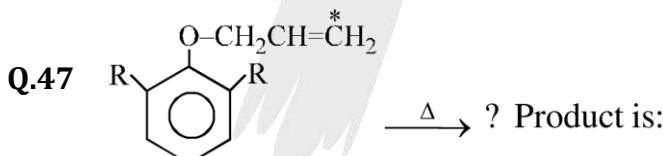
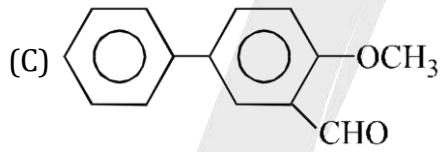
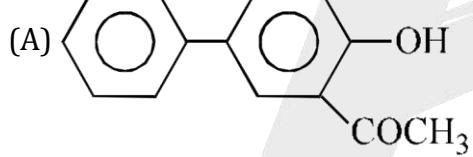
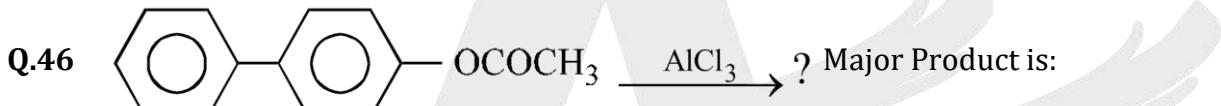


**Q.44** Select the reaction giving correct major product:



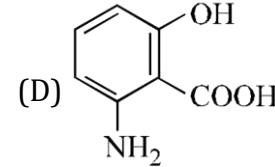
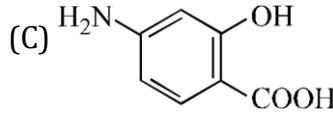
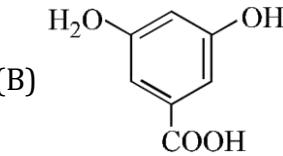
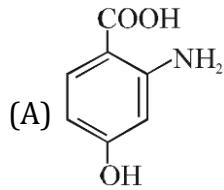
In this reaction, the end product C is:

- (A) Salicylaldehyde (B) Salicylic acid (C) Phenyl acetate (D) Aspirin



- (D) No reaction

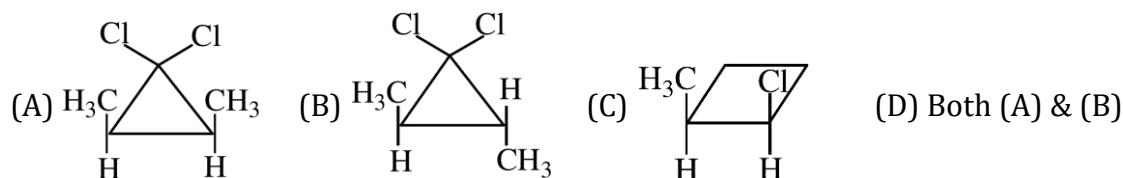
**Q.48** m-Aminophenol on treatment with NaOH and CO<sub>2</sub> gives which of the following as major product?

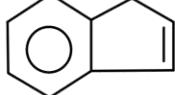


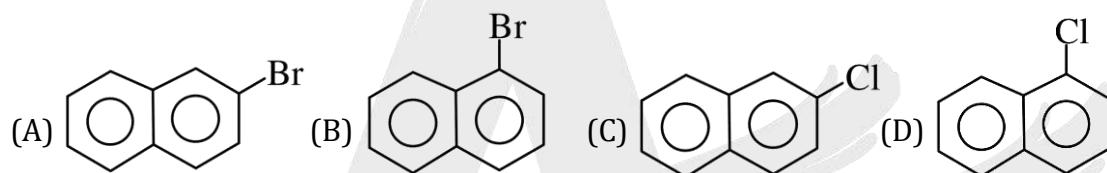
**Q.49** Stability order of following singlet halocarbene is

- (A)  $\text{CF}_2 > \text{CCl}_2 > \text{CBr}_2 > \text{Cl}_2$       (B)  $\text{Cl}_2 > \text{CBr}_2 > \text{CCl}_2 > \text{CF}_2$   
 (C)  $\text{CCl}_2 > \text{CF}_2 > \text{CBr}_2 > \text{Cl}_2$       (D)  $\text{CF}_2 > \text{Cl}_2 > \text{CCl}_2 > \text{CBr}_2$

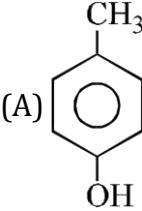
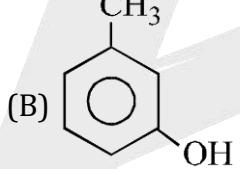
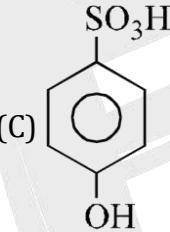
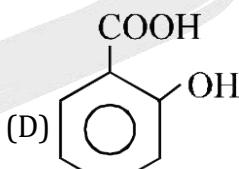
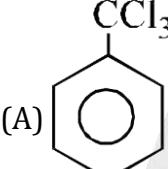
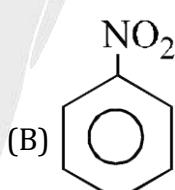
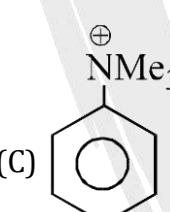
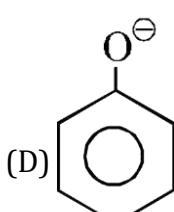
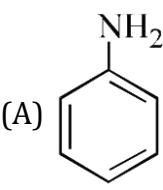
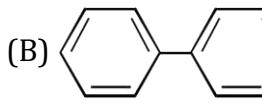
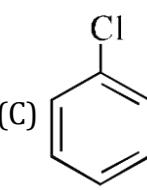
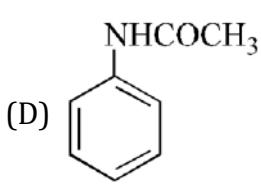
**Q.50** Trans-Butene- 2  $\xrightarrow[\text{Solvent}]{\text{CHCl}_3/\text{KOH}}$  Product



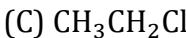
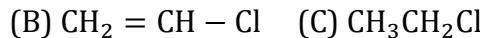
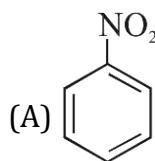
**Q.51**   $\xrightarrow[\text{KOH}]{\text{CHCl}_3\text{Br}}$  Product ; Product is :



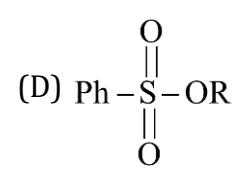
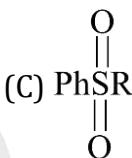
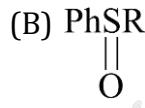
## EXERCISE # II

- Q.1** In which of the following reaction t-butylbenzene is formed:
- (A) Benzene + iso-butyl chloride,  $\text{AlCl}_3$       (B) Benzene +  $(\text{CH}_3)_2\text{C} = \text{CH}_2 \xrightarrow{\text{BF}_3 \cdot \text{HF}}$   
 (C) Benzene + t-butyl alcohol  $\xrightarrow[2]{\text{H}_2\text{SO}_4}$       (D) Benzene +  $(\text{CH}_3)_2\text{C} = \text{CH}_2 \xrightarrow{\text{AlCl}_3}$
- Q.2** The replacement of a hydrogen atom in benzene by alkyl group can be brought about with the following reagents :
- (A) Alkyl chloride and  $\text{AlCl}_3$       (B) Alkene and  $\text{AlCl}_3$   
 (C) Alkanol and alkali      (D) Alkanol and acid
- Q.3** Benzene reacts with n-propyl chloride in the presence of anhydrous  $\text{AlCl}_3$  to give predominantly:
- (A) n-Propylbenzene      (B) Isopropylbenzene  
 (C) 3-Propyl-1-chlorobenzene      (D) Cumene
- Q.4** The structure of the compound that gives a tribromo derivative on treatment with bromine water is:
- (A)  (B)  (C)  (D) 
- Q.5** Electrophilic attack of  $\text{NO}_2^+$  at meta position is observed in:
- (A)  (B)  (C)  (D) 
- Q.6** Which of the following will undergo nitration faster than benzene?
- (A)  (B)  (C)  (D) 
- Q.7** The good method for converting benzene into n-propyl benzene is:
- (A)  $\text{C}_6\text{H}_6 + \text{CH}_3\text{CH}_2\text{CH}_2\text{Cl} + \text{Anhyd. AlCl}_3$   
 (B)  $\text{C}_6\text{H}_6 + \text{CH}_3\text{CH}_2\text{COCl} + \text{Anhyd. AlCl}_3$  and then treatment with  $\text{Zn/Hg}/\text{HCl}$   
 (C)  $\text{C}_6\text{H}_6 + \text{CH}_3\text{CH}_2\text{COCl} + \text{Anhyd. AlCl}_3$  and then treatment with  $\text{H}_2/\text{Ni}$   
 (D)  $\text{C}_6\text{H}_6 + \text{Anhyd. AlCl}_3 + \text{cyclopropane}$

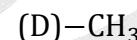
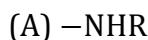
**Q.8** Which of the following can be used as reagent in Friedel Crafts reaction?



**Q.9** Of the species  $\text{PhSR}$ ,  $\text{PhS}(\text{O})\text{R}$ ,  $\text{PhS}(\text{O})_2\text{R}$  and  $\text{Ph}-\text{S}(\text{O})-\text{R}$  the meta-substituted product is obtained from



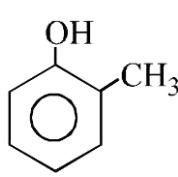
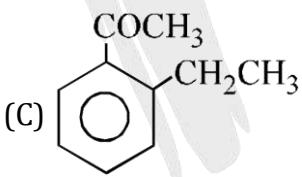
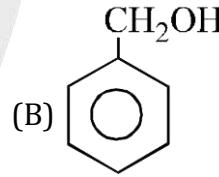
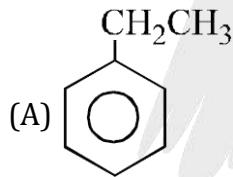
**Q.10** Amongst the following, the moderately activating group is



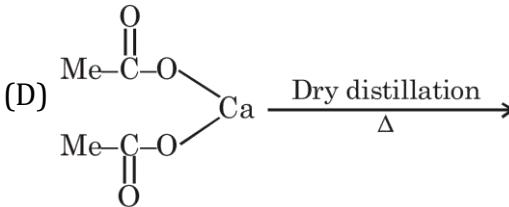
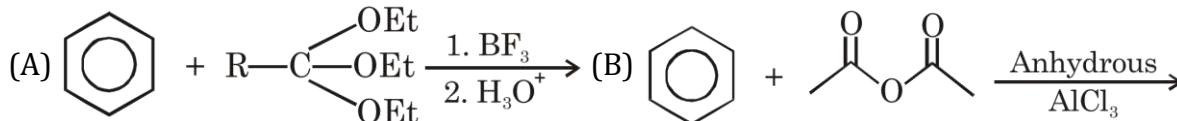
**Q.11** False statement is / are :

- (A) Although benzene contains three double bonds, normally it does not undergo addition reaction.
- (B) m-Chlorobromobenzene is an isomer of m-bromochlorobenzene.
- (C) In benzene, carbon uses all the three p orbitals for hybridization.
- (D) An electron donating substituent in benzene orients the incoming electrophilic group to the meta position.

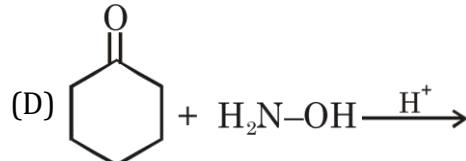
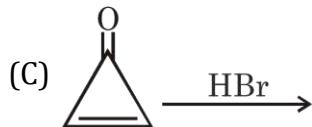
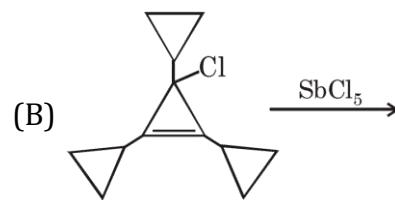
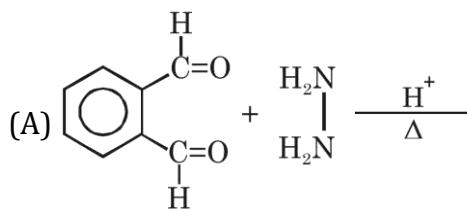
**Q.12** Benzoic acid may be prepared by the oxidation of:



**Q.13** Identify reactions give ketone product?



**Q.14** Which of the following reaction(s) will give aromatic product?



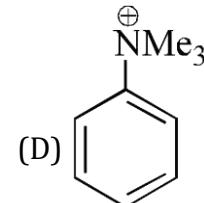
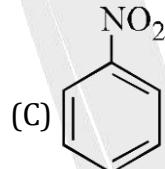
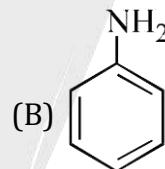
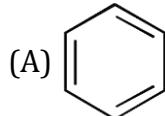
**Q.15** Which of the following statements is/are not true?

- (A) All ortho-para directing groups activates the ring towards electrophilic substitution.
- (B) Halobenzene is ortho para directing but deactivating in nature
- (C) All meta-directing groups have  $\pi$ -bond on the atom directly attached to the ring
- (D) All meta directing groups are deactivating.

**Q.16** Which of the following is not an ortho-para directing group?

- (A)  $CF_3$
- (B)  $CCl_3$
- (C)  $-CH = CH - COOH$
- (D)  $-N \equiv C$

**Q.17** Which of the following does not gives Friedel-Crafts reaction?



**Q.18** Which of the following reactions of benzene proves the presence of three carbon-carbon double bonds in it :

- (A) Formation of a triozonide
- (B) Hydrogenation of benzene to cyclohexane
- (C) Formation of  $C_6H_6Cl_6$  by addition of chlorine
- (D) Formation of nitrobenzene on heating benzene with a mixture of concentrated nitric acid and sulphuric acid

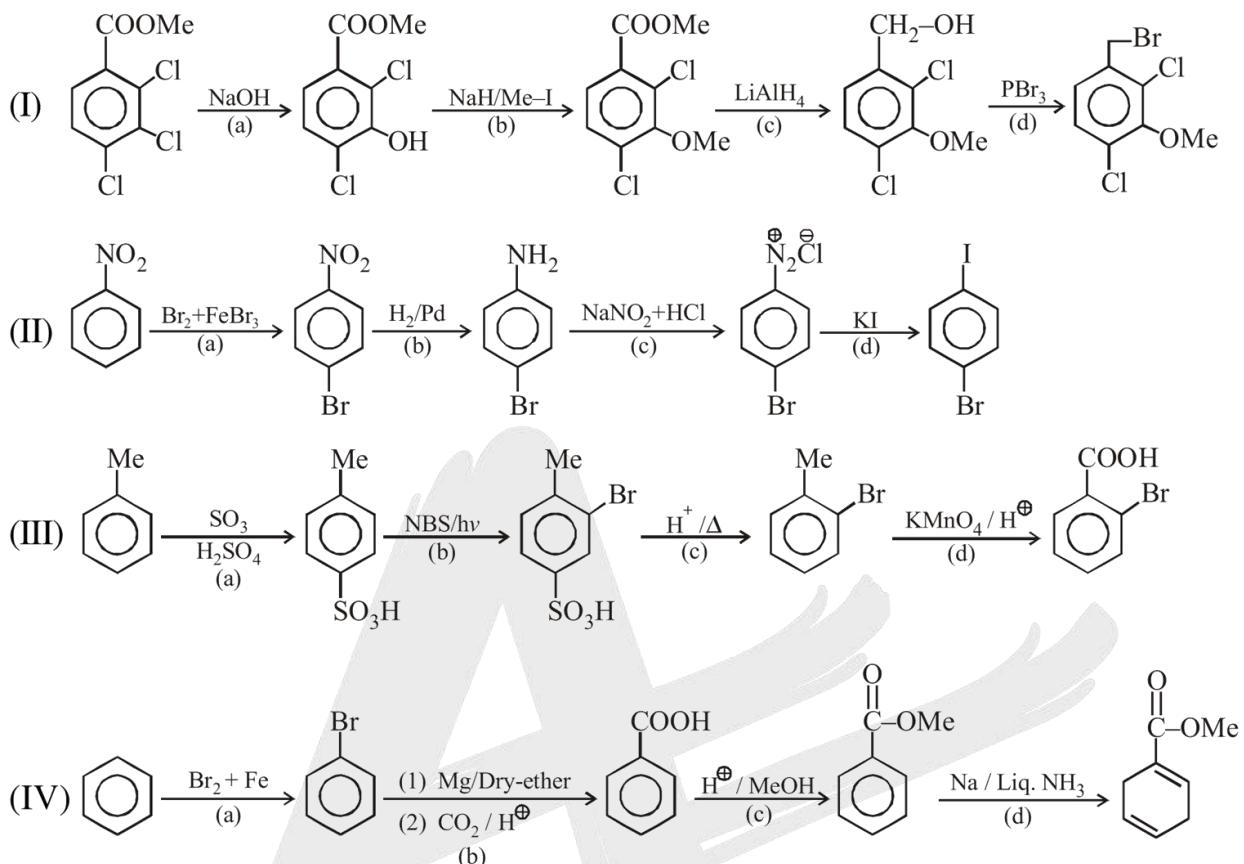
**Q.19** Which of the following are classified as aromatic ?

- (A) 1,2,3-Triphenylcyclopropenium cation
- (B) Cyclooctatetraenyl dianion
- (C) Azulene
- (D) Annulene [10]

**Q.20** Which of the following is/are name of 1,2,3,4,5,6 - hexachloro cyclohexane :

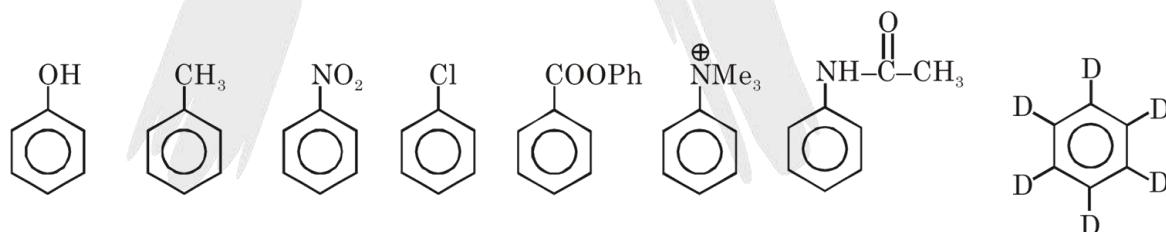
- (A) Lindane
- (B) Gammexane
- (C) 666
- (D) BHC

**Q.21** Among the following reaction sequences identify incorrect step :



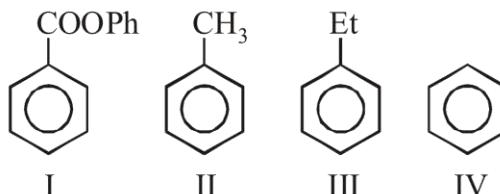



**Q.22** How many of following compounds are less reactive than benzene for sulphonation by conc.  $\text{H}_2\text{SO}_4$  :



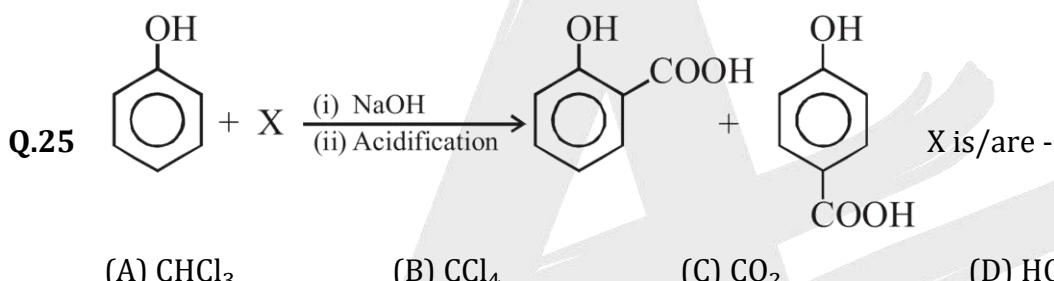
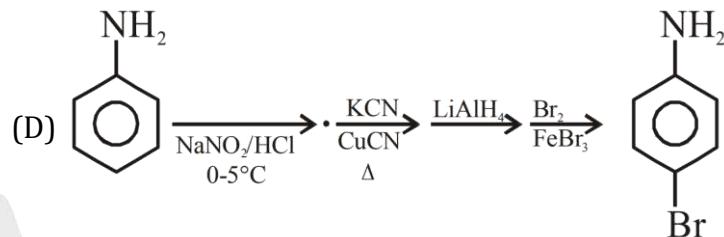
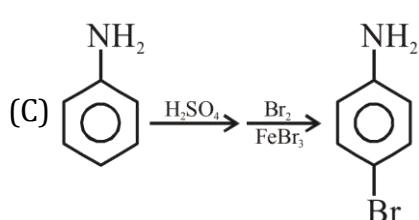
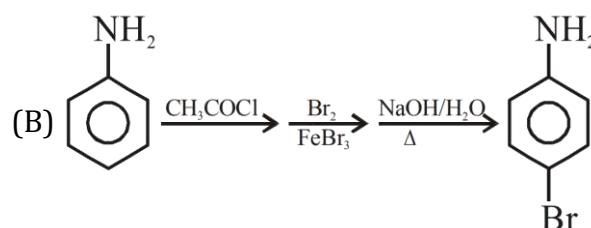
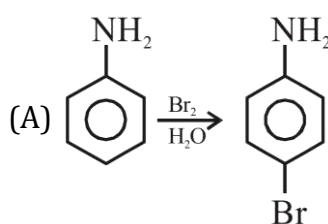



**Q.23** Decide the correct order of reactivity of following compounds towards halogenation with  $(Cl_2 + AlCl_3)$ .

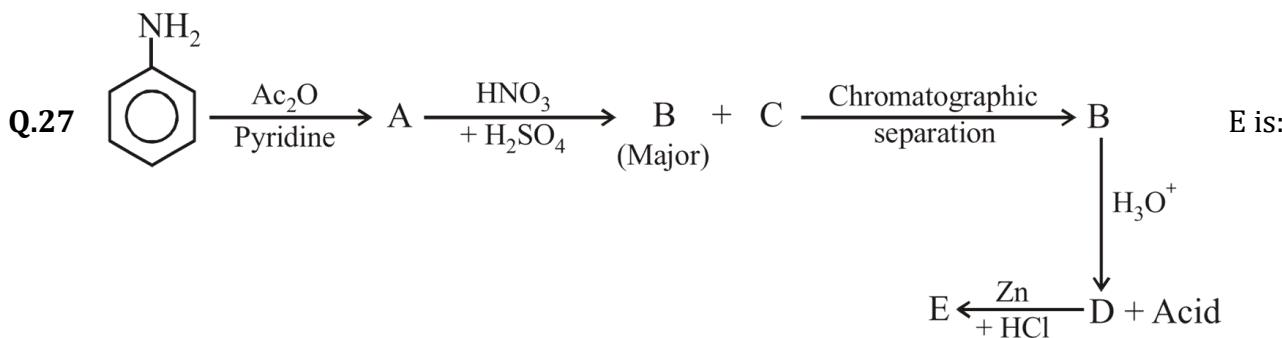
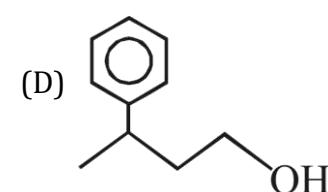
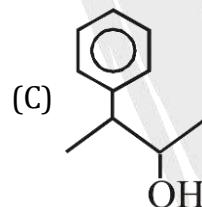
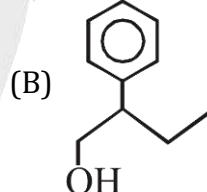
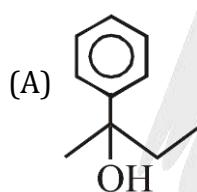
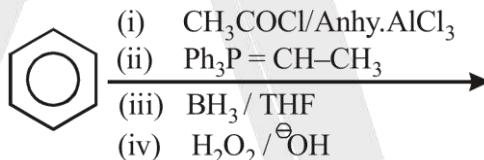


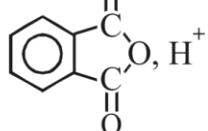
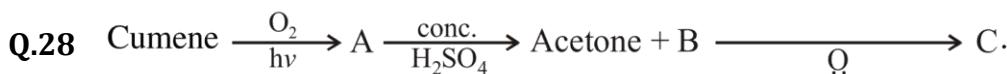
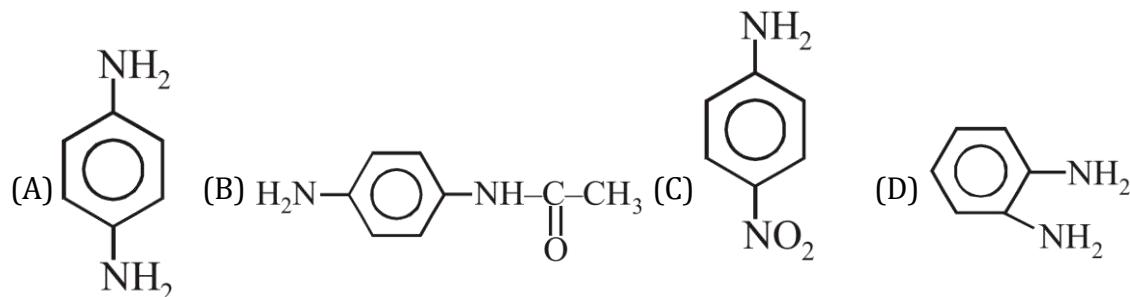
- (A) I > II > III > IV   (B) II > III > IV > I   (C) III > II > IV > I   (D) II > III > I > IV

**Q.24** Which of the following method(s) is/are not used to prepare p-bromo aniline as major product :



**Q.26** Which product is/are not obtained in following reaction.



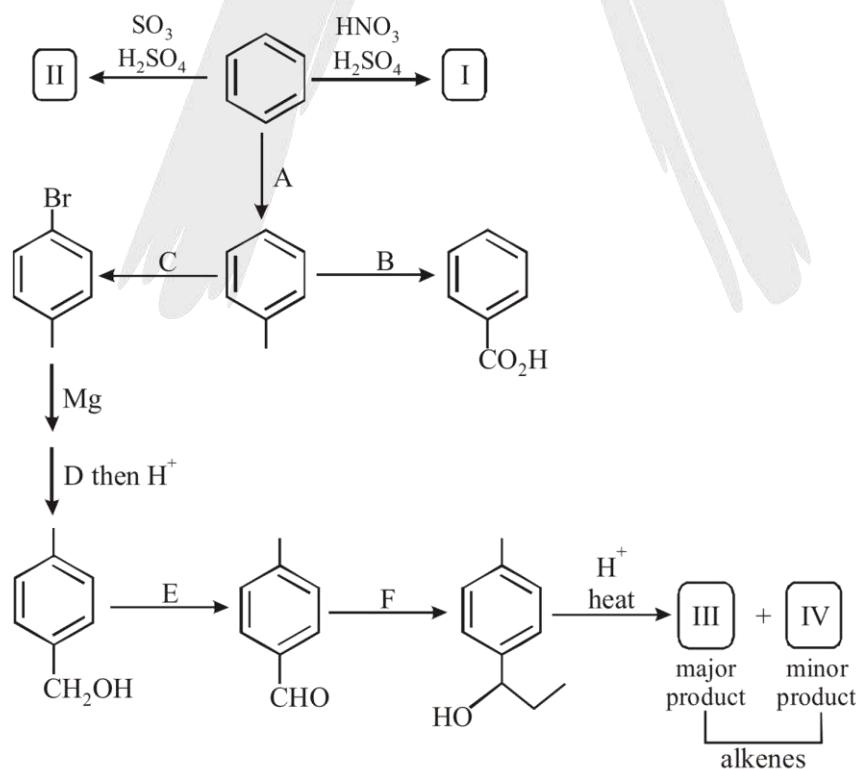


Identify correct statement:

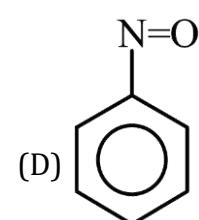
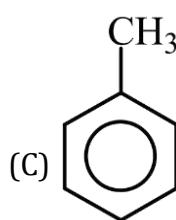
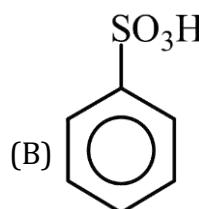
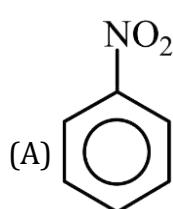
- (A) Product C is phenolphthalein indicator
- (B) Product B gives  $\text{CO}_2$  effervescence with  $\text{NaHCO}_3$
- (C) Product A formation involves carbocation intermediate
- (D) Product B gives no colour with neutral  $\text{FeCl}_3$

#### Paragraph for Q.29 to Q.30

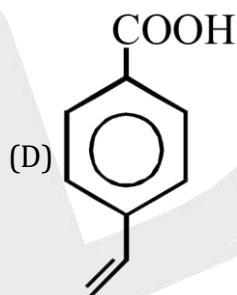
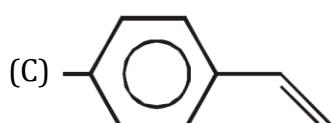
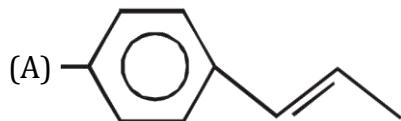
Identify reagent used and intermediate products in following conversion.



**Q.29** Identify II product -



**Q.30** (III) major product is?



**Q.31** Match the following:

**Column-I (Properties)**

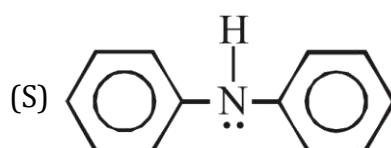
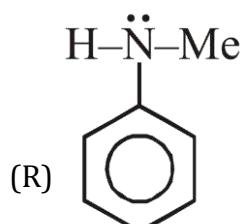
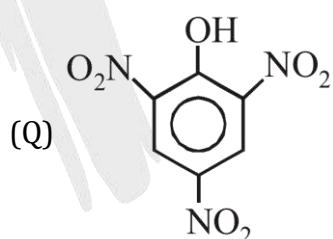
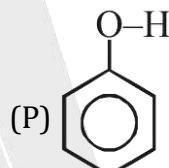
(A)  $\text{CO}_2 \uparrow$  is evolved from  $\text{NaHCO}_3$

(B) Gives libermann nitroso test

(C) Gives yellow oily liquid with  $\text{NaNO}_2 + \text{HCl}$

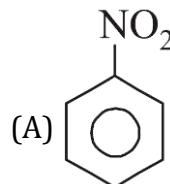
(D) Evolve a colourless gas with active metals

**Column-II (Compound)**



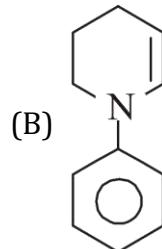
**Q.32** Match the following:

**Column-I**  
**(Compound)**

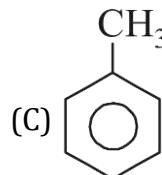


**Column-II**  
**(Properties)**

(P) Group attached with phenyl ring is +M.



(Q) Rate of electrophilic aromatic substitution is less than benzene ring

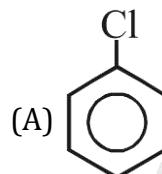


(R) Group attached with phenyl ring will show (+H) (Hyperconjugation)

(S) Group attached with phenyl ring will show (-H) effect (Hyperconjugation)

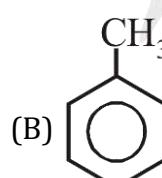
**Q.33** Match the following:

**Column-I (Compound)**

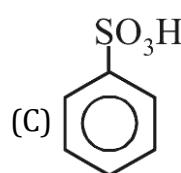


**Column-II (Properties)**

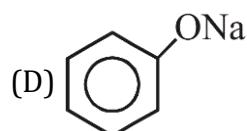
(P) o-p directing



(Q) m-directing



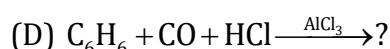
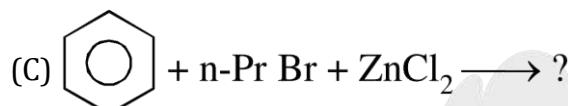
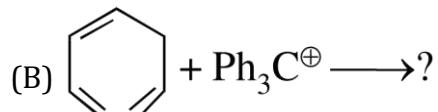
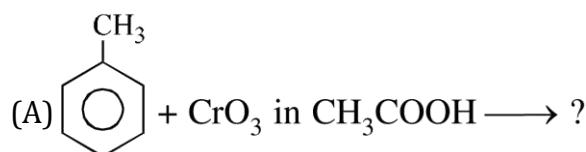
(R) Activating towards electrophile



(S) Deactivating towards electrophile

**Q.34** Match the following:

**Column-I (Reaction)**



**Column-II (Product & its property)**

(P) Tropylium ion

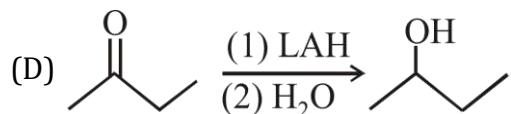
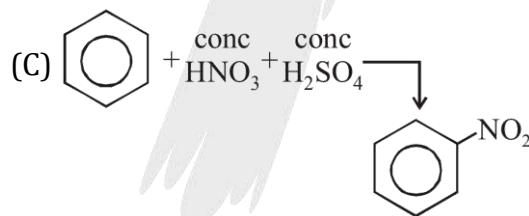
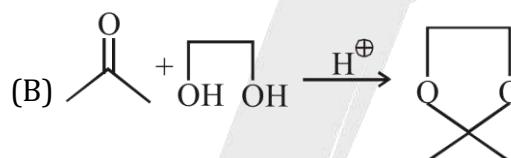
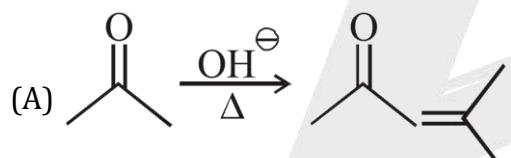
(Q) Benzaldehyde

(R) Product can oxidise by KMnO<sub>4</sub>/H<sup>+</sup>

(S) Aromatic product obtained

**Q.35** Match the following:

**Column-I (Reactions)**



**Column-II (Intermediate formed or type of reaction)**

(P) Product obtained as racemic mixture

(Q) Substitution reaction

(R) Nu<sup>−</sup> Addition takes place during reaction

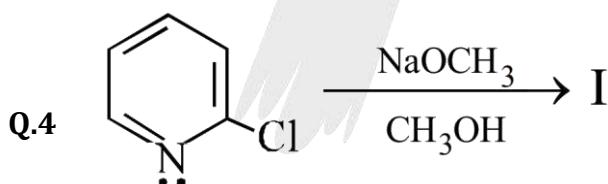
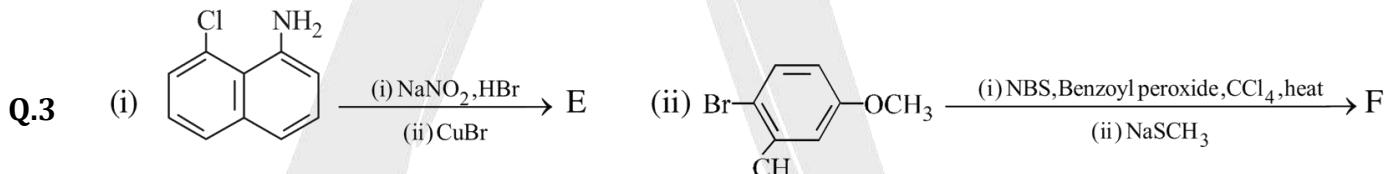
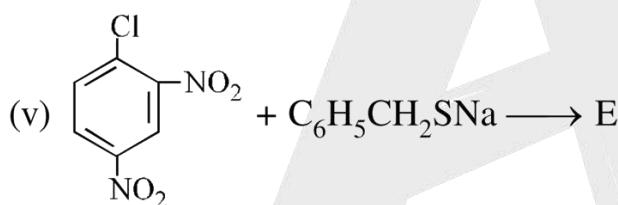
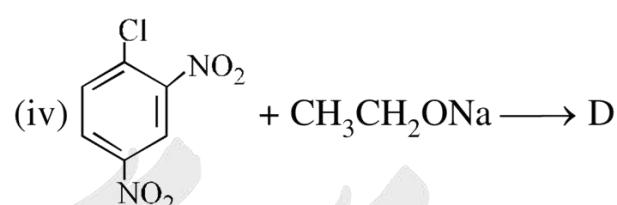
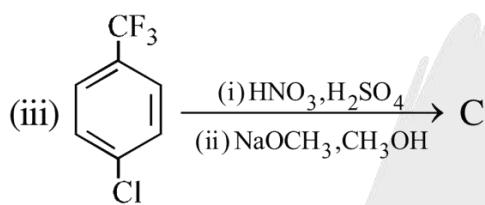
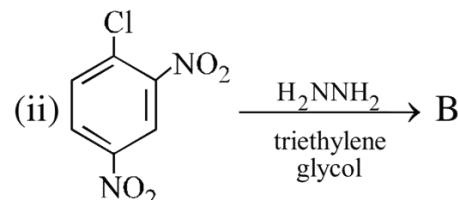
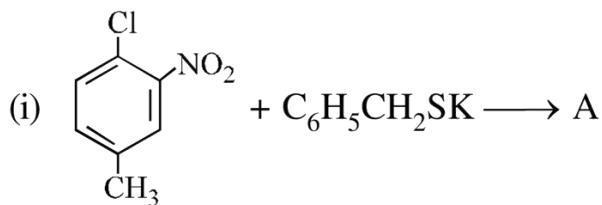
(S) Carbocation intermediate

(T) Carbanion intermediate

## EXERCISE #III

**Q.1** Write the most stable resonating structure for the cyclohexadienyl anion formed by reaction of methoxide ion with o-fluoronitrobenzene.

**Q.2** Write the principal organic product in each of the following reactions:

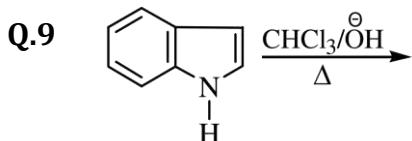
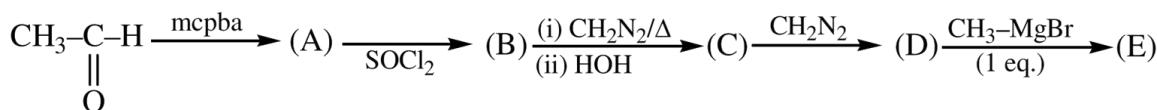


**Q.5** Reaction of 1,2,3-tribromo-5-nitrobenzene with sodium ethoxide in ethanol gave a single product, C<sub>8</sub>H<sub>7</sub>Br<sub>2</sub>NO<sub>3</sub>, in quantitative yield. Suggest a reasonable structure for this compound.

**Q.6** Offer an explanation for the observation that 4-chloropyridine is more reactive toward nucleophiles than 3-chloropyridine.

**Q.7** The dichlorocarbene reacts with phenol in base where as it doesn't react with benzene explain.

**Q.8** Find out the products in given reaction sequence:

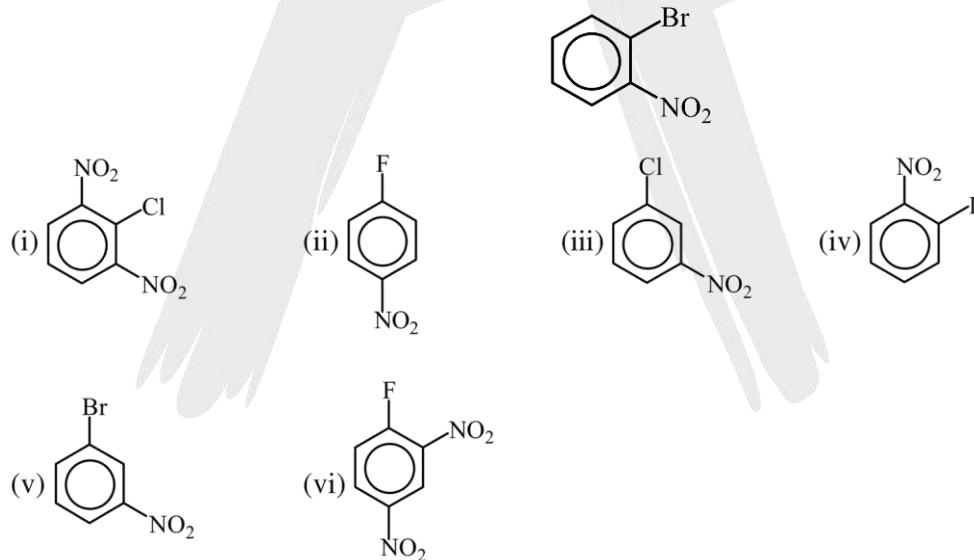


**Q.10** Compare the given characteristics of aniline and cyclohexanamine :

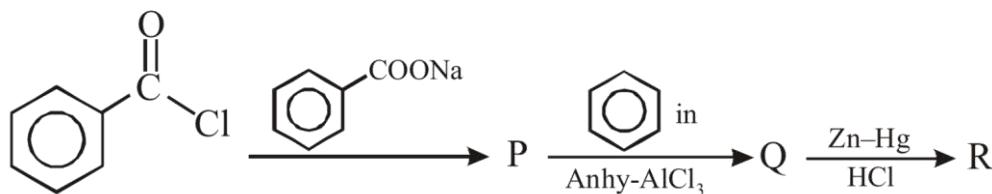
- (i) Both are primary amine
- (ii) Both can be acylated by  $\text{RCOCl}$
- (iii) Both reacts with  $\text{CHCl}_3/\text{KOH}$
- (iv) Both reacts with  $\text{NaNO}_2 + \text{HCl}$  at  $0 - 5^\circ\text{C}$
- (v) Both reacts with  $\text{PhSO}_2\text{Cl}$  to give a compound which is soluble in KOH
- (vi) Both gives coupling reaction with phenol
- (vii) Both gives electrophilic substitution reaction

How many of the given characteristics are correct?

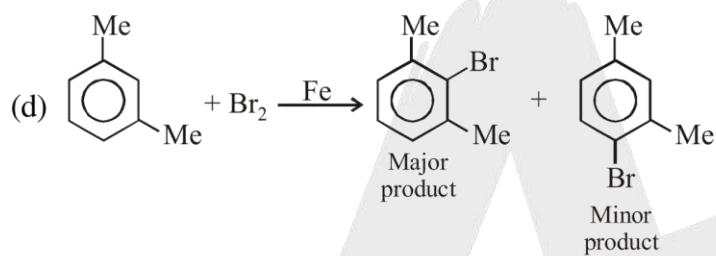
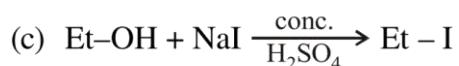
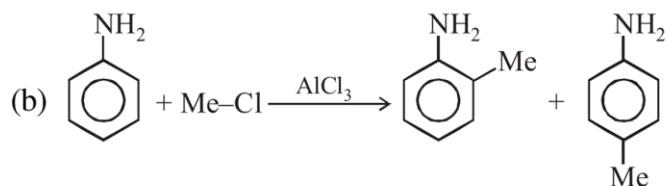
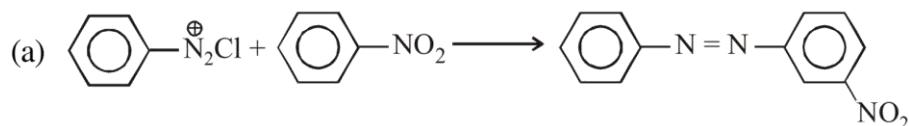
**Q.11** Number of compounds which can show faster rate of nucleophilic substitution of halogen than



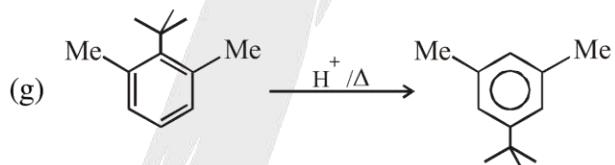
**Q.12** Number of possible monochlorinated isomer of R.



**Q.13** Identify total number of reactions incorrectly match with its product?

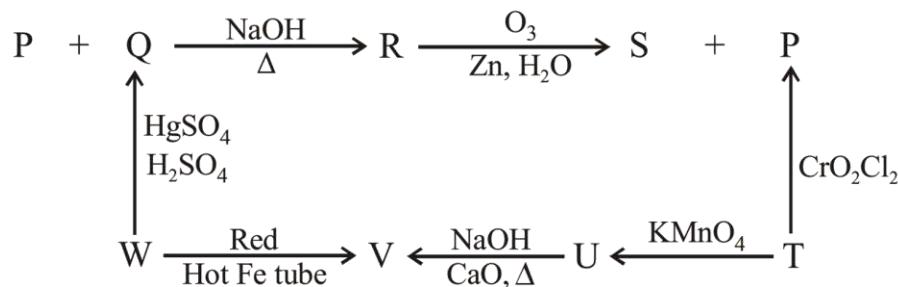


100 % product [Stereo specific reactions] /



### **Paragraph for Q. No. 14 to 15**

For given reaction sequence molecular formula for compound ' U ' is  $C_7H_6O_2$  & P gives negative Fehling test.



**Q.14** Compound which is not a hydrocarbon



**Q.15** Compound S is:

- (A)  $\text{CH}_3 - \text{CH} = \text{O}$     (B)  $\text{Ph} - \text{CH} = \text{O}$     (C)  $\begin{array}{c} \text{CH} & \text{O} \\ | & \\ \text{CH} = \text{O} & \end{array}$     (D)  $\begin{array}{c} \text{CH} & \text{CH}_2 & \text{CH} \\ || & & || \\ \text{O} & & \text{O} \end{array}$

## EXERCISE # IV (MAIN)

**Q.1** Reaction -

[AIEEE-2002]

Primary amine +  $\text{CHCl}_3$  + KOH  $\rightarrow$  product, here product will be -

- (A) Cyanide      (B) Isocyanide      (C) Amine      (D) Alcohol

**Q.2** The compound formed in the positive test for nitrogen with the Lassaigne solution of an organic compound is -

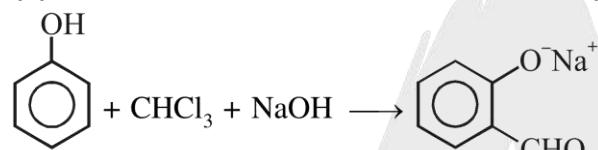
[AIEEE-2004]

- (A)  $\text{Fe}_4[\text{Fe}(\text{CN})_6]_3$     (B)  $\text{Na}_3[\text{Fe}(\text{CN})_6]$     (C)  $\text{Fe}(\text{CN})_3$     (D)  $\text{Na}_4[\text{Fe}(\text{CN})_5]\text{NO}_3$

**Q.3** Which one of the following methods is neither meant for the synthesis nor for separation of amines

[AIEEE-2005]

- (A) Hofmann method      (B) Hinsberg method  
(C) Curtius reaction      (D) Wurtz reaction

**Q.4**

The electrophile involved in the above reaction is

[AIEEE-2006]

- (A) dichlorocarbene ( $\text{CHCl}_2^\ominus$ )      (B) trichloromethyl anion ( $\text{CHCl}_2^\oplus$ )  
(C) formyl cation ( $: \text{CHCl}_2^\oplus$ )      (D) dichloromethyl cation ( $\text{CHO}^\oplus$ )

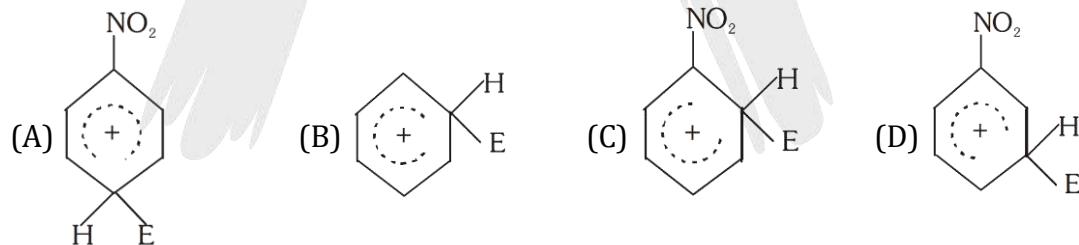
**Q.5** In the chemical reaction,  $\text{CH}_3\text{CH}_2\text{NH}_2 + \text{CHCl}_3 + 3\text{KOH} \rightarrow (\text{A}) + (\text{B}) + 3\text{H}_2\text{O}$ , the compounds (A) and (B) are respectively -

[AIEEE-2007]

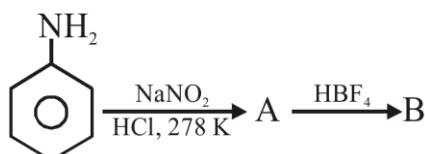
- (A)  $\text{C}_2\text{H}_5\text{CN}$  and  $3\text{KCl}$       (B)  $\text{CH}_3\text{CH}_2\text{CONH}_2$  and  $3\text{KCl}$   
(C)  $\text{C}_2\text{H}_5\text{NC}$  and  $\text{K}_2\text{CO}_3$       (D)  $\text{C}_2\text{H}_5\text{NC}$  and  $3\text{KCl}$

**Q.6** The electrophile,  $\text{E}^\oplus$  attacks the benzene ring to generate the intermediate  $\sigma$ -complex. Of the following, which  $\sigma$ -complex is of lowest energy?

[AIEEE-2008]

**Q.7** In the chemical reactions,

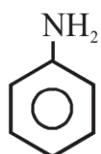
[AIEEE-2010]



the compounds 'A' and 'B' respectively are :-

- (A) Nitrobenzene and chlorobenzene      (B) Nitrobenzene and fluorobenzene  
(C) Phenol and benzene      (D) Benzene diazonium chloride and fluorobenzene

### **Q.8** In the chemical reactions



$$\xrightarrow[\text{HCl, 278K}]{\text{NaNO}_2} \text{A}$$

$$\xrightarrow[\Delta]{\text{CuCN}} \text{B},$$

The compounds A and B respectively are:

[AIEEE-2011]

- (A) Fluorobenzene and phenol      (B) Benzene diazonium chloride and benzonitrile  
(C) Nitrobenzene and chlorobenzene      (D) Phenol and bromobenzene

**Q.9** An organic compound A upon reacting with  $\text{NH}_3$  gives B. On heating, B gives C. C in presence of KOH reacts with  $\text{Br}_2$  to give  $\text{CH}_3\text{CH}_2\text{NH}_2$ . A is:- [JEE(Main)-2013]

- (A)  $\text{CH}_3\text{COOH}$       (B)  $\text{CH}_3\text{CH}_2\text{CH}_2\text{COOH}$   
 (C)  $\begin{array}{c} \text{CH}_3-\text{CH}-\text{COOH} \\ | \\ \text{CH}_3 \end{array}$       (D)  $\text{CH}_3\text{CH}_2\text{COOH}$

**Q.10** The gas leaked from a storage tank of the Union Carbide plant in Bhopal gas tragedy was:

[JEE(Main)-2013]

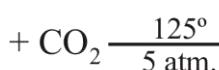
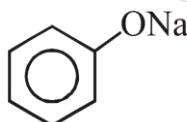


**Q.11** On heating an aliphatic primary amine with chloroform and ethanolic potassium hydroxide, the organic compound formed is :- [JEE(Main)-2014]



**Q.12** Sodium phenoxide when heated with  $\text{CO}_2$  under pressure at  $125^\circ\text{C}$  yields a product which on acetylation produces C. [JEE(Main)-2011]

[JEE(Main)-2014]



$$\rightarrow B \xrightarrow{H^+ / Ac_2O}$$

→ C the product E is:-

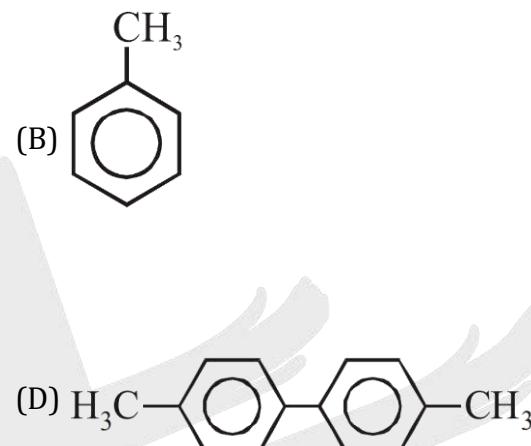
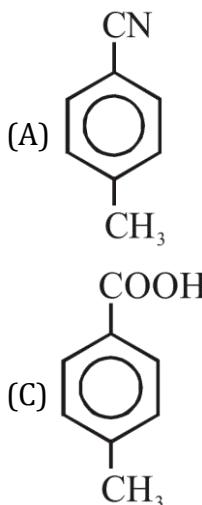
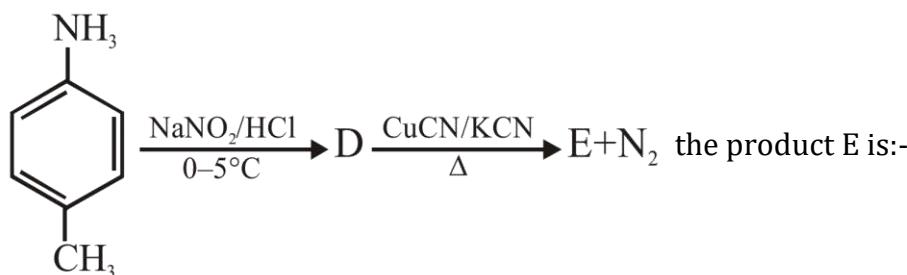
- (A)  (B) 

- $$\text{(C)} \begin{array}{c} \text{OCOCH}_3 \\ | \\ \text{C}_6\text{H}_4-\text{COOH} \end{array}$$

- (D) 

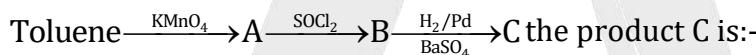
Q.13 In the reaction

[JEE(Main)-2015]



Q.14 In the following sequence of reactions:

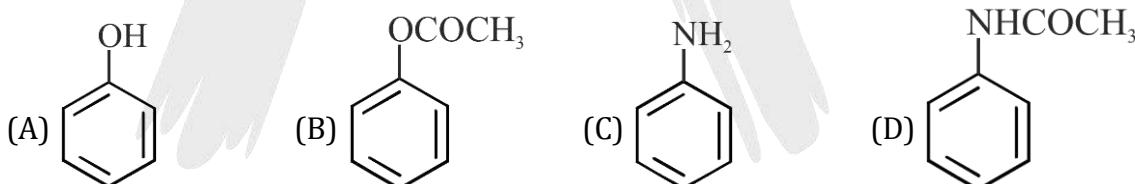
[JEE(Main)-2015]



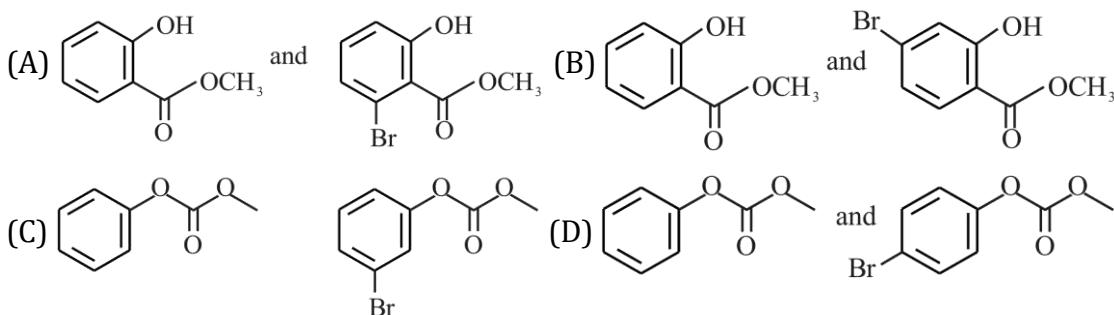
- (A) C<sub>6</sub>H<sub>5</sub>CH<sub>2</sub>OH      (B) C<sub>6</sub>H<sub>5</sub>CHO      (C) C<sub>6</sub>H<sub>5</sub>COOH      (D) C<sub>6</sub>H<sub>5</sub>CH<sub>3</sub>

Q.15 Which of the following compounds will significant amount of meta product during mono-nitration reaction?

[JEE(Main)-2017]

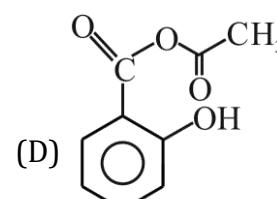
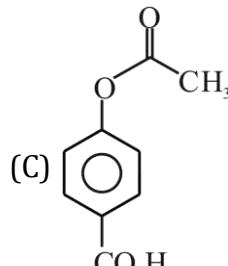
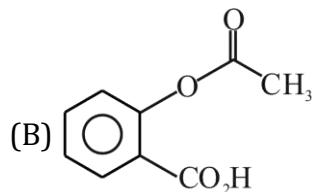
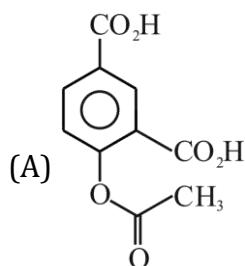
Q.16 Phenol react with methyl chloroformate in the presence of NaOH to form product A. A reacts with Br<sub>2</sub> to form product B. A and B are respectively.

IIT 2018



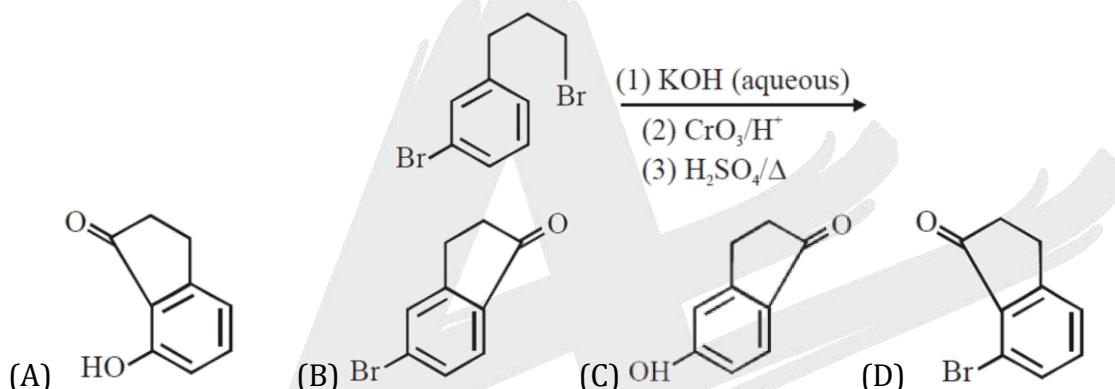
**Q.17** Phenol on treatment with  $\text{CO}_2$  in the presence of  $\text{NaOH}$  followed by acidification produces compound X as the major product. X on treatment with  $(\text{CH}_3\text{CO})_2\text{O}$  in the presence of catalytic amount of  $\text{H}_2\text{SO}_4$  produces **IIT 2018**

IIT 2018



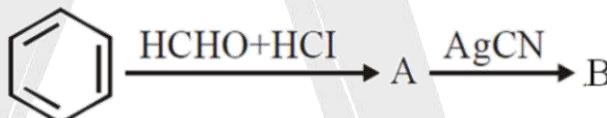
**Q.18** The major product of the following reaction is :

[JEE MAIN-2019]



**Q.19** The compounds A and B in the following reaction are, respectively:

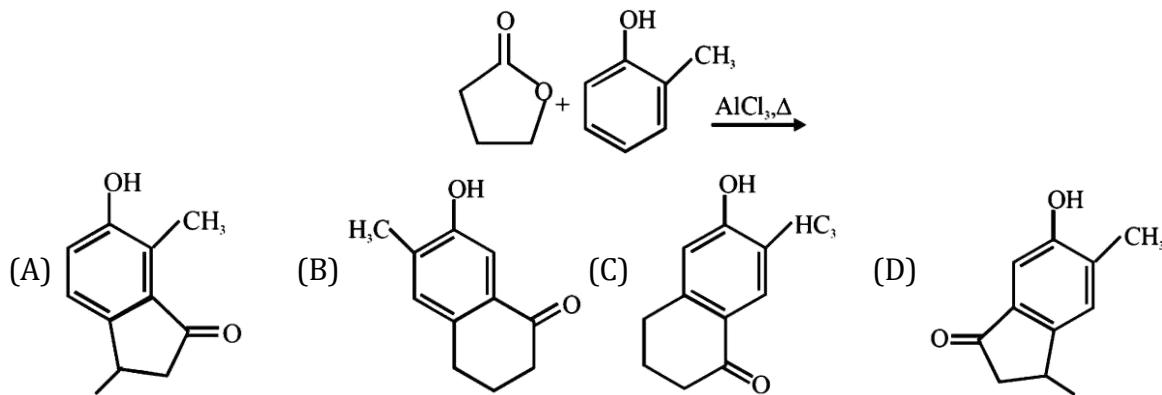
[JEE MAIN-2019]



- (A) A = Benzyl alcohol, B = Benzyl isocyanide
  - (B) A = Benzyl alcohol, B = Benzyl cyanide
  - (C) A = Benzyl chloride, B = Benzyl cyanide
  - (D) A = Benzyl chloride, B = Benzyl isocyanide

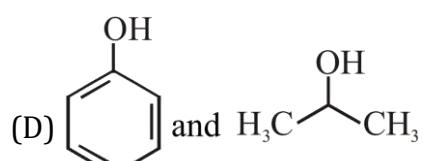
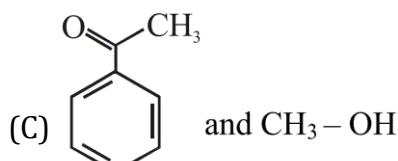
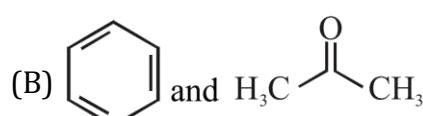
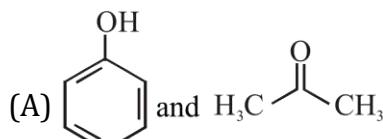
**Q.20** The major product of the following reaction is:

[JEE MAIN-2019]



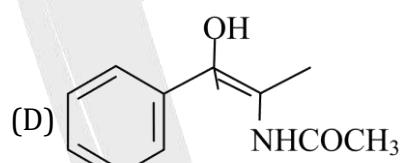
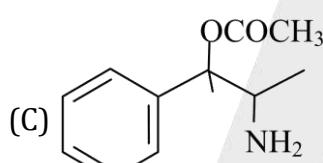
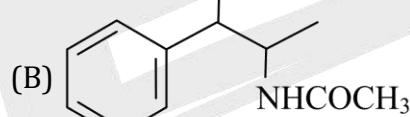
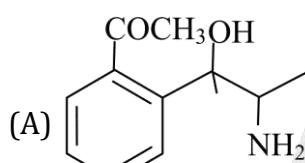
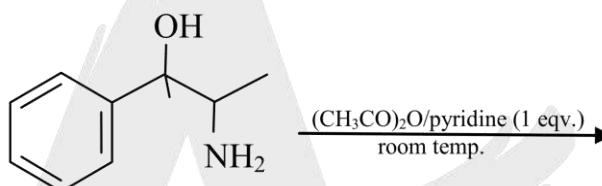
**Q.21** The products formed in the reaction of cumene with  $O_2$  followed by treatment with dil. HCl are:

[JEE MAIN-2019]



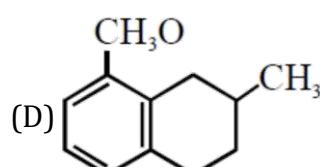
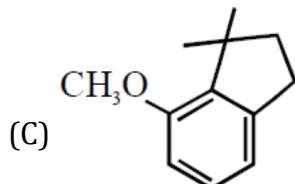
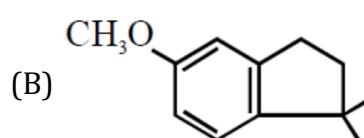
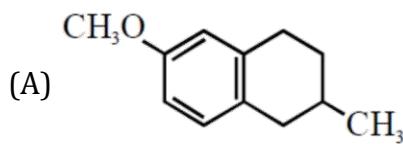
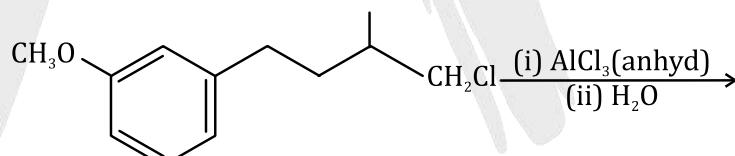
**Q.22** The major product obtained in the following reaction is:

[JEE MAIN-2019]



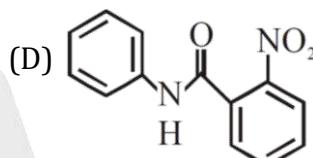
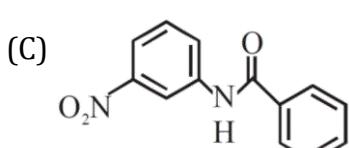
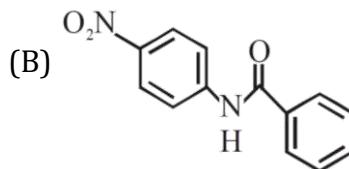
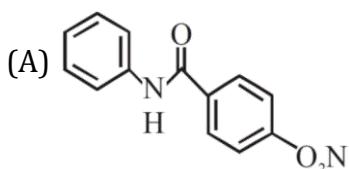
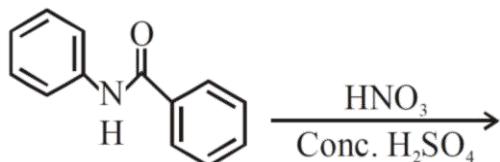
**Q.23** The major product of the following reaction is:

[JEE MAIN-2019]



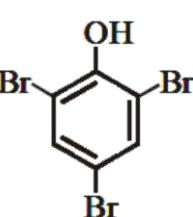
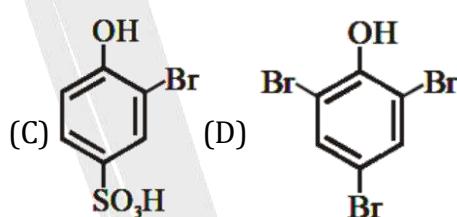
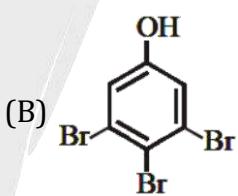
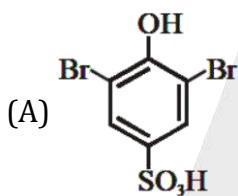
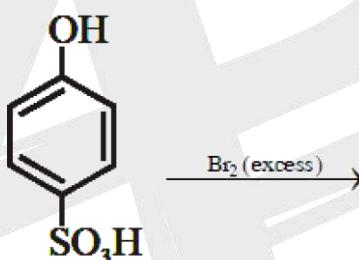
**Q.24** What will be the major product in the following mononitration reaction?

[JEE MAIN-2019]



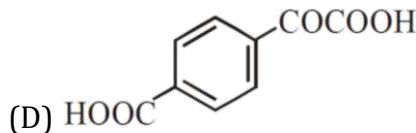
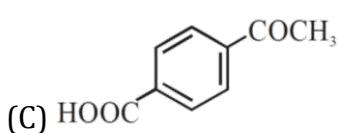
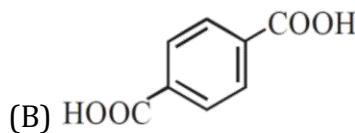
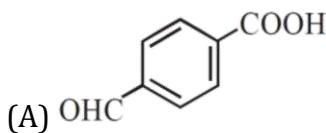
**Q.25** The major product of the following reaction is:

[JEE MAIN-2019]



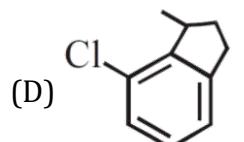
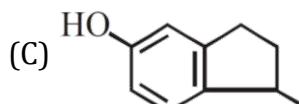
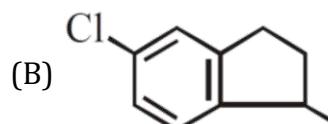
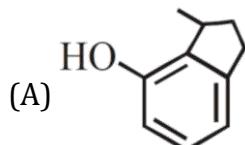
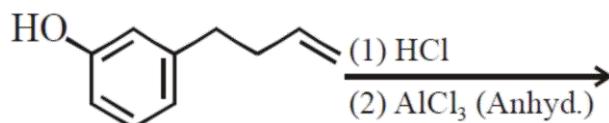
**Q.26** The major product of the following reaction is:

[JEE MAIN-2019]



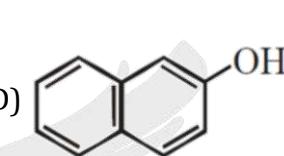
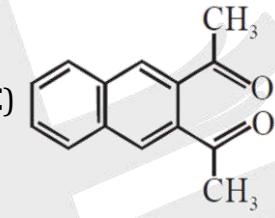
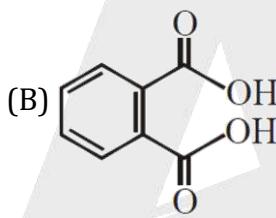
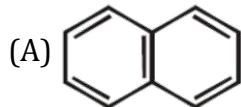
**Q.27** The major product of the following reaction is:

[JEE MAIN-2019]



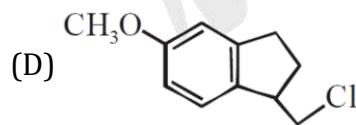
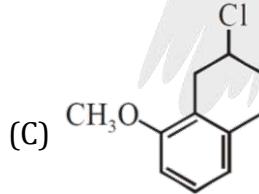
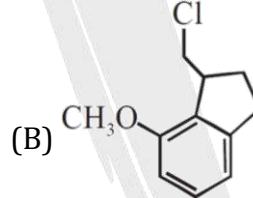
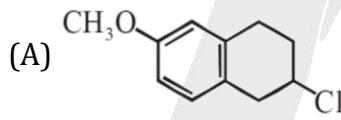
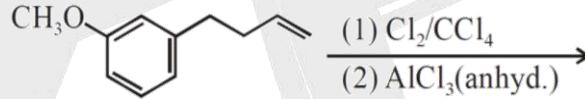
**Q.28** Among the following four aromatic compounds, which one will have the lowest melting point?

[JEE MAIN-2019]



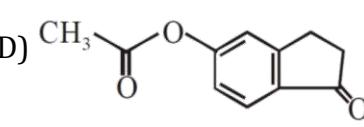
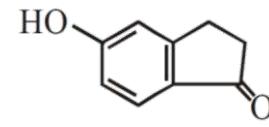
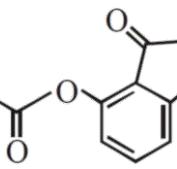
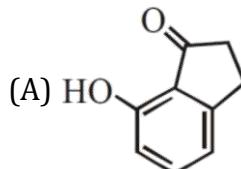
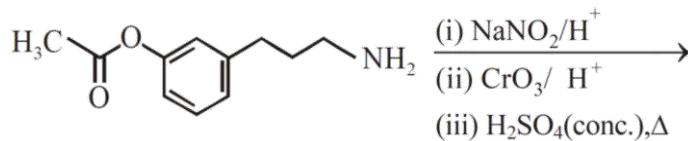
**Q.29** The major product of the following reaction is:

[JEE MAIN-2019]



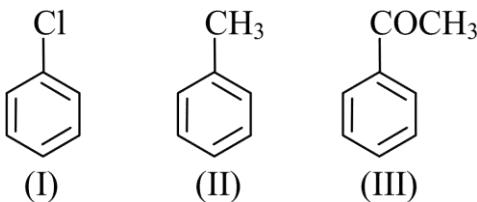
**Q.30** The major product of the following reaction is:

[JEE MAIN-2019]



31. The increasing order of the reactivity of the following compounds towards electrophilic aromatic substitution reactions is:

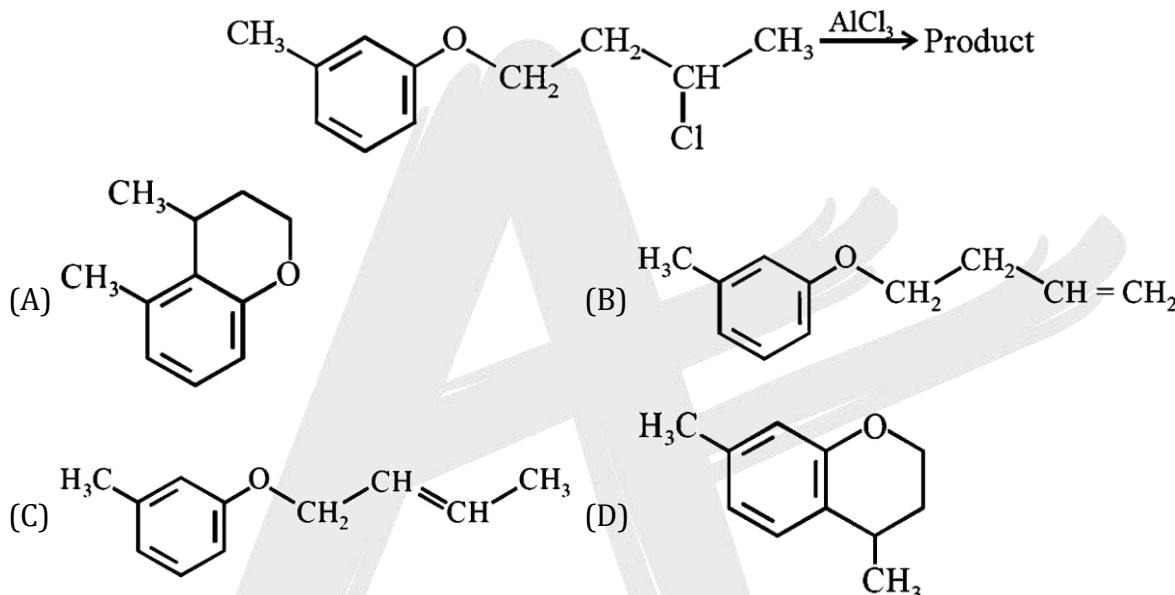
[JEE MAIN-2019]



- (A) III < II < I      (B) I < III < II      (C) II < I < III      (D) III < I < II

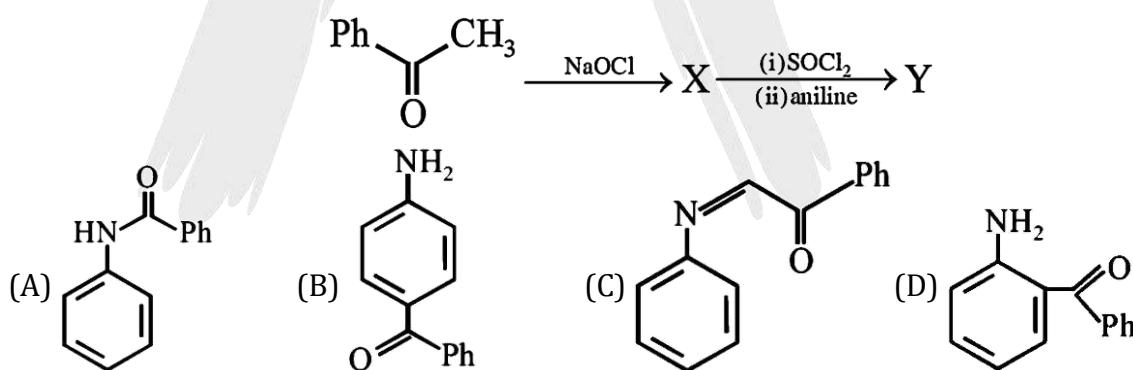
32. The major product obtained in the given reaction is:

[JEE MAIN-2019]



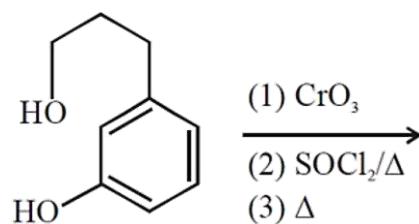
33. The major product 'Y' in the following reaction is:

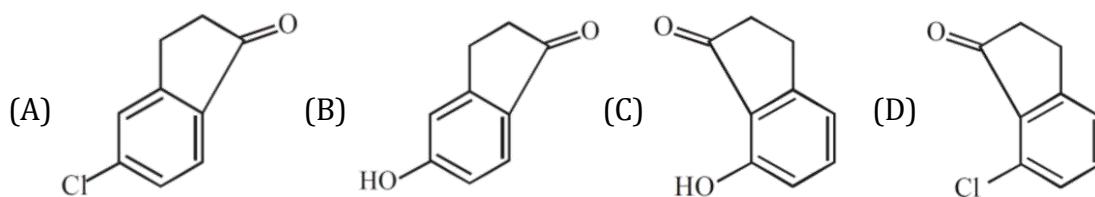
[JEE MAIN-2019]



34. The major product of the following reactions is:

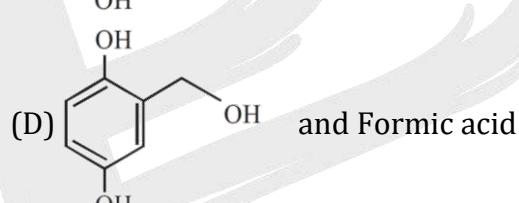
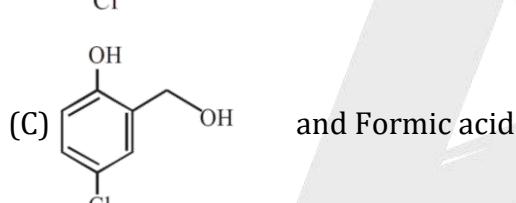
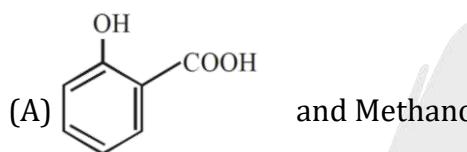
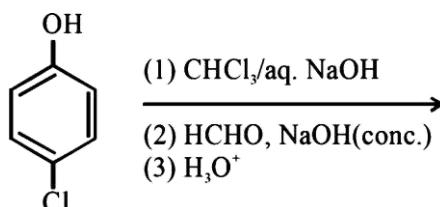
[JEE MAIN-2019]





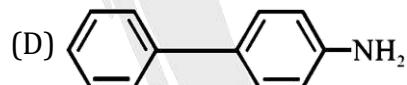
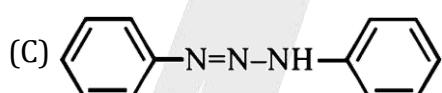
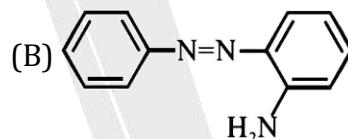
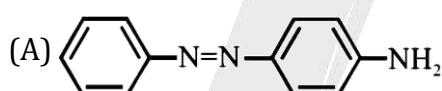
35. The major products of the following reaction are:

[JEE MAIN-2019]



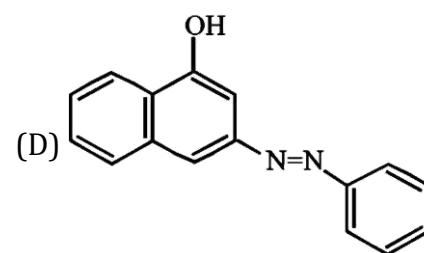
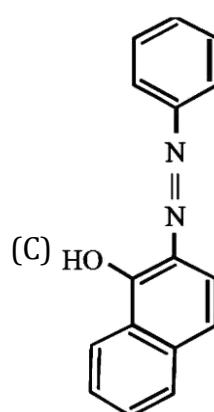
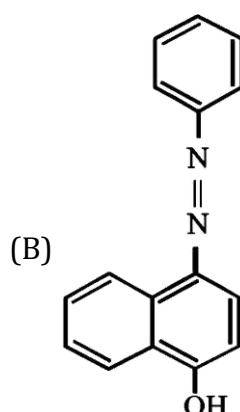
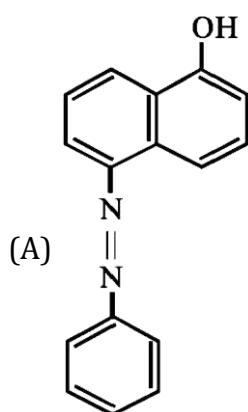
36. Benzene diazonium chloride on reaction with aniline in the presence of dilute hydrochloric acid gives:

[JEE MAIN-2019]

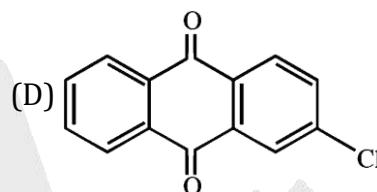
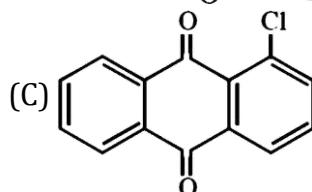
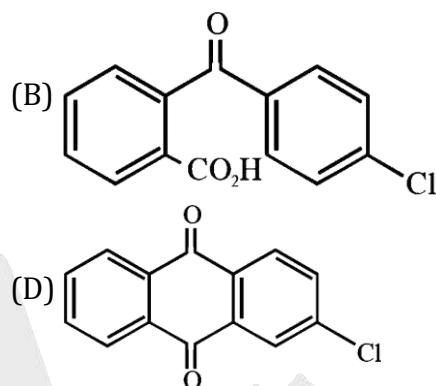
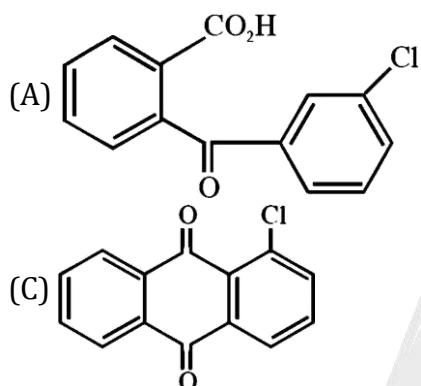
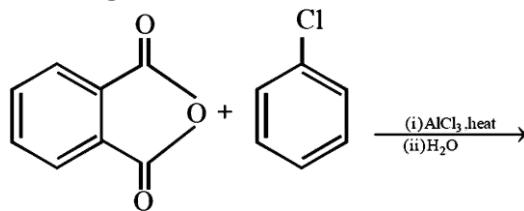


37. Coupling of benzene diazonium chloride with 1-naphthol in alkaline medium will give:

[JEE MAIN-2019]



38. The major product of the following reaction is:



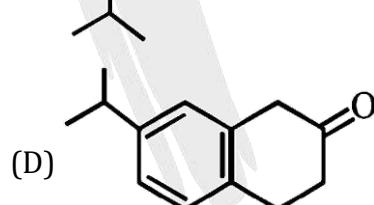
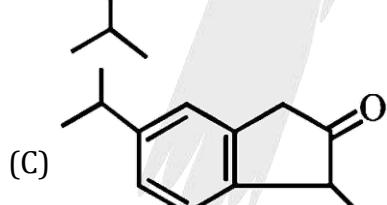
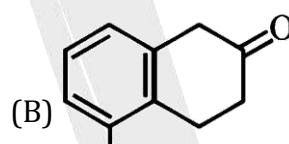
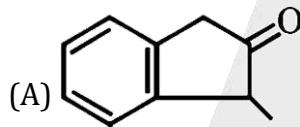
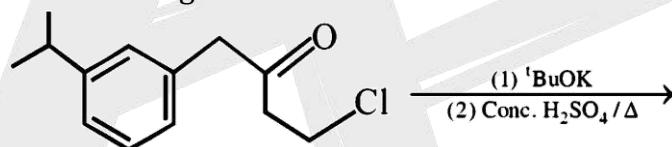
39. Polysubstitution is a major drawback in:

- (A) Friedel Craft's alkylation  
(B) Friedel Craft's acylation  
(C) Acetylation of aniline  
(D) Reimer Tiemann reaction

40. The major product of the following reaction is:

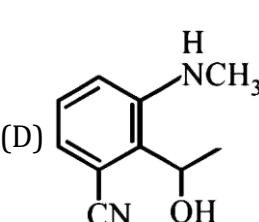
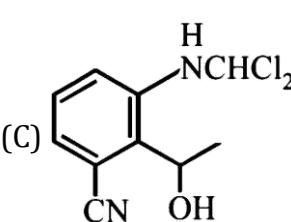
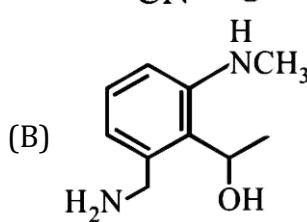
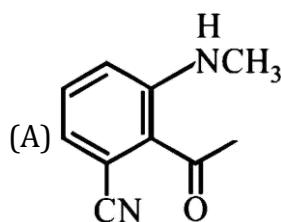
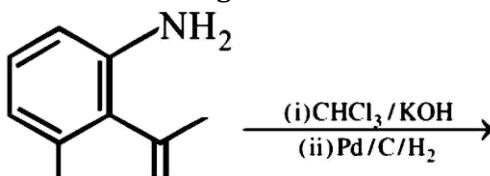
[JEE MAIN-2019]

[JEE MAIN-2019]



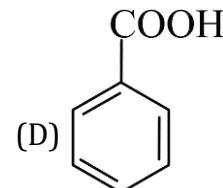
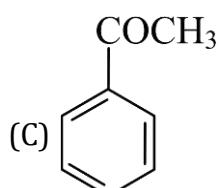
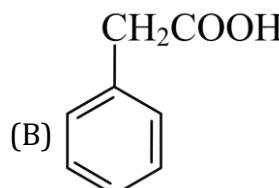
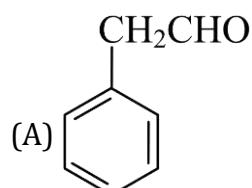
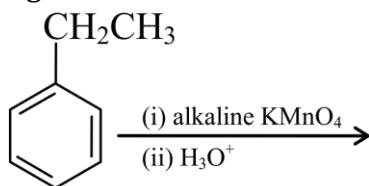
41. The major product obtained in the following reaction is:

[JEE MAIN-2019]



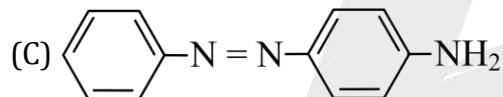
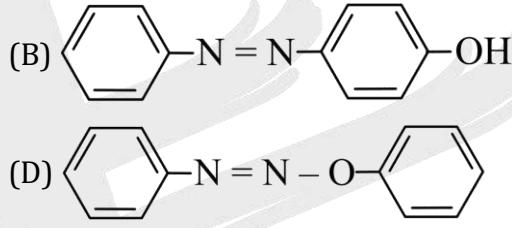
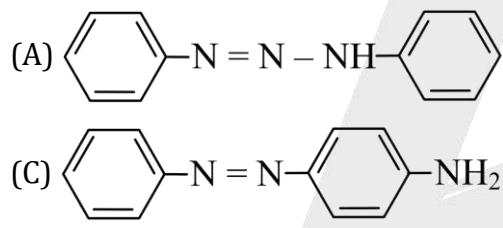
42. The major product of the following reaction is:

[JEE MAIN-2019]



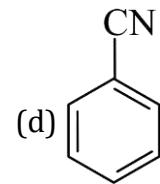
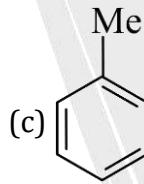
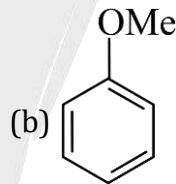
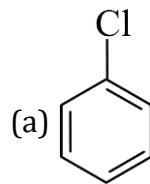
43. Aniline dissolved in dilute HCl is reacted with sodium nitrite at  $0^\circ\text{C}$ . This solution was added dropwise to a solution containing equimolar mixture of aniline and phenol in dil. HCl. The structure of the major product is:

[JEE MAIN-2019]



44. The increasing order of reactivity of the following compounds towards aromatic electrophilic substitution reaction is:

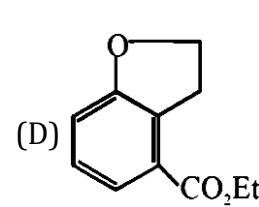
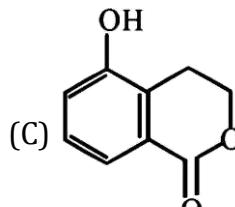
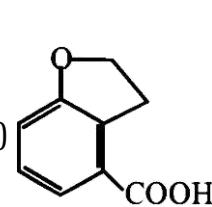
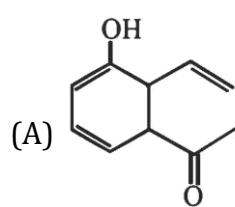
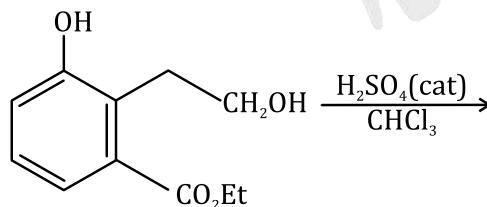
[JEE MAIN-2019]



- (A) a < b < c < d    (B) d < b < a < c    (C) d < a < c < b    (D) b < c < a < d

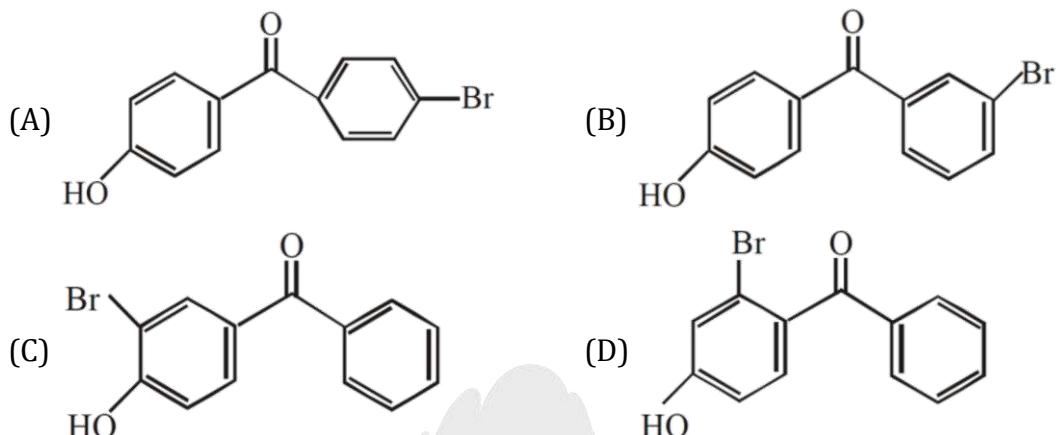
45. The major product of the following reaction is:

[JEE MAIN-2019]



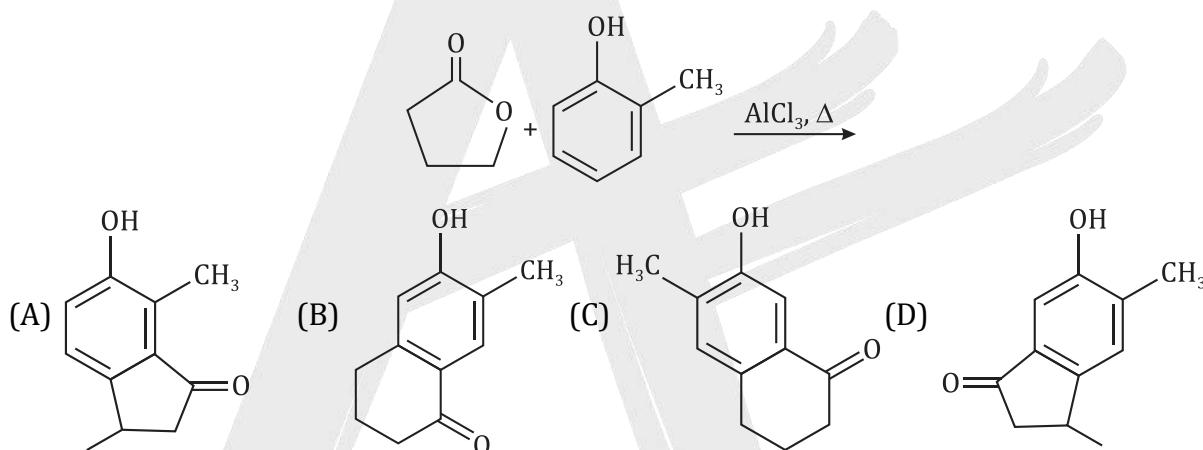
**46.** p-Hydroxybenzophenone upon reaction with bromine in carbon tetrachloride gives:

[JEE MAIN-2019]



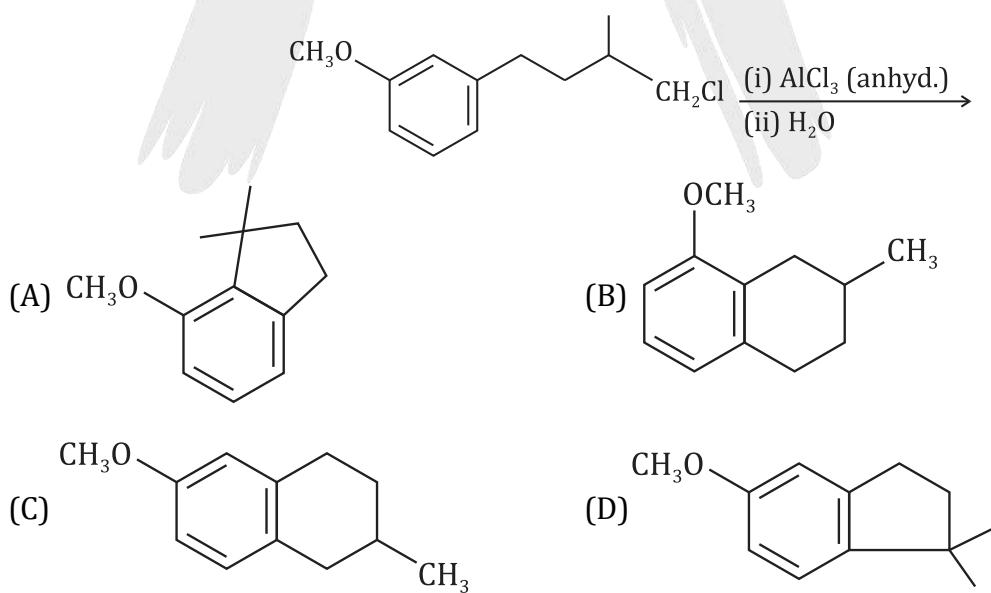
**47.** The major product of the following reaction is:

[JEE-MAIN 2019]



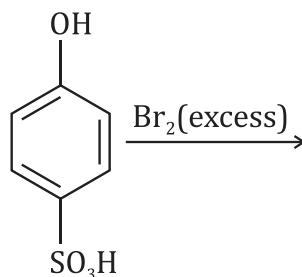
**48.** The major product of the following reaction is:

[JEE-MAIN 2019]



49. The major product of the following reaction is :

[JEE-MAIN 2019]



- (A) (B) (C) (D)

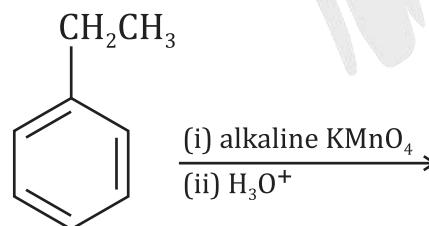
50. Among the following four aromatic compounds, which one will have the lowest melting point?

[JEE-MAIN 2019]

- (A) (B) (C) (D)

51. The major product of the following reaction is :

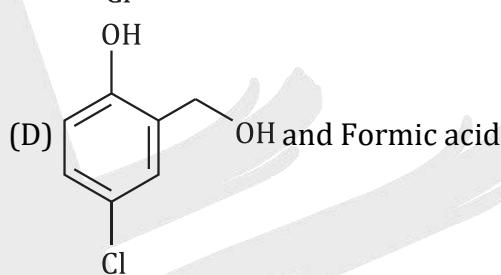
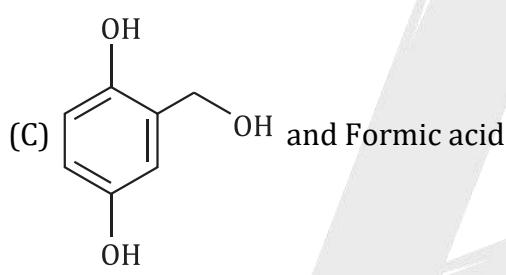
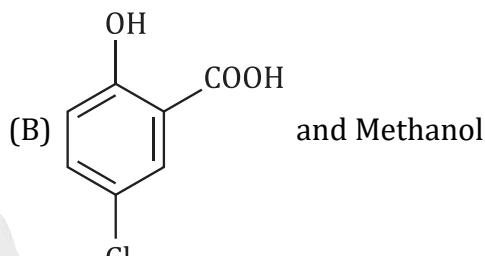
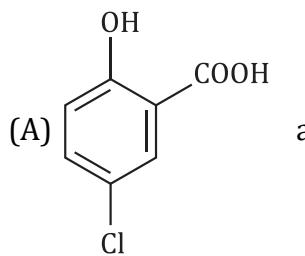
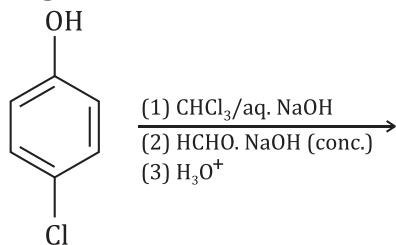
[JEE-MAIN 2019]



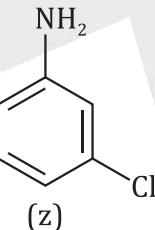
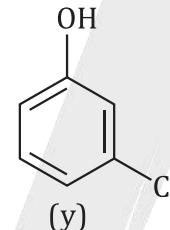
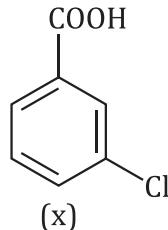
- (A) (B) (C) (D)

52. The major product of the following reaction is :

[JEE-MAIN 2019]



53.



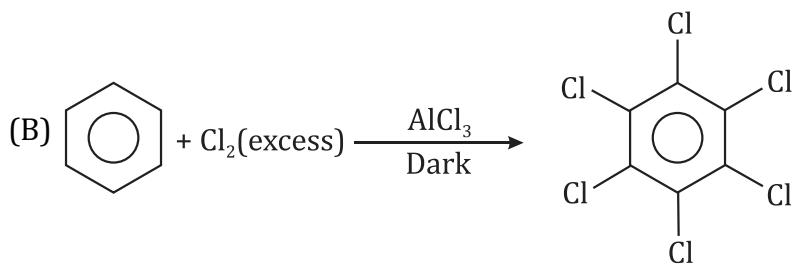
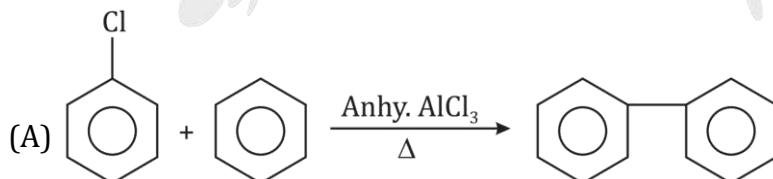
Mixture of above three organic compound was subjected to aq  $\text{NaHCO}_3$  and followed by dil  $\text{NaOH}$ . compounds which will be soluble in given solvent will be:

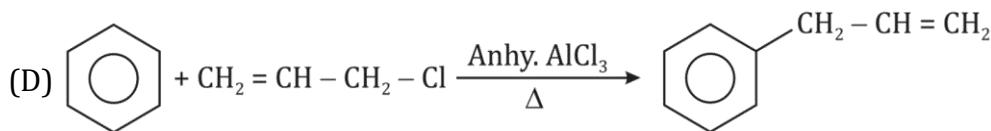
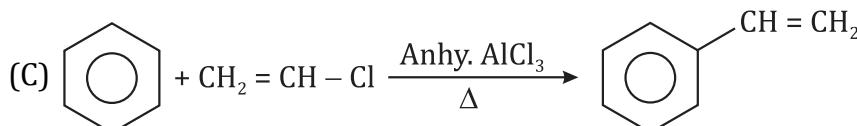
[JEE-MAIN 2020]

- (A) x in aq  $\text{NaHCO}_3$  and y in dil.  $\text{NaOH}$ .      (B) x in aq  $\text{NaHCO}_3$  and z in dil.  $\text{NaOH}$ .  
 (C) y in aq  $\text{NaHCO}_3$  and x in dil.  $\text{NaOH}$ .      (D) y is aq  $\text{NaHCO}_3$  and z in dil.  $\text{NaOH}$ .

54. Which of the following reactions are possible?

[JEE-MAIN 2020]





(A) A, B, C

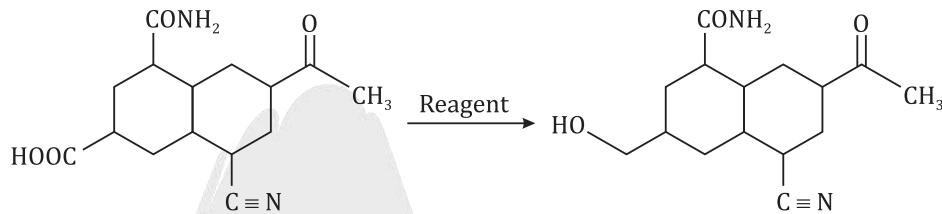
(B) B, D

(C) A, C, D

(D) A, C

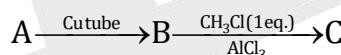
55. Reagent used for the given conversion is:

[JEE-MAIN 2020]

(A)  $\text{H}_2, \text{Pd}$ (B)  $\text{B}_2\text{H}_6$ (C)  $\text{NaBH}_4$ (D)  $\text{LiAlH}_4$ 

56. How many atoms lie in the same plane in the major product (C)?

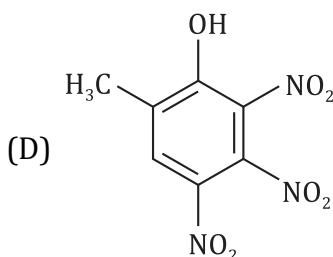
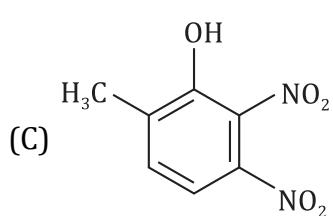
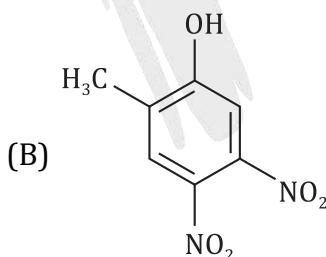
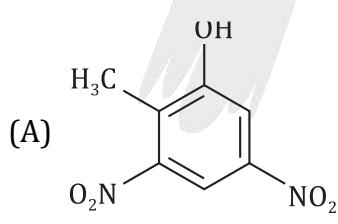
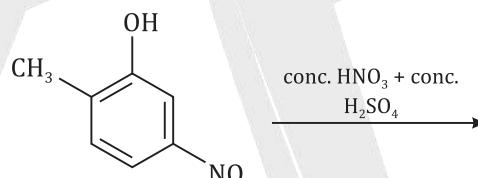
[JEE-MAIN 2020]



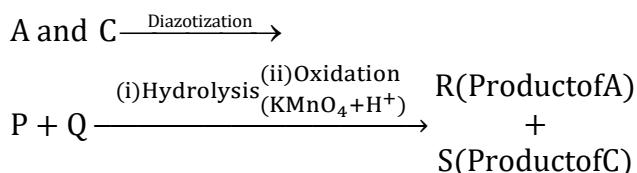
(Where A is the alkyne of lowest molecular mass)

57. The major product of the following reaction is:

[JEE-MAIN 2020]



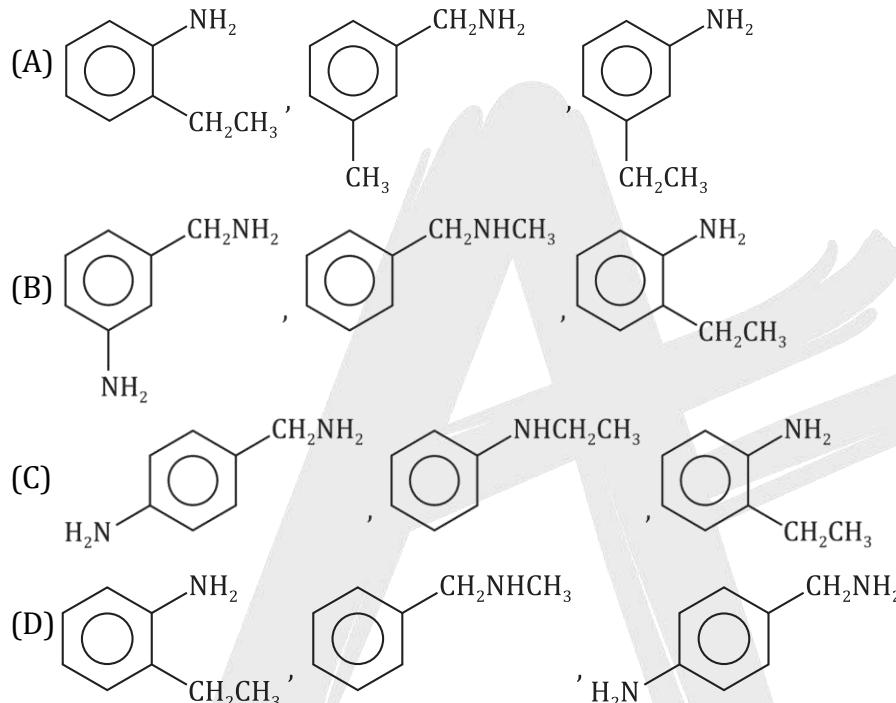
58. Three isomers A, B and C ( mol. formula  $C_8H_{11}N$ ) give the following results [JEE-MAIN 2020]



R has lower boiling point than S

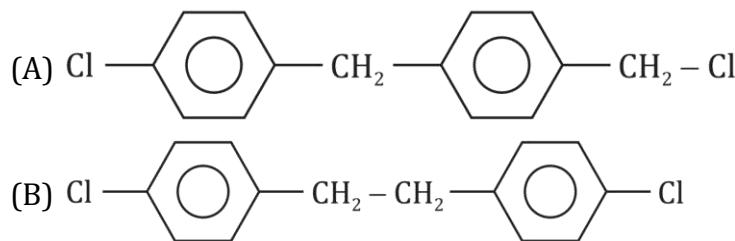
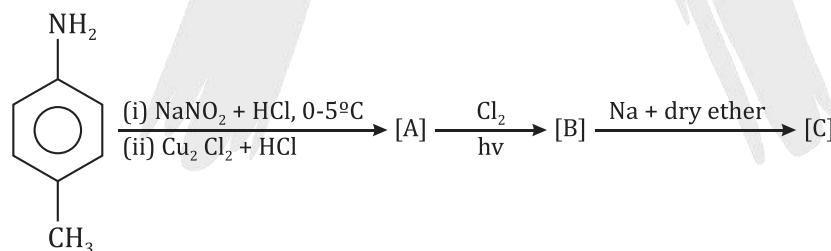
$$\text{B} \xrightarrow{\text{C}_6\text{H}_5\text{SO}_2\text{Cl}} \text{alkali-insoluble product}$$

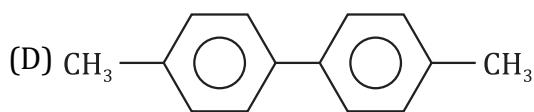
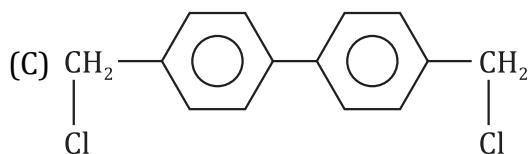
A, B and C, respectively are



- 59.** In the following reaction sequence, [C] is

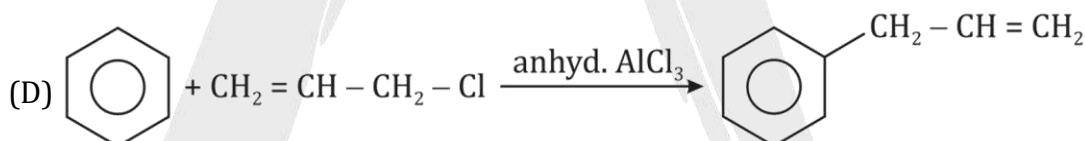
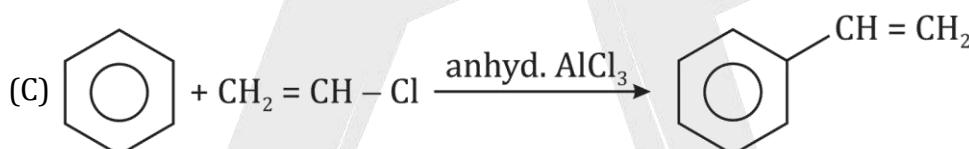
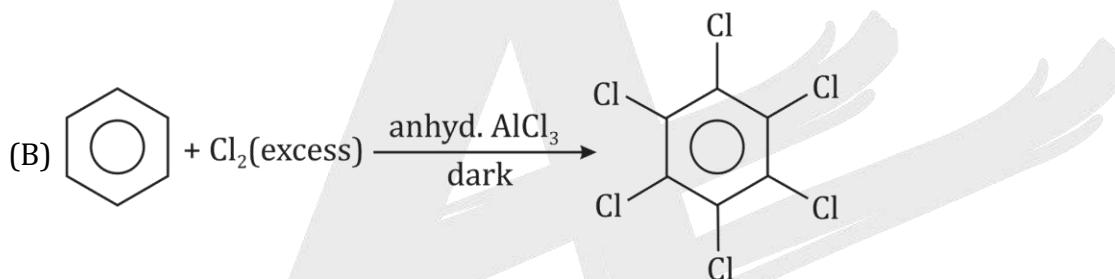
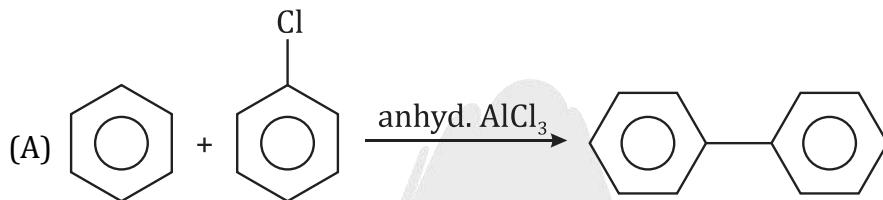
[JEE-MAIN 2020]





60. Which of the following reactions are possible?

[JEE-MAIN 2020]



(A) A, B, C

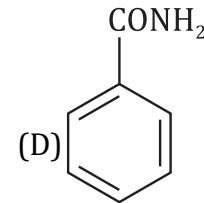
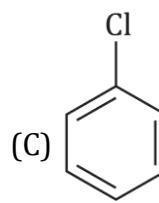
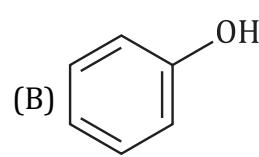
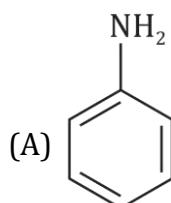
(B) B, D

(C) A, C, D

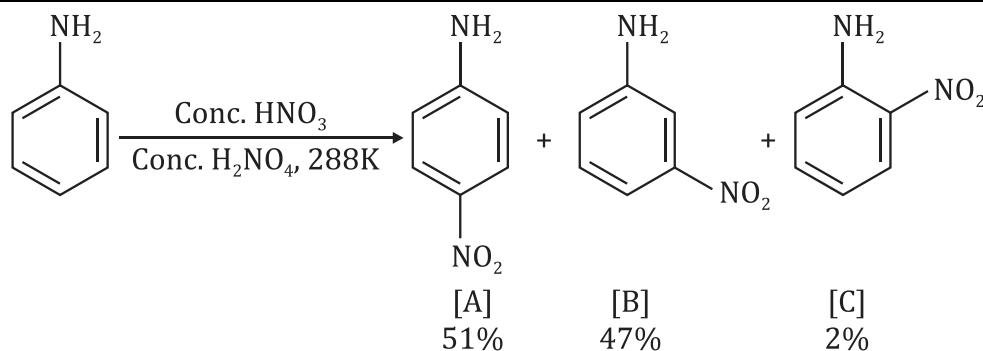
(D) A, C

61. Which of these will produce the highest yield in Friedel-Crafts reaction?

[JEE-MAIN 2020]



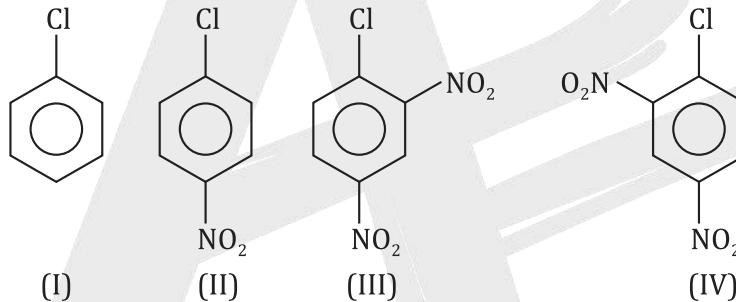
62. In the following reaction the reason why meta-nitro product also formed is: [JEE-MAIN 2021]



- (A) Formation of anilinium ion  
 (B)  $-\text{NO}_2$  substitution always takes place at meta-position  
 (C) low temperature  
 (D)  $-\text{NH}_2$  group is highly meta-directive

63. The correct order of the following compounds showing increasing tendency towards nucleophilic substitution reaction is :

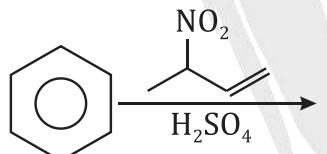
[JEE-MAIN 2021]



- (A) (iv) < (i) < (iii) < (ii)  
 (B) (iv) < (i) < (ii) < (iii)  
 (C) (i) < (ii) < (iii) < (iv)  
 (D) (iv) < (iii) < (ii) < (i)

64. The major product of the following reaction is :

[JEE-MAIN 2021]



- (A)   
 (B)   
 (C)   
 (D)

## **EXERCISE # IV A (ADVANCE)**

- Q.1** The chlorination of toluene in presence of ferric chloride gives predominantly: [JEE 1986]  
(A) Benzyl chloride (B) m-Chlorotoluene  
(C) Benzal chloride (D) o-and p-Chlorotoluene

**Q.2** Aryl halides are less reactive towards nucleophilic substitution reaction as compared to alkyl halide due to [JEE 1990]  
(A) The formation of less stable carbonium ion  
(B) Resonance stabilization  
(C) Longer carbon-halogen bond  
(D) The inductive effect

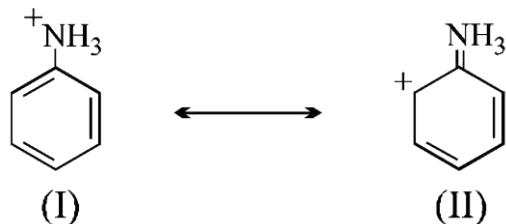
**Q.3** The most basic compound among the following is: [JEE 1990]  
(A) Benzylamine (B) Aniline (C) Acetaniline (D) p-Nitro aniline

**Q.4** Chlorination of toluene in the presence of light and heat followed by treatment with aqueous NaOH gives: [JEE 1990]  
(A) o-Cresol (B) p-Cresol  
(C) 2,4-Dihydroxytoluene (D) Benzoic acid

**Q.5** When nitrobenzene is treated with  $\text{Br}_2$  in presence of  $\text{FeBr}_3$  the major product formed is m-bromonitrobenzene. Correct statements are : [JEE 1992]  
(A) The electron density on meta carbon is more than on ortho and para position.  
(B) The intermediate carbonium ion formed after initial attack of  $\text{Br}^+$  attack the meta position is least destabilized.  
(C) Loss of aromaticity when  $\text{Br}^+$  attacks at the ortho and para positions and not at meta position.  
(D) Easier loss of  $\text{H}^+$  to regain aromaticity from the meta position than from ortho and para position.

**Q.6** Reaction of  $\text{R}-\text{CO}-\text{NH}_2$  with a mixture of  $\text{Br}_2$  and  $\text{KOH}$  gives  $\text{R}-\text{NH}_2$  as the main product. The intermediates involved in this reaction are: [JEE 1992]  
(A)  $\text{R}-\text{CO}-\text{NHBr}$  (B)  $\text{RNHBr}$  (C)  $\text{R}-\text{N}=\text{C}=\text{O}$  (D)  $\text{R.CO.NBr}$

**Q.7** Choose the correct statement from the ones given below for two aniline in: [JEE 1993]



- (A) II is not an acceptable canonical structure because carbonium ions are less stable than ammonium ions  
 (B) II is not an acceptable canonical structure because it is non aromatic  
 (C) II is not an acceptable canonical structure because the nitrogen has 10 valence electrons  
 (D) II is an acceptable canonical structure

**Q.8** Most stable carbonium ion is:

[JEE 1995]

- (A)  $p - \text{NO}_2 - \text{C}_6\text{H}_4 - {}^+ \text{CH}_2$       (B)  $\text{C}_6\text{H}_5 {}^+ \text{CH}_2$   
 (C)  $p - \text{Cl} - \text{C}_6\text{H}_4 {}^{++} \text{CH}_2$       (D)  $p - \text{CH}_3\text{O} - \text{C}_6\text{H}_4 - {}^+ \text{CH}_2$

**Q.9** Arrange in order of decreasing trend towards  $S_E$  reactions:

[JEE 1995]

- (I) Chlorobenzene    (II) Benzene    (III) Anilinium chloride    (IV) Toluene  
 (A) II > I > III > IV    (B) III > I > II > IV    (C) IV > II > I > III    (D) I > II > III > IV

**Q.10** Among the following statements on the nitration of aromatic compounds, the false one is:

[JEE 1997]

- (A) The rate of benzene is almost the same as that of hexadeuterobenzene  
 (B) The rate of nitration of toluene is greater than that of benzene.  
 (C) The rate of nitration of benzene is greater than that of hexadeuterobenzene  
 (D) Nitration is an electrophilic substitution reaction

**Q.11** Nitrobenzene can be prepared from benzene by using a mixture of conc.  $\text{HNO}_3$  and conc.  $\text{H}_2\text{SO}_4$ . In the nitrating mixture  $\text{HNO}_3$  acts as a:

[JEE 1997]

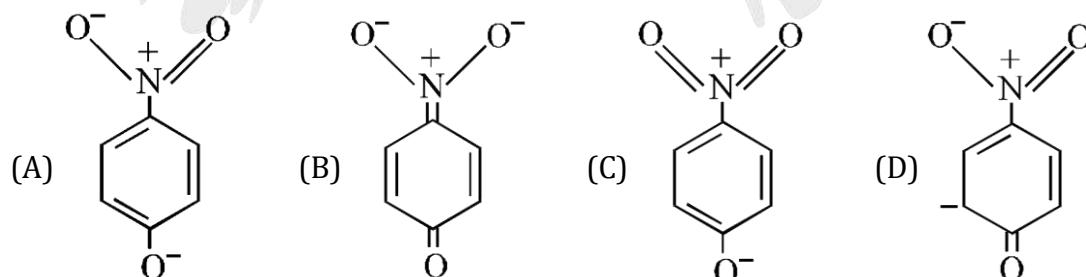
- (A) Base      (B) Acid      (C) Reducing agent    (D) Catalyst

**Q.12** Benzyl chloride ( $\text{C}_6\text{H}_5\text{CH}_2\text{Cl}$ ) can be prepared from toluene by chlorination with:

[JEE 1998]

- (A)  $\text{SO}_2\text{Cl}_2\text{hv}$     (B)  $\text{SOCl}_2$     (C)  $\text{Cl}_2\text{hv}$     (D)  $\text{NaOCl}$

**Q.13** The most unlikely representation of resonance structure of p-nitrophenoxide ion is: [JEE 1998]



**Q.14** Benzenediazonium chloride on reaction with phenol in weakly basic medium gives: [JEE 1998]

- (A) Diphenyl ether      (B) p-hydroxyazobenzene  
 (C) Chlorobenzene      (D) Benzene



**Q.15** A solution of (+) -1-chloro-1-phenylethane in toluene racemises slowly in the presence of small amount of  $SbCl_5$ , due to the formation of: [JEE 1999]

- (A) Carbanion      (B) Carbene      (C) Free-radical      (D) Carbocation

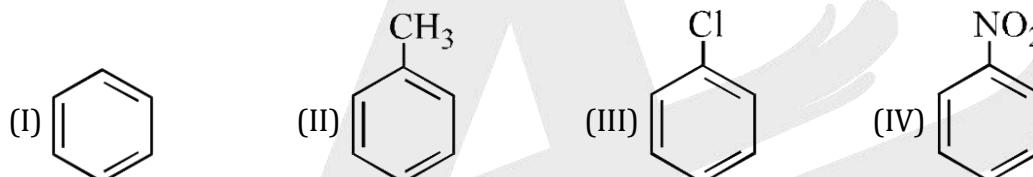
**Q.16** Toluene, when treated with  $Br_2/Fe$ , gives p-bromotoluene as the major product, because the  $CH_3$  group: [JEE 1999]

- (A) is para directing      (B) is meta directing  
(C) activates the ring by hyperconjugation (D) deactivates the ring

**Q.17** Amongst the following the strongest base is: [JEE 2000]

- (A)  $C_6H_5NH_2$       (B)  $p-O_2NC_6H_4NH_2$   
(C)  $m-O_2NC_6H_4NH_2$       (D)  $C_6H_5CH_2NH_2$

**Q.18** Identify the correct order of reactivity in electrophilic substitution reactions of the following compounds: [JEE 2002]



- (A) I > II > III > IV      (B) IV > III > II > I      (C) II > I > III > IV      (D) II > III > I > IV

**Q.19**  $\xrightarrow[\text{DMF}]{(CH_3)_2NH}$  A  $\xrightarrow[\text{(ii) } H_2 \text{ Catalytic Reduction}]{\text{(i) } NaNO_2 \text{ HCl } 0^\circ\text{--}5^\circ C}$  B [JEE 2003]

- (A)   
(B)   
(C)   
(D)

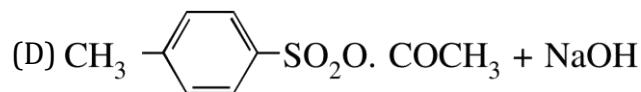
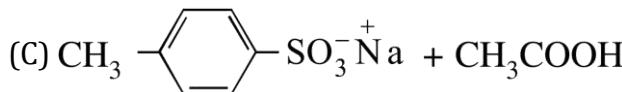
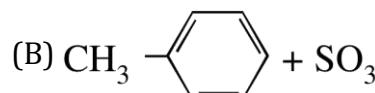
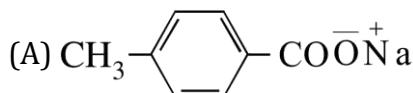
**Q.20**  $\xrightarrow[\text{Fe}]{Br_2}$  [JEE 2004]

Major product of above reaction is:

- (A)   
(B)   
(C)   
(D)

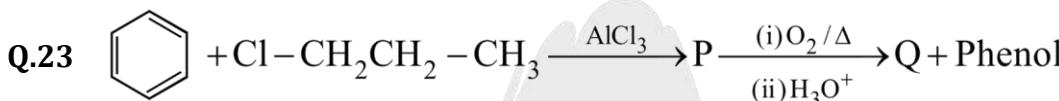
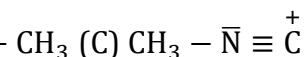
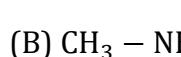
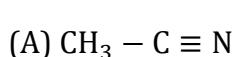
**Q.21** Which of the following is obtained when 4-Methylbenzenesulphonic acid is hydrolysed with excess of sodium acetate?

[JEE 2005]



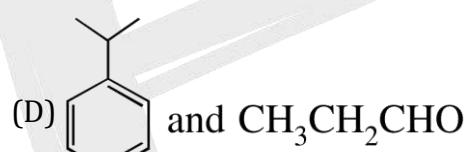
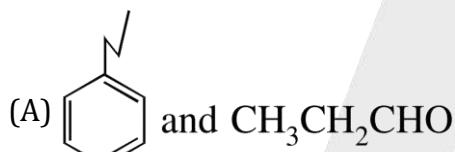
**Q.22**  $\text{CH}_3\text{NH}_2 + \text{CHCl}_3 + \text{KOH} \rightarrow$  Nitrogen containing compound +  $\text{KCl} + \text{H}_2\text{O}$ . Nitrogen containing compound is

[JEE 2006]



[JEE 2006]

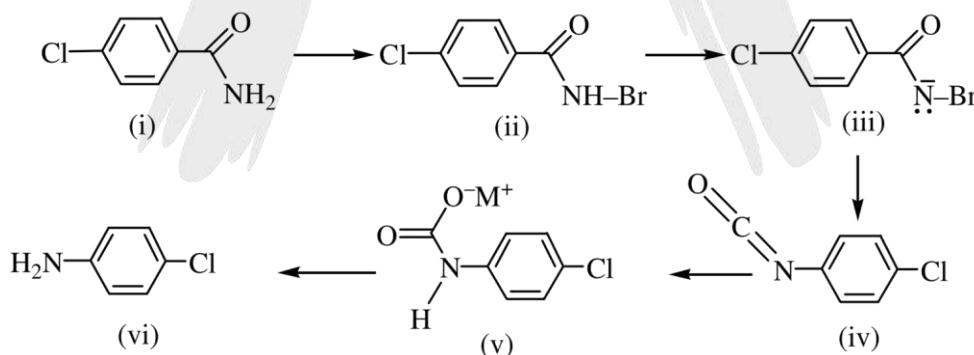
The major products P and Q are



### Question No. 24 to 26 ( 3 questions)

#### Comprehension I

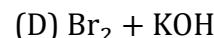
$\text{RCONH}_2$  is converted into  $\text{RNH}_2$  by means of Hofmann bromamide degradation.



In this reaction,  $\text{RCONHBr}$  is formed from which this reaction has derived its name. Electron donating group at phenyl activates the reaction. Hofmann degradation reaction is an intramolecular reaction.

**Q.24** How can the conversion of (i) to (ii) be brought about?

[JEE 2006]



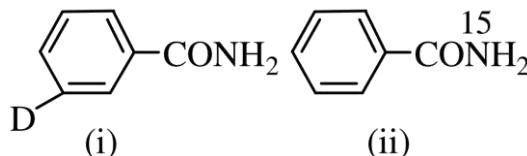
**Q.25** Which is the rate determining step in Hofmann bromamide degradation?

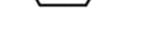
[JEE 2006]



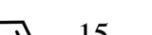
**Q.26** What are the constituent amines formed when the mixture of (i) and (ii) undergoes Hofmann bromamide degradation? [JEE 2006]

[JEE 2006]



- (A)  ,  ,  , 

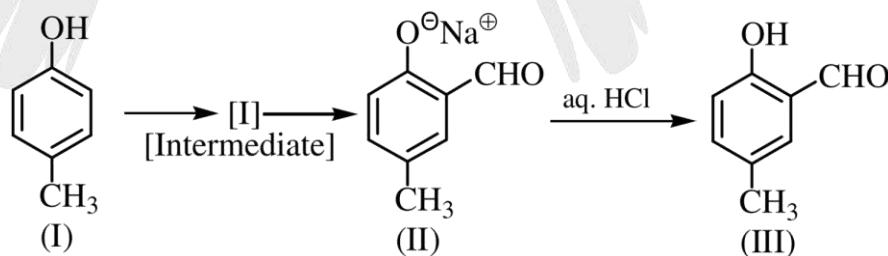
(B)  , 

(C)  , 

(D)  , 

### **Paragraph for Question Nos. 27 to 30 (4 questions)**

Riemer-Tiemann reaction introduces an aldehyde group, on to the aromatic ring of phenol, ortho to the hydroxyl group. This reaction involves electrophilic aromatic substitution. This is a general method for the synthesis of substituted salicylaldehydes as depicted below.



**Q.27** Which one of the following reagents is used in the above reaction?

[JEE 2007]



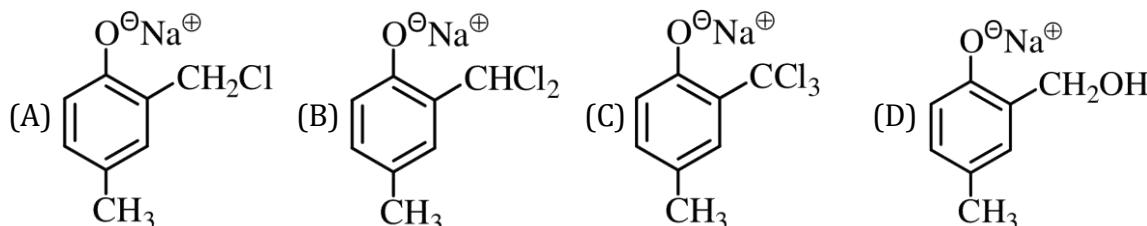
**Q.28** The electrophile in this reaction is

[JEE 2007]

- (A) :CHCl                    (B)  $^+CHCl_2$                     (C) :CCl<sub>2</sub>                    (D) ·CCl<sub>3</sub>

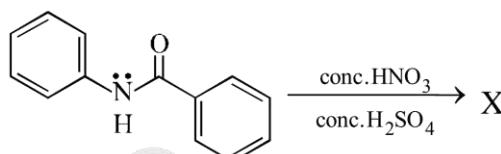
Q.29 The structure of the intermediate I is

[JEE 2007]

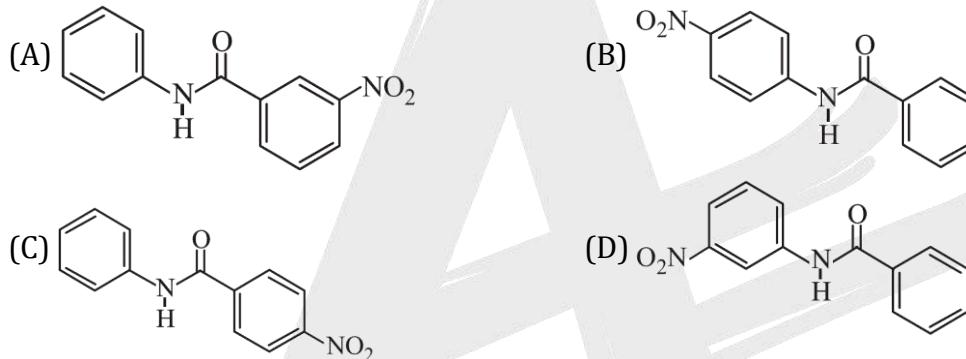


Q.30 In the following reaction,

[JEE 2007]



the structure of the major product 'X' is

Q.31 Statement - 1: Bromobenzene upon reaction with Br<sub>2</sub>/Fe gives 1, 4-dibromobenzene as the major product.

[JEE 2008]

**Statement-2:** In bromobenzene, the inductive effect of the bromo group is more dominant than the mesomeric effect in directing the incoming electrophile.

(A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1

(B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement 1

(C) Statement-1 is True, Statement-2 is False

(D) Statement-1 is False, Statement-2 is True

Q.32 **Statement-1 :** Aniline on reaction with NaNO<sub>2</sub>/HCl at 0°C followed by coupling with  $\beta$ -naphthol gives a dark blue coloured precipitate.**Statement-2 :** The colour of the compound formed in the reaction of aniline with NaNO<sub>2</sub>/HCl at 0° followed by coupling with  $\beta$ -naphthol is due to the extended conjugation.

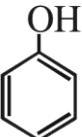
(A) Statement-1 is True, Statement-2 is True ; Statement-2 is a correct explanation for Statement-1

(B) Statement-1 is True, Statement-2 is True ; Statement-2 is NOT a correct explanation for Statement 1

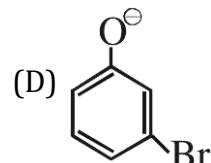
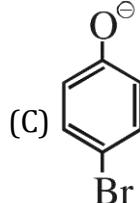
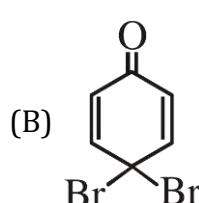
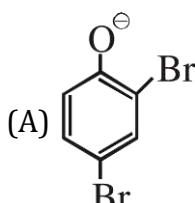
(C) Statement-1 is True, Statement-2 is False

(D) Statement-1 is False, Statement-2 is True

[JEE 2008]

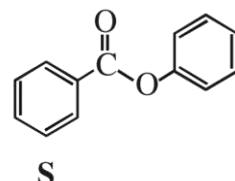
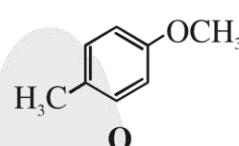
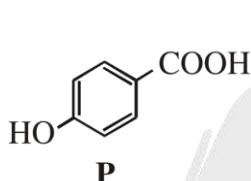
**Q.33** In the reaction   $\xrightarrow{\text{NaOH(aq)}/\text{Br}_2}$  the intermediate(s) is(are)-

[JEE 2009]

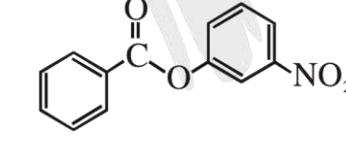
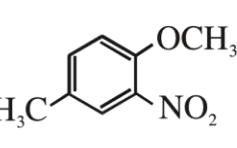
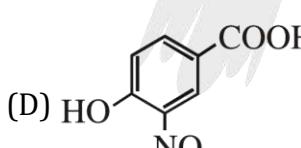
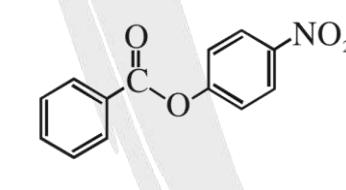
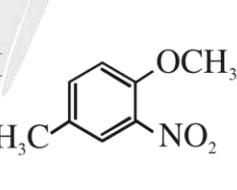
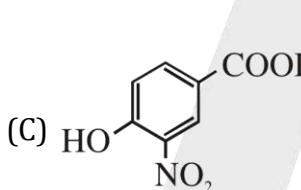
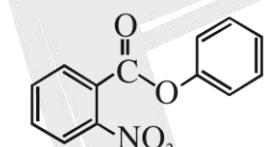
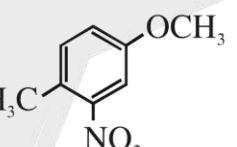
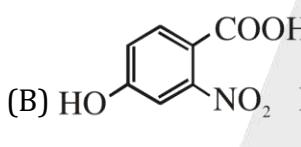
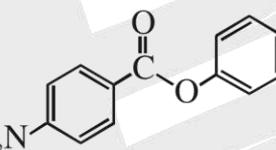
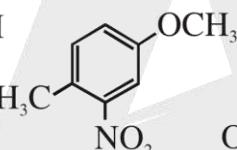
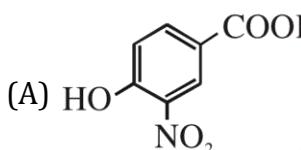


**Q.34** The compounds P, Q and S

[JEE 2009]

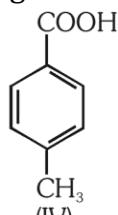
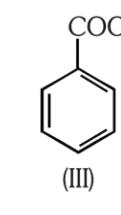
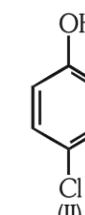
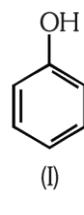


were separately subjected to nitration using  $\text{HNO}_3/\text{H}_2\text{SO}_4$  mixture. The product formed in each case respectively, is



**Q.35** The correct acidity order of the following is:

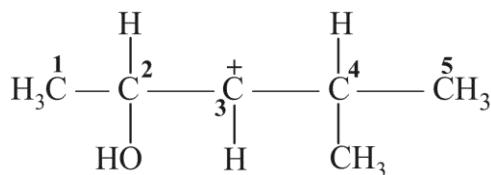
[JEE 2009]



- (A) (III) > (IV) > (II) > (I)  
(C) (III) > (II) > (I) > (IV)

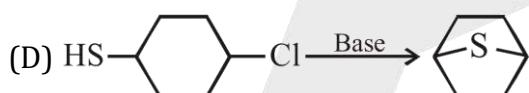
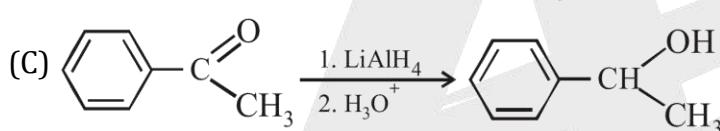
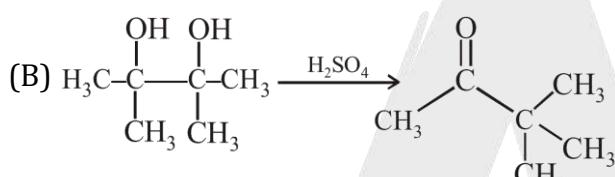
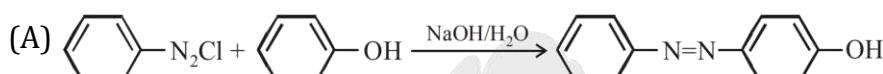
- (B) (IV) > (III) > (I) > (II)  
(D) (II) > (III) > (IV) > (I)

**Q.36** In the following carbocation, H/CH<sub>3</sub> that is most likely to migrate to the positively charged carbon is: [JEE 2009]



- (A) CH<sub>3</sub> at C – 4      (B) H at C – 4      (C) CH<sub>3</sub> at C – 2      (D) H at C – 2

**Q.37** Match the reactions in Column-I with appropriate options in Column-II. [IIT-JEE-2010]

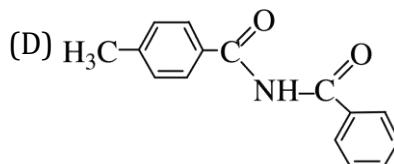
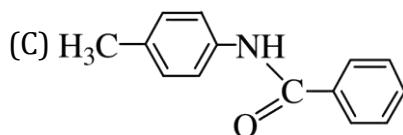
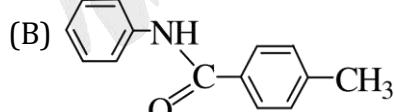
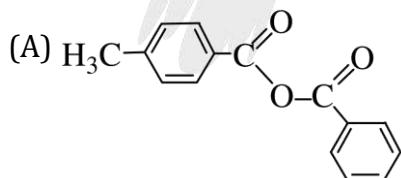
**Column-I**

(T) Carbocation intermediate

**Q.38** In the reaction (i)

The structure of the Product T is:

[JEE 2010]

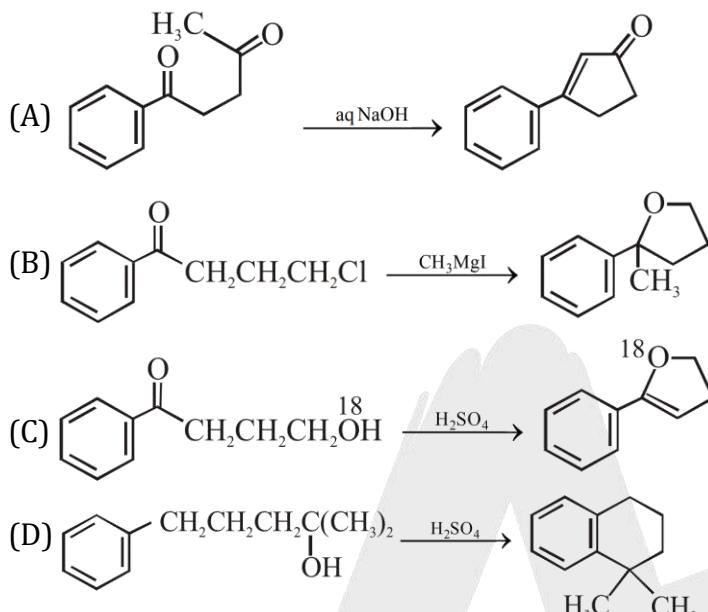


**Q.39** Among the following compounds, the most acidic is

[JEE 2011]

- (A) p-nitrophenol      (B) p-hydroxybenzoic acid  
(C) o-hydroxybenzoic acid      (D) p-toluic acid

**Q.40** Match the reactions in Column-I with appropriate types of step/reactive intermediate involved in these reactions as given in Column-II [IIT-JEE-2012]

**Column-I****Column-II**

(P) Nucleophilic substitution

(Q) Electrophilic substitution

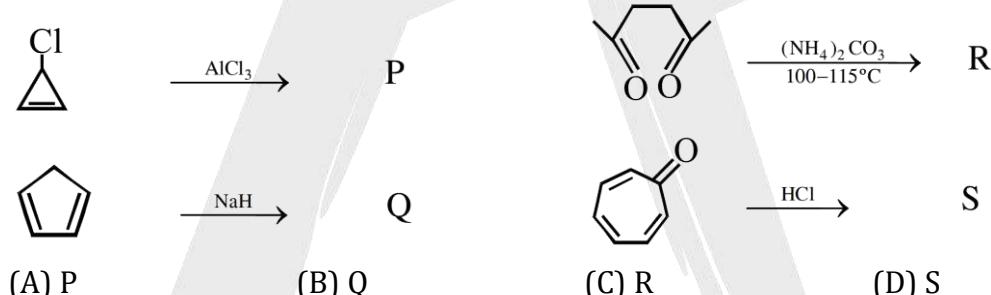
(R) Dehydration

(S) Nucleophilic addition

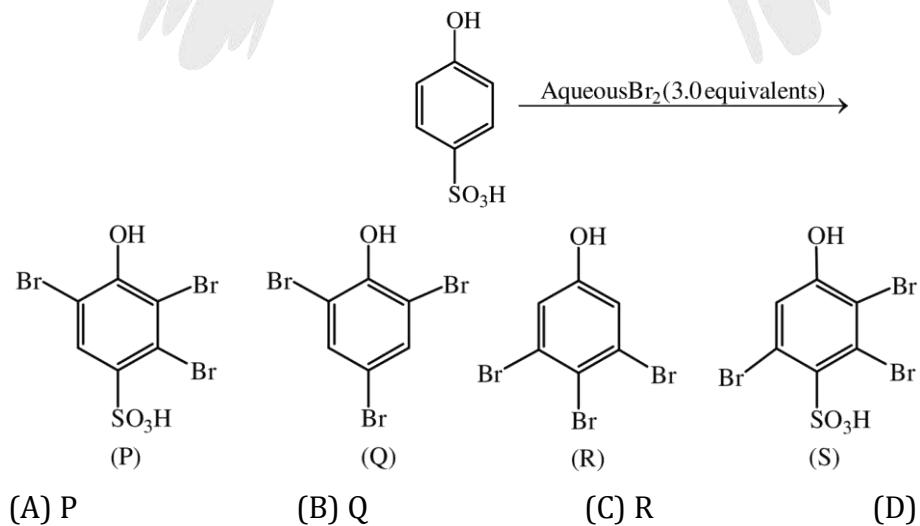
(R) Carbanion

**Q.41** Among P, Q, R and S, the aromatic compound(s) is / are:

[JEE 2013]

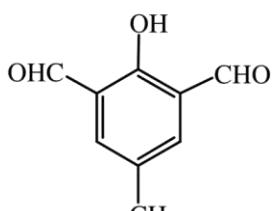
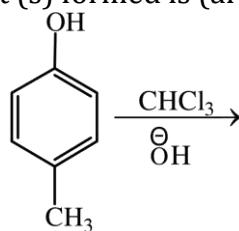
**Q.42** The major product(s) of the following reaction is (are) -

[JEE 2013]

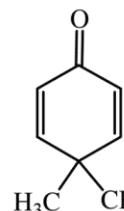


**Q.43** In the following reaction, the product(s) formed is (are)

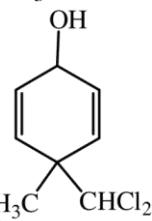
[JEE 2013]



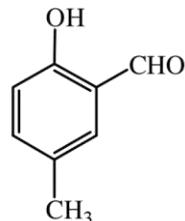
(A) P (major)



(B) Q (minor)



(C) R (minor)



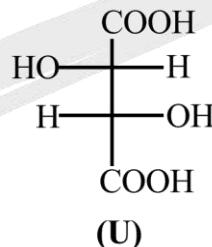
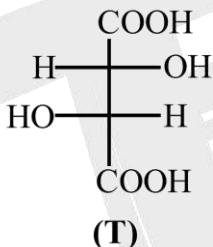
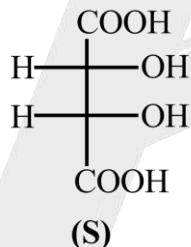
(D) S (major)

**Paragraph for Question 44 and 45**

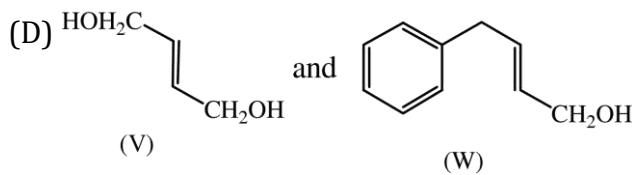
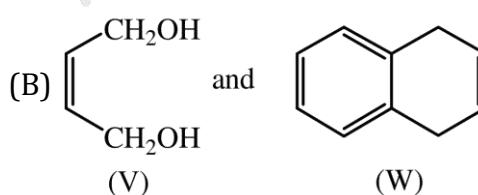
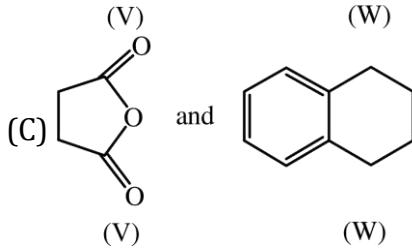
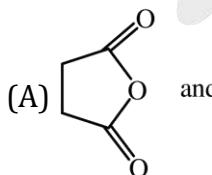
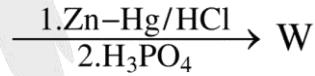
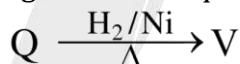
P&Q are isomers of dicarboxylic acid  $\text{C}_4\text{H}_4\text{O}_4$ . Both decolorize  $\text{Br}_2/\text{H}_2\text{O}$ , On heating P forms the cyclic anhydride.

Upon treatment with dilute alkaline  $\text{KMnO}_4$ , P as well as Q could produce one or more than one from S, T and U.

[JEE 2013]



**Q.44** In the following reaction sequences V and W are, respectively -

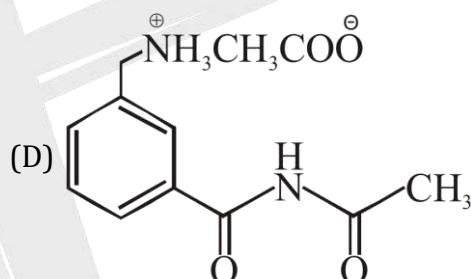
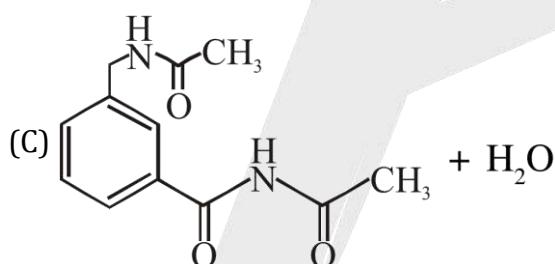
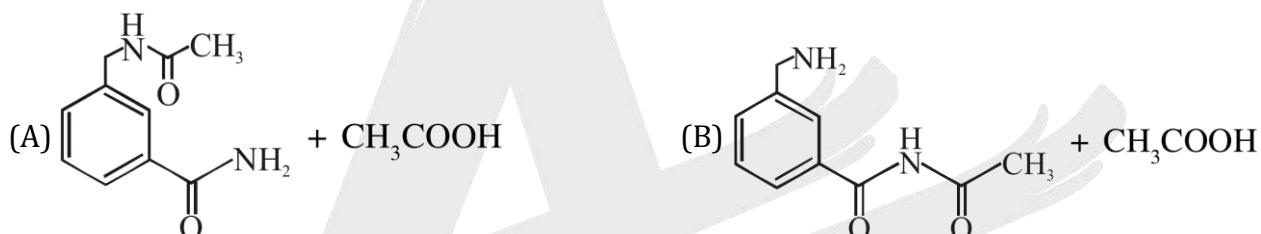
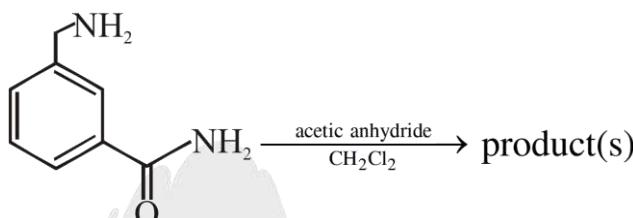


**Q.45** Compounds formed from P and Q are respectively

- (A) Optically active S and optically active pair (T, U)
- (B) Optically inactive S and optically inactive pair (T, U)
- (C) Optically active pair (T, U) and optically active S
- (D) Optically inactive pair (T, U) and optically inactive S

**Q.46** In the reaction shown below, the major product(s) formed is / are:

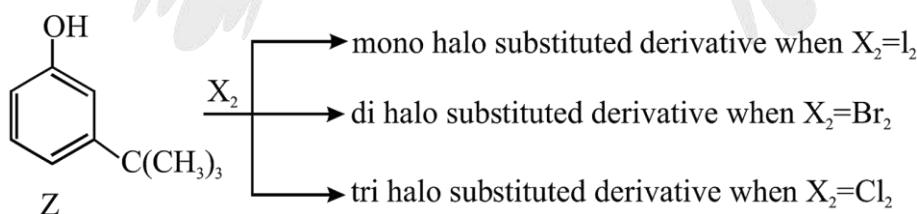
[JEE 2014]



**Q.47** The reactivity of compound Z with different halogens under appropriate conditions is given

below:

[JEE 2014]

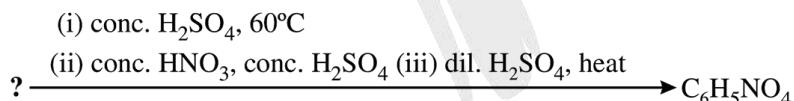
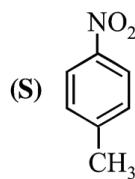
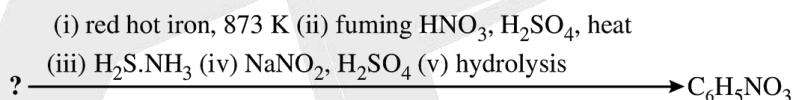
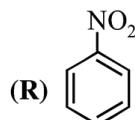
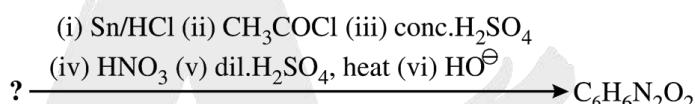
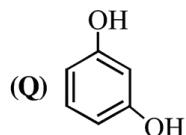
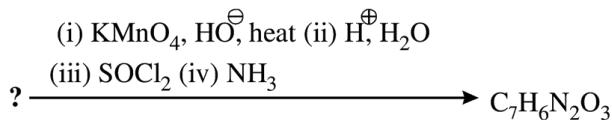
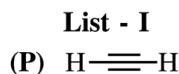


The observed pattern of electrophilic substitution can be explained by -

- (A) The steric effect of the halogen
- (B) The steric effect of the tert-butyl group
- (C) The electronic effect of the phenolic group
- (D) The electronic effect of the tert-butyl group

**Q.48** Match the four starting materials (P, Q, R, S) given in List I with the corresponding reaction scheme (I, II, III, IV) provided in List - II and select the correct answer using the code given below in lists.

[JEE 2014]

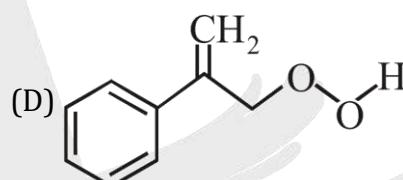
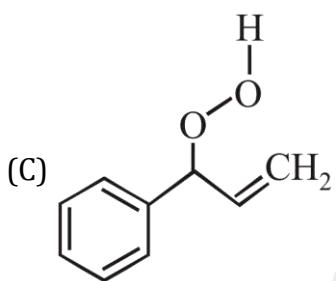
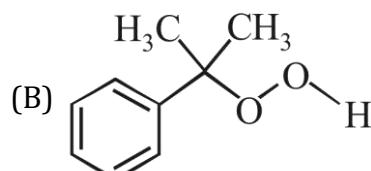
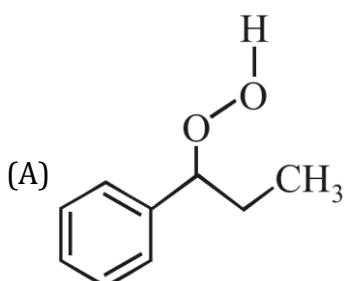
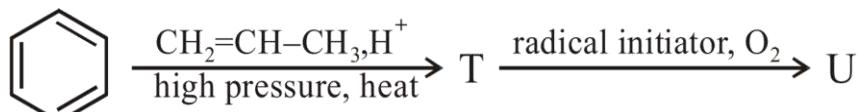


**Code :**

	P	Q	R	S
(A)	1	4	2	3
(B)	3	1	4	2
(C)	3	4	2	1
(D)	4	1	3	2

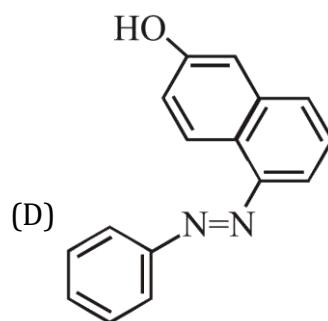
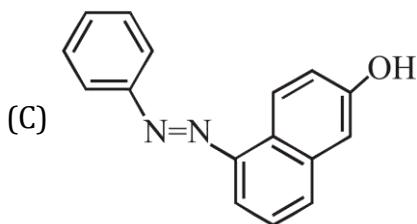
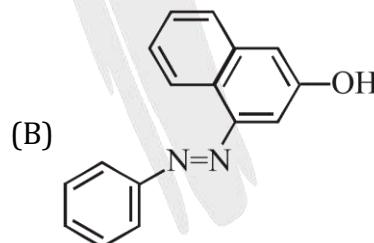
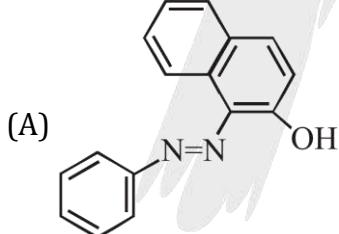
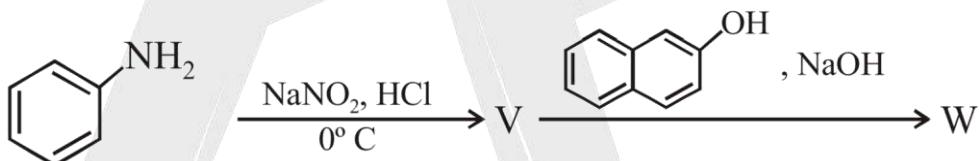
**Q.49** The major product *U* in the following reactions is:

[IIT 2015]

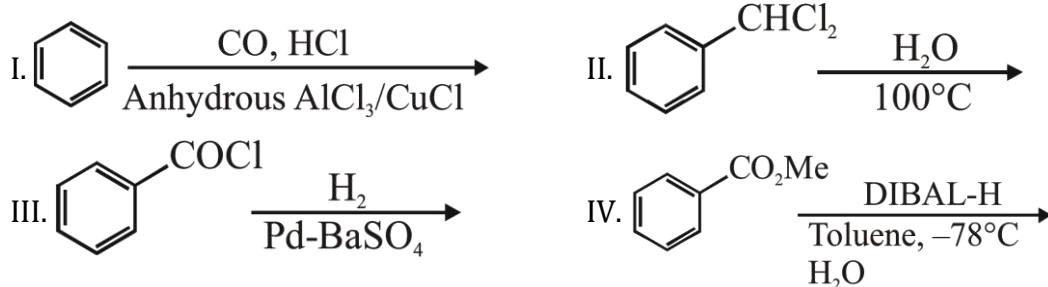


**Q.50** In the following reactions, the major product *W* is:

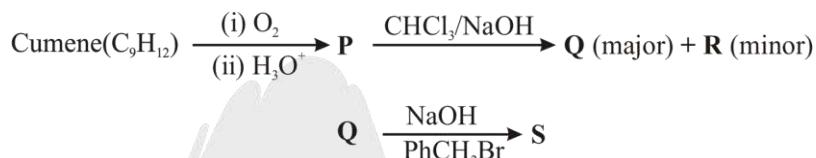
[IIT 2015]



**Q.51** Among the following the number of reaction(s) that produce(s) benzaldehyde is: [IIT 2015]

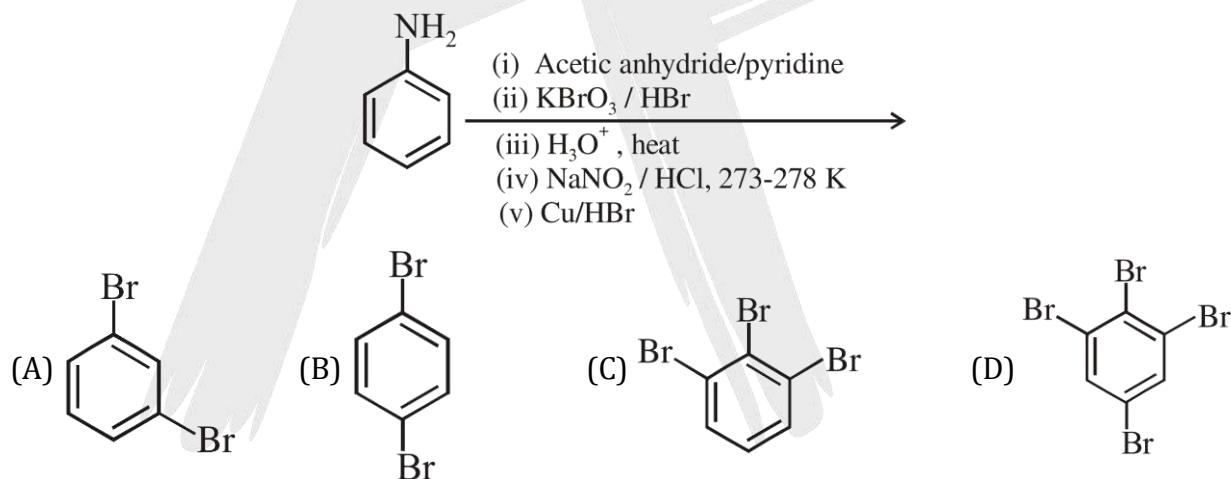


**Q.52** The correct statement(s) about of the following reaction sequence is(are) [IIT 2016]

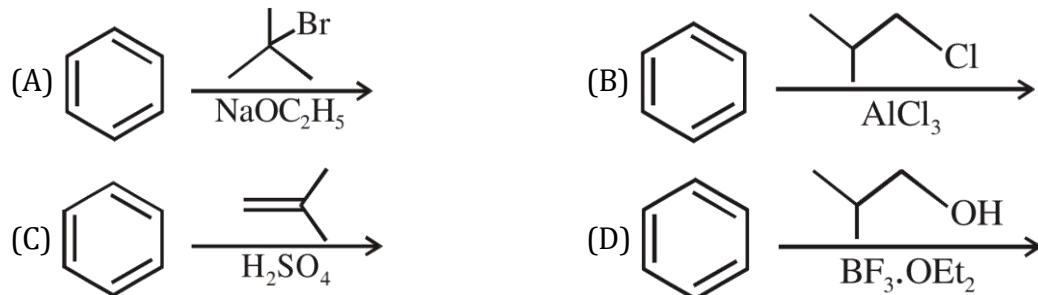


- (A) R is steam volatile  
 (B) Q gives dark violet coloration with 1% aqueous  $\text{FeCl}_3$  solution  
 (C) S gives yellow precipitate with 2, 4, -dinitrophenylhydrazine  
 (D) S gives dark violet coloration with 1% aqueous  $\text{FeCl}_3$  solution

**Q.53** The product(s) of the following reaction sequence is(are) [IIT 2016]

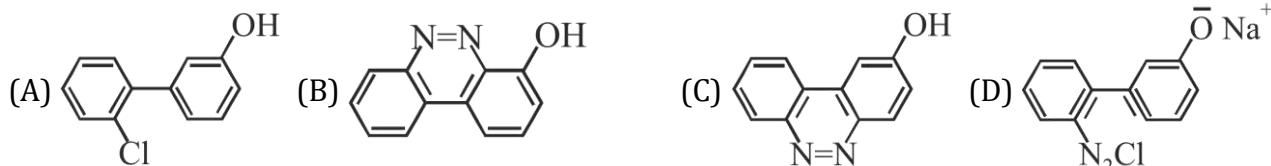
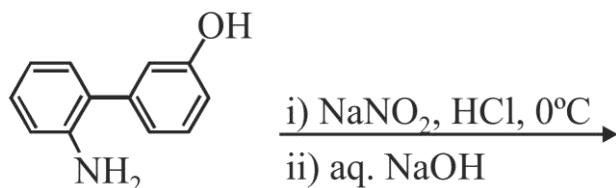


**Q.54** Among the following reaction(s) which gives (give) tert-butyl benzene as the major product is(are) [IIT 2016]



Q.55 The major product of the following reaction is

[IIT 2017]



Answer Q.56, Q.57 and Q.58 by appropriately matching the information given in the three columns of the following table.

[IIT 2017]

Column-1, 2 and 3 contain starting materials, reactions conditions, and type of		
Column-1	Column-2	Column-3
(I) Toluene	(i) $\text{NaOH}/\text{Br}_2$	(P) Condensation
(II) Acetophenone	(ii) $\text{Br}_2/\text{hv}$	(Q) Carboxylation
(III) Benzaldehyde	(iii) $(\text{CH}_3\text{CO})_2\text{O}/\text{CH}_3\text{COOK}$	(R) Substitution
(IV) Phenol	(iv) $\text{NaOH}/\text{CO}_2$	(S) Haloform

Q.56 For the synthesis of benzoic acid, the only CORRECT combination is

- (A) (III) (iv) (R)      (B) (IV) (ii) (P)      (C) (I) (iv) (Q)      (D) (II) (i) (S)

Q.57 The only CORRECT combination in which the reaction proceeds through radical mechanism is

- (A) (I) (ii) (R)      (B) (II) (iii) (R)      (C) (III) (ii) (P)      (D) (IV) (i) (Q)

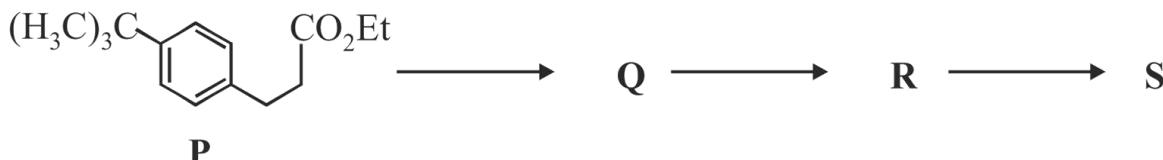
Q.58 The only CORRECT combination that give two different carboxylic acids is

- (A) (IV) (iii) (Q)      (B) (III) (iii) (P)      (C) (II) (iv) (R)      (D) (I) (i) (S)

#### Paragraph for Q. No. 59 to 60

The reaction of compound P with  $\text{CH}_3\text{MgBr}$  (excess) in  $(\text{C}_2\text{H}_5)_2\text{O}$  followed by addition of  $\text{H}_2\text{O}$  gives Q. The compound Q on treatment with  $\text{H}_2\text{SO}_4$  at  $0^\circ\text{C}$  gives R. The reaction of R with  $\text{CH}_3\text{COCl}$  in the presence of anhydrous  $\text{AlCl}_3$  in  $\text{CH}_2\text{Cl}_2$  followed by treatment with  $\text{H}_2\text{O}$  produces compound S. [Et in compound P is ethyl group]

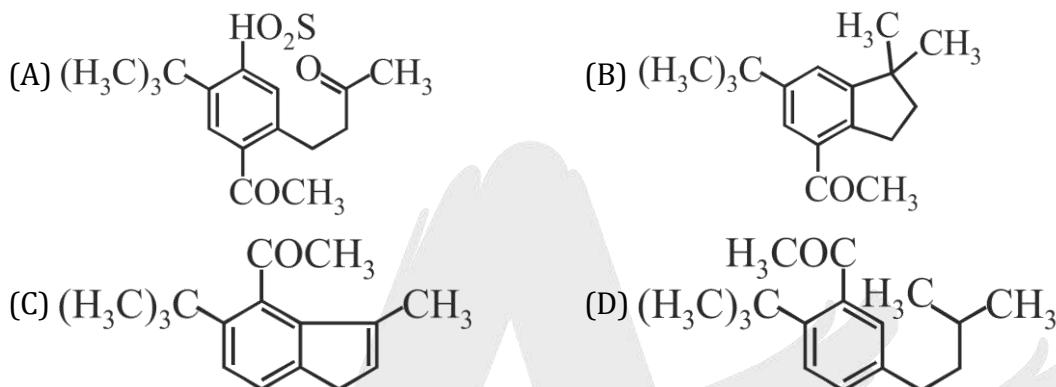
[IIT 2017]



**Q.59** The reactions, Q to R and R to S, are

- (A) Dehydration and Friedel-Crafts acylation
- (B) Friedel-Crafts alkylation, dehydration and Friedel-Crafts acylation
- (C) Aromatic sulfonation and Friedel-Crafts acylation
- (D) Friedel-Crafts alkylation and Friedel-Crafts acylation

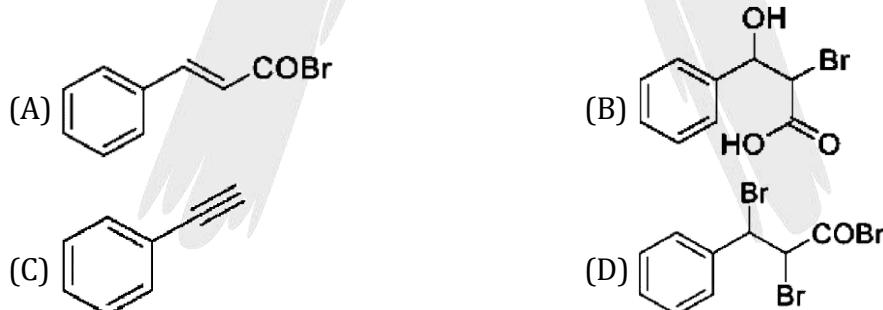
**Q.60** The product **S** is



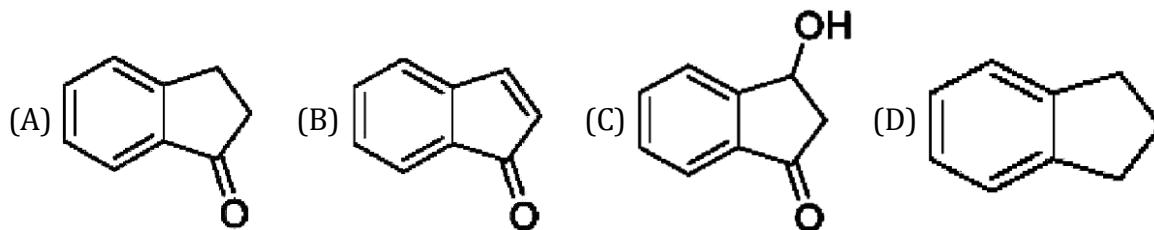
#### PARAGRAPH Q.61 to Q.62

Treatment of benzene with CO/HCl in the presence of anhydrous AlCl<sub>3</sub>/CuCl followed by reaction with Ac<sub>2</sub>O/NaOAc gives compound **X** as the major product. Compound **X** upon reaction with Br<sub>2</sub>/Na<sub>2</sub>CO<sub>3</sub>, followed by heating at 473 K with moist KOH furnishes **Y** as the major product. Reaction of **X** with H<sub>2</sub>/Pd – C, followed by H<sub>3</sub>PO<sub>4</sub> treatment gives **Z** as the major product. [IIT 2018]

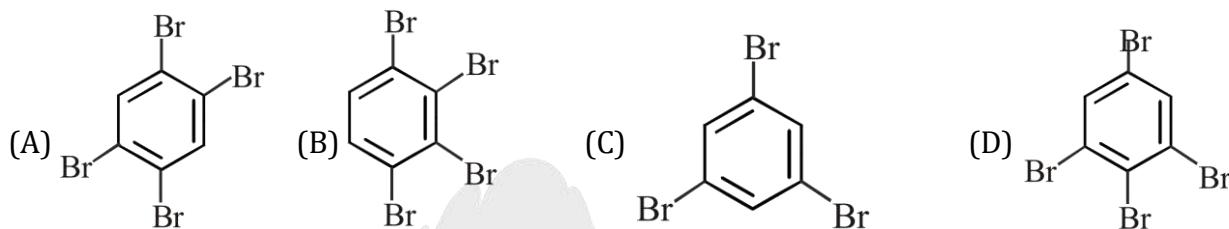
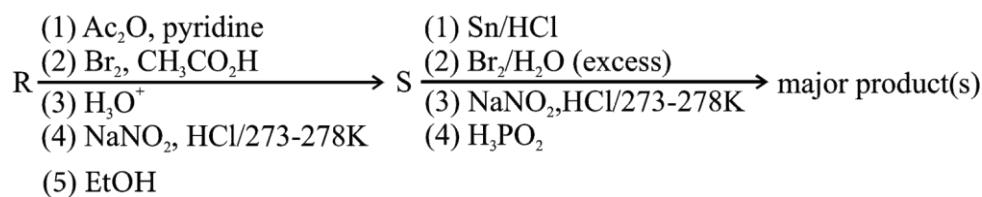
**Q.61** The compound **Y** is



**Q.62** The compound **Y** is

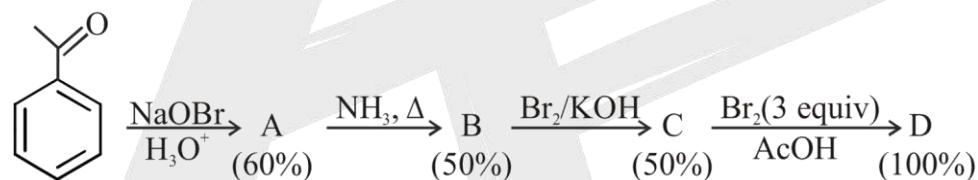


**Q.63** Aniline reacts with mixed acid (conc.  $\text{HNO}_3$  and conc.  $\text{H}_2\text{SO}_4$ ) at 288 K to give **P**(51%), **Q**(47%) and **R**(2%). The major product(s) of the following reaction sequence is (are) [IIT 2018]



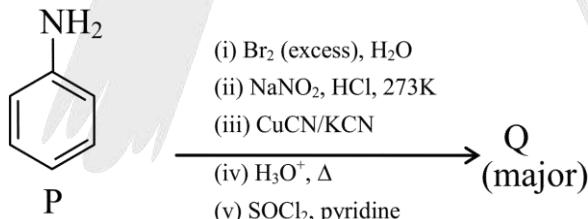
**Q.64** In the following reaction sequence, the amount of **D** (in g) formed from 10 moles of acetophenone is

(Atomic weights in  $\text{gmol}^{-1}$ : H = 1, C = 12, N = 14, O = 16, Br = 80. The yield (%) corresponding to the product in each step is given in the parenthesis) [IIT 2018]

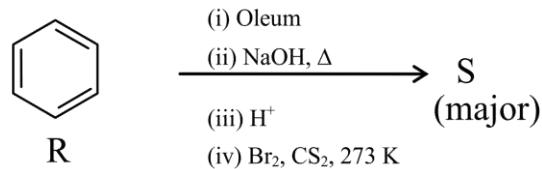


**Q.65** Schemes 1 and 2 describe the conversion of *P* to *Q* and *R* to *S*, respectively. Scheme 3 describes the synthesis of *T* from *Q* and *S*. The total number of Br atoms in a molecule of *T* is [IIT 2019]

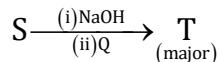
**Scheme 1:**



**Scheme 2:**

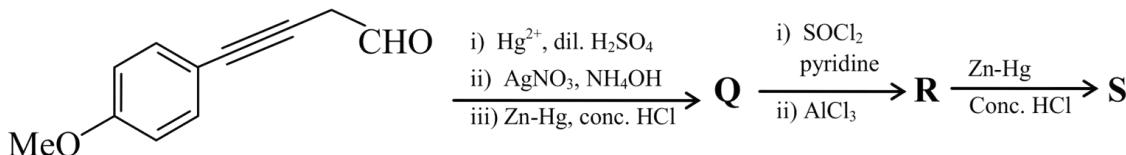


**Scheme 3:**

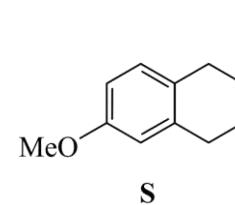
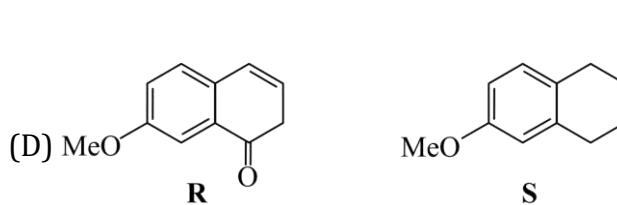
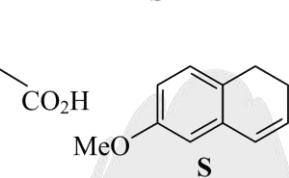
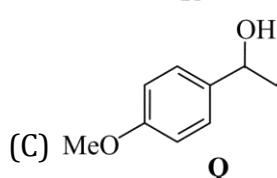
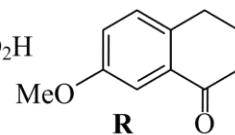
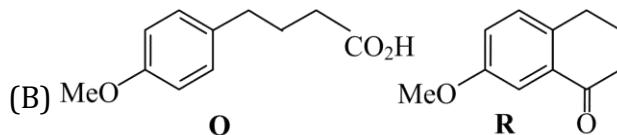
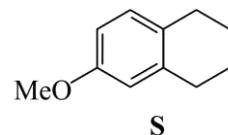
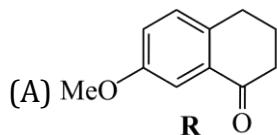


Q.66 Choose the correct option(s) for the following reaction sequence

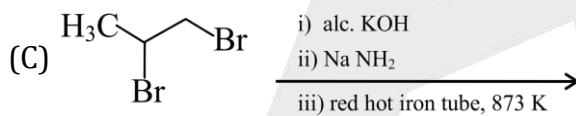
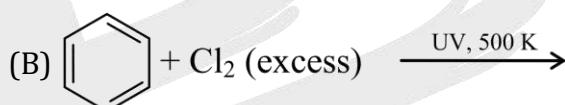
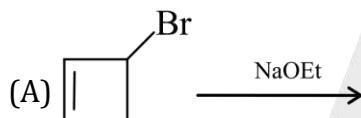
[IIT 2019]



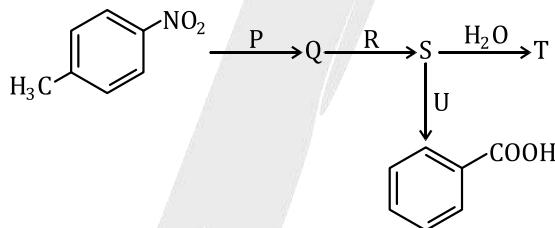
Consider Q, R and S as major products



Q.67 Choose the correct option(s) that gives(s) an aromatic compound as the major product [IIT 2019]



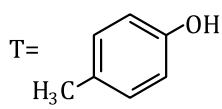
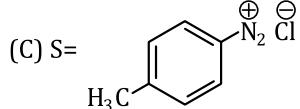
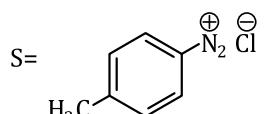
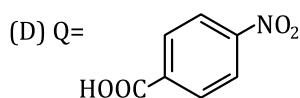
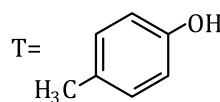
Q.68 Considering the following reaction sequence,



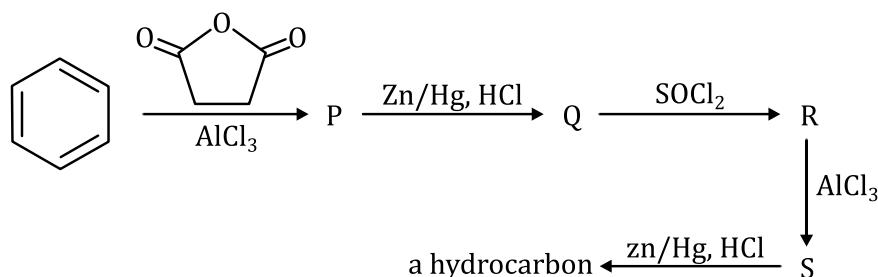
the correct option(s) is(are)

(A) P=  $\text{H}_2/\text{Pd}$ , ethanolR=  $\text{NaNO}_2/\text{HCl}$ U= 1.  $\text{H}_3\text{PO}_2$ 2.  $\text{KMnO}_4 - \text{KOH, heat}$ 

(B) P= Sn/HCl

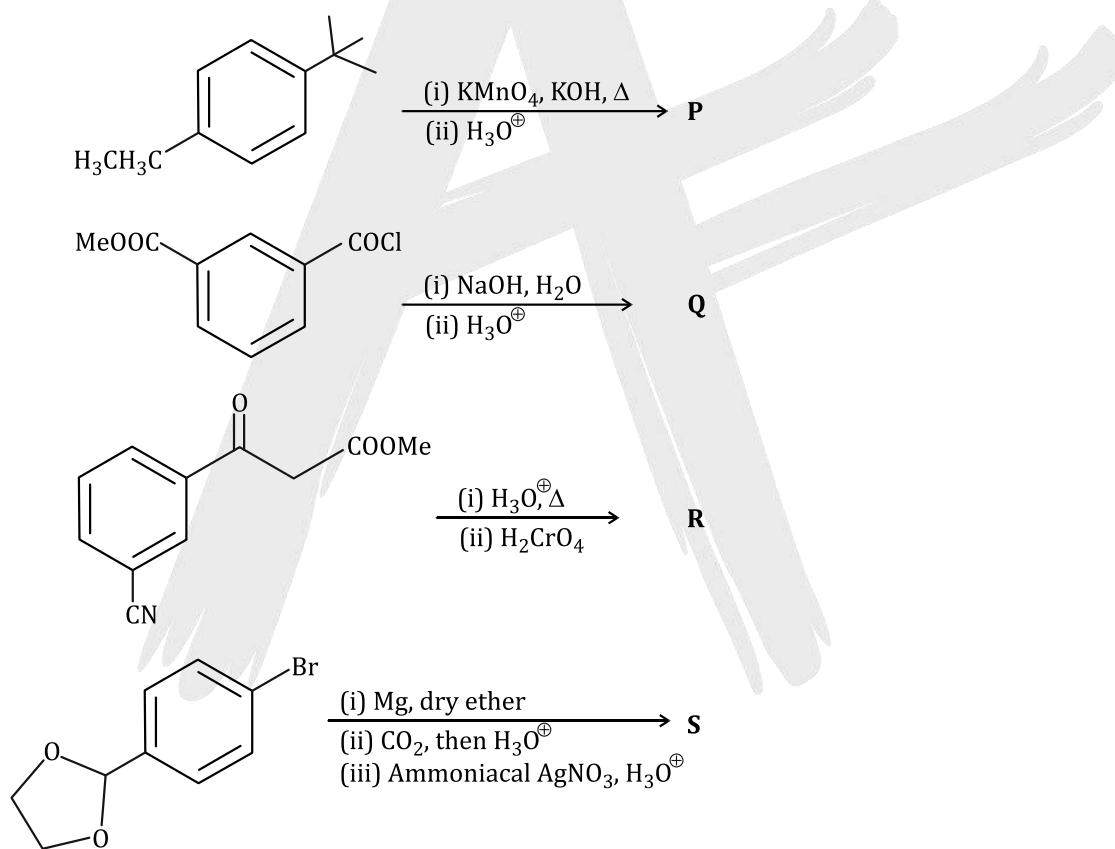
R=  $\text{HNO}_2$ U= 1.  $\text{CH}_3\text{CH}_2\text{OH}$   
2.  $\text{KMnO}_4 - \text{KOH, heat}$ R=  $\text{H}_2/\text{Pd}$ , ethanol

**Q.69** Considering the following reaction sequence, the correct statement(s) is (are)



- (A) Compounds P and Q are carboxylic acids.
- (B) Compounds S decolorizes bromine water.
- (C) Compounds P and S react with hydroxylamine to give the corresponding oximes.
- (C) Compound R reacts with dialkylcadmium to give the corresponding tertiary alcohol.

**Q.70** In the following reactions, P, Q, R and S are the major products.

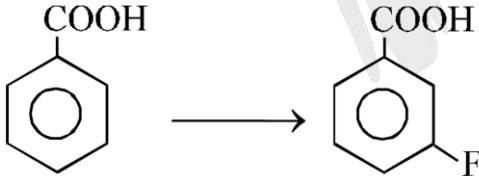


The correct statement(s) about P, Q, R, and S is(are)

- (A) P and Q are monomers of polymers dacron and glyptal, respectively.
- (B) P, Q, and R are dicarboxylic acids.
- (C) Compounds Q and R are the same.
- (D) R does not undergo aldol condensation and S does not undergo Cannizzaro reaction.

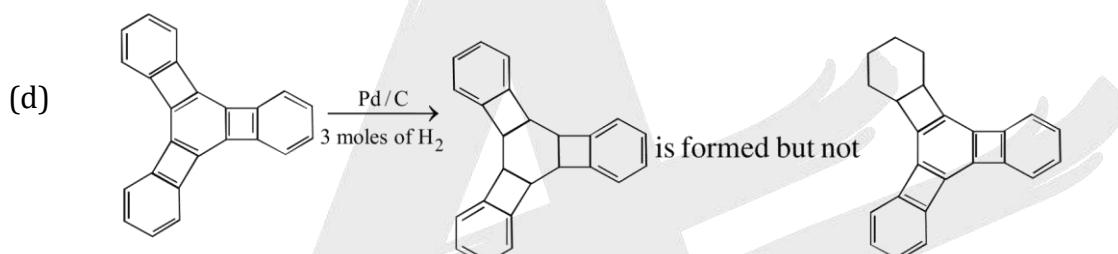
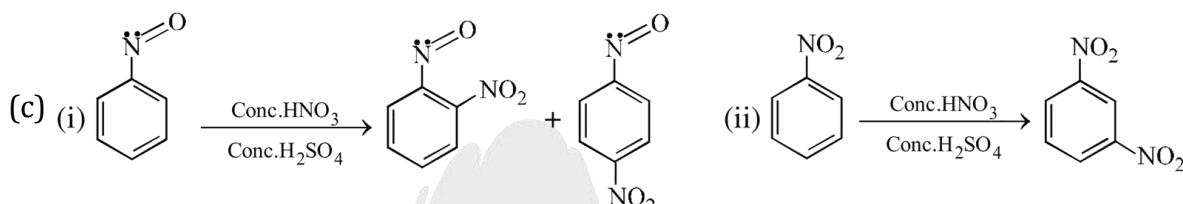
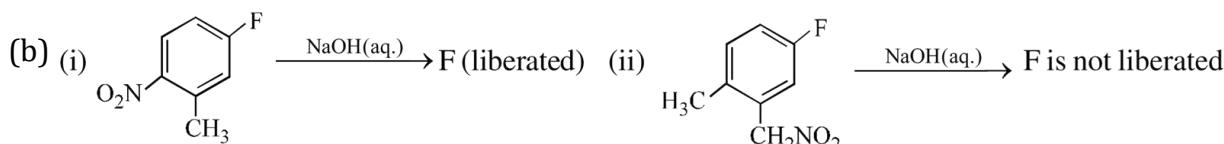
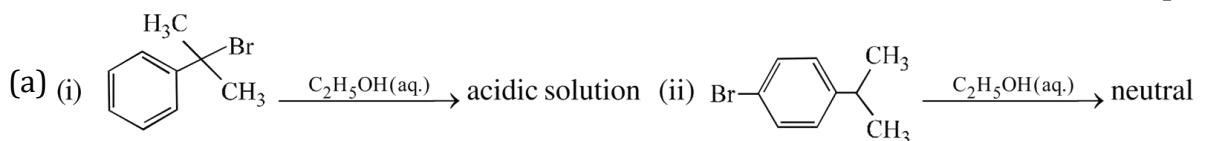


## EXERCISE # IV B (ADVANCE)

- Q.1**  +  $(CH_3)_2CH.CH_2Cl \xrightarrow{AlCl_3} (A)$  [JEE 1992]
- Q.2**  $C_6H_5C_2H_5 \xrightarrow{(i) Br_2, Heat, Light}$   $\xrightarrow{(ii) NaCN} (B)$  [JEE 1994]
- Q.3** An organic compound (A).  $C_8H_6$  on treatment with dilute sulphuric acid containing mercuric sulphate gives a compound (B), which can also be obtained from a reaction of benzene with an acid chloride in the presence of anhydrous aluminium chloride. The compound (B), when treated with iodine in aqueous KOH, yields (C) and a yellow compound (D). Identify (A), (B), (C) and (D) with justification. Show how (B) is formed from (A)? [JEE 1994]
- Q.4** Toluene reacts with bromine in the presence of light to give benzyl bromide while in presence of  $FeBr_3$  it gives p-bromotoluene. Give explanation for the above observations. [JEE 1996]
- Q.5** Show the steps to carry out the following transformations: [JEE 1998]
   
(a) Ethylbenzene  $\rightarrow$  benzene
   
(b) Ethylbenzene  $\rightarrow$  2-phenylpropionic acid
- Q.6**  $C_6H_5CH_2CHClC_6H_5 \xrightarrow{\text{alcoholic KOH, heat}} (A) + (B)$  [JEE 1998]
   
(Cis and trans forms)
- Q.7** Normally, benzene gives electrophilic substitution reaction rather than thus electrophilic addition reaction although it has double bonds. [JEE 2000]
- Q.8** How would you synthesis 4 methoxyphenol from bromobenzene in NOT more than five steps? State clearly the reagents used in each step and show the structures of the intermediate compounds in your synthetic scheme. [JEE 2001]
- Q.9** Carry out following conversions in 3 or less steps. [JEE 2003]
- 
- Q.10** A compound  $C_9H_7O_2Cl$  exists in keto form A and enolic form B. Enolic form B predominates at equilibrium. On oxidation with  $KMnO_4$  it gives m-chlorobenzoic acid. Give structures of A and B. [JEE 2003]
- Q.11** 7-bromo-1, 3, 5-cycloheptatriene is ionic compound, whereas 5-bromo-1,3-cyclopentadiene can't ionise even in the presence of  $Ag^+$ , Explain why? [JEE 2004]

Q.12 Give reasons:

[JEE 2005]



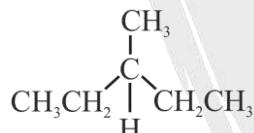
Q.13  $\left( \begin{array}{l} \text{Brown fumes and} \\ \text{pungent smell} \end{array} \right)$  B  $\xleftarrow{\text{NaBr} + \text{MnO}_2}$  A  $\xrightarrow{\text{Conc. HNO}_3}$  C (intermediate)  $\xrightarrow{\text{C}_6\text{H}_5\text{CH}_3}$  D (Explosive product)

Find A, B, C and D. Also write equations A to B and A to C.

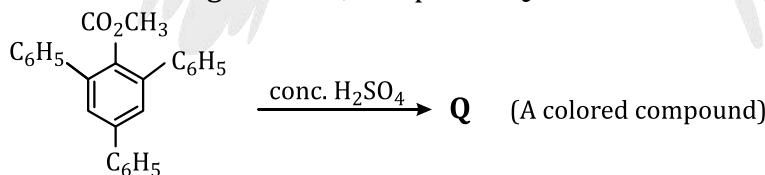
[JEE 2005]

Q.14 The maximum number of isomers (including stereoisomers) that are possible on mono-chlorination of the following compounds, is

[JEE 2011]

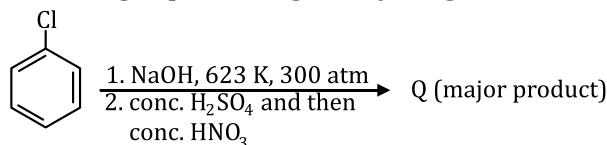


Q.15 In the following reaction, compound Q is obtained from compound P via an ionic intermediate.

**P**

What is the degree of unsaturation of Q?

Q.16 The weight percentage of hydrogen in Q, formed in the following reaction sequence, is



[Given: Atomic mass of H = 1, C = 12, N = 14, O = 16, S = 32, Cl = 35]

**ANSWER KEY****EXERCISE-I**

- |            |   |            |   |            |   |            |   |            |   |            |   |            |   |
|------------|---|------------|---|------------|---|------------|---|------------|---|------------|---|------------|---|
| <b>1.</b>  | B | <b>2.</b>  | C | <b>3.</b>  | C | <b>4.</b>  | C | <b>5.</b>  | C | <b>6.</b>  | B | <b>7.</b>  | D |
| <b>8.</b>  | B | <b>9.</b>  | B | <b>10.</b> | D | <b>11.</b> | A | <b>12.</b> | C | <b>13.</b> | A | <b>14.</b> | B |
| <b>15.</b> | A | <b>16.</b> | B | <b>17.</b> | B | <b>18.</b> | D | <b>19.</b> | B | <b>20.</b> | B | <b>21.</b> | A |
| <b>22.</b> | A | <b>23.</b> | B | <b>24.</b> | C | <b>25.</b> | A | <b>26.</b> | C | <b>27.</b> | B | <b>28.</b> | B |
| <b>29.</b> | B | <b>30.</b> | A | <b>31.</b> | D | <b>32.</b> | C | <b>33.</b> | C | <b>34.</b> | D | <b>35.</b> | D |
| <b>36.</b> | A | <b>37.</b> | D | <b>38.</b> | C | <b>39.</b> | C | <b>40.</b> | A | <b>41.</b> | A | <b>42.</b> | B |
| <b>43.</b> | C | <b>44.</b> | A | <b>45.</b> | D | <b>46.</b> | A | <b>47.</b> | A | <b>48.</b> | C | <b>49.</b> | A |
| <b>50.</b> | B | <b>51.</b> | C |            |   |            |   |            |   |            |   |            |   |

**EXERCISE-II**

- |            |                |            |     |            |                          |            |     |            |                            |            |                         |            |     |
|------------|----------------|------------|-----|------------|--------------------------|------------|-----|------------|----------------------------|------------|-------------------------|------------|-----|
| <b>1.</b>  | ABCD           | <b>2.</b>  | ABD | <b>3.</b>  | BD                       | <b>4.</b>  | BCD | <b>5.</b>  | ABC                        | <b>6.</b>  | ABD                     | <b>7.</b>  | BD  |
| <b>8.</b>  | CD             | <b>9.</b>  | CD  | <b>10.</b> | BC                       | <b>11.</b> | BCD | <b>12.</b> | AB                         | <b>13.</b> | ABCD                    | <b>14.</b> | ABC |
| <b>15.</b> | AC             | <b>16.</b> | ABD | <b>17.</b> | BCD                      | <b>18.</b> | ABC | <b>19.</b> | ABC                        | <b>20.</b> | ABCD                    | <b>21.</b> | C   |
| <b>22.</b> | B              | <b>23.</b> | A   | <b>24.</b> | ACD                      | <b>25.</b> | BC  | <b>26.</b> | ABD                        | <b>27.</b> | A                       | <b>28.</b> | A   |
| <b>29.</b> | B              | <b>30.</b> | A   | <b>31.</b> | A→Q; B→PRS; C→RS; D→PQRS |            |     | <b>33.</b> | A→PS; B→PR; C→QS; D→PR     |            |                         |            |     |
| <b>32.</b> | A→Q; B→P; C→R; |            |     |            |                          |            |     | <b>34.</b> | A→QRS; B→PRS; C→RS; D→QRS; | <b>35.</b> | A→RT; B→RS; C→QS; D→PR; |            |     |



## EXERCISE-III

- Q.1**
- Q.2** (i) (ii) (iii) (iv) (v)
- Q.3** (i) (ii)
- Q.4**
- Q.5**
- Q.7** Due to more electron density
- Q.8** (A)  $\text{CH}_3 - \underset{\underset{\text{O}}{\parallel}}{\text{C}} - \text{OH}$  (B)  $\text{CH}_3 - \underset{\underset{\text{O}}{\parallel}}{\text{C}} - \text{Cl}$  (C)  $\text{CH}_3 - \text{CH}_2 - \underset{\underset{\text{O}}{\parallel}}{\text{C}} - \text{OH}$
- (D)  $\text{CH}_3 - \text{CH}_2 - \underset{\underset{\text{O}}{\parallel}}{\text{C}} - \text{OCH}_3$  (E)  $\text{CH}_3 - \text{CH}_2 - \underset{\underset{\text{O}}{\parallel}}{\text{C}} - \text{CH}_3$
- Q.9**
- Q.10** 5      **Q.11** 3      **Q.12** 4      **Q.13** 7      **Q.14** B      **Q.15** C

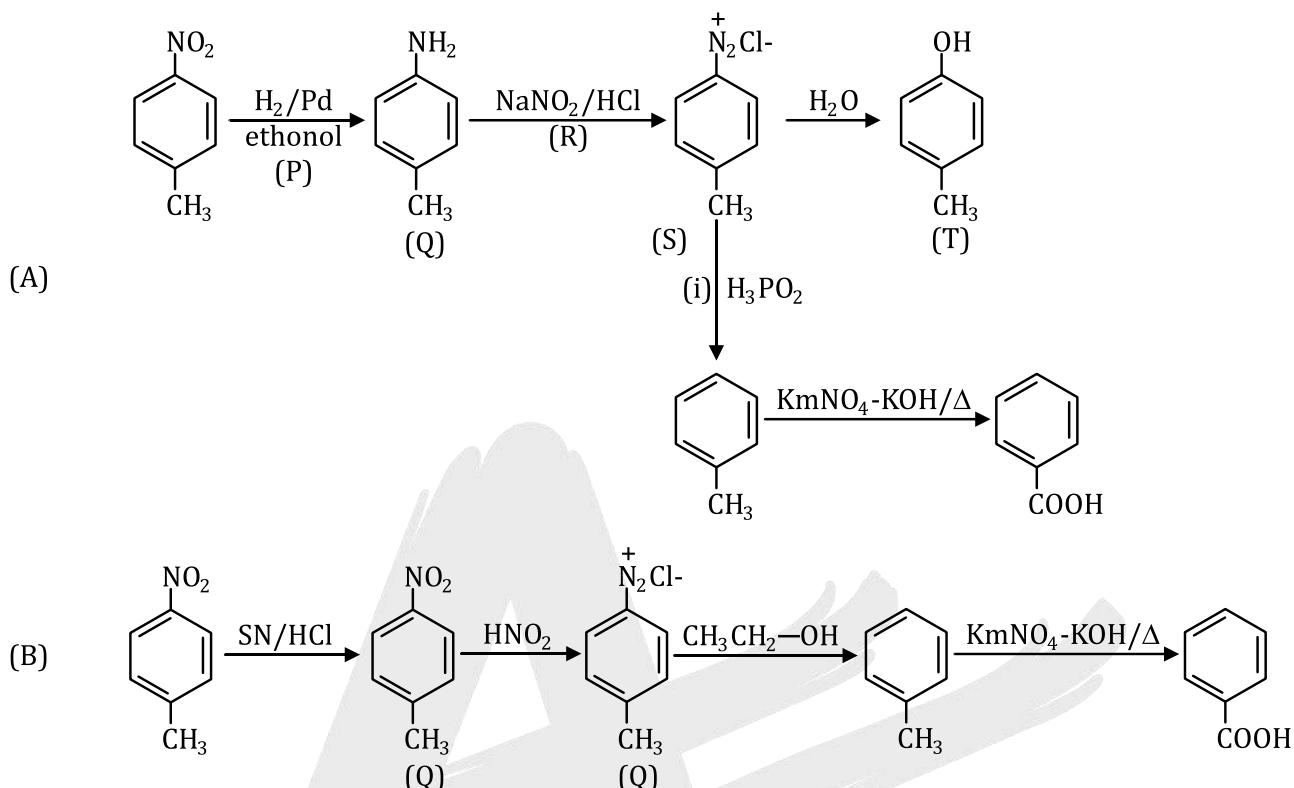
**EXERCISE-IV (JEE-MAIN)**

- |            |         |            |     |            |     |            |     |            |     |
|------------|---------|------------|-----|------------|-----|------------|-----|------------|-----|
| <b>1.</b>  | 2       | <b>2.</b>  | 1   | <b>3.</b>  | 4   | <b>4.</b>  | 1   | <b>5.</b>  | 4   |
| <b>6.</b>  | 2       | <b>7.</b>  | 4   | <b>8.</b>  | 2   | <b>9.</b>  | 4   | <b>10.</b> | 1   |
| <b>11.</b> | 2       | <b>12.</b> | 3   | <b>13.</b> | 1   | <b>14.</b> | 2   | <b>15.</b> | 3   |
| <b>16.</b> | 4       | <b>17.</b> | 2   | <b>18.</b> | 2   | <b>19.</b> | 4   | <b>20.</b> | 3   |
| <b>21.</b> | 1       | <b>22.</b> | 2   | <b>23.</b> | 1   | <b>24.</b> | 2   | <b>25.</b> | 4   |
| <b>26.</b> | 2       | <b>27.</b> | 3   | <b>28.</b> | 1   | <b>29.</b> | 4   | <b>30.</b> | 4   |
| <b>31.</b> | 4       | <b>32.</b> | 4   | <b>33.</b> | 1   | <b>34.</b> | 2   | <b>35.</b> | 3   |
| <b>36.</b> | 1       | <b>37.</b> | 2   | <b>38.</b> | 2   | <b>39.</b> | 1   | <b>40.</b> | 4   |
| <b>41.</b> | 2       | <b>42.</b> | 2   | <b>43.</b> | 3   | <b>44.</b> | 3   | <b>45.</b> | 3   |
| <b>46.</b> | 3       | <b>47.</b> | (C) | <b>48.</b> | (B) | <b>49.</b> | (A) | <b>50.</b> | (4) |
| <b>51.</b> | (1)     | <b>52.</b> | (D) | <b>53.</b> | (A) | <b>54.</b> | (B) | <b>55.</b> | (B) |
| <b>56.</b> | (13.00) | <b>57.</b> | (B) | <b>58.</b> | (D) | <b>59.</b> | (B) | <b>60.</b> | (B) |
| <b>61.</b> | (C)     | <b>62.</b> | (A) | <b>63.</b> | (C) | <b>64.</b> | (D) |            |     |

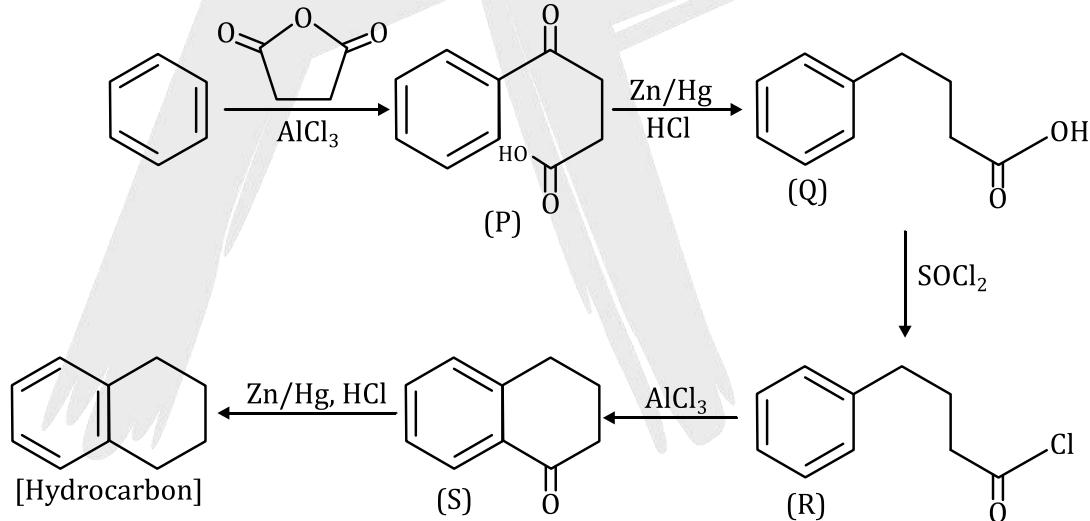
**EXERCISE-IV- A (JEE-ADVANCE)**

- |            |                          |            |                       |            |      |            |     |            |         |
|------------|--------------------------|------------|-----------------------|------------|------|------------|-----|------------|---------|
| <b>1.</b>  | D                        | <b>2.</b>  | B                     | <b>3.</b>  | A    | <b>4.</b>  | D   | <b>5.</b>  | AB      |
| <b>6.</b>  | C                        | <b>7.</b>  | C                     | <b>8.</b>  | D    | <b>9.</b>  | C   | <b>10.</b> | C       |
| <b>11.</b> | A                        | <b>12.</b> | AC                    | <b>13.</b> | C    | <b>14.</b> | B   | <b>15.</b> | D       |
| <b>16.</b> | AC                       | <b>17.</b> | D                     | <b>18.</b> | C    | <b>19.</b> | B   | <b>20.</b> | D       |
| <b>21.</b> | C                        | <b>22.</b> | D                     | <b>23.</b> | C    | <b>24.</b> | D   | <b>25.</b> | D       |
| <b>26.</b> | B                        | <b>27.</b> | C                     | <b>28.</b> | C    | <b>29.</b> | B   | <b>30.</b> | B       |
| <b>31.</b> | C                        | <b>32.</b> | D                     | <b>33.</b> | ABC  | <b>34.</b> | C   | <b>35.</b> | A       |
| <b>36.</b> | D                        | <b>37.</b> | A-RS; B-T; C-PQ; D-R; |            |      | <b>38.</b> | C   | <b>39.</b> | C       |
| <b>40.</b> | A-RST; B-PS; C-RS; D-QR; |            |                       | <b>41.</b> | ABCD | <b>42.</b> | B   | <b>43.</b> | BD      |
| <b>44.</b> | A                        | <b>45.</b> | B                     | <b>46.</b> | A    | <b>47.</b> | ABC | <b>48.</b> | C       |
| <b>49.</b> | B                        | <b>50.</b> | A                     | <b>51.</b> | 4    | <b>52.</b> | BC  | <b>53.</b> | B       |
| <b>54.</b> | BCD                      | <b>55.</b> | C                     | <b>56.</b> | D    | <b>57.</b> | A   | <b>58.</b> | B       |
| <b>59.</b> | D                        | <b>60.</b> | B                     | <b>61.</b> | C    | <b>62.</b> | A   | <b>63.</b> | D       |
| <b>64.</b> | 495                      | <b>65.</b> | 4.00                  | <b>66.</b> | 1AB  | <b>67.</b> | CD  | <b>68.</b> | (A,B,C) |
| <b>69.</b> | (A, C)                   | <b>70.</b> | (C, D)                |            |      |            |     |            |         |

68. Sol.



69. Sol.

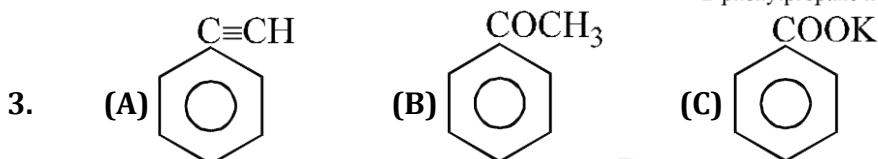


Opt: - A \* Compound P and Q are carboxylic acid

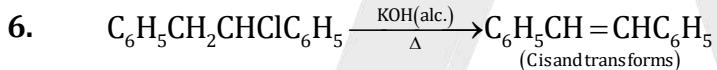
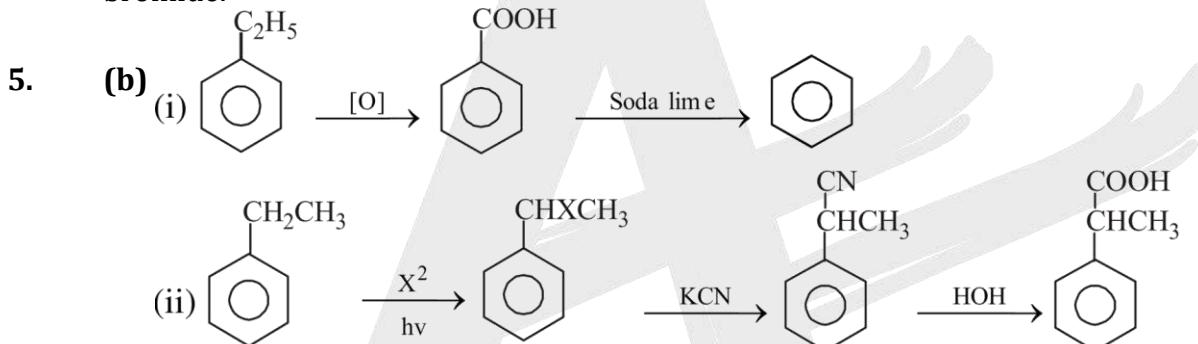
\* Compound S do not decolourise bromine water due to absence of (C = C) bond.

\* Compound P and S react with hydroxylamine to give the corresponding oximes due to presence of ketone group.

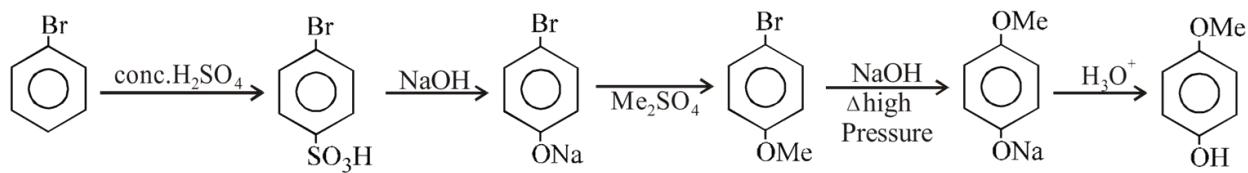
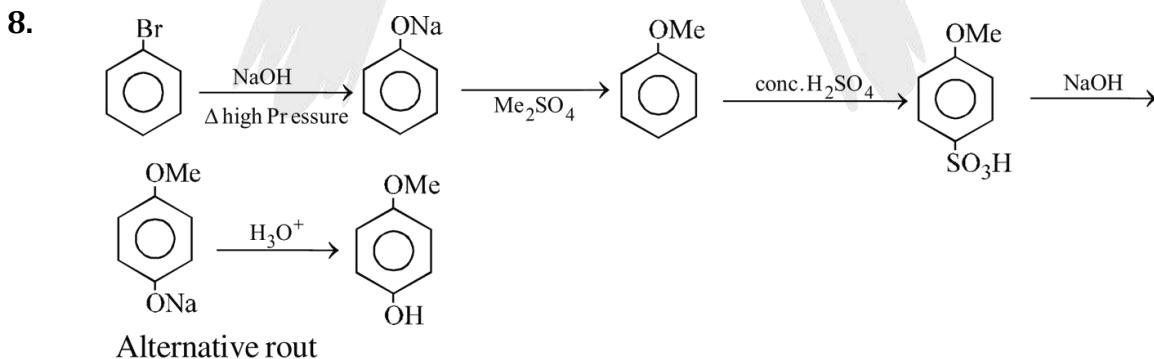
## EXERCISE-IV- B (SUBJECTIVE)

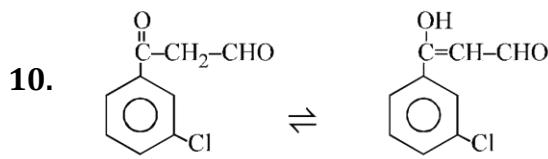
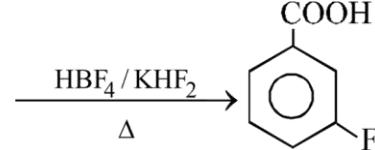
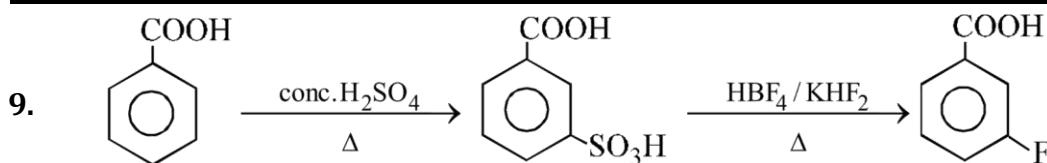


4. In presence of  $\text{FeBr}_3$ ,  $\text{Br}_2$  produces  $\text{Br}^+$  (an electrophile) which attacks the benzene ring at o-, p-position to give p-bromotoluene. In presence of light, side chain is attacked to produce benzyl bromide.



7. Benzene has resonance stabilization due to delocalisation of  $\pi$ -electrons. Also during electrophilic addition reactions, it loses its aromaticity. In electrophilic substitution reaction aromaticity is retained.

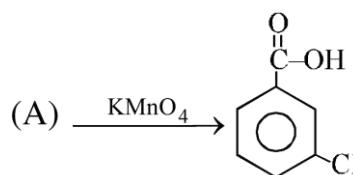




(A)  
Keto

(B)  
Enol

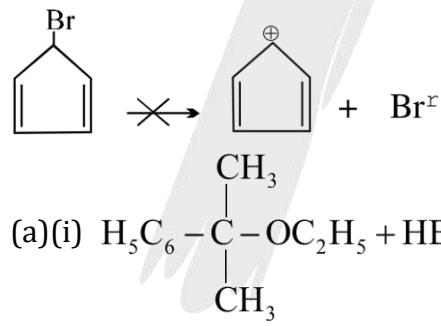
Enol form is more stable due to extended conjugation



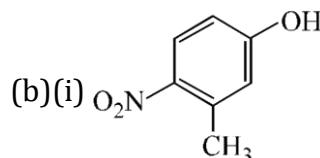
11. On ionization 7-bromo-1,3,4-cycloheptatriene gives tropolium ion which is aromatic with  $6\pi$  electrons.

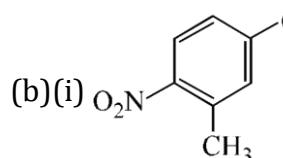


5-bromo-1,3-cyclopentadiene can't ionise as it will in that case give highly unstable antiaromatic cation with  $4\pi$  electrons.



12. (a)(i)  $\text{H}_5\text{C}_6 - \text{C}(\text{CH}_3)_2 - \text{OC}_2\text{H}_5 + \text{HBr}$  (acid); (ii) no reaction due to partial double bond character

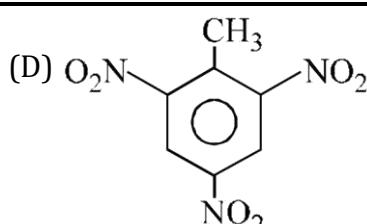


- (b)(i)  +  $\text{F}^-$  is liberated; (ii) Bimolecular mechanism is not possible in (ii) case

(c) (i) Due to presence of lone pair of nitrogen atom NO group is electron donating and ortho, para directing

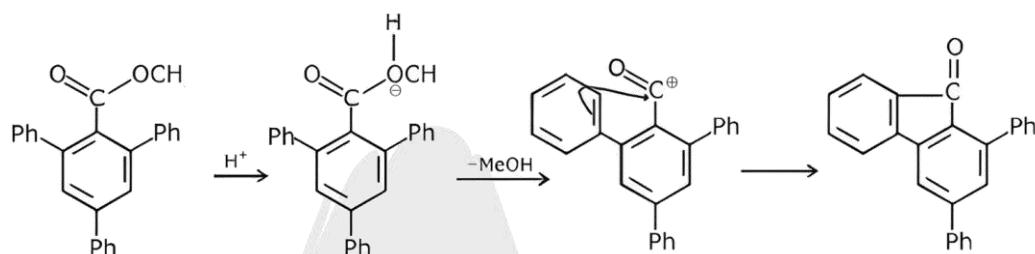
(ii)  $\text{NO}_2$  group is electron withdrawing and meta directing

(d) Due to reduction of central ring, three four membered antiaromatic rings become stable while on reduction of terminal ring only one antiaromatic ring can be stabilized.

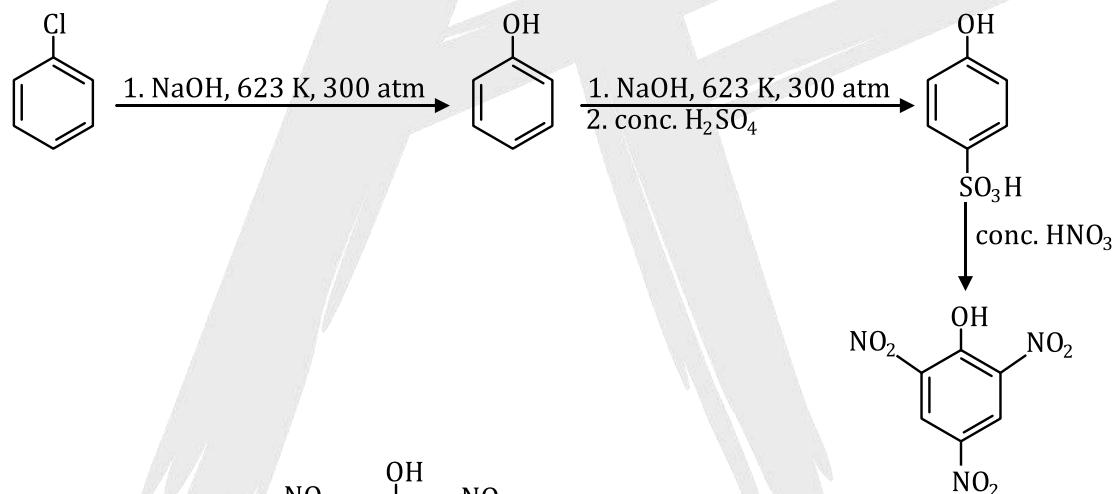
13. (A)  $\text{H}_2\text{SO}_4$ , (B)  $\text{Br}_2$ ,(C)  $\text{NO}_2^\oplus$ ,

14. (8)

15. (18)



The total degree of unsaturation = 18

16.  $1.31\oplus\ominus$ 

Molecular formula of

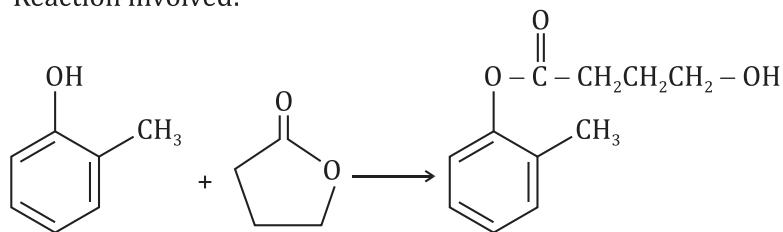
Molecular mass of  $\text{C}_6\text{H}_3\text{N}_3\text{O}_7$  = 229

$$\% \text{ of hydrogen} = \frac{3}{229} \times 100 = 1.31\%$$

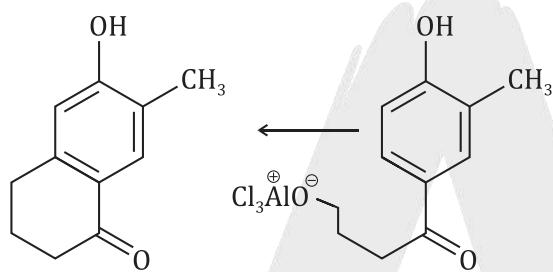
## SOLUTION

## JEE-MAIN

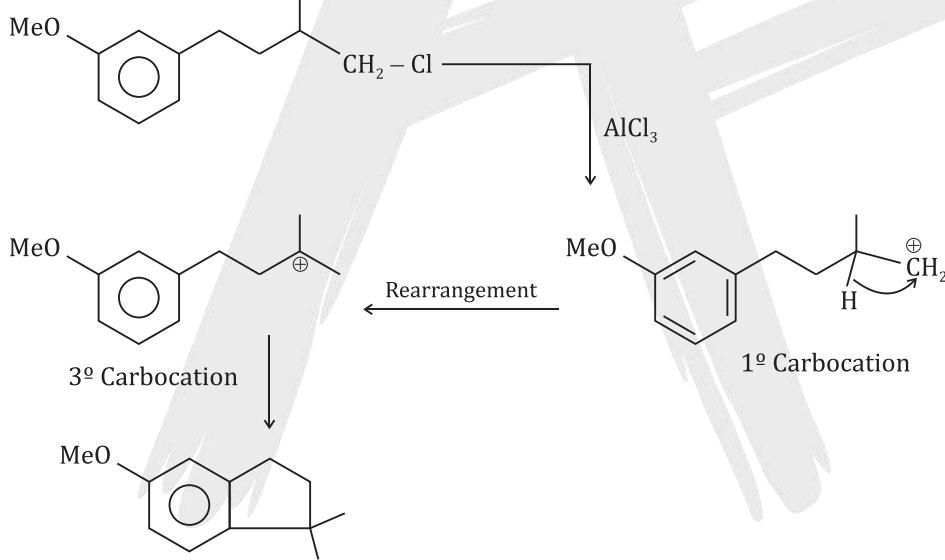
**47.** Reaction involved:



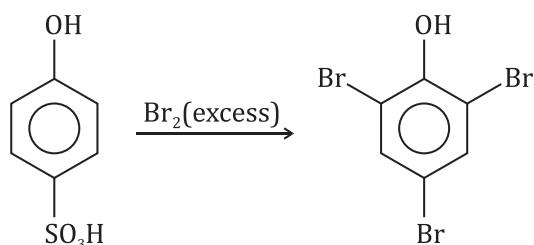
(Fries migration)  $\xrightarrow{\text{AlCl}_3}$



**48.**

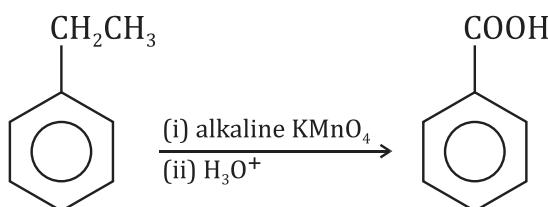


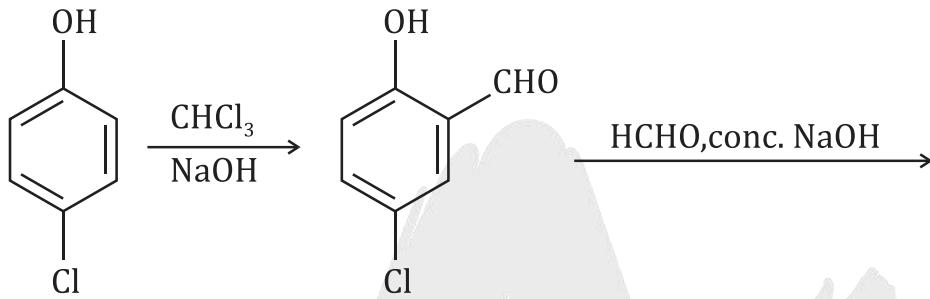
**49.**

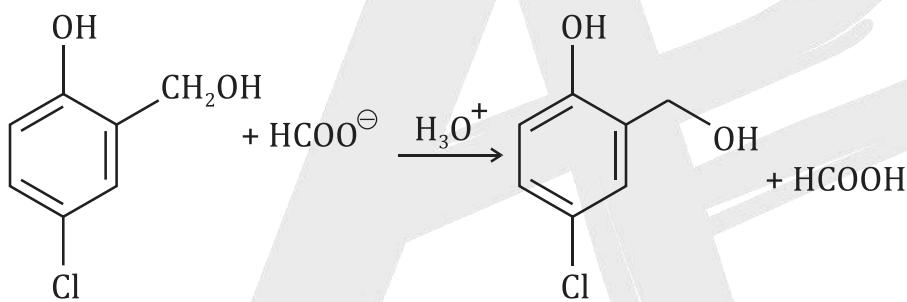


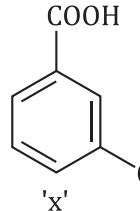
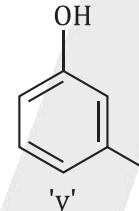
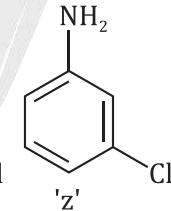
**50.** The force of attraction between the molecules affects the melting point of a compound. Polarity increases the intermolecular force of attraction and as a result increases the melting point.

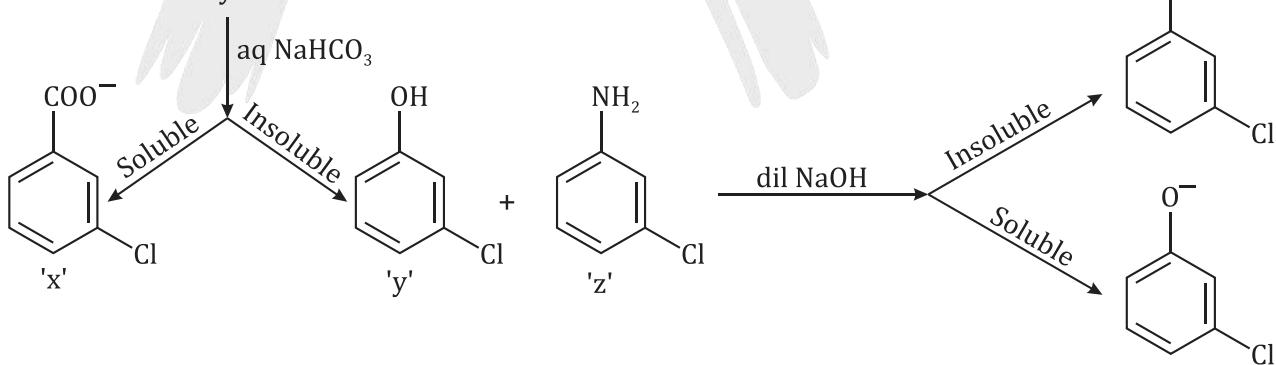
51. Alkaline  $\text{KMnO}_4$  converts  with a benzylic hydrogen into benzoic acid.



52. 
- $\text{OH}$
- $\text{CHCl}_3$   
 $\text{NaOH}$
- $\text{OH}$   
 $\text{CHO}$
- $\text{HCHO, conc. NaOH}$

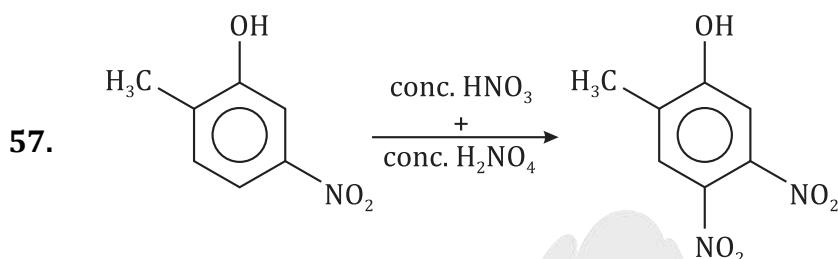
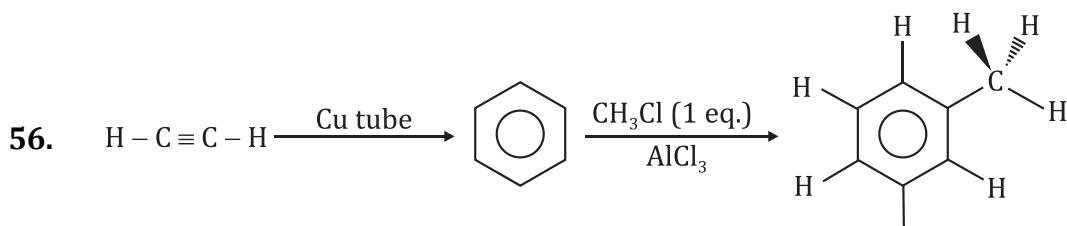


- 53.
- 'x': 
- 'y': 
- 'z': 

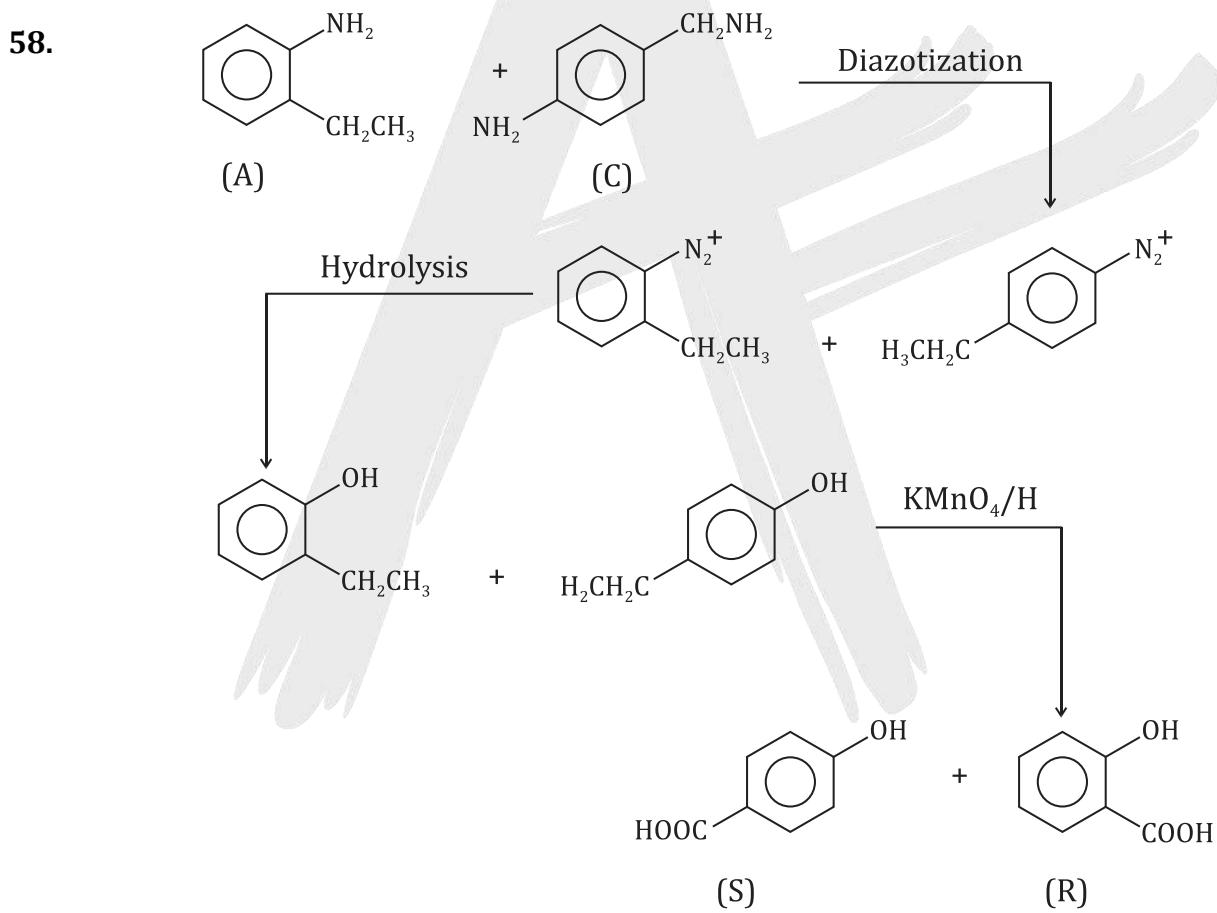


54. Vinyl halides and aryl halides do not give Friedel craft's reaction.

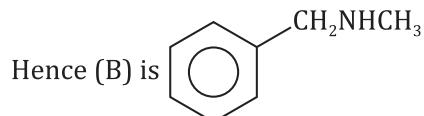
55.  $\text{B}_2\text{H}_6$  is very selective and usually used to reduce acid to alcohol



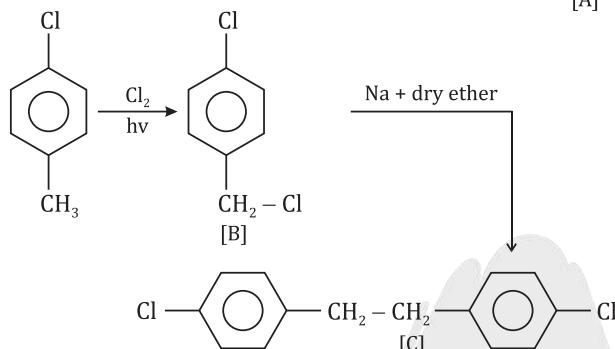
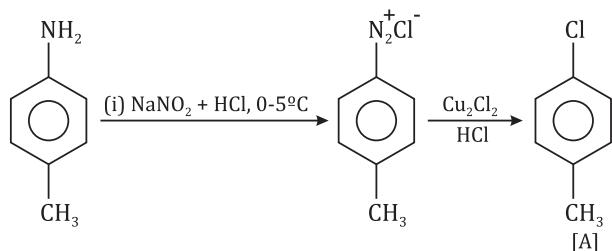
Position of electrophilic attack is directed by the electron donating group present in ring.



(B) gives insoluble product with  $\text{C}_6\text{H}_5\text{SO}_2\text{Cl}$ .



59.



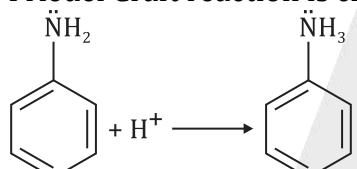
60.

Vinyl halides and aryl halides do not give Friedel craft's reaction.

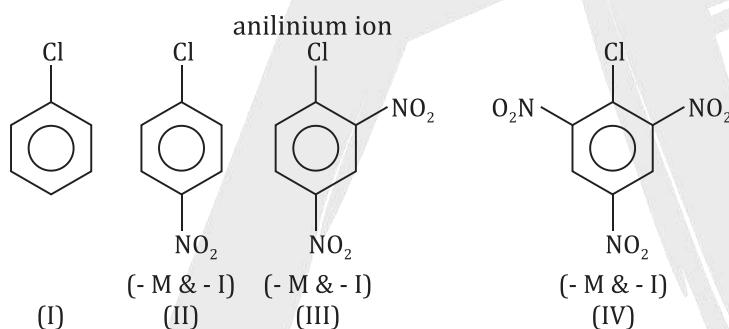
61.

Aniline and phenol form complex with lewis acid so most reactive among the given compounds for Friedel Craft reaction is chlorobenzene.

62.



63.



Reactivity  $\propto$  -m group present at O/P position.

64.

