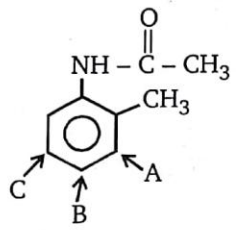
12 AROMATIC COMPOUNDS

LEVEL-1

1.



Identify the position where electrophilic aromatic substitution (EAS) is most favourable.

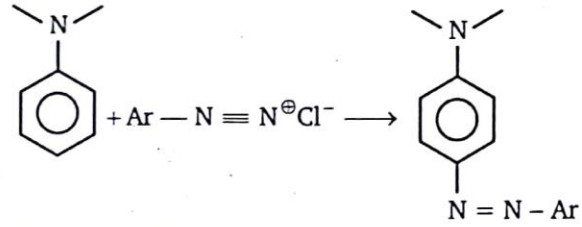
(a) A
(b) B
(c) C
(d) A and C

2.

(a) (b) (c) (d)

Correct order of rate of EAS (electrophilic aromatic substitution) is :

(a) $c > b > a > d$
(b) $c > d > a > b$
(c) $a > b > c > d$
(d) $c > d > b > a$

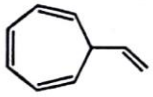
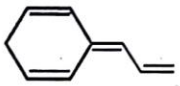
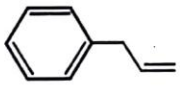
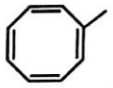
3. 

Above (C—N) coupling reaction take place at :

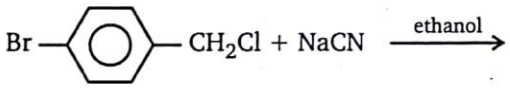
(a) low pH (b) Intermediate pH

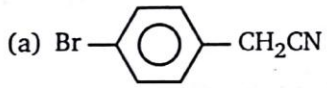
(c) high pH (d) any pH

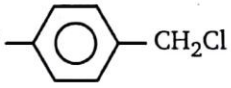
4. Which of the following has the lowest heat of combustion ?

(a)  (b)  (c)  (d) 

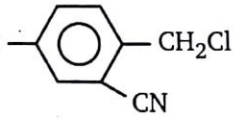
5. The product obtained from the reaction is :

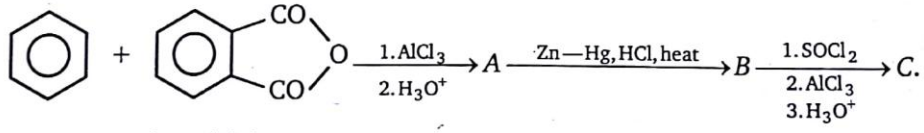


(a) 

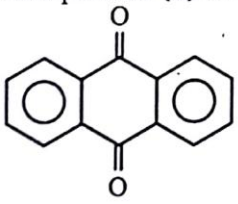
(b) 

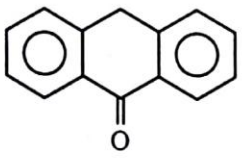
(c) 

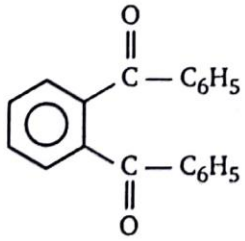
(d) 

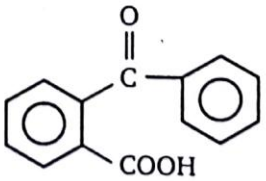
6. 

The end product (*C*) is :

(a) 

(b) 

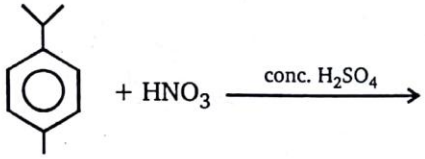
(c) 

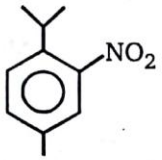
(d) 

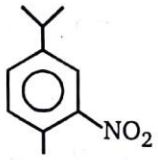
7. How many benzylic hydrogens are present in the hydrocarbon shown below ?

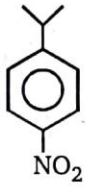
(a) 3 (b) 4 (c) 5 (d) 6 (e) 8

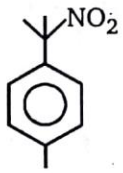
8. The major product formed in the reaction is :



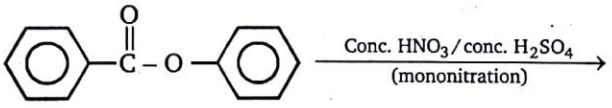
(a) 

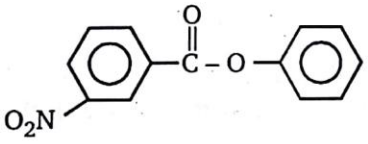
(b) 

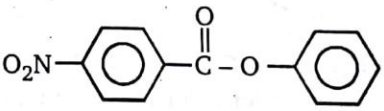
(c) 

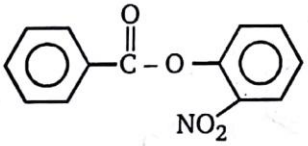
(d) 

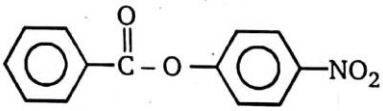
9. The major product formed in the reaction is :



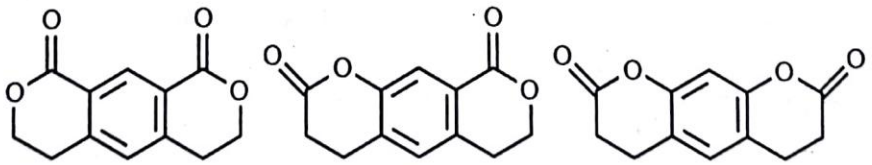
(a) 

(b) 

(c) 

(d) 

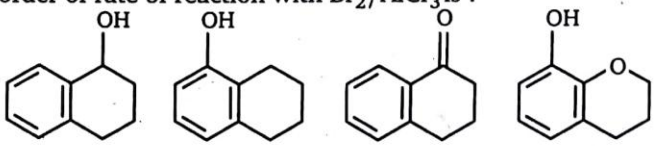
10. Increasing order of rate of reaction with HNO_3/H_2SO_4 is :



(i) (ii) (iii)

(a) iii < ii< i (b) ii < iii < i (c) i < iii < ii (d) i < ii < iii

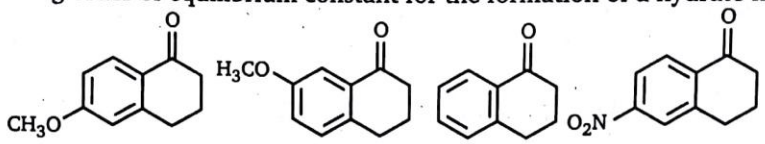
11. Increasing order of rate of reaction with $Br_2/AlCl_3$ is :



(i) (ii) (iii) (iv)

(a) iii < i < ii < iv (b) iv < ii < i < iii (c) ii < iv < iii < i (d) iv < ii < iii < i

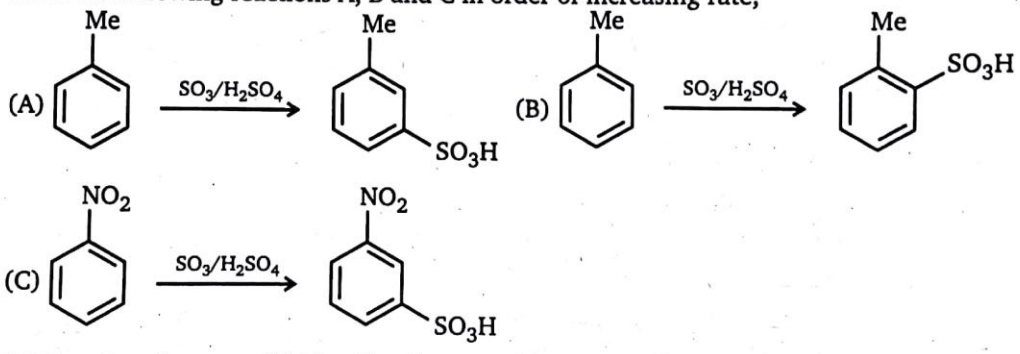
12. Increasing order of equilibrium constant for the formation of a hydrate is :



(i) (ii) (iii) (iv)

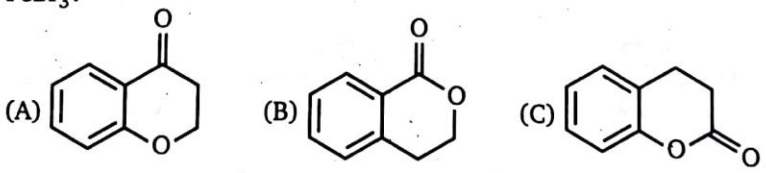
(a) i < ii < iii < iv (b) iv < ii < i < iii (c) ii < iv < iii < i (d) iv < ii < iii < i

13. Rank the following reactions A, B and C in order of increasing rate,



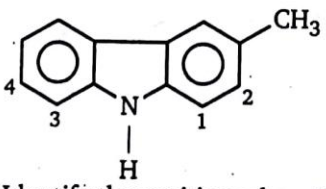
(a) B > A > C (b) B > C > A (c) A > B > C (d) A > C > B

14. Rank in order of increasing rate of reaction towards EAS with bromine in the presence of $FeBr_3$.



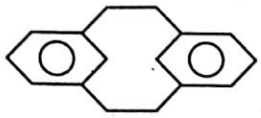
(a) B < A < C (b) B < C < A
(c) A < B < C (d) A < C < B

15.

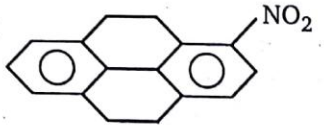


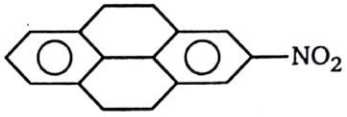
Identify the position where E.A.S. can take place.

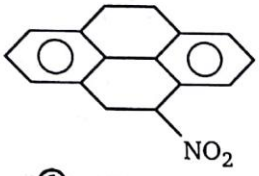
(a) 1 (b) 2 (c) 3 (d) 4

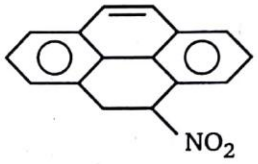
16.  $\xrightarrow[\Delta]{H^+}(A)\xrightarrow[\Delta]{HNO_3}(B).$

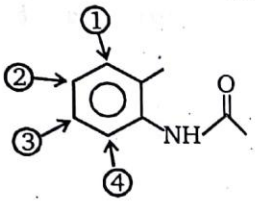
Product (B) in the above reactions is:

(a) 

(b) 

(c) 

(d) 

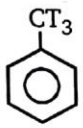
17.  Sulphonation is most favourable at the carbon number... .

(a) 1 (b) 2 (c) 3 (d) 4

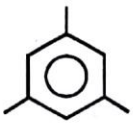
18. Arrange the following in decreasing order of reactivity towards EAS (electrophilic aromatic substitution)


(a)

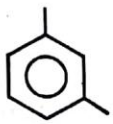

(b)

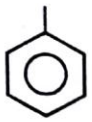

(c)

(a) $a > b > c$ (b) $c > b > a$ (c) $a > c > b$ (d) $c > a > b$

19. 
(a)


(b)


(c)

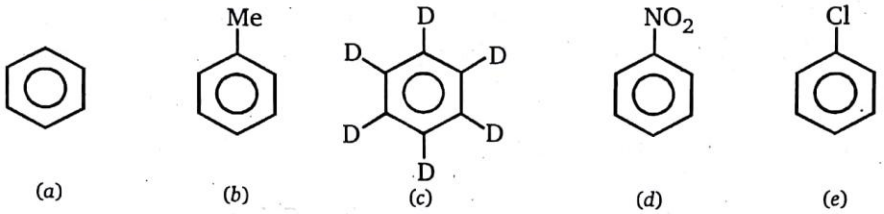

(d)

Decreasing order of rate of electrophilic aromatic substitution is :

(a) $a > b > c > d$ (b) $a > c > b > d$

(c) $b > a > c > d$ (d) $b > c > a > d$

20. Arrange the following in increasing order of rate of Nitration:

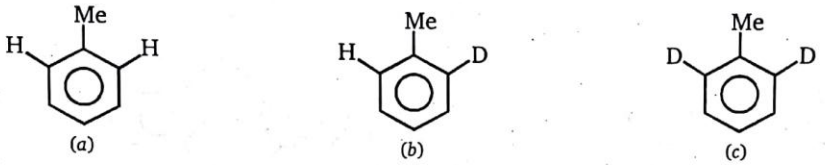


(a) (b) (c) (d) (e)

(a) $b < c < a < d < e$ (b) $d < e < a = c < b$

(c) $d < a = c < e < b$ (d) $a < c < b < e < d$

21.

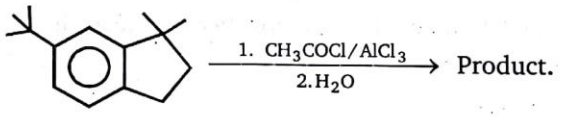


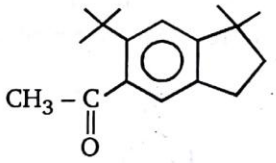
(a) (b) (c)

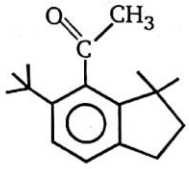
The rate of nitration will be:

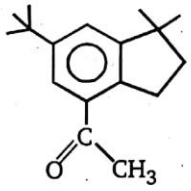
(a) $a > b > c$ (b) $a > c > b$ (c) $a = b = c$ (d) $c > a > b$

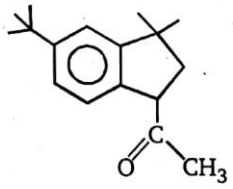
22. The major product of the reaction is



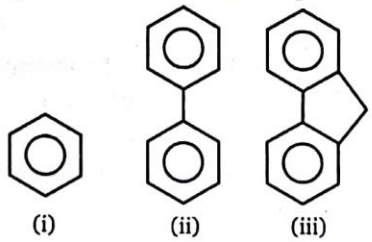
(a) 

(b) 

(c) 

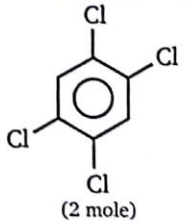
(d) 

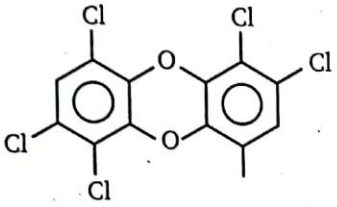
23. Arrange in their decreasing order of rate of electrophilic aromatic substitution :

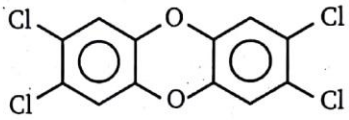


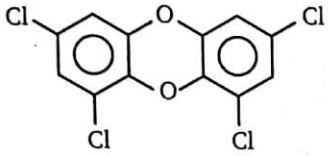
(i) (ii) (iii)

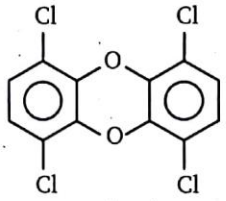
(a) i > ii > iii (b) iii > ii > i (c) iii > i > ii (d) i > iii > ii

24.  + HO^- (4 mole) $\longrightarrow$ (*A*) (major) ; Product (*A*) of the given reaction is :

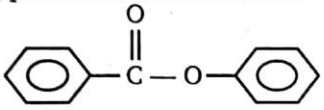
(a) 

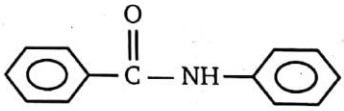
(b) 

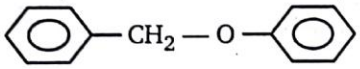
(c) 

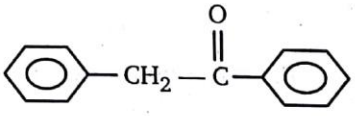
(d) 

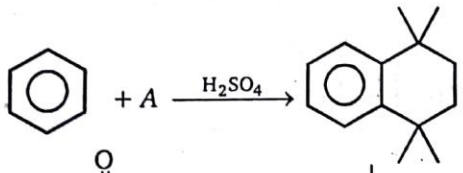
25. In which of the following compound electrophilic aromatic substitution take place in phenyl ring present in left hand side ?

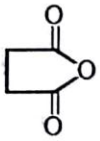
(a) 

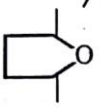
(b) 

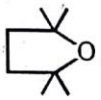
(c) 

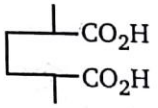
(d) 

26.  ; Reactant (*A*) is :

(a) 

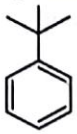
(b) 

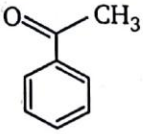
(c) 

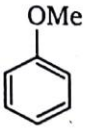
(d) 

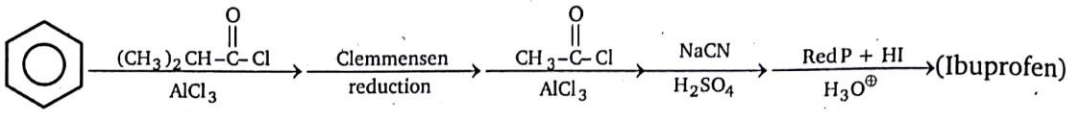
27. Which of the following compounds is the slowest to react with nitrosonium ion (NO^+)?

(a) 

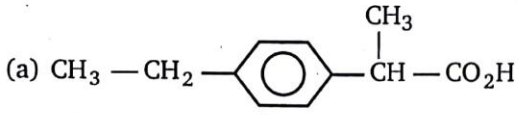
(b) 

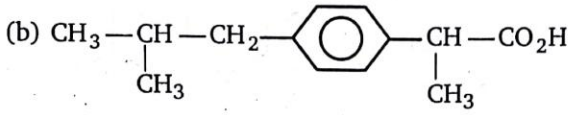
(c) 

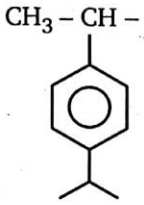
(d) 

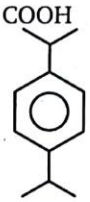
28. 

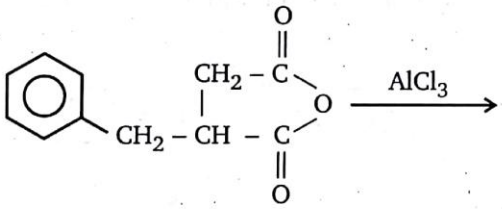
Ibuprofen is :

(a) 

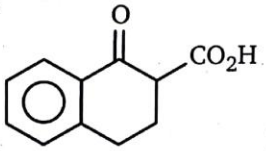
(b) 

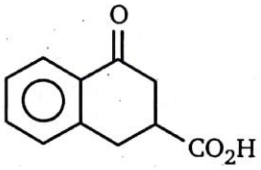
(c) 

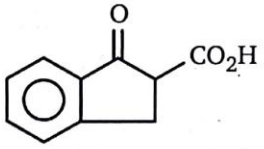
(d) 

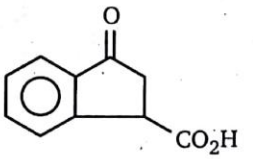
29. 

What is the major product of above Friedel-Craft reaction ?

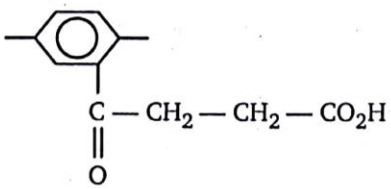
(a) 

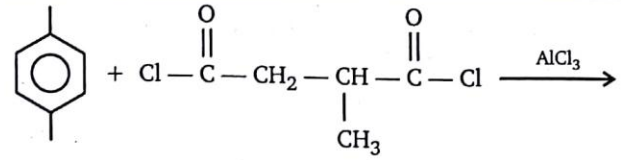
(b) 

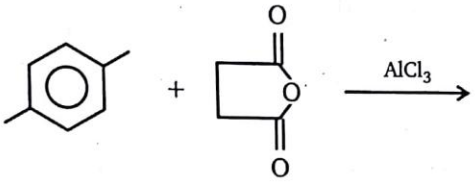
(c) 

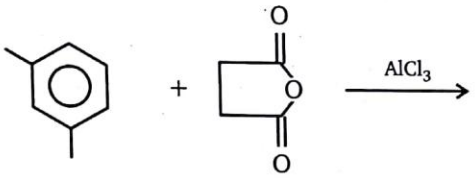
(d) 

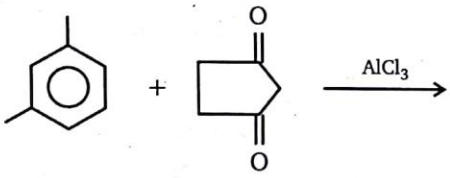
30. What combination of acid chloride or anhydride and arene would you choose to prepare given compound ?



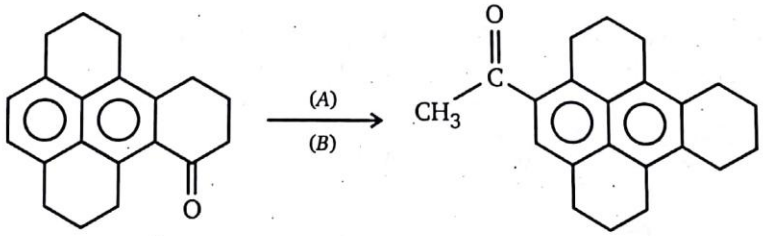
(a) 

(b) 

(c) 

(d) 

31. In the given conversion best yield will obtained with :



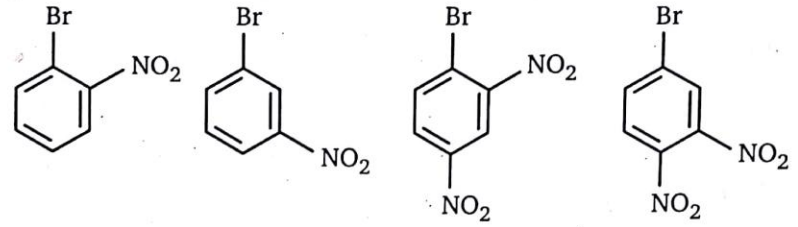
(a) $A = CH_3 - \overset{O}{\overset{\|}{C}} - Cl, AlCl_3$, $B = Zn(Hg)$, HCl

(b) $A = Zn(Hg), HCl$, $B = CH_3 - \overset{O}{\overset{\|}{C}} - Cl$, $AlCl_3$

(c) $A = CH_3 - CH_2 - Cl$, $AlCl_3$, $B = Zn(Hg)$, HCl

(d) $A = NH_2 - NH_2/HO^-, D$, $B = CH_3 - CH_2 - Cl$, $AlCl_3$

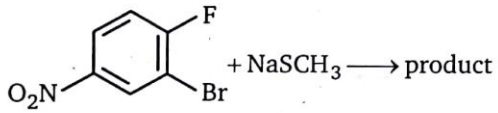
32. Rank the following in order of decreasing rate of reaction with alkoxide ion ($CH_3CH_2O^-$) in a nucleophilic aromatic substitution reaction :



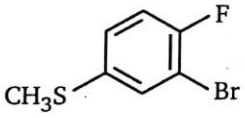
1 2 3 4

(a) 3 > 4 > 1 > 2 (b) 3 > 4 > 2 > 1 (c) 2 > 1 > 4 > 3 (d) 4 > 3 > 2 > 1

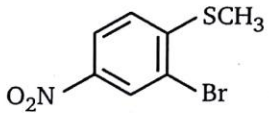
33. Identify the principal organic product of the following reaction.



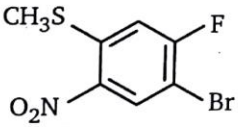
(a)



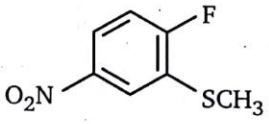
(b)



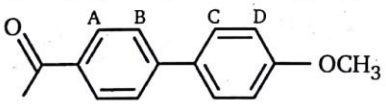
(c)



(d)

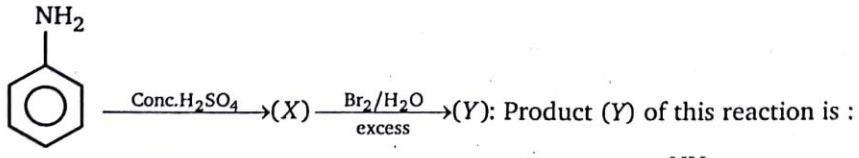


34. Which position will be attacked most rapidly by the nitronium ion $(-NO_2)^+$ when the compound undergoes nitration with HNO_3/H_2SO_4 :



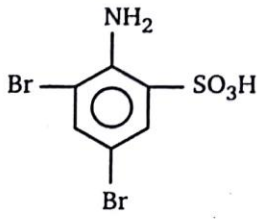
(a) A (b) B (c) C (d) D

35.

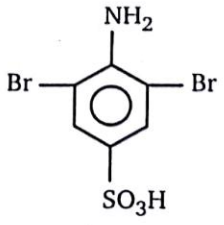


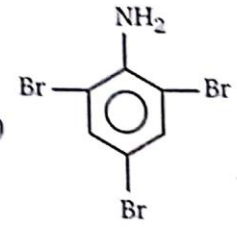
: Product (Y) of this reaction is :

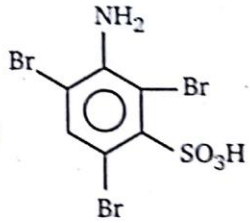
(a)



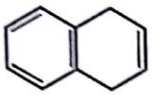
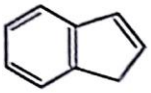
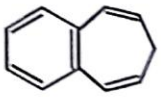
(b)

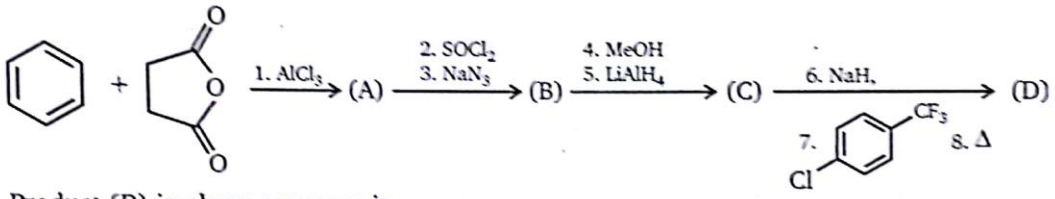


(c) 

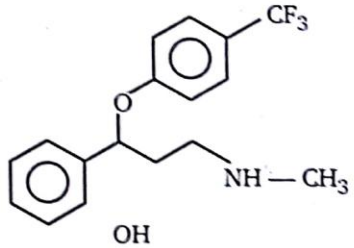
(d) 

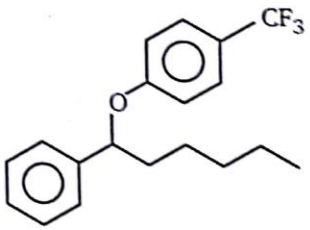
36. All the hydrocarbons shown are very weak acids. One, however, is far more acidic than the others. Which one is the strongest acid ?

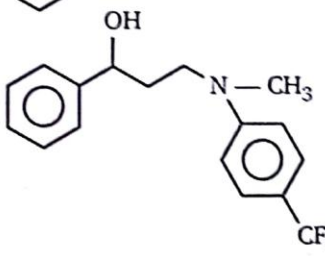
(a)  (b)  (c)  (d) 

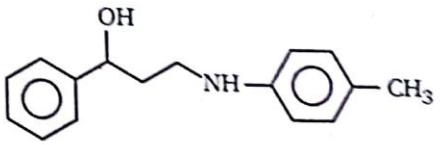
37. 

Product (*D*) in above sequence is :

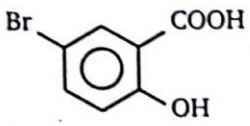
(a) 

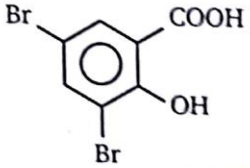
(b) 

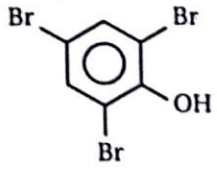
(c) 

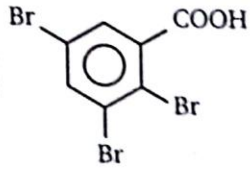
(d) 

38. The action of bromine water (excess) on salicylic acid results in the formation of :

(a) 

(b) 

(c) 

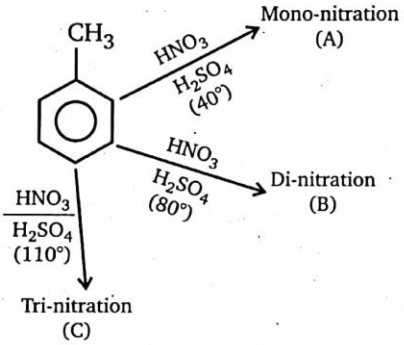
(d) 

39. What is the correct order of *o*/*p* ratio when E^+ attacks the following system ?

PhF (A) PhCl (B) PhBr (C) PhI (D)

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

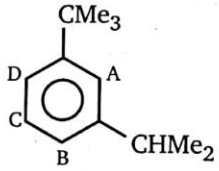
40. How many products are capable of beings formed from toluene in each of following reaction ?



(a) A = 3, B = 6, C = 8 (b) A = 3, B = 6, C = 6

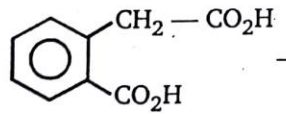
(c) A = 3, B = 6, C = 10 (d) A = 3, B = 4, C = 6

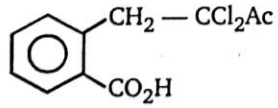
41. Nitration takes place at the which position of the given compound ?

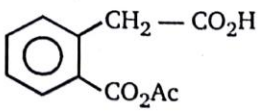


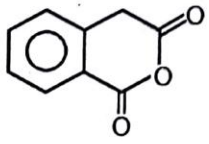
(a) A (b) B

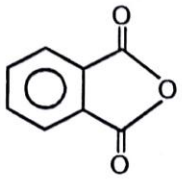
(c) C (d) D

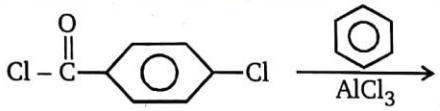
42.  $\xrightarrow[\Delta]{Ac_2O}$? , Indentify the product.

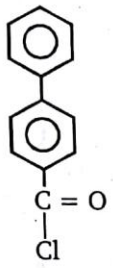
(a) 

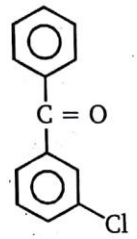
(b) 

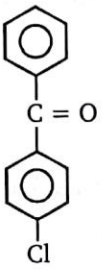
(c) 

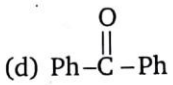
(d) 

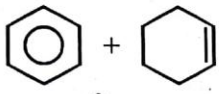
43.  (*A*) ; Unknown (*A*) is :

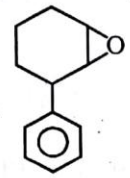
(a) 

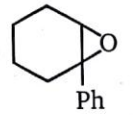
(b) 

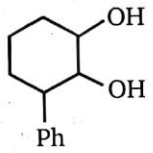
(c) 

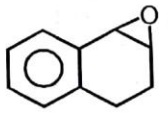
(d) 

44.  (*A*) $\xrightarrow[\text{(2) alc. KOH}]{\text{(1) NBS}}$ (*B*) $\xrightarrow{RCO_3H}$ (*C*). Product (*C*) is :

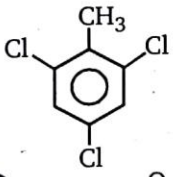
(a) 

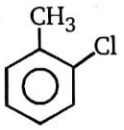
(b) 

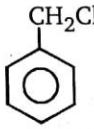
(c) 

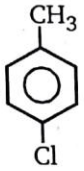
(d) 

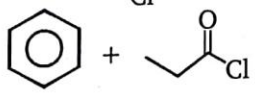
45. The reaction of toluene with chlorine in the presence of light gives :

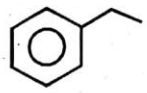
(a) 

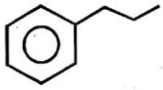
(b) 

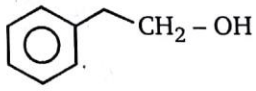
(c) 

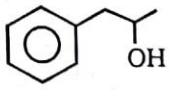
(d) 

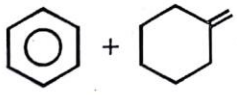
46.  $\xrightarrow[H_2O]{AlCl_3}$ (*A*) $\xrightarrow[HO^-, \Delta]{NH_2-NH_2}$ (*B*), Product (*B*) in this reaction is :

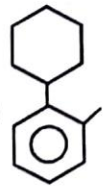
(a) 

(b) 

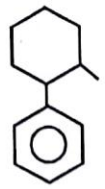
(c) 

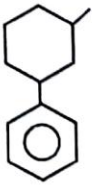
(d) 

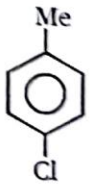
47.  $\xrightarrow[\Delta]{HF}$ Suitable product of this reaction is :

(a) 

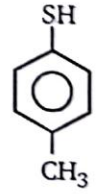
(b) 

(c) 

(d) 

48. 

$\xrightarrow{NaSH}$ *A*; Product (*A*) of the reaction is :

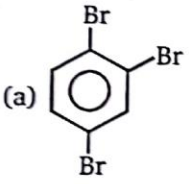
(a) 

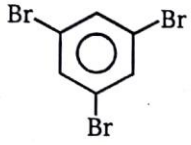
(b) no reaction (c) 

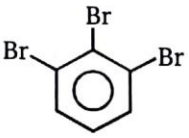
(d) 

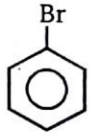
49. 

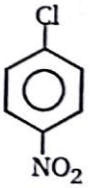
$\xrightarrow[H_2O]{Br_2}$ (*A*) $\xrightarrow[(ii)\ H_3PO_2]{(i)\ NaNO_2/HCl}$ (*B*), Product (*B*) in this reaction is :

(a) 

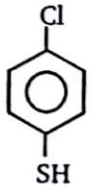
(b) 

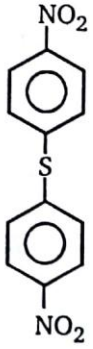
(c) 

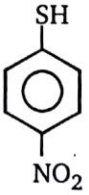
(d) 

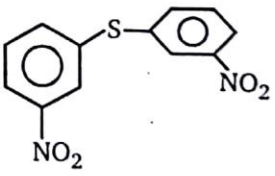
50. 2 

$\xrightarrow{Na_2S}$ (*A*), Product (*A*) in this reaction is :

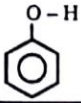
(a) 

(b) 

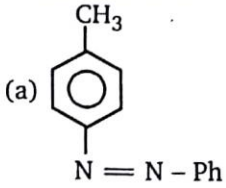
(c) 

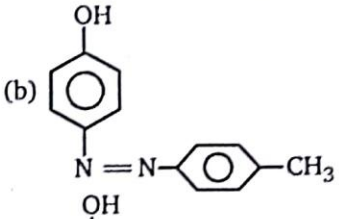
(d) 

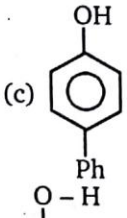
51. 

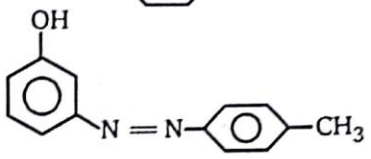
$\xrightarrow{NaNO_2/HCl}$ (*A*) $\xrightarrow[\text{(mild basic medium)}]{}$ 

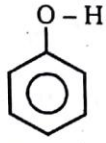
(*B*), (Major) Product (*B*) of this reaction is :

(a) 

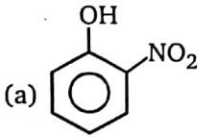
(b) 

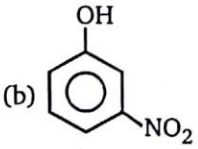
(c) 

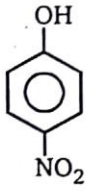
(d) 

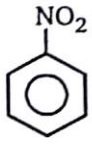
52.  $\xrightarrow{HNO_3/H_2SO_4}$ (*A*) (more volatile) + (*B*) (less volatile)

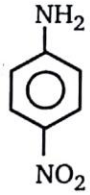
Product (*A*) of the above reaction is :

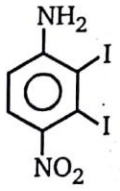
(a) 

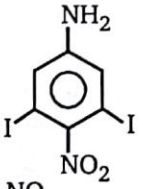
(b) 

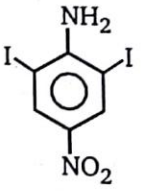
(c) 

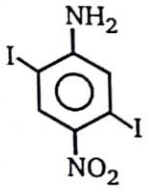
(d) 

53.  $\xrightarrow[(56-63\%)]{2ICl}$ *x* + 2HCl; Major product (*x*) in this reaction is :

(a) 

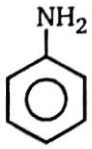
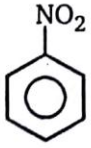
(b) 

(c) 

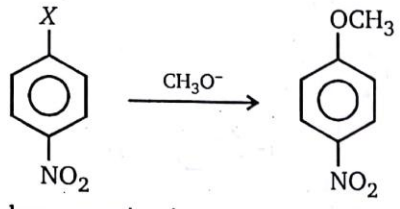
(d) 

54.  $\xrightarrow[H_2SO_4]{HNO_3}$  , van't-Hoff factor (*i*) for this reaction is :

(a) 2 (b) 3 (c) 4 (d) 5

55.  $\xrightarrow{?}$  , the missing reagent is :

(a) CF_3CO_3H (b) H_2SO_4 (c) LAH (d) $NaBH_4$

56. 

above reaction is an example of Nucleophilic aromatic substitution. Which of the following halide ($-X$) is most readily replaced.

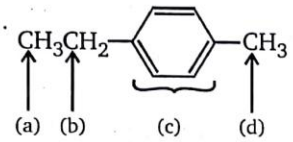
(a) – F (b) – Cl (c) – Br (d) – I

57. When comparing the hydrogenation of benzene with that of a hypothetical 1, 3, 5-cyclohexatriene, benzene _____ than the cyclohexatriene.

(a) absorbs 152 kJ /mol more heat (b) gives off 152 kJ/mol more heat

(c) absorbs 152kJ /mol less heat (d) gives off 152 kJ/mol less heat

58. Which of the following hydrogens is most easily abstracted on reaction with bromine free radicals, Br• ?



(a) a (b) b (c) c (d) d

59. The electrophilic aromatic substitution proceeds through a :

(a) free radical (b) sigma complex (c) benzyne (d) carbene

60. Which of the following substitution of benzene is ortho-para in electrophilic substitution and ortho-para in nucleophilic substitution ?

(a) $-NO_2$ (b) – NO

(c) $-SO_3H$ (d) $-SO_2Me$

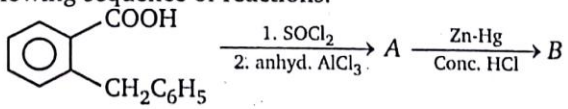
61. The number of possible isomers of dichloronitrobenzene is :

(a) 3 (b) 4 (c) 6 (d) 8

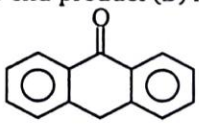
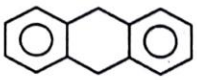
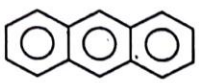
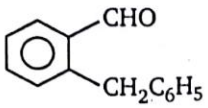
62. Which of the following is not an aromatic compound ?

(a)  (b)  (c)  (d) 

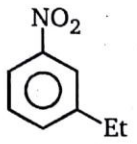
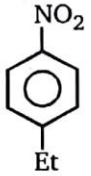
63. Consider the following sequence of reactions.



The end product (B) is:

(a)  (b)  (c)  (d) 

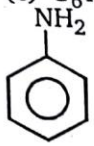
64. $Ph-NO_2 + Et-Cl \xrightarrow{AlCl_3} (A)$, Product (A) of the given reaction is :

(a) $Ph-NH-Et$ (b) no–reaction (c)  (d) 

65. In nitration of benzene by mixed acid the rate of reaction will be :

(a) $C_6H_6 = C_6D_6 = C_6T_6$ (b) $C_6H_6 > C_6D_6 > C_6T_6$

(c) $C_6H_6 = C_6D_6 > C_6T_6$ (d) $C_6H_6 < C_6D_6 < C_6T_6$

66.  $\xrightarrow{H_2SO_5}$ (A) $\xrightarrow[EtO^-/\Delta]{Ph-CH_2CN}$ (B) ; Product (B) is :

(a) $Ph-N=\underset{\displaystyle Ph}{\overset{\displaystyle |}{C}}-CN$ (b) $Ph-N=C-Ph$

(c) $Ph-N=N-Ph$ (d) $Ph-CH=CH-Ph$

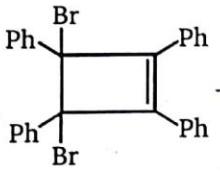
67. Which of the following ring compounds obeys Huckel's rule ?

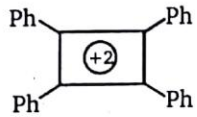
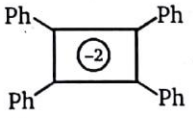
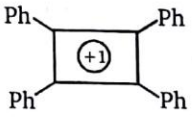
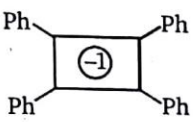
(a) $C_4H_4^{-1}$ (b) $C_4H_4^{+1}$ (c) $C_4H_4^{-2}$ (d) C_4H_4

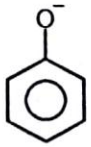
68. Nitration of which of the following reactant gives maximum % of meta product (using HNO_3/H_2SO_4) ?

(a) Toluene (b) Aniline

(c) Benzene (d) Isopropyl benzene

69.  $\xrightarrow{2AgBF_4}$ (x) $2BF_4^-$; compound (x) will be :

(a)  (b)  (c)  (d) 

70.  $\xrightarrow[(2)\ H^{\oplus}]{(1)\ CO_2}$ (A)

Which of the following is true statement about the reaction ?

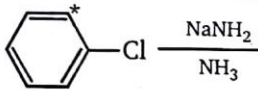
(a) Ortho isomer is major if PhONa is used

(b) Para isomer is major if PhOK is used

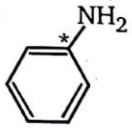
(c) Product formed is further used for preparation of drug aspirin

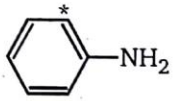
(d) All of these

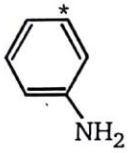
71. Two benzyne intermediates are likely to be formed equally. Reaction with amide ion can occur in two different directions with each benzyne, giving three possible products. They are formed in a 1 : 2 : 1 ratio. Asterisk (*) refers to ^{14}C.

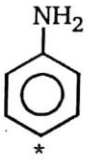


(A) Product major; product (*A*) is :

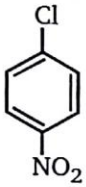
(a) 

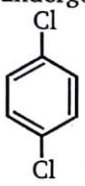
(b) 

(c) 

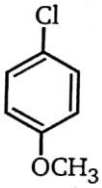
(d) 

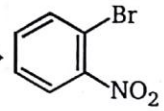
72. Which one of the following undergoes nucleophilic aromatic substitution at the fastest rate ?

(a) 

(b) 

(c) 

(d) 

73. For the reaction ; ?  ; the best combination of reactants is :

(a) $C_6H_5Br + HNO_3$, H_2SO_4
(b) $C_6H_5Br + H_2SO_4$, heat
(c) $C_6H_5NO_2 + Br_2$, $FeBr_3$
(d) $C_6H_5NO_2 + HBr$

74. The action of $AlCl_3$ in Friedel Craft's reaction is:

(a) to absorb HCl
(b) to release HCl
(c) to produce electrophile
(d) to produce nucleophile

75. *n*-Butylbenzene on oxidation with hot alkanine $KMnO_4$ gives :

(a) benzoic acid (b) butanoic acid (c) benzyl alcohol (d) benzaldehyde

76. Which sequence of steps describes the best synthesis of 2-phenylpropene ?

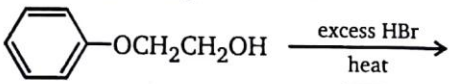
(a) Benzene + 2-chloropropene , $AlCl_3$

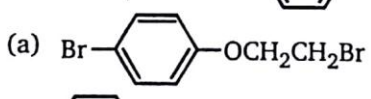
(b) 1. Benzaldehyde ($C_6H_5CH=O$) + CH_3CH_2MgBr, diethyl ether
2. H_3O^+ 3. H_2SO_4, heat

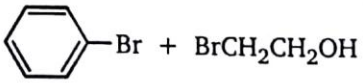
(c) 1. Bromobenzene + Mg, diethyl ether 2. Propanal ($CH_3CH_2CH=O$)
3. H_3O^+ 4. H_2SO_4, heat

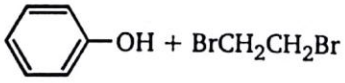
(d) 1. Bromobenzene + Mg, diethyl ether 2. Acetone [$(CH_3)_2C=O$]
3. H_3O^+ 4. H_2SO_4, heat

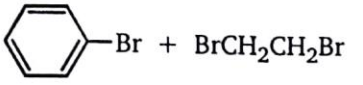
77. What are the products of the following reaction ?



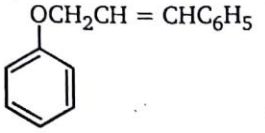
(a) 

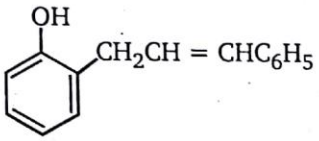
(b) 

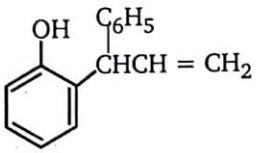
(c) 

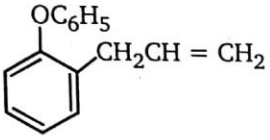
(d) 

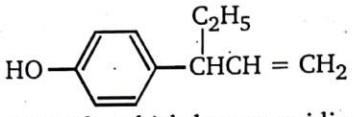
78. What is the product obtained by heating the following allylic ether of phenol ?



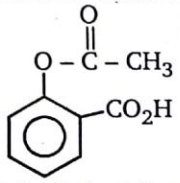
(a) 

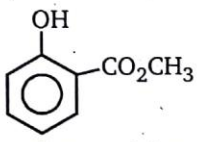
(b) 

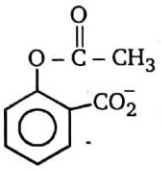
(c) 

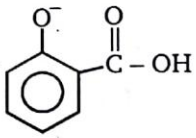
(d) 

79. When you ingest aspirin, it passes through your stomach, which has an acidic pH, before traveling through the basic environment of your intestine. Provide the structure form as it exists in the intestine.

(a) 

(b) 

(c) 

(d) 

80. Which of the following sets of reagents, used in the order shown, would be enable for the preparation of *p*-chlorophenol from *p*-chloronitrobenzene ?

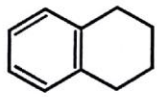
(a) 1. Fe, HCl ; 2. NaOH ; 3. $NaNO_2$, H_2SO_4 ; 4. H_3PO_2

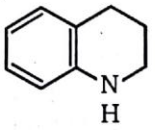
(b) 1. Fe, HCl ; 2. NaOH ; 3. $NaNO_2$, H_2SO_4 ; 4. H_2O, heat

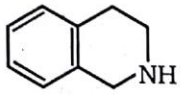
(c) 1. Fe, HCl ; 2. NaOH ; 3. $NaNO_2$, H_2SO_4 ; 4. ethanol

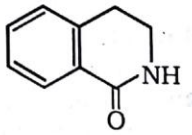
(d) 1. NaOH, heat ; 2. HCl

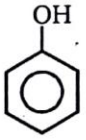
81. Which one of the following compounds undergoes bromination of its aromatic ring (electrophilic aromatic substitution) at the fastest rate ?

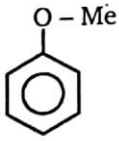
(a) 

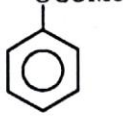
(b) 

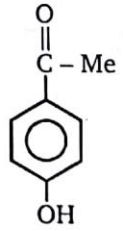
(c) 

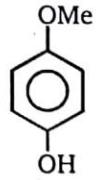
(d) 

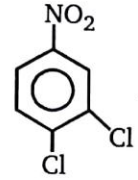
82.  $\xrightarrow{CH_3-\overset{O}{\overset{\|}{C}}-Cl}$ (*P*) $\xrightarrow[\Delta]{\text{Anhy. } AlCl_3}$ (*Q*). Product (*Q*) in this reaction is :

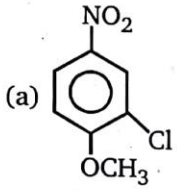
(a) 

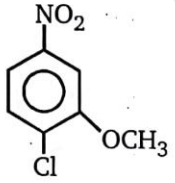
(b) 

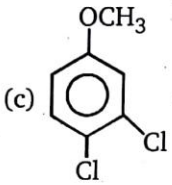
(c) 

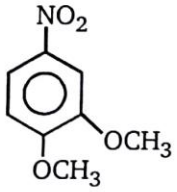
(d) 

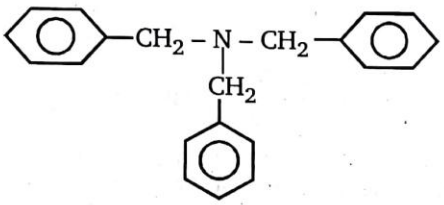
83.  $\xrightarrow[CH_3OH,\Delta]{CH_3O^-}$ (*P*) (major) ; The product (*P*) will be :

(a) 

(b) 

(c) 

(d) 

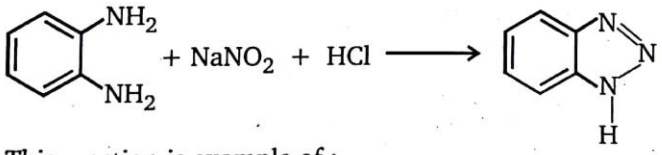
84.  $\xrightarrow[HCl,\ 90°C]{NaNO_2,}$ (*A*) ; Product (*A*) is :

(a) $Ph-CH_2-\underset{\underset{N=O}{|}}{N}-CH_2-Ph$

(b) $Ph-CH_2-\underset{\underset{Ph}{|}}{N}-N=O$

(c) $Ph-CH_2-\overset{\oplus}{\underset{\underset{N=O}{|}}{N}}(CH_2-Ph)(CH_2-Ph)$

(d) $Ph-N=O$

85. 

This reaction is example of :

(a) Intermolecular C – N coupling (b) Intramolecular C – N coupling

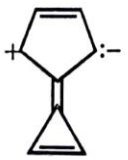
(c) Intermolecular N – N coupling (d) Intramolecular N – N coupling

86. The total number of isomeric trimethylbenzene is :

(a) 2 (b) 3 (c) 4 (d) 6

87. Caliene, C_7H_6, is expected to be a fairly polar aromatic molecule. Which of the following resonance forms contributes to the greatest extent towards the real structure (resonance hybrid) of the molecule ?

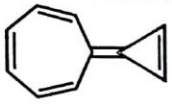
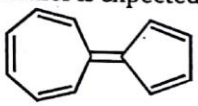
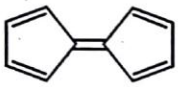
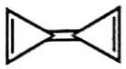
(a) 

(b) 

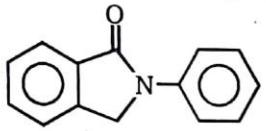
(c) 

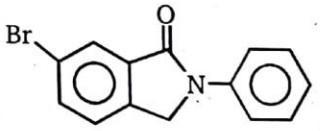
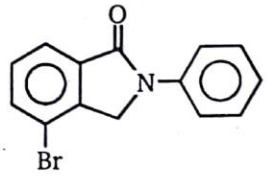
(d) 

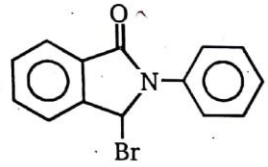
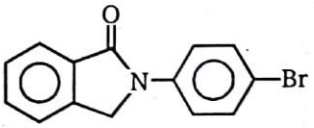
88. Which of the following molecules is expected to have the greatest resonance stabilization ?

(a)  (b)  (c)  (d) 

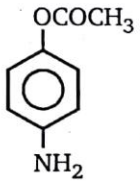
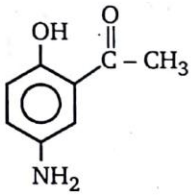
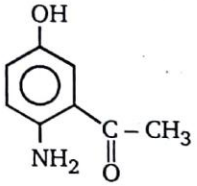
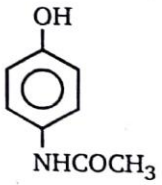
89. In the reaction given below, the major product formed is :



(a)  (b) 

(c)  (d) 

90. *p*-aminophenol reacts with one equivalent of acetyl chloride in the presence of pyridine to give mainly :

(a)  (b)  (c)  (d) 

91. Which of the following reactions can be used to prepare acetophenone ?

(a) $C_6H_6 + CH_3COCl \xrightarrow[2\,H_2O]{1.\,AlCl_3}$ (b) $(C_6H_5COO)_2Ca + (CH_3COO)_2Ca \xrightarrow{heat}$

(c) $C_6H_6CN \xrightarrow[2\,H_3O^+]{1.\,CH_3MgI}$ (d) All of these

92. Consider the following sequence of reactions.

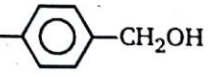
$$C_6H_6 + CH_3CH=CH_2 \xrightarrow[heat]{H_3PO_4} A \xrightarrow[2.\,H_3O^+,\ heat]{1.\,O_2,\,heat} B + C$$

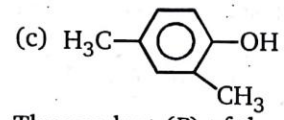
The products (*B*) and (*C*) are :

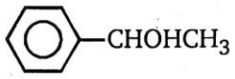
(a) benzaldehyde and acetaldehyde (b) benzoic acid and acetic acid

(c) phenol and propionaldehyde (d) phenol and acetone

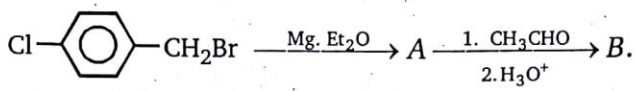
93. An organic compound having the molecular formula $C_8H_{10}O$ on being heated with I_2 and dilute NaOH gives a yellow precipitate. The expected compound is :

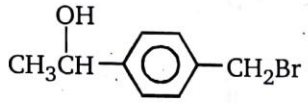
(a) $C_6H_5CH_2CH_2OH$ (b) 

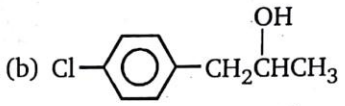
(c) 

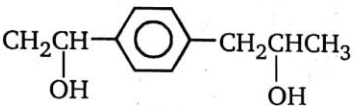
(d) 

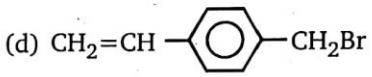
94. The product (*B*) of the reaction sequence is :



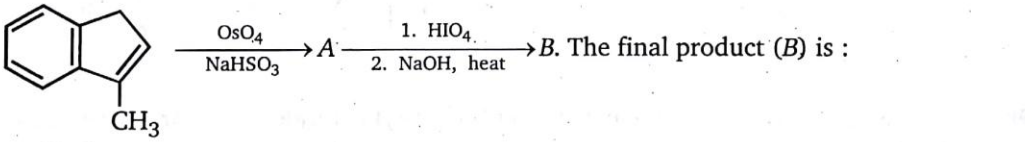
(a) 

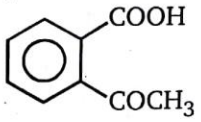
(b) 

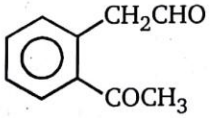
(c) 

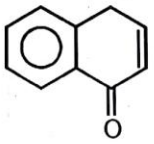
(d) 

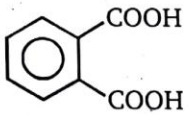
95. Consider the following sequence of reactions.



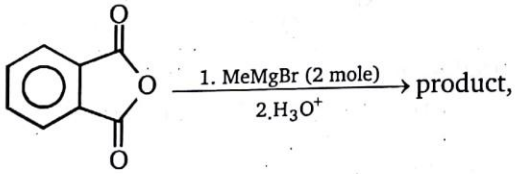
(a) 

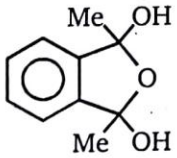
(b) 

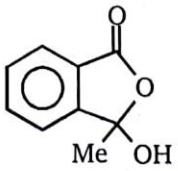
(c) 

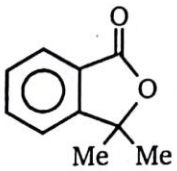
(d) 

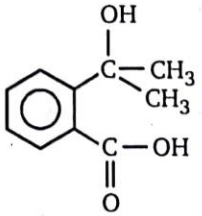
96. For the reaction, the product expected is :



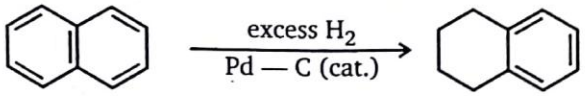
(a) 

(b) 

(c) 

(d) 

97. Hydrogenation of naphthalene (*P*) with excess hydrogen gas stops cleanly at 1, 2, 3, 4-tetrahydronaphthalene (*Q*). What conclusion can be drawn from this experiment ?



(*P*) (*Q*)

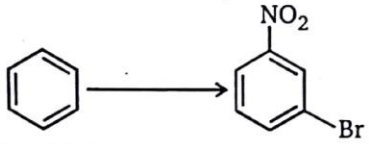
(a) the hydrogenation of *P* is exothermic

(b) one aromatic ring of *P* is more reactive than the aromatic ring of *Q*

(c) one aromatic ring of *P* is less reactive than the other ring of *Q*

(d) reduction of the first C = C of *P* is faster than reduction of the second or third C = C

98. Suggest the best reaction conditions for the synthesis shown below.



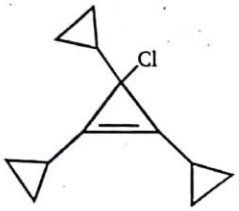
(a) (1) HNO_3, H_2SO_2; then (2) Br_2

(b) (1) Br_2; then (2) HNO_3, H_2SO_2

(c) (1) CH_3Br, $AlBr_3$; then (2) HNO_3, H_2SO_3

(d) HNO_3, H_2SO_2, then (2) Br_2, $FeBr_3$

99.



In the above compound Cl will liberated easily in the form of :

(a) $Cl^{\oplus}$ (b) Cl^{-} (c) $Cl^{\bullet}$ (d) Cl^{2+}

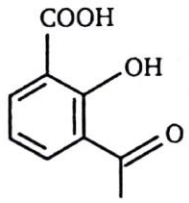
100. Consider the following sequence of reactions:

$PhCO_2H \xrightarrow[2.NH_3]{1.\ PCl_5} A \xrightarrow[2.H_2/Ni]{1.\ P_4O_{10},\ heat} B.$ The final product (*B*) is :

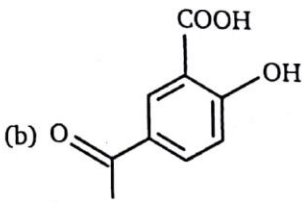
(a) benzonitrile (b) benzylamine (c) aniline (d) benzamide

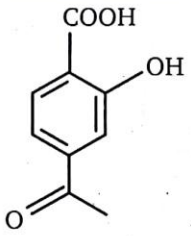
101. The major product of the acetylation of salicylic acid with Ac_2O/H^+ followed by heating with anhydrous $AlCl_3$ is :

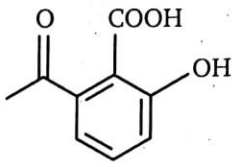
(a)



(b)



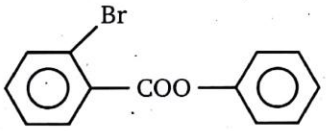
(c) 

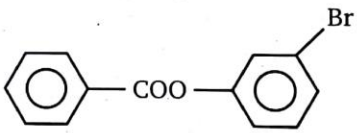
(d) 

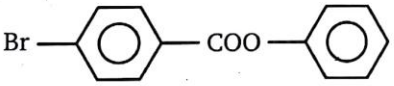
102. Which one of the following statements is **True:**

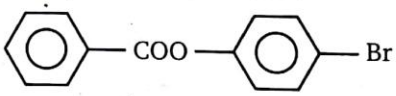
(a) PhLi adds to both compounds with equal ease
(b) PhLi does not add to either of the compounds
(c) PhLi reacts readily with 1 but does not add to 2
(d) PhLi reacts readily with 2 but does not add to 1

103. The major product expected from the mono-bromination of phenyl benzoate is :

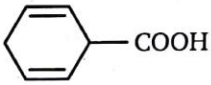
(a) 

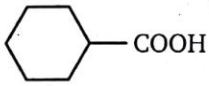
(b) 

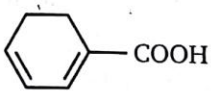
(c) 

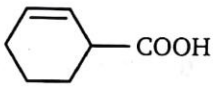
(d) 

104. The Birch reduction of benzoic acid gives :

(a) 

(b) 

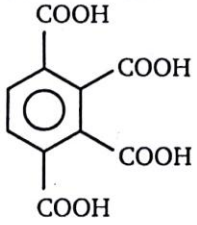
(c) 

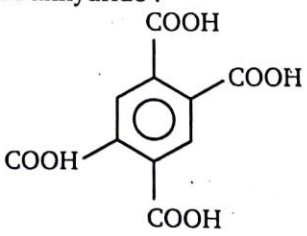
(d) 

105. The decreasing order of reactivity of meta-nitrobromobenzene (I), 2,4,6-trinitrobromobenzene (II), para-nitrobromobenzene (III), and 2,4-dinitrobromobenzene (IV) towards HO^- ions is :

(a) I > II > III > IV (b) II > IV > III > I (c) IV > II > III > I (d) II > IV > I > III

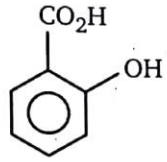
106. Which of the following tetracarboxylic acid form di-anhydride :

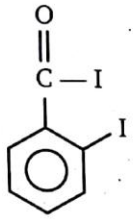
(a) 

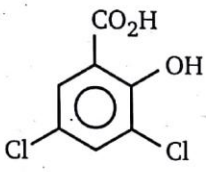
(b) 

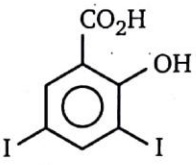
(c) neither (a) nor (b)

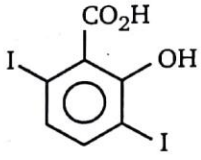
(d) both (a) and (b)

107.  $\xrightarrow{2I-Cl}$ (*A*); unknown (*A*) is :

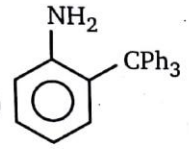
(a) 

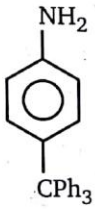
(b) 

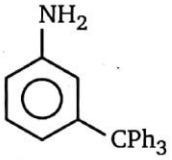
(c) 

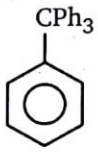
(d) 

108. $Ph-NH_2 + Ph_3COH \xrightarrow{H^+/D} \underset{\text{(major)}}{P}$ (not a N-derivative), Product (*P*) is :

(a) 

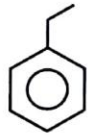
(b) 

(c) 

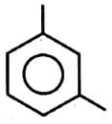
(d) 

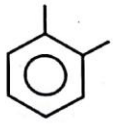
109. Deduce structure of (*A*).

(*A*) $C_8H_{10} \xrightarrow{KMnO_4}$ (*B*) $C_8H_6O_4 \xrightarrow[Fe]{Br_2} C_8H_5BrO_4$ (*C*) (one-product only) :

(a) 

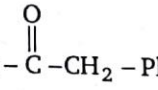
(b) 

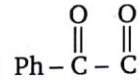
(c) 

(d) 

110. The deamination of $Ph_2C(OH)CH_2NH_2$ with $NaNO_2 - HCl$ gives a product (*P*), which on oxidation gives benzoic acid only. Identify the product (*P*).

(a) $Ph-CH_2-CH_2-Ph$

(b) 

(c) 

(d) $Ph-CH_2-NH-Ph$

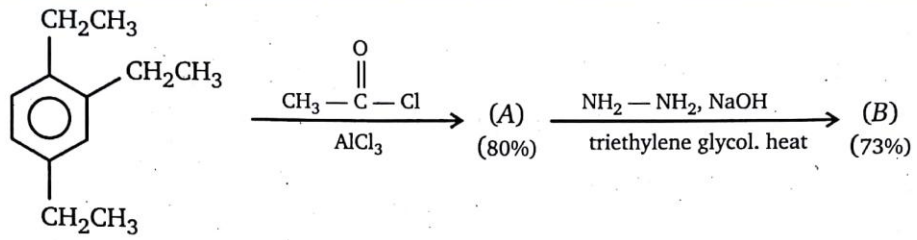
111. $Ph-CO_2H \xrightarrow{SOCl_2} A \xrightarrow{Me_2NH} B \xrightarrow{(C)} Ph-CHO$, unknown reagent (*C*) is :

(a) $LiAlH_4$

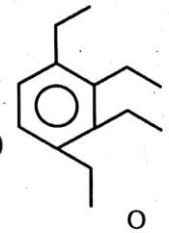
(b) $NaBH_4$

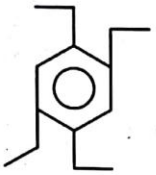
(c) $LiAlH_4(t\text{-}BuO)_3$

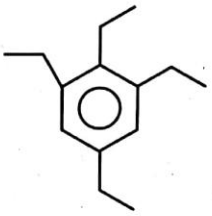
(d) PCC/CH_2Cl_2

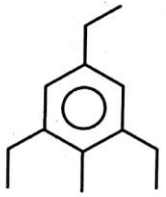
112. 

Product (*B*) is :

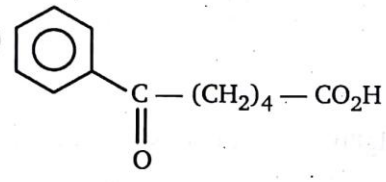
(a) 

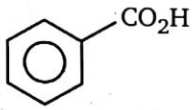
(b) 

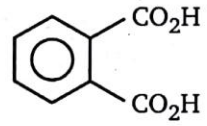
(c) 

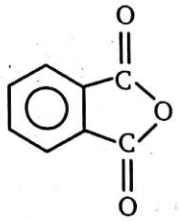
(d) 

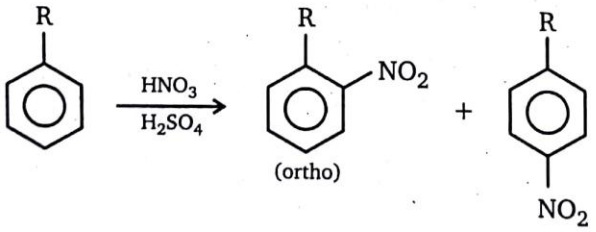
113. $C_6H_5(CH_2)_5\overset{O}{\overset{\|}{C}}-Cl \xrightarrow[CS_2]{AlCl_3} \underset{C_{12}H_{14}O}{(A)} \xrightarrow[H_3O^{\oplus}]{KMnO_4,\ D} (B)$; Compound (*B*) is :

(a) 

(b) 

(c) 

(d) 

114. 

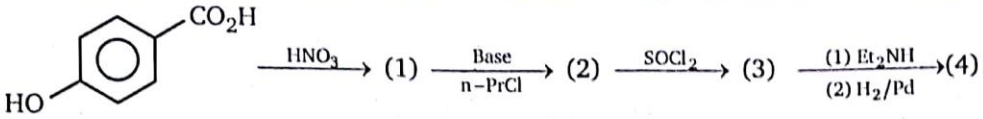
In the above reaction *o/p* ratio will be highest when :

(a) R = – CH_3

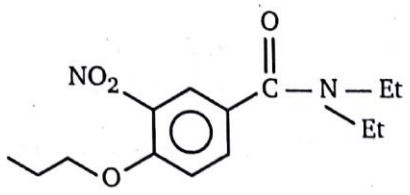
(b) R = – CH_2 – CH_3

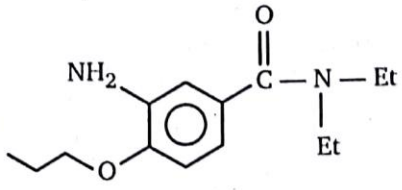
(c) R = – $CHMe_2$

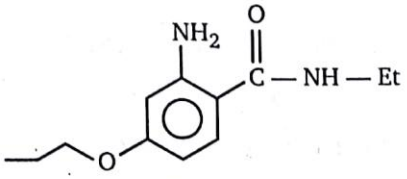
(d) R = – CMe_3

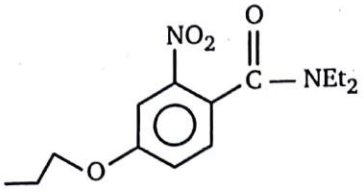
115. 

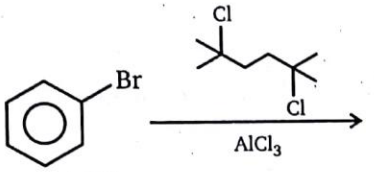
product (4) in the above reaction is :

(a) 

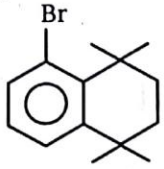
(b) 

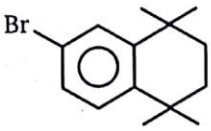
(c) 

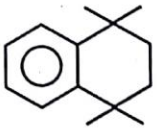
(d) 

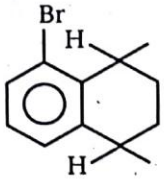
116. 

(*A*); Product (*A*) of the reaction is :

(a) 

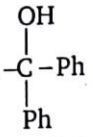
(b) 

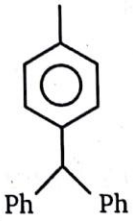
(c) 

(d) 

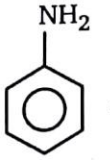
117. Ph – CHO + 2  $\xrightarrow{H_2SO_4}$ major product of this reaction is :

(a) Ph_3CH

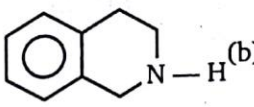
(b) 

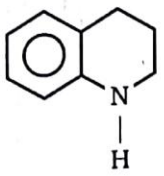
(c) 

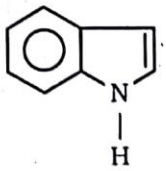
(d) Ph_2CH_2

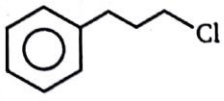
118. 

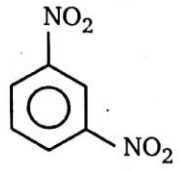
(*A*); Product (*A*) of this reaction is :

(a) 

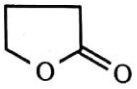
(b) 

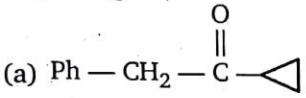
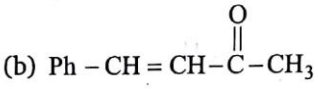
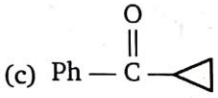
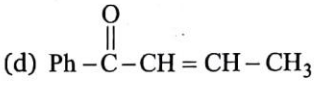
(c) 

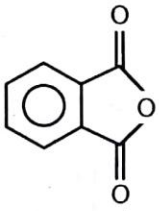
(d) 

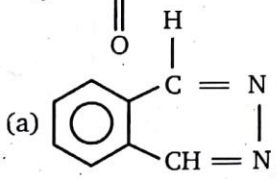
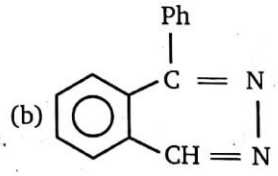
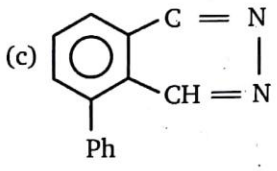
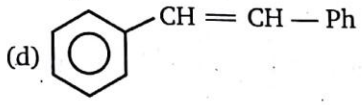
119.  $\xrightarrow[\text{five days to complete}]{HNO_3+H_2SO_4}$ (*X*); Compound (*X*) is :

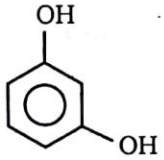
(a) 1,2,4-Trinitrobenzene
(b) 1,3,5-Trinitrobenzene
(c) 1,2,3 -Trinitrobenzene
(d) Tri-nitro toluene (TNT)

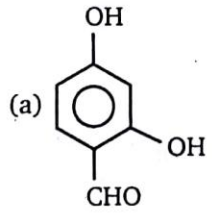
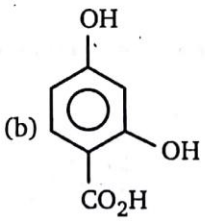
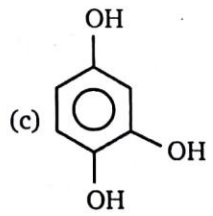
120.  $\xrightarrow[(ii)\ SOCl_2]{(i)\ HCl}$ (*A*) $\xrightarrow[AlCl_3]{Ph-H}$ (*B*) $\xrightarrow{KOH/MeOH}$ (*C*); Compound (*C*) is :

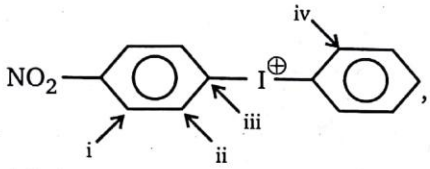
(a) 
(b) 
(c) 
(d) 

121.  $\xrightarrow[AlCl_3]{C_6H_6}$ (*A*) $\xrightarrow[(ii)\ H_2/Pd-BaSO_4]{(i)\ PCl_5}$ (*B*) $\xrightarrow{NH_2-NH_2}$ (*C*); Compound (*C*) is :

(a) 
(b) 
(c) 
(d) 

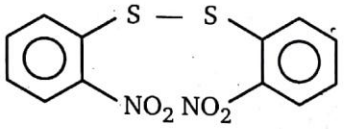
122.  $\xrightarrow[H_3O^+]{(i)\ aq\ NaHCO_3/boil}$ (*A*) (major), Product (*A*) in this reaction is :

(a) 
(b) 
(c) 
(d) No reaction

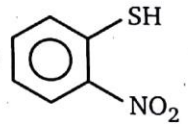
123. 

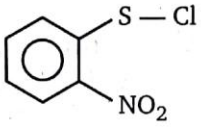
, Identify position where attack of (ArO^-) is favourable.

(a) i (b) ii (c) iii (d) iv

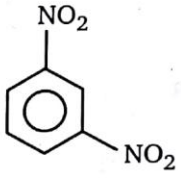
124. 

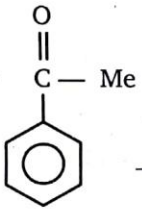
$\xrightarrow{Cl_2}(A)$, Product (*A*) of this reaction is :

(a) 

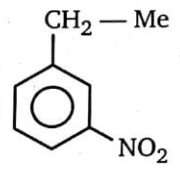
(b) 

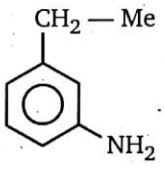
(c) 

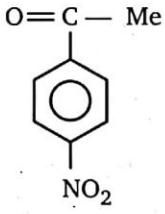
(d) 

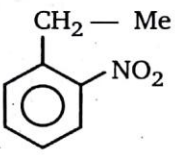
125. 

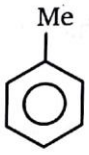
$\xrightarrow[H_2SO_4]{HNO_3}(A)\xrightarrow[HCl]{Zn(Hg)}$ (*B*), Product (*B*) of this reaction is :

(a) 

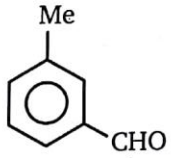
(b) 

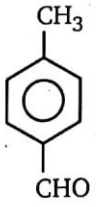
(c) 

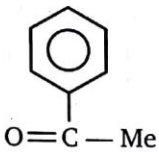
(d) 

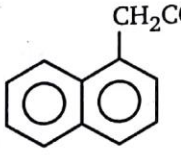
126. 

$+HN=CH-Cl\xrightarrow{AlCl_3}(A)\xrightarrow{H_3O^+}(B)$, Product (*B*) of this reaction is :

(a) 

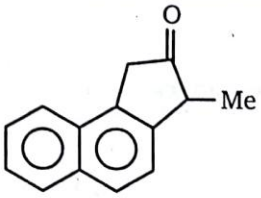
(b) 

(c) No-reaction (d) 

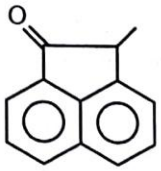
127. 

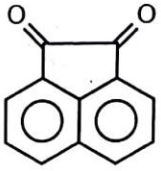
$\xrightarrow[H^+]{EtOH}\xrightarrow[(ii)\ MeI]{(i)\ NaH}\xrightarrow[(ii)\ H^+]{(i)\ NaOH}\xrightarrow[(ii)\ AlCl_3]{(i)\ SOCl_2}$; Product

End product of the above reaction is :

(a) 

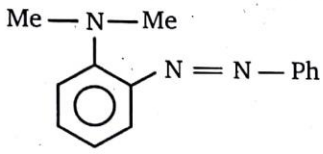
(b) 

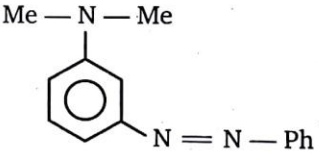
(c) 

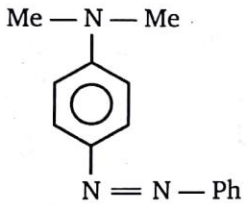
(d) 

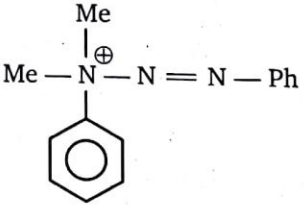
128. $Ph-NH_2 \xrightarrow{CH_3-Cl\ (2mole)} (A) \xrightarrow{Ph-\overset{\oplus}{N}_2\ \overset{-}{Cl}} \underset{\text{Butter yellow}}{(B)}$ (major)

Product of the above reaction is :

(a) 

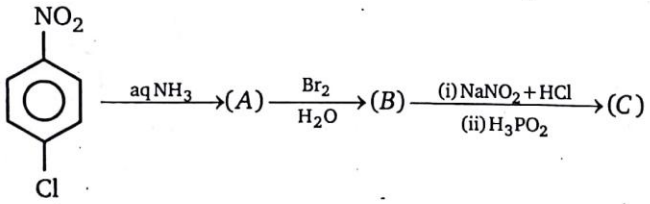
(b) 

(c) 

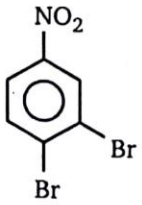
(d) 

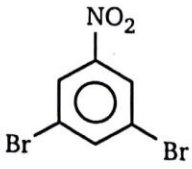
129. *p*-Toluedine reacts with benzene diazonium chloride to form compound, which on boiling with aq. H_2SO_4 give ..... products :

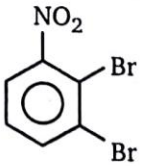
(a) 3 (b) 2 (c) 4 (d) 5

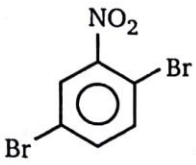
130. 

Product (*C*) of the above reaction is :

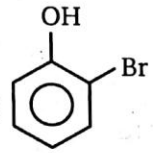
(a) 

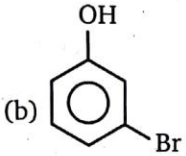
(b) 

(c) 

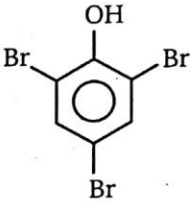
(d) 

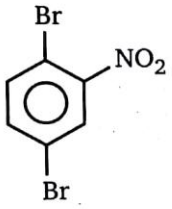
131.  $\xrightarrow[\underset{\text{(Fenton's reagent)}}{H_2O_2}]{Fe^{+2}}$ (A) $\xrightarrow[H_2O]{Br_2}$ (B) $(\equiv 100\%)$; Major product (B) of this reaction is :

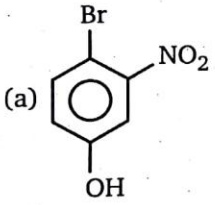
(a) 

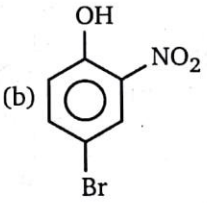
(b) 

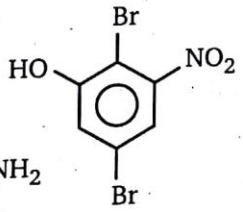
(c) 

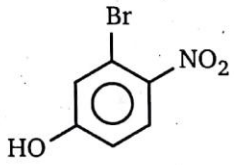
(d) 

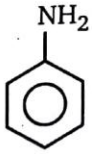
132.  $\xrightarrow{HO^-}$ (A) ; Product of the given reaction is :

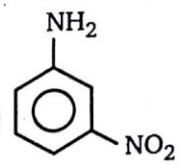
(a) 

(b) 

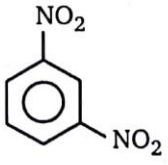
(c) 

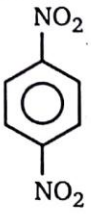
(d) 

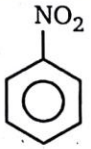
133.  $\xrightarrow{(CH_3CO)_2O}$ (A) $\xrightarrow[H_2SO_4]{HNO_3}$ (B) $\xrightarrow[H_2O]{H^+}$ (C), Product (C) of this reaction is :

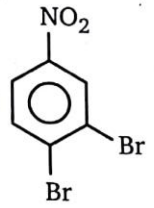
(a) 

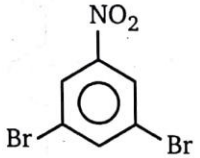
(b) 

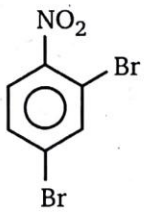
(c) 

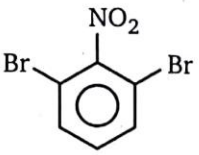
(d) 

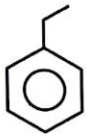
134.  $\xrightarrow[Fe]{Br_2\ (2mole)}$ (*A*) (major) ; Product (*A*) will be :

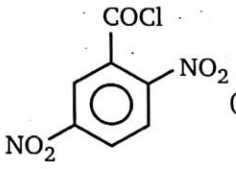
(a) 

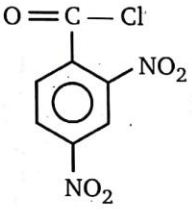
(b) 

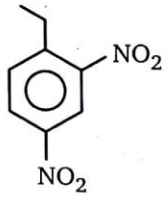
(c) 

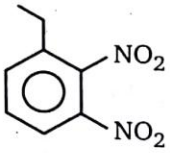
(d) 

135.  $\xrightarrow[(ii)\ H_2SO_4]{(i)\ HNO_3}$ (*A*) (Di- nitro product) $\xrightarrow{KMnO_4/\Delta}$ (*B*) $\xrightarrow{SOCl_2}$ (*C*); Product (*C*) of this reaction is :

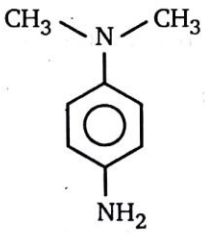
(a) 

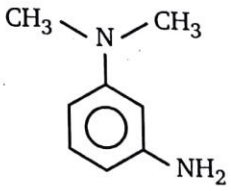
(b) 

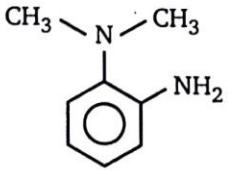
(c) 

(d) 

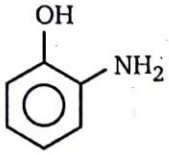
136.  $\xrightarrow{CH_3-NH-CH_3}$ (*A*) $\xrightarrow[HCl]{Fe}$ (*B*) ; Product (*B*) of this reaction is :

(a) 

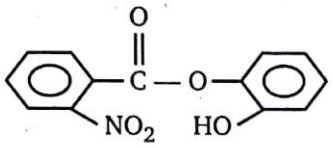
(b) 

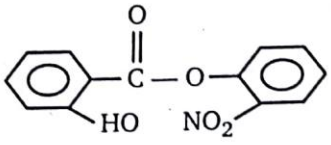
(c) 

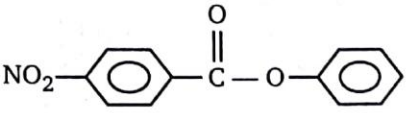
(d) None of these

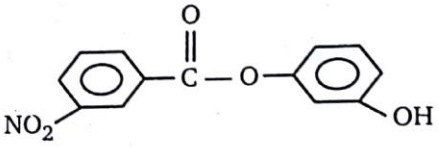
137. $(A) \xrightarrow[(ii)\,NH_3]{(i)\,SOCl_2} (B) \xrightarrow{Br_2 + KOH}$ 

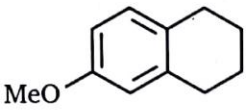
Which of the following compound on hydrolysis gives reactant (*A*) :

(a) 

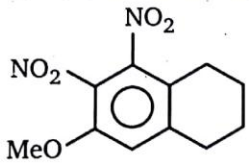
(b) 

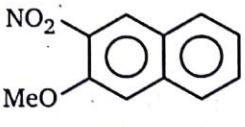
(c) 

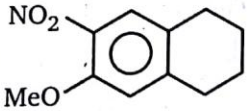
(d) 

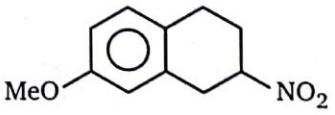
138.  $\xrightarrow{HNO_3/H_2SO_4}$ (*A*);

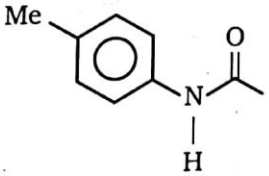
Product (*A*) of the above reaction is :

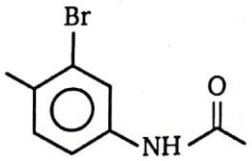
(a) 

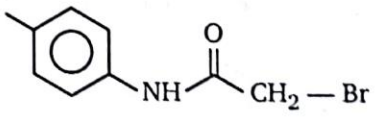
(b) 

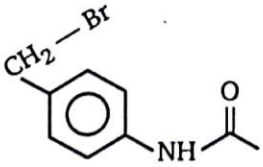
(c) 

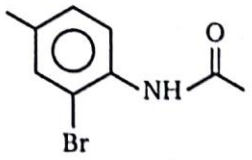
(d) 

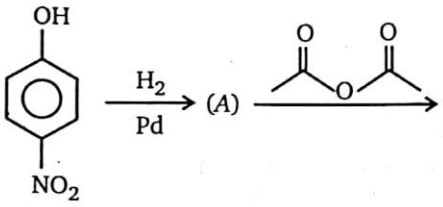
139.  $\xrightarrow[CS_2]{Br_2}$; Product of the reaction is :

(a) 

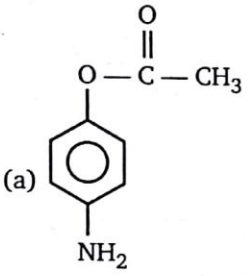
(b) 

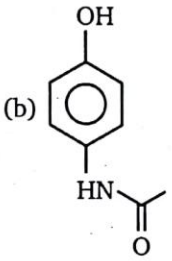
(c) 

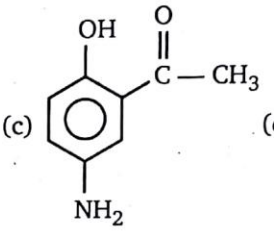
(d) 

140. 

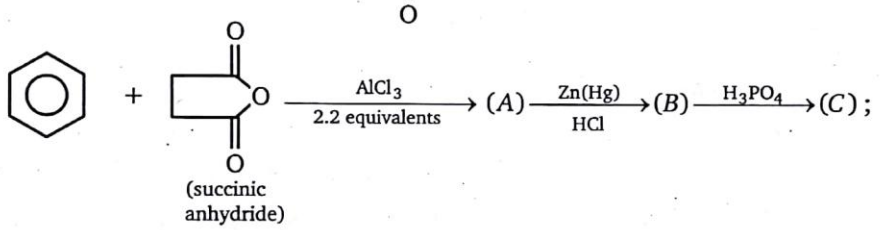
; Product (*B*) of this reaction is :

(a) 

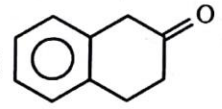
(b) 

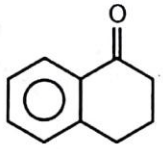
(c) 

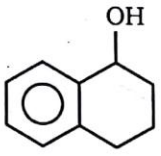
(d) 

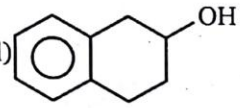
141. 

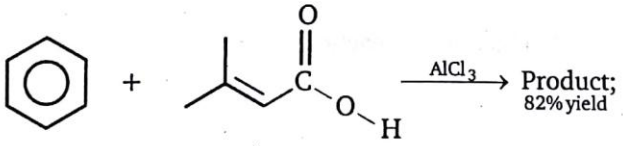
Product (*C*) of the above reaction is :

(a) 

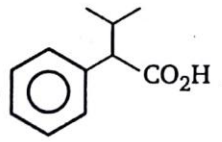
(b) 

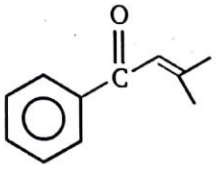
(c) 

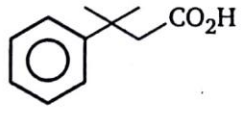
(d) 

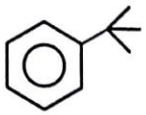
142. 

Product of the above Friedel-Craft reaction is :

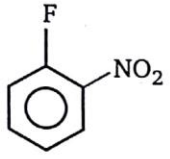
(a) 

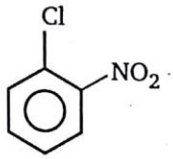
(b) 

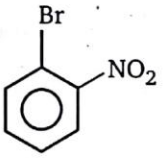
(c) 

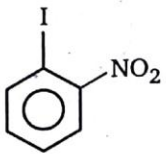
(d) 

143. Which of the following 2-halo nitrobenzene is most reactive towards nucleophilic aromatic substitution ?

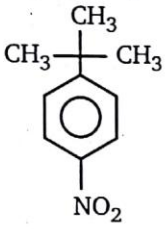
(a) 

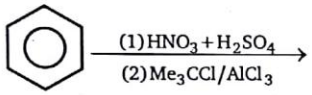
(b) 

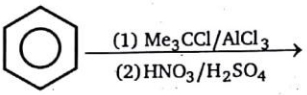
(c) 

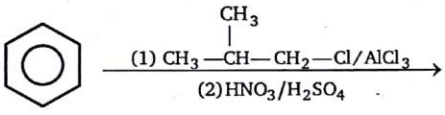
(d) 

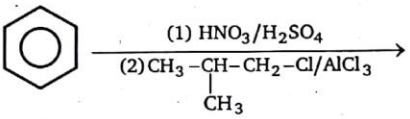
144. Choose the best method to prepare given compound :

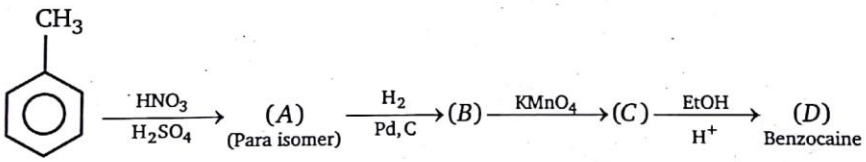


(a) 

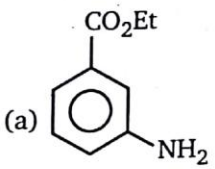
(b) 

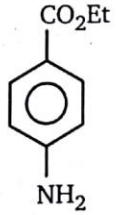
(c) 

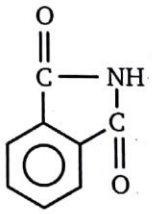
(d) 

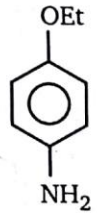
145. 

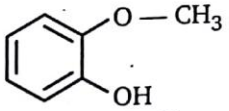
Benzocaine has been used as a component of appetite suppressants, burn and sunburn remedies. Benzocaine is :

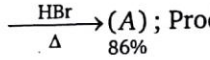
(a) 

(b) 

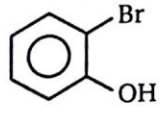
(c) 

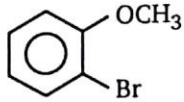
(d) 

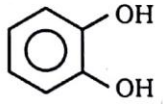
146. 

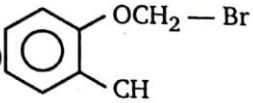


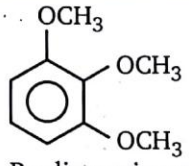
; Product (*A*) of this reaction is :

(a) 

(b) 

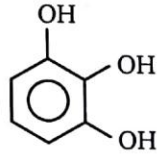
(c) 

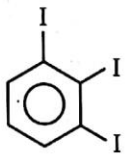
(d) 

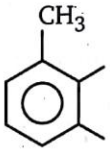
147. 

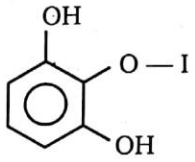
$\xrightarrow[\Delta]{HI\,(excess)}$ Product.

Predict major product of the above reaction is :

(a) 

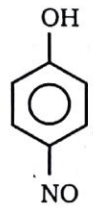
(b) 

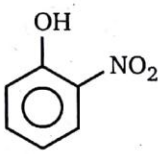
(c) 

(d) 

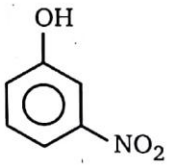
148. 

$\xrightarrow[HNO_3]{HNO_2}$ (A) (Major) ; Product (A) is :

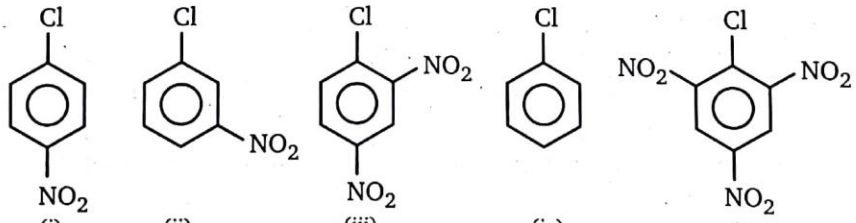
(a) 

(b) 

(c) 

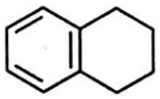
(d) 

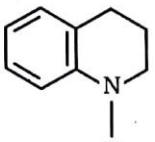
149. Arrange in their decreasing order of rate in SNAr.

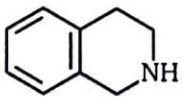


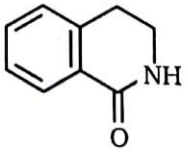
(a) i > ii > iv > iii > v
(b) ii > i > iii > v > iv
(c) v > iii > i > ii > iv
(d) v > iii > ii > i > iv

150. Which one of the following compounds undergoes bromination of its aromatic ring (electrophilic aromatic substitution) at the fastest rate ?

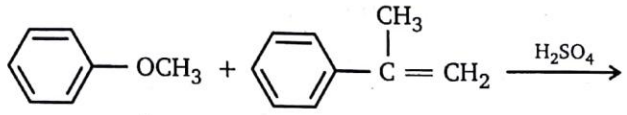
(a) 

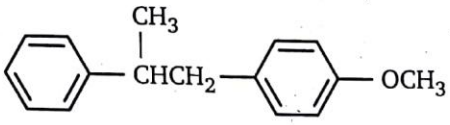
(b) 

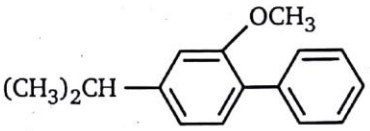
(c) 

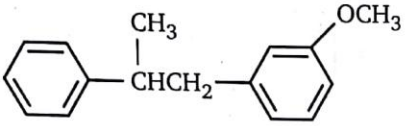
(d) 

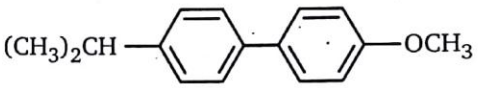
151. What is the product of the following reaction ?



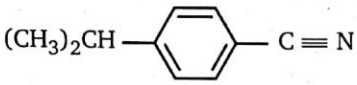
(a) 

(b) 

(c) 

(d) 

152. Which sequence represents the best synthesis of 4-isopropylbenzonitrile ?



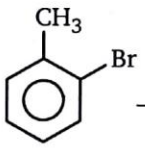
4-Isopropylbenzonitrile

(a) **1.** Benzene + $(CH_3)_2CHCl, AlCl_3$; **2.** $Br_2, FeBr_3$; **3.** KCN

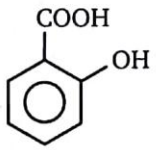
(b) **1.** Benzene + $(CH_3)_2CHCl, AlCl_3$; **2.** HNO_3, H_2SO_4; **3.** Fe, HCl,; **4.** NaOH **5.** $NaNO_2$, HCl, H_2O

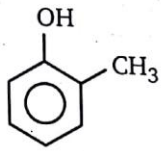
(c) **1.** Benzene +$(CH_3)_2CHCl, AlCl_3$; **2.** HNO_3, H_2SO_4 ; **3.** Fe, HCl ; **4.** $NaNO_2$/HCl **5.** KCN

(d) **1.** Benzene + HNO_3, H_2SO_4 ; **2.** $(CH_3)_2CHCl, AlCl_3$; **3.** Fe, HCl; **4.** $NaNO_2, HCl, H_2O$; **5.** CuCN

153. 

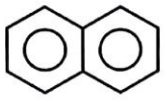
$\xrightarrow[2.\ H_3O^+]{1.\ Mg/Ether}$ $\xrightarrow[4.\ H^+]{3.\ KMnO_4/OH^-}$ *A*, Product *A* is :

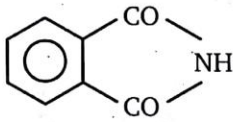
(a) 

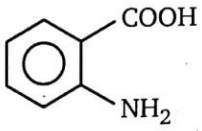
(b) 

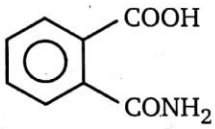
(c) 

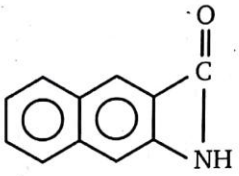
(d) 

154.  $\xrightarrow[2.\ NH_3,\Delta \\ 3.\ KOBr,\Delta]{1.\ Air,V_2O_5,\Delta}$ *A*, Product *A* is :

(a) 

(b) 

(c) 

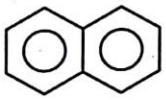
(d) 

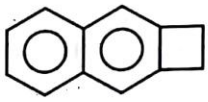
155. What is correct order of rate of nitration of the following compounds ?

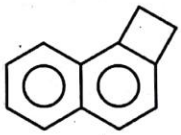
$\underset{A}{C_6H_5CH_3}$ $\underset{B}{C_6H_6}$ $\underset{C}{C_6D_6}$ $\underset{D}{C_6T_6}$ $\underset{E}{C_6H_5Br_3}$ $\underset{F}{C_6H_5\overset{+}{N}R_3}$ $\underset{G}{C_6H_5NMe_2}$

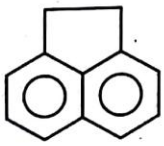
(a) G > A > B > C > D > E > F (b) G > B > C > D > A > F

(c) G > A > B = C = D > E > F (d) G > A > B > C = D > E > F

156.  $+$  $\xrightarrow{AlCl_3}[X]\xrightarrow[\text{excess}]{Na—Hg,HCl}[Y]$; Product *Y* is :

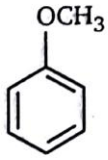
(a) 

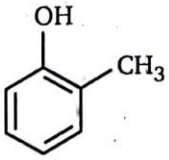
(b) 

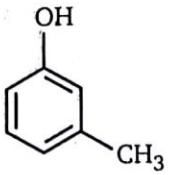
(c) 

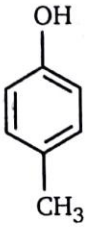
(d) 

157. Compound *A* (C_7H_8O) is insoluble in water, dilute HCl & aqueous $NaHCO_3$, but it dissolves in dilute NaOH. When *A* is treated with Br_2 water it is converted into a compound $C_7H_5OBr_3$ rapidly. The structure of A is :

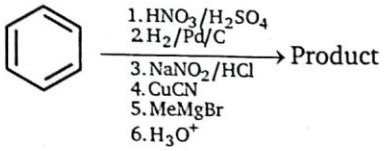
(a) 

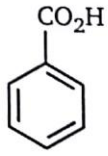
(b) 

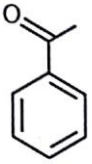
(c) 

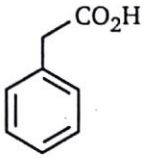
(d) 

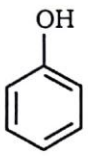
158. Give the product of the following reaction sequence :



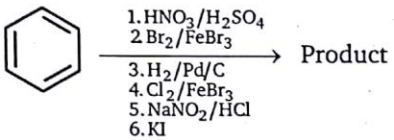
(a) 

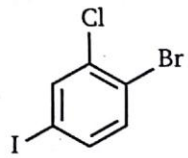
(b) 

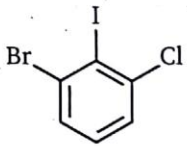
(c) 

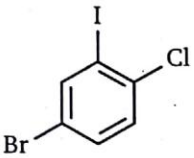
(d) 

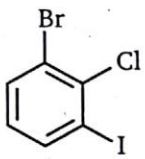
159. Give the product of the following reaction sequence:



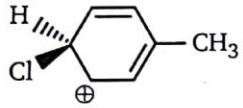
(a) 

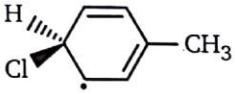
(b) 

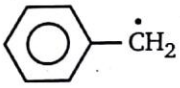
(c) 

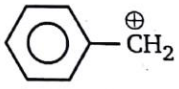
(d) 

160. Which represents an intermediate formed in the reaction of toluene and chlorine at elevated temperature in sunlight ?

(a) 

(b) 

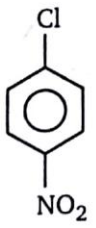
(c) 

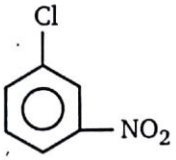
(d) 

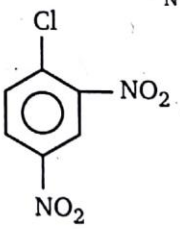
161. The decreasing order of reactivity of *m*-nitrobromobenzene (I), 2, 4, 6- trinitrobromo-benzene (II), *p*-nitrobromobenzene (III), and 2,4-dinitrobromobenzene (IV), towards OH^- ions is :

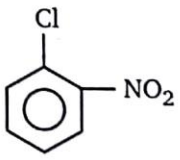
(a) I > II > III > IV
(b) II > IV > III > I
(c) IV > II > III > I
(d) II > IV > I > III

162. Which one of the following compounds is most reactive for ArS_{N^2} reaction ?

(a) 

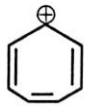
(b) 

(c) 

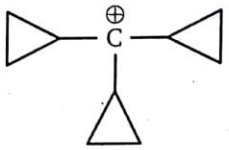
(d) 

163. Which one amongst the following carbocations is most stable ?

(a) $C_6H_5-\overset{\oplus}{C}H-C_6H_5$

(b) 

(c) $CH_3-\overset{\oplus}{C}(CH_3)-CH_3$ (with CH_3 below)

(d) 

164. Cyclopentadiene is much more acidic than cyclopentane. The reason is that :

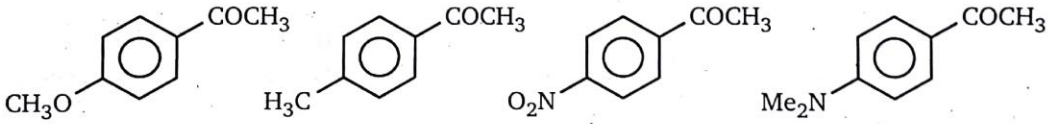
(a) cyclopentadiene has conjugated double bonds

(b) cyclopentadiene has both sp^2 and sp^3 hybridized carbon atoms

(c) cyclopentadiene is a strain-free cyclic system

(d) cyclopentadienide ion, the conjugate base of cyclopentadiene, is an aromatic species and hence has higher stability

165.



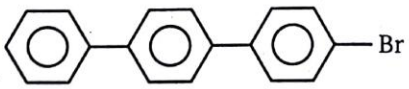
(I) (II) (III) (IV)

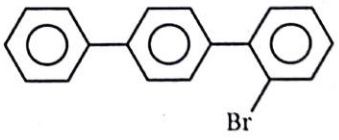
Friedel-Crafts acylation reaction can be used to obtain the compounds

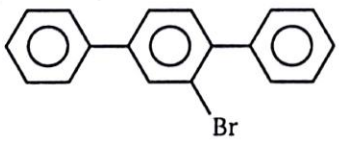
(a) II, III and IV (b) I, III and IV

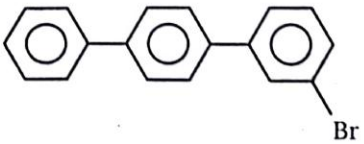
(c) I and II (d) II and III

166. The major product of the reaction is :

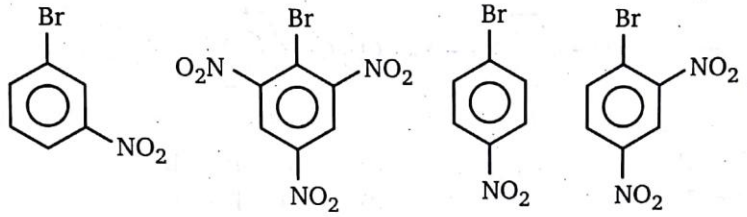
(a) 

(b) 

(c) 

(d) 

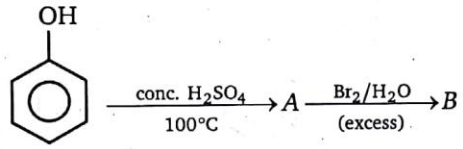
167. The decreasing order of reactivity of given compound towards nucleophilic substitution with aqueous NaOH is :

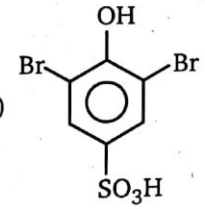
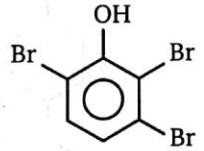
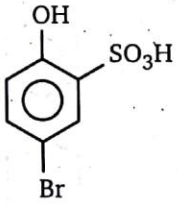
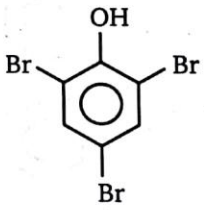


(I) (II) (III) (IV)

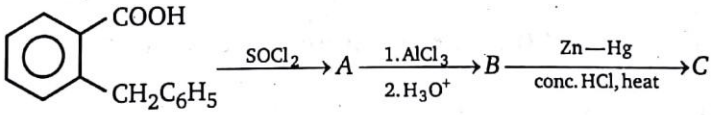
(a) I > II > III > IV
(b) II > IV > III > I
(c) IV > II > III > I
(d) II > IV > I > III

168. Identify the end product (*B*) of the following sequence of reactions.

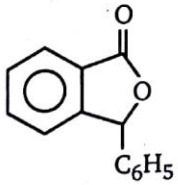
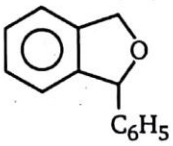
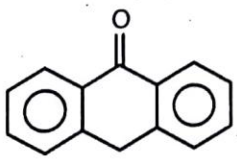
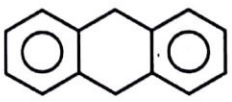


(a) 
(b) 
(c) 
(d) 

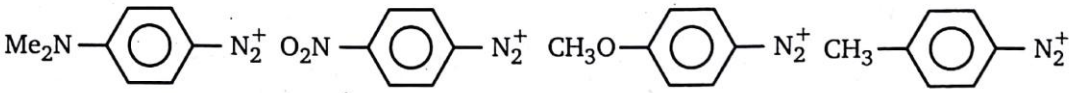
169. Consider the following sequence of reactions :



The end product (*C*) is :

(a) 
(b) 
(c) 
(d) 

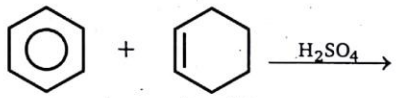
170. For the diazonium ions the order of reactivity towards diazo-coupling with phenol in the presence of dilute NaOH is :



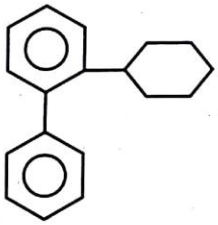
(I) (II) (III) (IV)

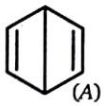
(a) I < IV < II < III
(b) I < III < IV < II
(c) III < I < II < IV
(d) III < I < IV < II

171. Major product obtained in given reaction is :

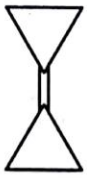


(2 mole)

(a) 
(b) 
(c) 
(d) 

172. 
(A)
$\xrightarrow[\text{or } AlCl_3]{H^{\oplus}}$ (major) (B) ; (A) & (B) are isomers. Product (B) is :

Dewar's Benzene

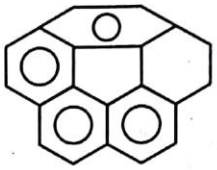
(a) 
(b) 
(c) 
(d) 

173. The step shown below is a recent synthesis of corannulene.

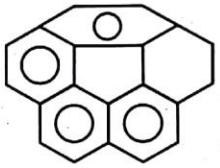
$\xrightarrow[(\Delta)]{Pd/C}$ (*A*) $C_{20}H_{10}$ Corannulene

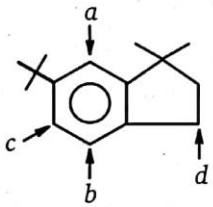
Product (*A*) is :

(a) 

(b) 

(c) 

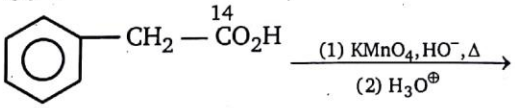
(d) 

174. 

Identify the position where E.A.S. will take place :

(a) *a* (b) *b*

(c) *c* (d) all the position are identical

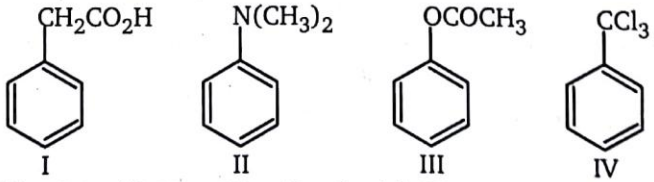
175. 

The labelled carbon goes with :

(a) Ph — $\overset{14}{C}O_2H$ (b) $\overset{14}{C}O_2$ (c) Ph — $\overset{14}{C}H_2$ — CO_2H (d) $\overset{14}{C}H_4$

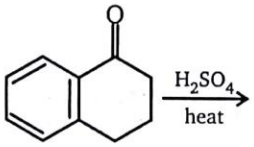
176. What is the expected order of reactivity of the following compounds in electrophilic chlorination ($Cl_2 + FeCl_3$) ?

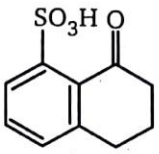
(more reactive > less reactive)

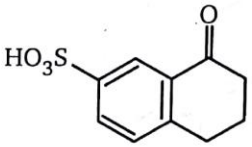


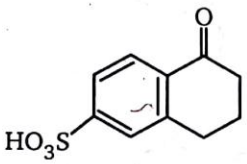
(a) I > II > III > IV (b) IV > III > II > I (c) III > I > IV > II (d) II > III > I > IV

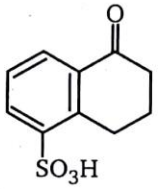
177. Which of the following is the major product from sulfonation of α-tetralone ?



(a) 

(b) 

(c) 

(d) 

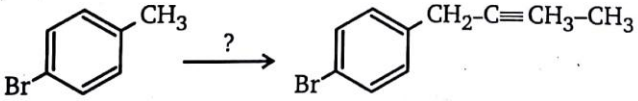
178. Which of the following procedures would be best for the preparation of phenyl benzyl ether ?

$C_6H_5OCH_2C_6H_5$

(a) $C_6H_5Cl + C_6H_5CH_2O^{(-)}Na^{(+)}$ (b) $C_6H_5O^{(-)}Na^{(+)} + C_6H_5CH_2Cl$

(c) $2C_6H_5Cl + Na_2O$ (d) $2C_6H_5MgBr + CH_2O$

179. Which of the following procedures would be best for achieving the following reaction ?



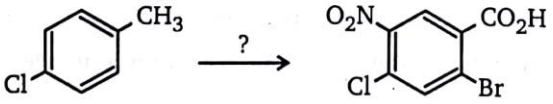
(a) (i) KOH and heat (ii) $CH_3C \equiv C - Br$

(b) (i) $KMnO_4$ and heat (ii) $CH_3C \equiv C^{(-)}Na^{(+)}$ (iii) excess H_2O

(c) (i) NBS in CCl_4 and heat (ii) $CH_3C \equiv C^{(-)}Na^{(+)}$

(d) (i) Mg in ether (ii) $CH_3C \equiv CBr$ (iii) excess H_3PO_4

180. Which of the following procedures would be best for achieving the following reaction ?



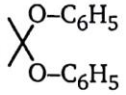
(a) (i) $Br_2 + FeBr_3$ (ii) $KMnO_4$ and heat (iii) HNO_3 and H_2SO_4

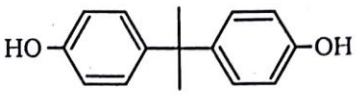
(b) (i) $KMnO_4$ and heat (ii) $Br_2 + FeBr_3$ (iii) HNO_3 and H_2SO_4

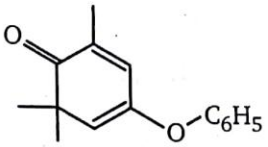
(c) (i) NBS in CCl_4 and heat (ii) $KMnO_4$ and heat (iii) HNO_3 and H_2SO_4

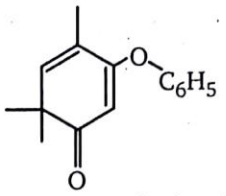
(d) (i) NBS in CCl_4 and heat (ii) $NaNO_2$ and heat

181. Phenol reacts with acetone in the presence of conc. sulphuric acid to form a $C_{15}H_{16}O_2$ product. Which of the following compounds is this product ?

(a) 

(b) 

(c) 

(d) 

182. Heating benzene in a large excess of 80% D_2SO_4 in D_2O results in what product ?

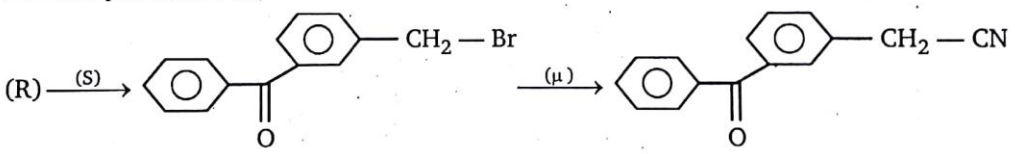
(a) $C_6H_5SO_3D$ (b) C_6H_5OD (c) C_6H_5D (d) C_6D_6

183. A solution of cyclohexene in benzene is stirred at 0°C while concentrated sulphuric acid is added. After washing away the acid and removing the excess benzene, what product is isolated?

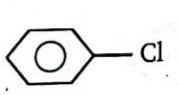
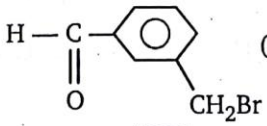
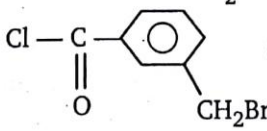
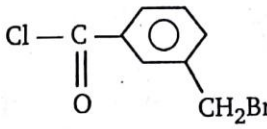
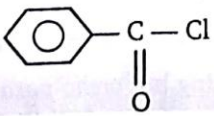
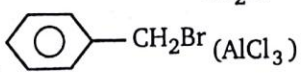
(a) cyclohexylbenzene (b) 1-cyclohexylcyclohexene

(c) *trans*-1,2-diphenylcyclohexane (d) 1,1-diphenylcyclohexane

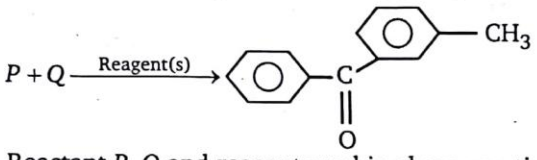
184. Indentify the reagents S and μ in the scheme below in which R is converted to the nitrite V via the benzylic halide T.



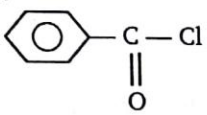
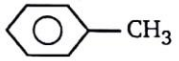
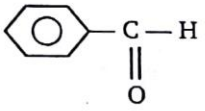
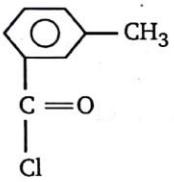
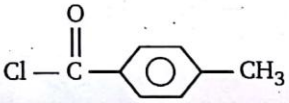
R, S and μ respectively are :

	R	S	μ
(a)		 $(AlCl_3)$	HCN
(b)		 $(AlCl_3)$	HCN
(c)		 $(AlCl_3)$	KCN
(d)		 $(AlCl_3)$	KCN

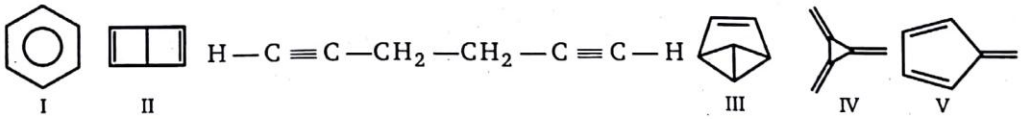
185. Two aromatic compounds *P* and *Q* give product *R*.



Reactant *P*, *Q* and reagent used in above reaction are :

	P	Q	Reagent
(a)			$AlCl_3$
(b)			$AlCl_3$
(c)			$AlCl_3$
(d)			$ZnCl_2$

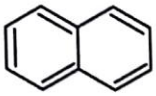
186. Which of the following C_6H_6 compounds has a single set of structurally equivalent hydrogen atoms ?



I II III IV V

(a) I and II (b) I and IV (c) I and V (d) I, II and III

187. Which of the following compounds would not be considered aromatic in its behaviour?

(a)  (b)  (c)  (d) 

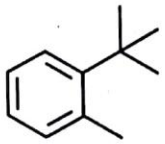
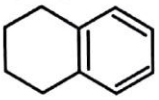
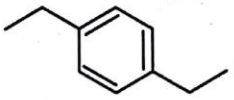
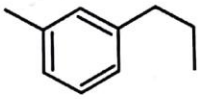
188. A C_8H_{10} hydrocarbon is nitrated by HNO_3 and sulphuric acid. Two, and only two, $C_8H_9NO_2$ isomers are obtained. Which of the following fits this evidence ?

(a) ethyl benzene (b) *ortho*-xylene (c) *meta*-xylene (d) *para*-xylene

189. Which of the following benzene ring substituents is deactivating but *ortho-para* directing ?

(a) $-N=O$ (b) $-OCH_3$ (c) $-COCH_3$ (d) $-NO_2$

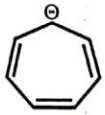
190. Which of the following compounds forms *ortho*- benzenedicarboxylic acid when oxidized by hot aqueous potassium permanganate ?

(a)  (b)  (c)  (d) 

191. Which of the following organic chlorides will not give a Friedel-Craft alkylation product when heated with benzene and $AlCl_3$?

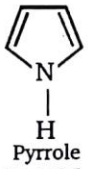
(a) $(CH_3)_3CCl$ (b) $CH_2=CHCH_2Cl$ (c) CH_3CH_2Cl (d) $CH_2=CHCl$

192. Which of the following is aromatic ?

(a)  (b)  (carbene) (c)  (d)  (carbene)

193. Which of the following substance will increase the acidity of phenol ?

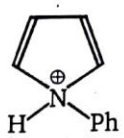
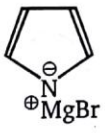
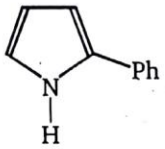
(a) Dil. H_2SO_4 (b) Dil. HCl (c) Conc. H_2SO_4 (d) Conc. CH_3COOH

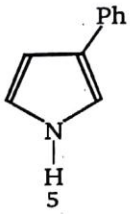
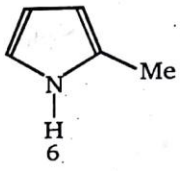
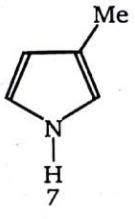
194.  + PhMgBr $\longrightarrow E + F$

Pyrrole

E + MeCl $\longrightarrow G + H$

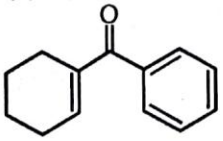
F + MeCl $\longrightarrow$ no reaction without a catalyst

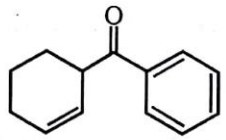
 1  2  3  4

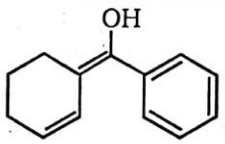
 5  6  7

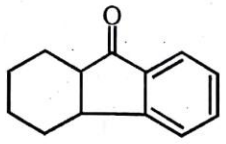
The structure of products $E - H$, respectively are

(a) 3, 2, 6, 7 (b) 4, 5, 6, 1 (c) 3, 4, 5, 2 (d) 3, 2, 4, 5

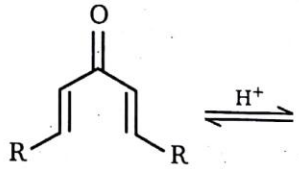
195.  $\xrightarrow{H^+}$ (A); Product A is :

(a) 

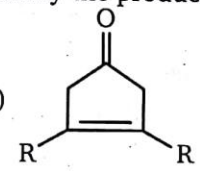
(b) 

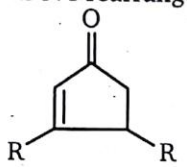
(c) 

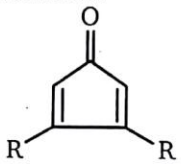
(d) none of these

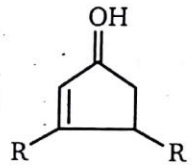
196. 

Identify the product of the above rearrangement reaction.

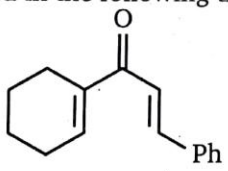
(a) 

(b) 

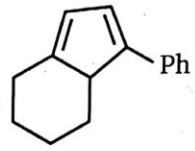
(c) 

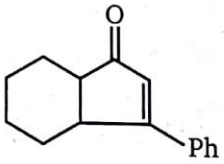
(d) 

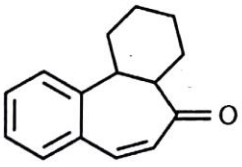
197. Product obtained in the following transformation is :

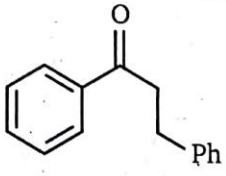


PPA = polyphosphoric acid

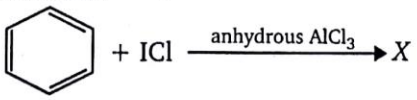
(a) 

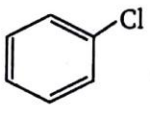
(b) 

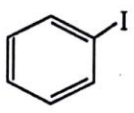
(c) 

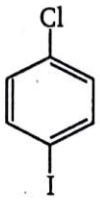
(d) 

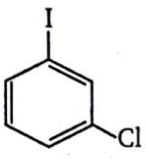
198. The compound *X* in the reaction.

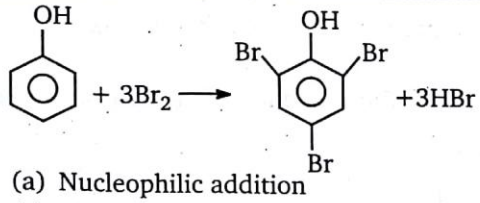


(a) 

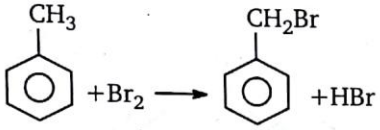
(b) 

(c) 

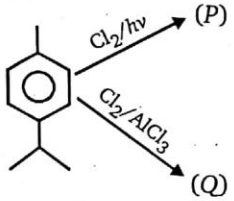
(d) 

199. 

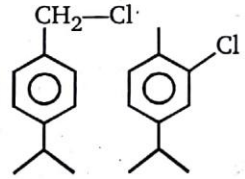
(a) Nucleophilic addition
(b) Nucleophilic substitution
(c) Electrophilic addition
(d) Electrophilic substitution
(e) Free radical substitution

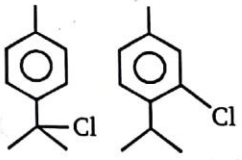
200. 

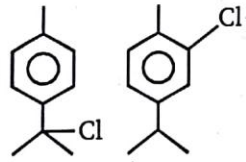
(a) Nucleophilic addition
(b) Nucleophilic substitution
(c) Electrophilic addition
(d) Electrophilic substitution
(e) Free radical substitution

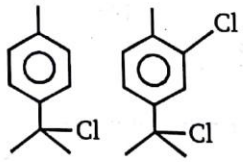
201. 

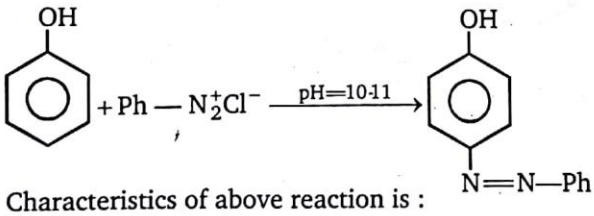
Identify major product of both respectively.

(a) 

(b) 

(c) 

(d) 

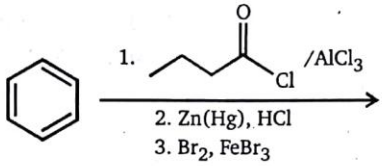
202. 

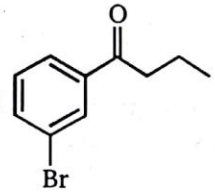
Characteristics of above reaction is :
(a) C — N coupling reaction ; Carbocation is intermediate
(b) N — N coupling reaction ; Carbocation is intermediate
(c) C — N coupling reaction ; Carbanion is intermediate
(d) N — N coupling reaction ; Carbanion is intermediate

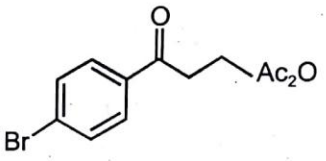
203. The compound formed on heating chlorobenzene with chloral in the presence of concentrated sulphuric acid, is :

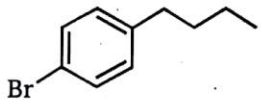
(a) Freon (b) DDT (c) Gammexene (d) Hexachloroethane

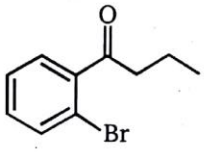
204. Predict the product of the following reaction.



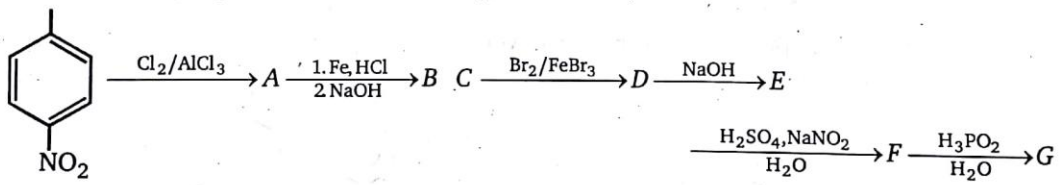
(a) 

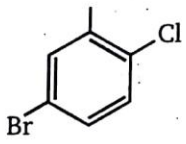
(b) 

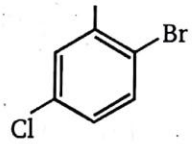
(c) 

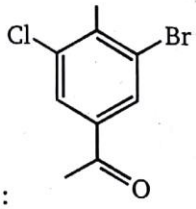
(d) 

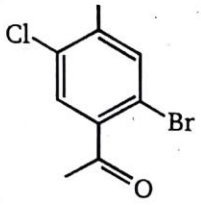
205. Predict the major product of the following reaction sequence.



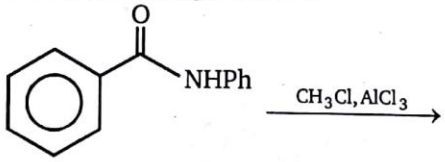
(a) 

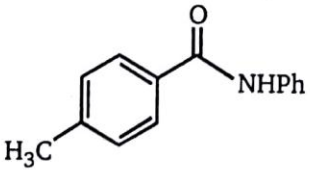
(b) 

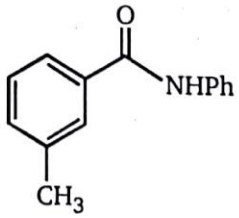
(c) 

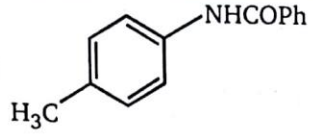
(d) 

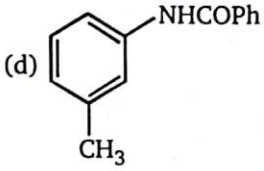
206. Give the major product of the following reaction :

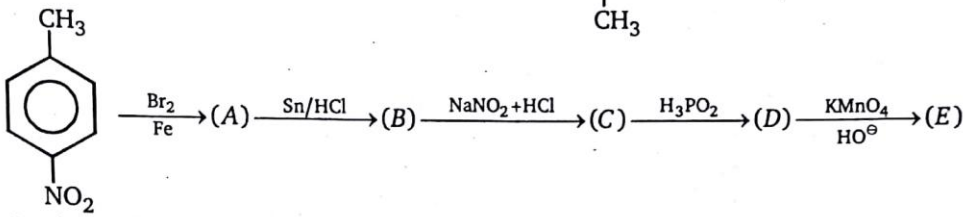


(a) 

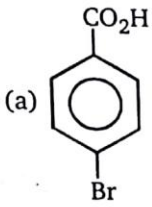
(b) 

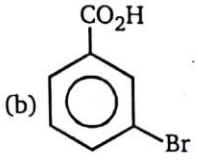
(c) 

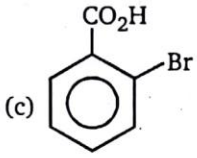
(d) 

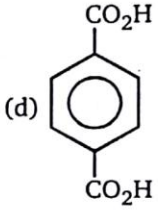
207. 

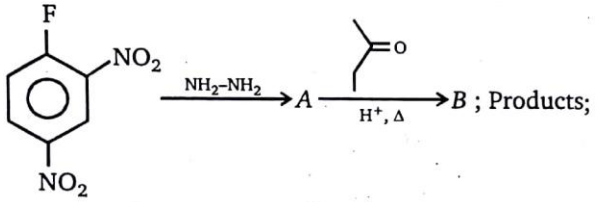
Product (*E*) is :

(a) 

(b) 

(c) 

(d) 

208. 

Incorrect statements regarding above reaction is

(a) Product *A* is 2, 4-DNP

(b) *A* to *B* dehydration reaction

(c) *A* to *B*, geometrical isomersm will obtained as a product

(d) B is known as oxime

209. (i) chlorobenzene is mono-nitrated to M

(ii) nitrobenezene is mono-chlorinated to N

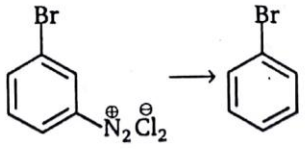
(iii) anisole is mono-nitrated to P

(iv) 2-nitrochlorobenzene is mono-nitrated to Q.

Out of M, N, P and Q the compound that undergoes reaction with aq. NaOH fastest is

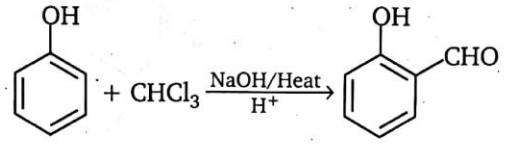
(a) M (b) N (c) P (d) Q

210. For the transformation the reagent used is



(a) $LiAlH_4$ (b) H_3PO_2 (c) H_3O^+ (d) H_2 / Pt

211. The reaction

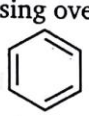
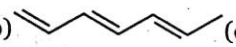


is known as

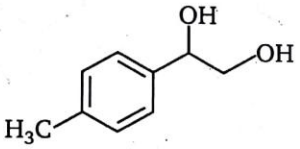
(a) Perkin reaction (b) Sandmeyer reaction

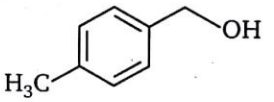
(c) Reimer-Tiemann reaction (d) Cannizzaro reaction

212. A compound X formed after heating coke with lime react with water to give *Y* which on passing over redhot iron at 873 produces *Z*. The compound *Z* is

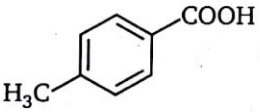
(a)  (b)  (c)  (d) 

213. The reaction of 50% aq KOH on an equimolar mixture of 4-methylbenzaldehyde and formaldehyde followed by acidification gives :

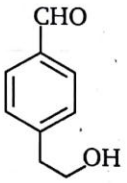
(a) 

(b) 

+ HCOOH

(c) 

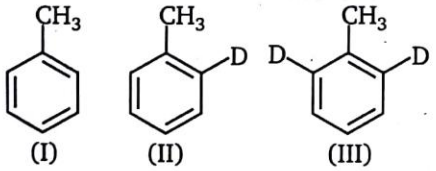
+CH_3OH

(d) 

214. Which isomer of xylene can give three different monochloroderivatives ?

(a) o-xylene (b) m-xylene (c) *p*-xylene

(d) xylene cannot give a monochloro derivative

215. 

(I) (II) (III)

The rate of o-nitration of the above compounds, (I) toluene, (II) 2-D-toluene and (III) 2, 6-D_2-toluene is in the following order

(a) I > II > III (b) II > I > III (c) III > I > II

(d) The rate is the same for all the three compounds

216. Cyclooctatetraene is expected to have :

(a) a planar structure (b) a tub-shaped structure

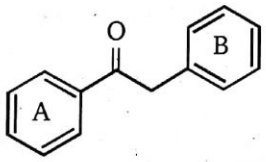
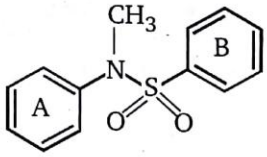
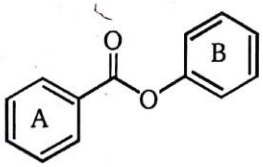
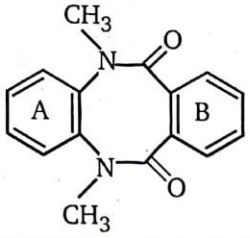
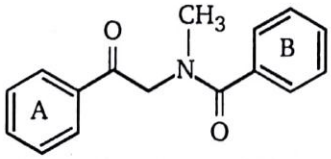
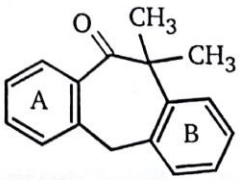
(c) open chain isomeric structure (d) tatutomeric bicyclic structure

ANSWERS — LEVEL 1															
1.	(b)	**2.**	(d)	**3.**	(b)	**4.**	(c)	**5.**	(a)	**6.**	(b)	**7.**	(c)	**8.**	(b)
9.	(d)	**10.**	(d)	**11.**	(a)	**12.**	(a)	**13.**	(a)	**14.**	(a)	**15.**	(a)	**16.**	(b)
17.	(b)	**18.**	(a)	**19.**	(b)	**20.**	(b)	**21.**	(c)	**22.**	(c)	**23.**	(b)	**24.**	(b)
25.	(d)	**26.**	(c)	**27.**	(c)	**28.**	(b)	**29.**	(b)	**30.**	(b)	**31.**	(b)	**32.**	(a)
33.	(b)	**34.**	(d)	**35.**	(c)	**36.**	(c)	**37.**	(a)	**38.**	(c)	**39.**	(a)	**40.**	(b)
41.	(b)	**42.**	(c)	**43.**	(c)	**44.**	(b)	**45.**	(c)	**46.**	(b)	**47.**	(b)	**48.**	(b)
49.	(b)	**50.**	(b)	**51.**	(b)	**52.**	(a)	**53.**	(c)	**54.**	(c)	**55.**	(a)	**56.**	(a)
57.	(d)	**58.**	(b)	**59.**	(b)	**60.**	(b)	**61.**	(c)	**62.**	(b)	**63.**	(b)	**64.**	(b)
65.	(a)	**66.**	(a)	**67.**	(c)	**68.**	(b)	**69.**	(a)	**70.**	(d)	**71.**	(b)	**72.**	(a)
73.	(a)	**74.**	(c)	**75.**	(a)	**76.**	(d)	**77.**	(c)	**78.**	(b)	**79.**	(c)	**80.**	(b)
81.	(b)	**82.**	(c)	**83.**	(a)	**84.**	(c)	**85.**	(d)	**86.**	(b)	**87.**	(d)	**88.**	(b)
89.	(d)	**90.**	(d)	**91.**	(d)	**92.**	(d)	**93.**	(d)	**94.**	(b)	**95.**	(c)	**96.**	(d)
97.	(b)	**98.**	(d)	**99.**	(b)	**100.**	(b)	**101.**	(b)	**102.**	(c)	**103.**	(d)	**104.**	(a)
105.	(b)	**106.**	(d)	**107.**	(c)	**108.**	(b)	**109.**	(b)	**110.**	(b)	**111.**	(c)	**112.**	(b)
113.	(c)	**114.**	(a)	**115.**	(b)	**116.**	(b)	**117.**	(a)	**118.**	(b)	**119.**	(b)	**120.**	(c)
121.	(b)	**122.**	(b)	**123.**	(c)	**124.**	(b)	**125.**	(b)	**126.**	(b)	**127.**	(c)	**128.**	(c)
129.	(c)	**130.**	(b)	**131.**	(d)	**132.**	(b)	**133.**	(b)	**134.**	(a)	**135.**	(b)	**136.**	(a)
137.	(b)	**138.**	(c)	**139.**	(d)	**140.**	(b)	**141.**	(b)	**142.**	(c)	**143.**	(a)	**144.**	(b)
145.	(b)	**146.**	(c)	**147.**	(a)	**148.**	(c)	**149.**	(c)	**150.**	(b)	**151.**	(d)	**152.**	(c)
153.	(c)	**154.**	(b)	**155.**	(c)	**156.**	(c)	**157.**	(c)	**158.**	(b)	**159.**	(c)	**160.**	(c)
161.	(b)	**162.**	(c)	**163.**	(d)	**164.**	(d)	**165.**	(c)	**166.**	(c)	**167.**	(b)	**168.**	(d)
169.	(d)	**170.**	(b)	**171.**	(b)	**172.**	(a)	**173.**	(a)	**174.**	(b)	**175.**	(b)	**176.**	(d)
177.	(b)	**178.**	(b)	**179.**	(c)	**180.**	(a)	**181.**	(b)	**182.**	(d)	**183.**	(a)	**184.**	(c)
185.	(c)	**186.**	(b)	**187.**	(b)	**188.**	(b)	**189.**	(a)	**190.**	(b)	**191.**	(d)	**192.**	(b)
193.	(c)	**194.**	(a)	**195.**	(c)	**196.**	(b)	**197.**	(b)	**198**	(b)	**199**	(d)	**200**	(e)
201.	(c)	**202.**	(c)	**203.**	(b)	**204.**	(c)	**205.**	(a)	**206.**	(c)	**207.**	(c)	**208.**	(d)
209.	(d)	**210.**	(a)	**211.**	(c)	**212.**	(a)	**213.**	(b)	**214**	(b)	**215.**	(d)	**216.**	(b)

LEVEL-2

1. Each of the six compounds shown at the bottom of the page has two aromatic (benzene) rings. In each case the two rings are different and are labeled A & B. **If an electrophilic substitution, such as nitration or bromination**, is carried out on each compound, then identify which ring (A or B) will be preferentially attacked, and indicate the orientation of the substitution (ortho/para, meta or all sites).

Compound	Reactivity		Substitution		Compound	Reactivity		Substitution	
1.	A		ortho/para		2.	A		ortho/para	
	B		meta			B		meta	
			all sites					all sites	
3.	A		ortho/para		4.	A		ortho/para	
	B		meta			B		meta	
			all sites					all sites	
5.	A		ortho/para		6.	A		ortho/para	
	B		meta			B		meta	
			all sites					all sites	

	Compound		Compound
1.		2.	
3.		4.	
5.		6.	

2. When given substituents on a benzene ring, as activating or de-activating and as ortho-para or meta directing for elctrophilic aromatic substitution fill the following by appropriate (✓) right or (✗) wrong.

	Substituent	Activating	De-activating	Ortho/para	Meta
1.	$-OCH_3$				
2.	$-\overset{\overset{O}{\|}}{C}-O-CH_3$				
3.	$-O-\overset{\overset{O}{\|}}{C}-CH_3$				
4.	$-CH_3$				
5.	$-F$				
6.	$-Ph$				
7.	$-NH-\overset{\overset{O}{\|}}{C}-CH_3$				
8.	$-\overset{\overset{O}{\|}}{C}-NH-CH_3$				
9.	$-Br$				
10.	$-CN$				
11.	$-CF_3$				
12.	$-\overset{\overset{O}{\|}}{C}-NH_2$				
13.	$-\overset{\overset{O}{\|}}{C}-OH$				
14.	$-CH=CH_2$				

15.	$-CH=CH-\overset{\overset{O}{\|\|}}{C}-OH$				
16.	$-CH=CH-\overset{\overset{O}{\|\|}}{C}-H$				
17.	$-S-Et$				
18.	$-\overset{\overset{O}{\|\|}}{S}-Et$				
19.	$-\overset{\overset{O}{\|\|}}{\underset{\underset{O}{\|\|}}{S}}-Et$				
20.	$-N=O$				
21.	$-CH_2X$				
22.	$-CHX_2$				

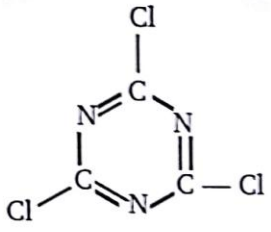
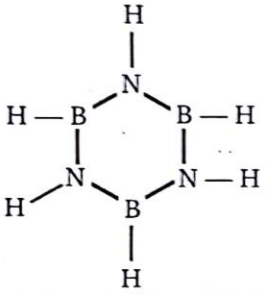
3. Devise a series of reactions to convert benzene into *meta*-chlorobromobenzene.

Select reagents and conditions from the following table, listing them in the order of use.

	Compound		Compound		Compound
1.	sulphuric acid (conc.) heat	**5.**	Mg in ether	**9.**	Cu_2Br_2 + HBr
2.	Cl_2 + $FeCl_3$ and heat	**6.**	PBr_3	**10.**	$(CH_3CO)_2O$ + Pyridine
3.	$NaNO_2$ + $H_3O^{(+)}$ 0°C	**7.**	H_3PO_2		
4.	H_2 Pt catalyst	**8.**	HNO_3(conc.)+ H_2SO_4(conc.) and heat		

(a) 1 then 2 then 6
(b) 2 then 8 then 4 then 3 then 9
(c) 8 then 4 then 10 then 2 then 3 then 9
(d) 8 then 2 then 4 then 3 then 9

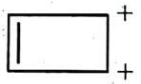
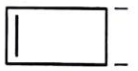
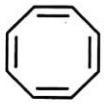
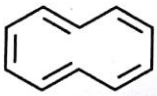
4. Match the Column (I) and Column (II). (Matrix)

Column (I)		Column (II)	
(a)		**(p)**	Aromatic
(b)		**(q)**	$(4n + 2)\pi$ electron in a single ring
(c)	$Fe(C_5H_5)_2$	**(r)**	$4n\pi$ electron in a single ring
(d)	$Cr(C_6H_6)_2$	**(s)**	Effective atomic number of metal = 36

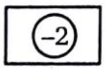
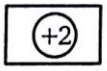
5. Match the Column (I) and Column (II).

Column (I)		Column (II)	
Compound (Monocyclic)		**Number of π- electron**	
(a)	$C_4H_4^{-2}$	**(p)**	$2\pi e$
(b)	$C_4H_4^{+2}$	**(q)**	$6\pi e$
(c)	$C_9H_9^{+1}$	**(r)**	$8\pi e$
(d)	$C_9H_9^{-1}$	**(s)**	$10\pi e$

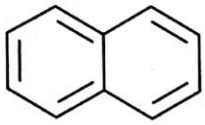
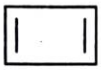
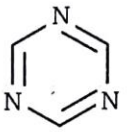
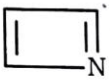
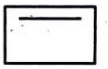
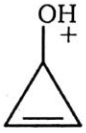
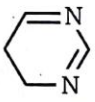
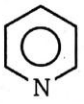
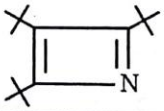
6. Match the Column (I), Column (II) and Column (III). (Matrix)

Column I		Column II		Column III	
(a)		(p)	Aromatic	(w)	$(4n + 2)\pi$ electron. $n = 0, 1, 2, 3$
(b)		(q)	Non-aromatic	(x)	$4n\pi$ electron $n = 1, 2, 3$
(c)		(r)	Anti- aromatic	(y)	Non-planar compound
(d)		(s)	Planar compound	(z)	Readily reacts with active metal

7. Match the Column (I), Column (II) and Column (III). (Matrix)

Column I		Column II		Column III	
(a)		(p)	Readily react with active metal	(w)	Aromatic
(b)		(q)	Readily undergo Dimerization at room temperature	(x)	Anti-aromatic
(c)		(r)	$(4n + 2)\pi$ electron $n = 0, 1, 2, 3$	(y)	Non-aromatic
(d)		(s)	$4n\pi$ electron	(z)	High dipole

8. Among the following compound.

	Compound		Compound		Compound
(a)		**(b)**		**(c)**	
(d)		**(e)**		**(f)**	
(g)	$C_8H_8^{-2}$	**(h)**	$C_3H_3^+$	**(i)**	
(j)		**(k)**		**(l)**	

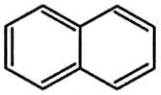
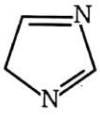
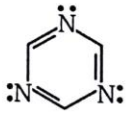
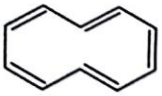
(a) Number of compounds which are aromatic = P
(b) Number of compounds which are anti-aromatic = Q
(c) Number of compounds which are non-aromatic = R
(d) Number of compounds which readily = S
Undergo dimerization at room temperature
(e) Number of compound which reacts with active metal = T

Sum of $P+Q+R+S+T$ =

9. Of the following compounds which will react with Br_2 at room temperature in dark.

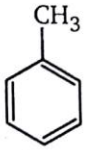
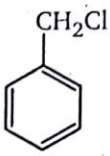
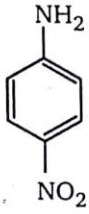
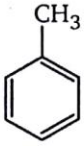
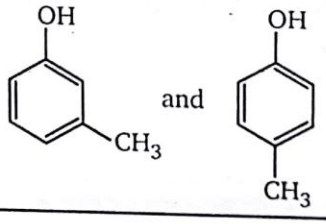
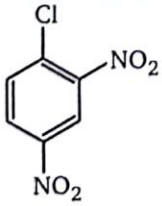
(a)	Benzene (C_6H_6)	
(b)	Cyclohexene (C_6H_{10})	
(c)	Cyclohexane (C_6H_{12})	
(d)	Propanoic Acid ($C_2H_5CO_2H$)	
(e)	Phenol (C_6H_5OH)	
(f)	Nitrobenzene ($C_6H_5NO_2$)	
(g)	Hexyne (C_6H_{10})	
(h)	2,2-dichloropropane ($C_3H_6Cl_2$)	

10. Among the following compound.

	Compound		Compound		Compound
(a)		**(b)**	$C_8H_8^{-2}$	**(c)**	
(d)		**(e)**		**(f)**	
(g)		**(h)**		**(i)**	$C_3H_3^{+1}$
(j)		**(k)**		**(l)**	

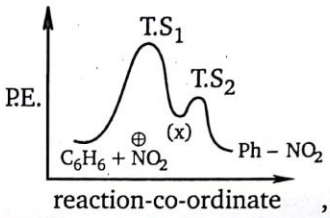
(a) Number of compounds which are aromatic = w
(b) Number of compounds which are non-aromatic = x
(c) Number of compounds which are anti-aromatic = y
(d) Number of compounds which readily undergo Dimerization at room temperature = z
Sum of $w + x + y + z$ = ...

11. Complete the following table.

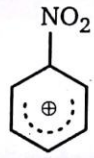
	Reactant	Reagents(s)/Conditions	Major Organic Products
(a)		**(A)**	
(b)		1. $NaNO_2$ in dilute H_2SO_4/0 – 5 °C 2. heat or boiling	**(B)**
(c)		SO_3/conc. H_2SO_4	**(C)**
(d)	**(D)**	1. NaOH heated at 330°C 2. dilute H_3O^+	
(e)		1. aqueous NaOH heated at 60°C 2. dilute H_3O^+	**(E)**

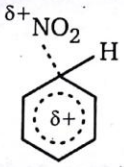
12. Comprehension

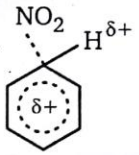
Given is the energy profile diagram of nitration of benzene using mixed acid. ($HNO_3 + H_2SO_4$).



A. Identify (x) in above reaction :

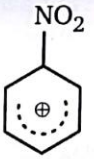
(a) 

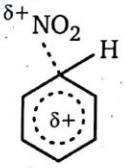
(b) 

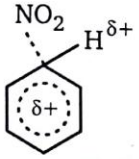
(c) 

(d) None

B. Identify $T.S_1$ in the above reaction.

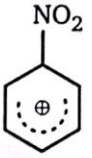
(a) 

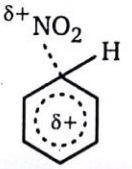
(b) 

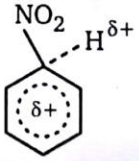
(c) 

(d) None

C. Identify $T.S_2$ in the above reaction :

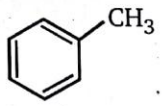
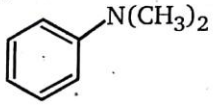
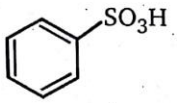
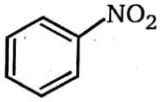
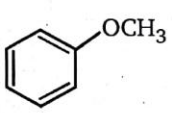
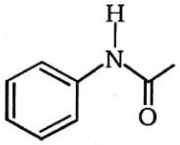
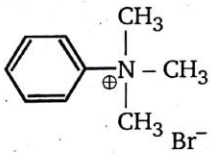
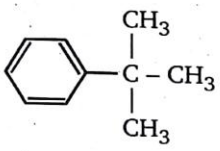
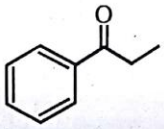
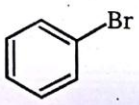
(a) 

(b) 

(c) 

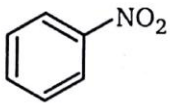
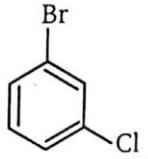
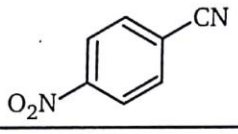
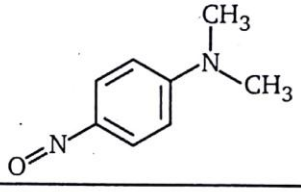
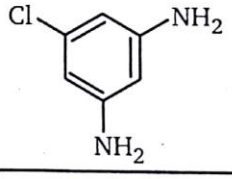
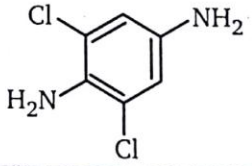
(d) None

13. Examine the ten structural formulas shown below and select those that satisfy each of the following conditions. Enter one or more letters (a through j) in each answer box, reflecting your choice for each.

	Compound		Compound
a.		**b.**	
c.		**d.**	
e.		**f.**	
g.		**h.**	
i.		**j.**	

A.	Which compounds undergo electrophilic nitration more rapidly than benzene ?	
B.	Which compounds give meta substitution under electrophilic bromination conditions ?	

14. Nitrobenzene is a versatile compound that may be converted into a wide variety of substituted benzenes. Five such synthesis are shown below. In each reaction box above an arrow write letters designating the reagents and conditions, selected from the list at the bottom of the page, that would effect the transformation. The reagents must be written in the answer box in the correct order of their use. You may assume appropriate heating or cooling takes place, and more than one equivalent of the reagent may be used if needed.

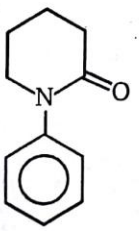
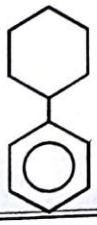
Reactant	Reagent			Product
 nitrobenzene	**a.**	⟶	**v.**	
	b.	⟶	**w.**	
	c.	⟶	**x.**	
	d.	⟶	**y.**	
	e.	⟶	**z.**	

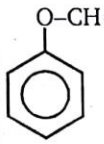
Reagents		Reagents	
A.	H_2, Ni catalyst	**F.**	Cl_2 & $FeCl_3$
B.	KBr & Cu_2Br_2	**G.**	NaOH 10% solution
C.	KCN & $Cu_2(CN)_2$	**H.**	$(CH_3CO)_2O$, pyridine
D.	HNO_2 0°C	**I.**	HNO_3/H_2SO_4
E.	CH_3I & pyridine		

15. Match the column I and II.

Column (I)		Column (II)	
Group		**Effect on phenyl ring**	
(a)	$-CH=CH-CO_2H$	**(p)**	*o*/*p*-directors
(b)	$-O-\overset{\overset{O}{\|\|}}{S}-CH_3$	**(q)**	meta-directors
(c)	$-NH-\overset{\overset{O}{\|\|}}{C}-CH_3$	**(r)**	Activating group
(d)	$-\overset{\overset{O}{\|\|}}{S}-CH_3$	**(s)**	De-activating group

16. Match the column I and II.

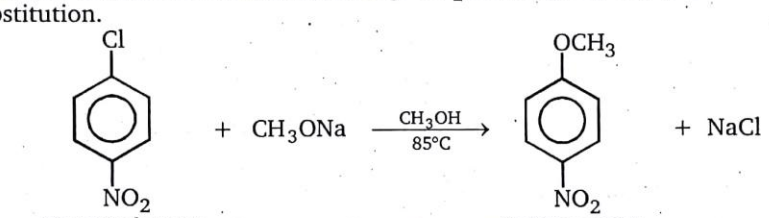
Column (I)		Column (II)	
Group		**Effect on phenyl group**	
(a)		**(p)**	Activating group
(b)		**(q)**	De-activating group

(c)		(r)	*o*/*p*-director
(d)		(s)	meta-director

17. Comprehension

Nucleophilic Aromatic substitution (SN_{Ar}) :

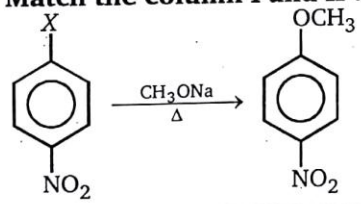
A substituted benzene derivative containing- NO_2 and Cl group at *p*-position is subjected to Nu-substitution.



p-chloronitrobenzene

(*p*-Nitroanisole)
(92%)

A. Match the column I and II :

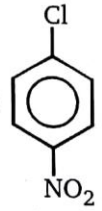


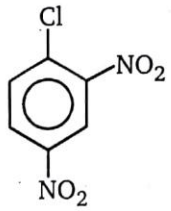
Column (I)		Column (II)	
***X* = halogen**		**relative reactivity toward (SN_{Ar}).**	
(a)	– F	**(p)**	312
(b)	– Cl	**(q)**	1
(c)	– Br	**(r)**	0.8
(d)	– I	**(s)**	0.6

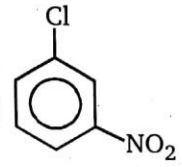
B. If step-2 were rate determining step, which halogen of aryl halide is most reactive toward SN_{Ar}.

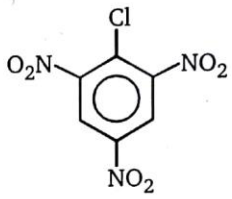
(a) Fluoride (b) Chloride (c) Bromide (D) Iodide

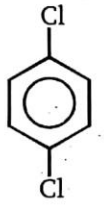
C. Which of the following is most reactive toward SN_{Ar}.

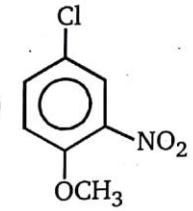
(a) 

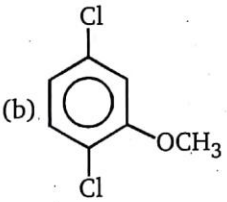
(b) 

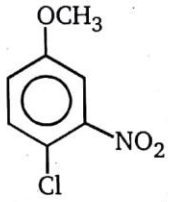
(c) 

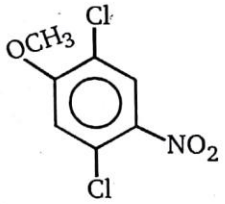
(d) 

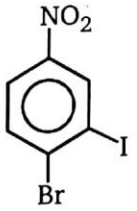
D.  $\xrightarrow{HNO_3}$ (*A*) $\xrightarrow{CH_3ONa}$ (*B*) (Major) , product (*B*) is :

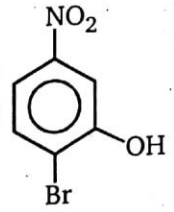
(a) 

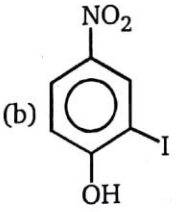
(b) 

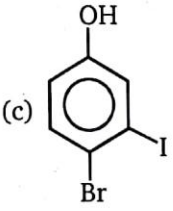
(c) 

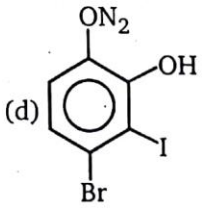
(d) 

E.  $\xrightarrow[(2)\ H_3O^{\oplus}]{(1)\ NaOH,\ \Delta}$ (*A*) , Product (*A*) is :

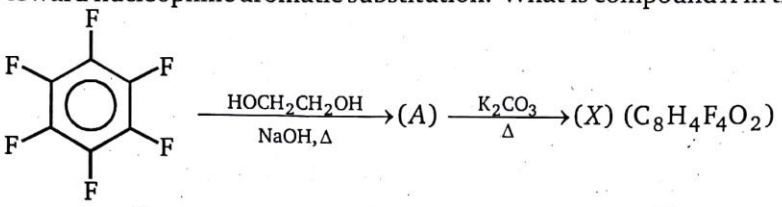
(a) 

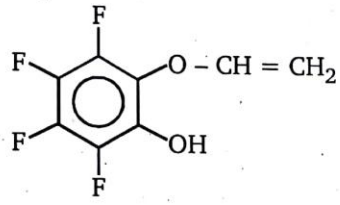
(b) 

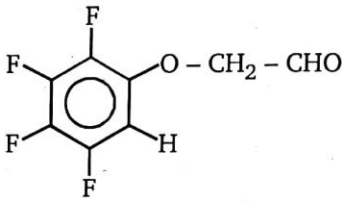
(c) 

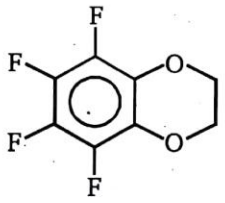
(d) 

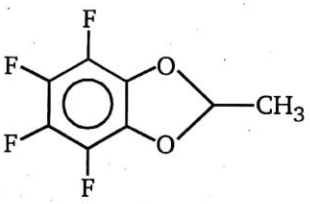
F. The cumulative effect of their fluorine activate the rings of penta and hexa fluorobenzene toward nucleophilic aromatic substitution. What is compound *X* in the following synthesis ?

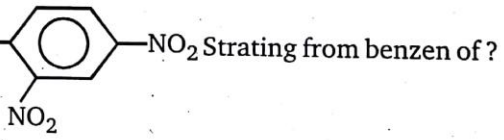


(a) 

(b) 

(c) 

(d) 

G. Which is the best route for the synthesis of 

Strating from benzen of ?

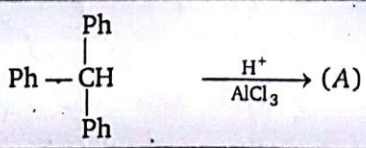
(a) $\xrightarrow[FeBr_3]{Br_2} \xrightarrow[H_2SO_4]{HNO_3} \xrightarrow[H_2SO_4]{HNO_3} \xrightarrow[CH_3OH]{NaOCH_3}$

(b) $\xrightarrow[H_2SO_4]{HNO_3} \xrightarrow[H_2SO_4]{HNO_3} \xrightarrow[FeBr_3]{Br_2} \xrightarrow[CH_3OH]{NaOCH_3}$

(c) $\xrightarrow[H_2SO_4]{HNO_3} \xrightarrow[FeBr_3]{Br_2} \xrightarrow[H_2SO_4]{HNO_3} \xrightarrow[CH_3OH]{NaOCH_3}$

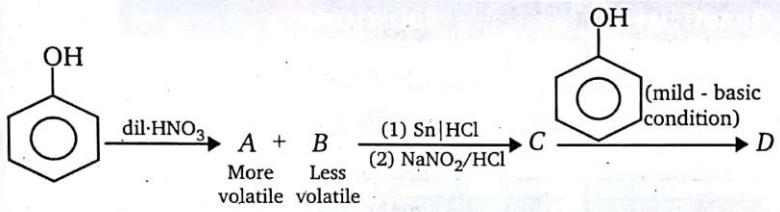
(d) $\xrightarrow[H_2SO_4]{HNO_3} \xrightarrow[FeBr_3]{Br_2} \xrightarrow[CH_3OH]{NaOCH_3} \xrightarrow[H_2SO_4]{HNO_3}$

18. Identify product (*A*) and write its structure.



SUBJECTIVE PROBLEMS

1.



Double bond equivalent of *D* is :

2. How many isomers '*x*' of C_8H_{10} when reacts with hot alkaline $KMnO_4$ give only aromatic dicarboxylic acid ? How many isomers '*y*' of C_4H_8 when reacts with hot alkaline $KMnO_4$ give carbondioxide ?

Sum of $x+y$=?

3. How many groups are *o*/*p* director in the electrophilic aromatic substitution ?

(i) $-NH_2$ (ii) $-COH$ (iii) $-N=O$ (iv) $-COOH$

(v) $-OMe$ (vi) $-O-\overset{\overset{O}{\|}}{C}-Me$ (vii) $-Et$ (viii) $-\overset{\overset{O}{\|}}{C}-NH-Me$

(ix) $-N=NH_2$ (x) $-SO_3H$

ANSWERS — LEVEL 2

1.

Compound	Reactivity	Substitution
1	B	ortho/para
2	A	ortho/para
3	B	ortho/para
4	A	ortho/para
5	B	meta
6	B	ortho/para

2.

	Substituent	Activating	De-activating	Ortho/para	Meta
1.	$-OCH_3$	✓	✗	✓	✗
2.	$-\overset{\overset{O}{\|\|}}{C}-O-CH_3$	✗	✓	✗	✓
3.	$-O-\overset{\overset{O}{\|\|}}{C}-CH_3$	✓	✗	✓	✗
4.	$-CH_3$	✓	✗	✓	✗
5.	$-F$	✗	✓	✓	✗
6.	$-Ph$	✓	✗	✓	✗
7.	$-NH-\overset{\overset{O}{\|\|}}{C}-CH_3$	✓	✗	✓	✗
8.	$-\overset{\overset{O}{\|\|}}{C}-NH-CH_3$	✗	✓	✗	✓
9.	$-Br$	✗	✓	✓	✗
10.	$-CN$	✗	✓	✗	✓

11.	$-CF_3$	✗	✓	✗	✓
12.	$-\overset{\overset{O}{\|\|}}{C}-NH_2$	✗	✓	✗	✓
13.	$-\overset{\overset{O}{\|\|}}{C}-OH$	✗	✓	✗	✓
14.	$-CH=CH_2$	✓	✗	✓	✗
15.	$-CH=CH-\overset{\overset{O}{\|\|}}{C}-OH$	✗	✓	✓	✗
16.	$-CH=CH-\overset{\overset{O}{\|\|}}{C}-H$	✗	✓	✓	✗
17.	$-S-Et$	✓	✗	✓	✗
18.	$\begin{matrix}-S-Et\\ \|\|\\ O\end{matrix}$	✗	✓	✓	✗
19.	$\begin{matrix}O\\ \|\|\\ -S-Et\\ \|\|\\ O\end{matrix}$	✗	✓	✗	✓
20.	$-N=O$	✗	✓	✓	✗
21.	$-CH_2X$	✗	✓	✗	✓
22.	$-CHX_2$	✗	✓	✗	✓

3. d

4. a – p, q; b – p, q; c – p, q,s ; d – p, q, s

5. a – q; b – p; c – r; d – s

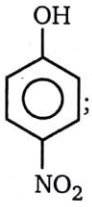
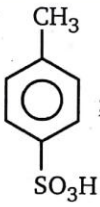
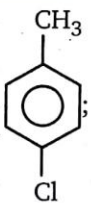
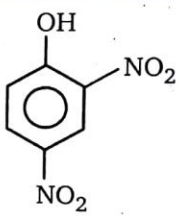
6. a – p, s – w; b – p, s – w; c – q – x, y, z; d – q – w – y

7. a – p, q, s – x; b – p – s – y; c – r – w, z; d – r – w, z

8. $P+Q+R+S+T=19$

9. b, e, g

10. $w+x+y+z=14$

11. A – $Cl_2/h\nu$ or $SO_2Cl_2/h\nu$; B –  ; C –  ; D –  ; E – 

12. A – a; B – b; C – c

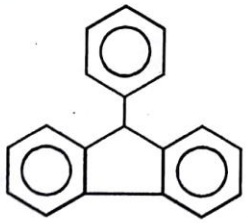
13. A – a, b, e, f, h; B – c, d, g, i (Note : yet C_6H_5Br is less reactive than C_6H_6 but *o*/*p* directing)

14. v – F, A, D, B; w – A, H, I, G, D, C; x – A, E, D; y – F, I, A or I, F, A;
z – A, H, I, F, G, A or A, H, I, F, A, G

15. a – p, s; b – p, r; c – p, r; d – p, s

16. a – p, r; b – p, r; c – p, r; d – p, r

17. A –a – p, b – q, c – r, d – s; B – d; C – d; D – a; E – b; F – c; G – a

18. 

Subjective Problems

1. 9 **2.** 5 **3.** 6