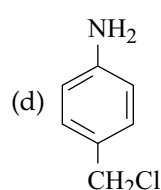
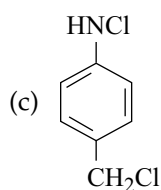
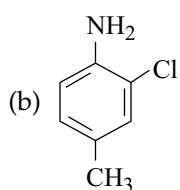
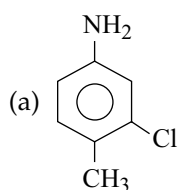


ESR Amines and Phenols

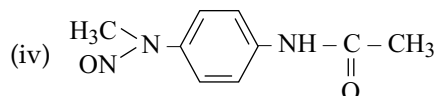
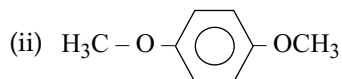
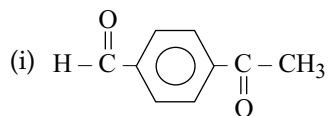
Question Bank

LEVEL 1

1. In the given reaction $\text{H}_2\text{N}-\text{C}_6\text{H}_4-\text{CH}_3 \xrightarrow[\text{Pyridine}]{(\text{CH}_3\text{CO})_2\text{O}} \text{A} \xrightarrow[\text{AlCl}_3]{\text{Cl}_2} \text{B} \xrightarrow{\text{H}_3\text{O}^+} \text{C}$ the product (C) will be



2. Rank the following compounds in order of decreasing reactivity for nitration.



Select the correct answer from the following:

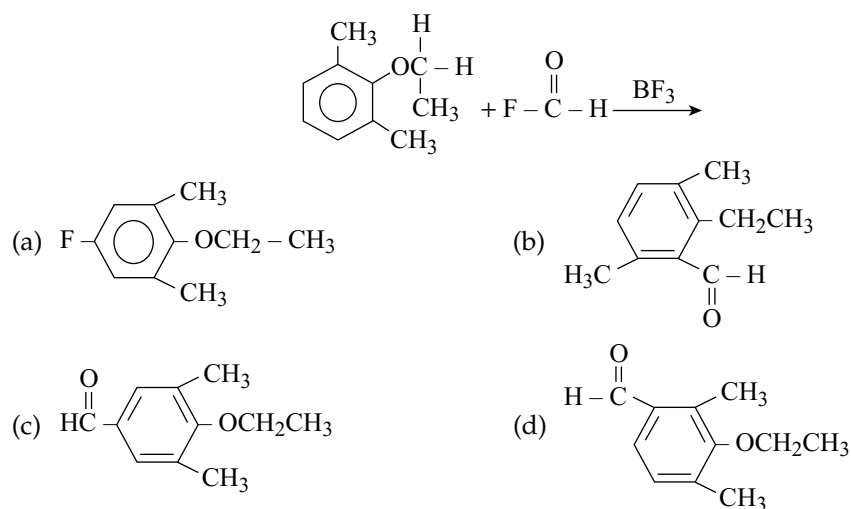
(a) $\text{iv} > \text{ii} > \text{i} > \text{iii}$

(b) $\text{ii} > \text{iv} > \text{iii} > \text{i}$

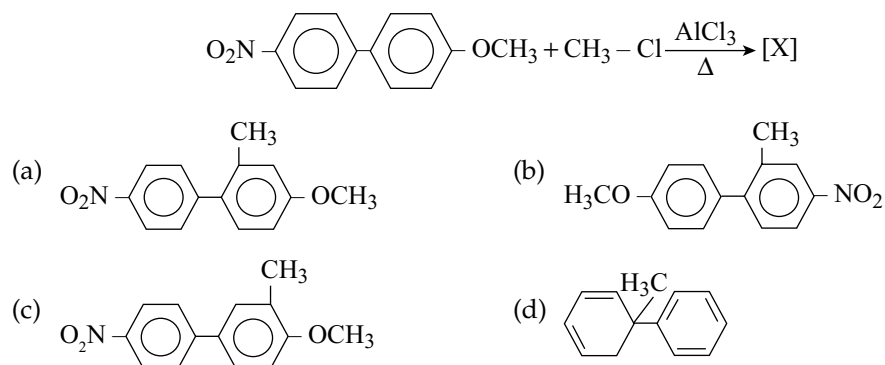
(c) $\text{ii} > \text{iv} > \text{i} > \text{iii}$

(d) $\text{i} > \text{ii} > \text{iii} > \text{iv}$

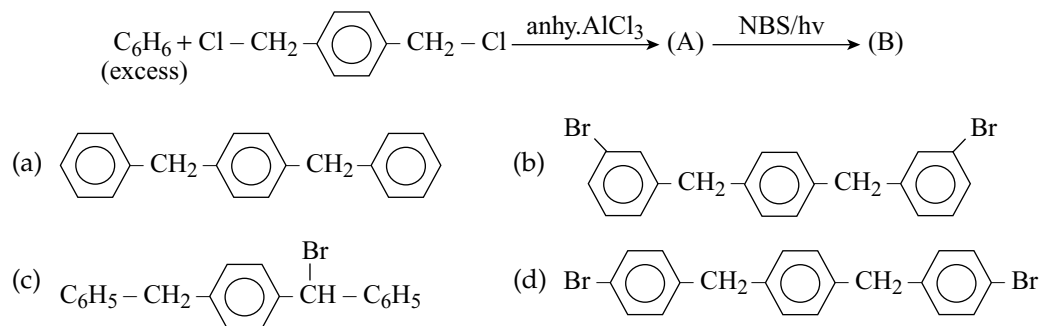
3. In the given reaction major product (P) will be



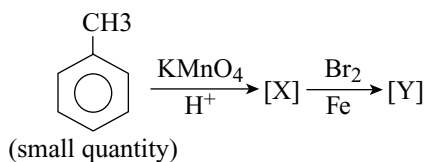
4. The major product [X] of the given reaction is

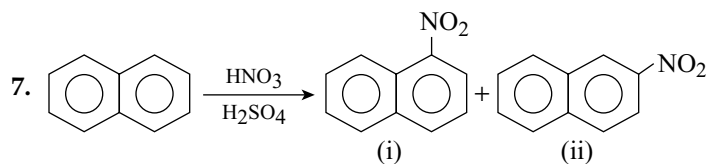
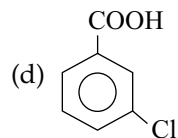
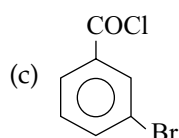
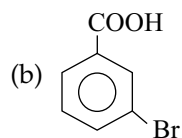
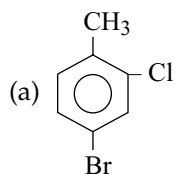


5. In the given reaction sequence, identify (B)



6. The final product of the given reaction is





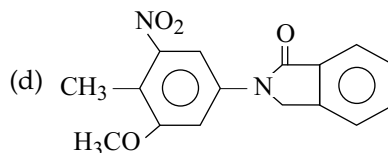
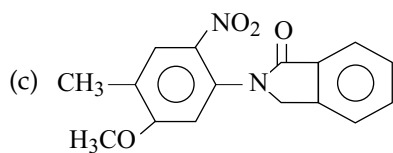
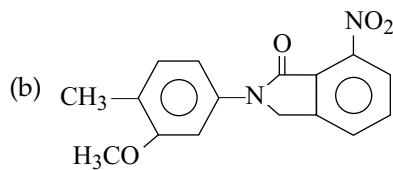
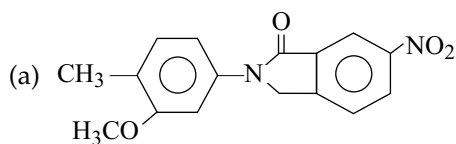
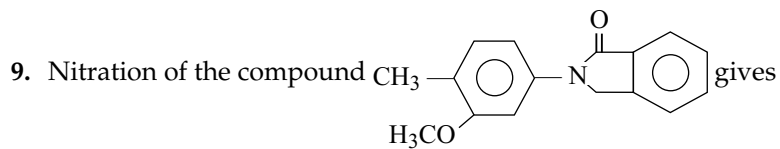
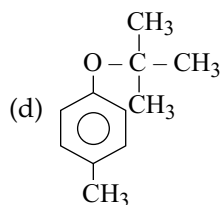
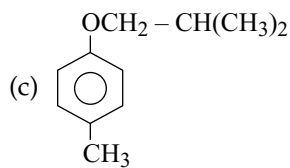
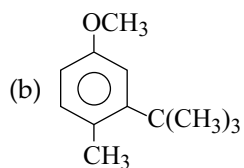
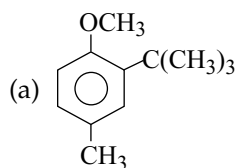
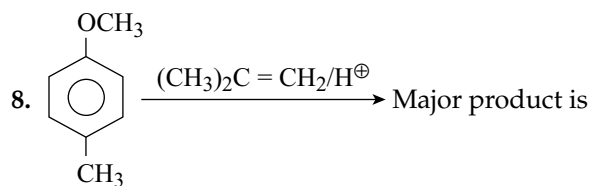
Which statement is correct?

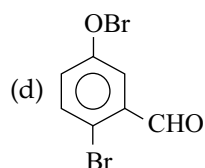
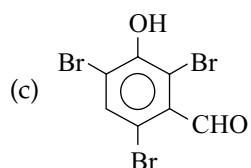
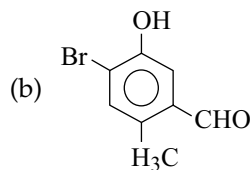
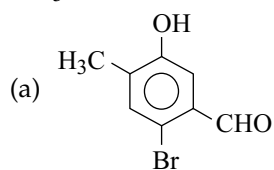
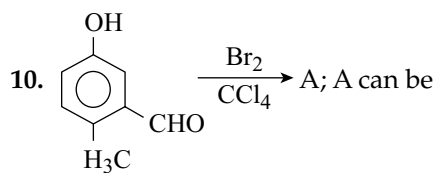
(a) i form in large quantity

(b) ii form in large quantity

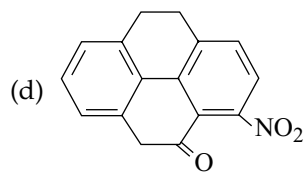
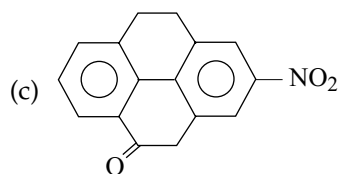
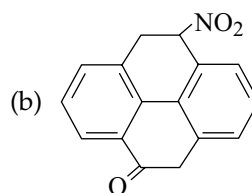
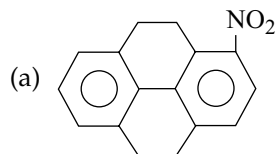
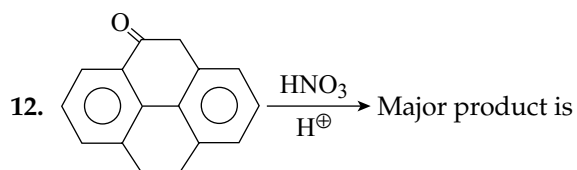
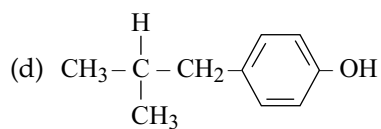
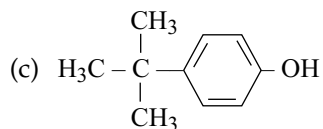
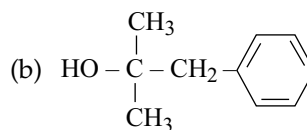
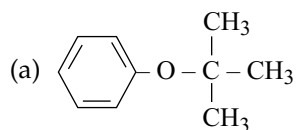
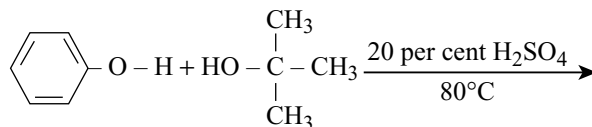
(c) i, ii form in equal quantity

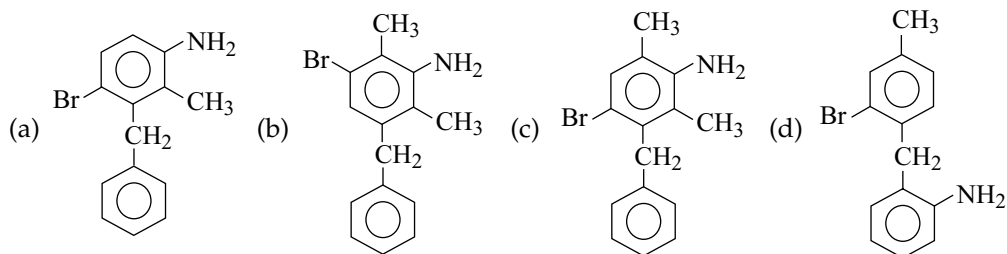
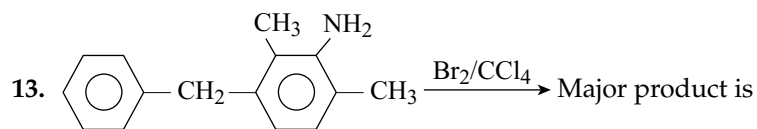
(d) naphthalene does not show nitration



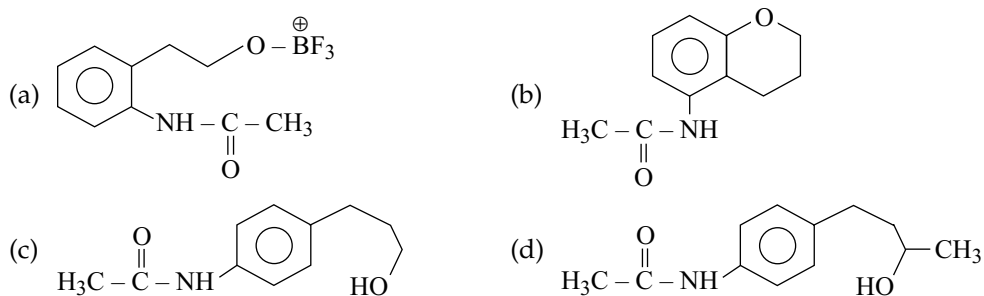
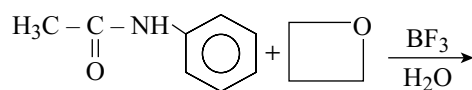


11. The major product of the following reaction is

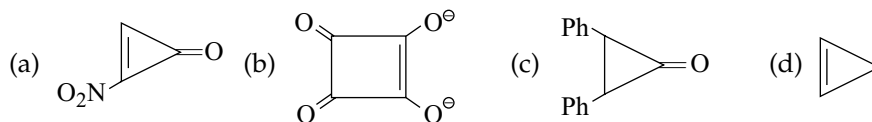




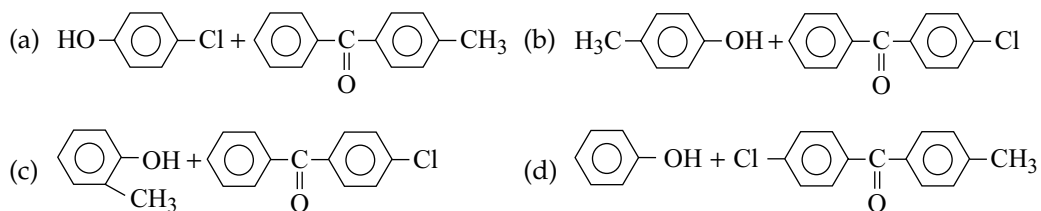
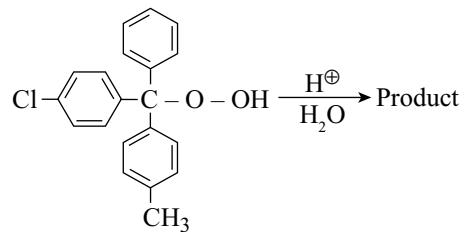
14. The product of the following reaction is



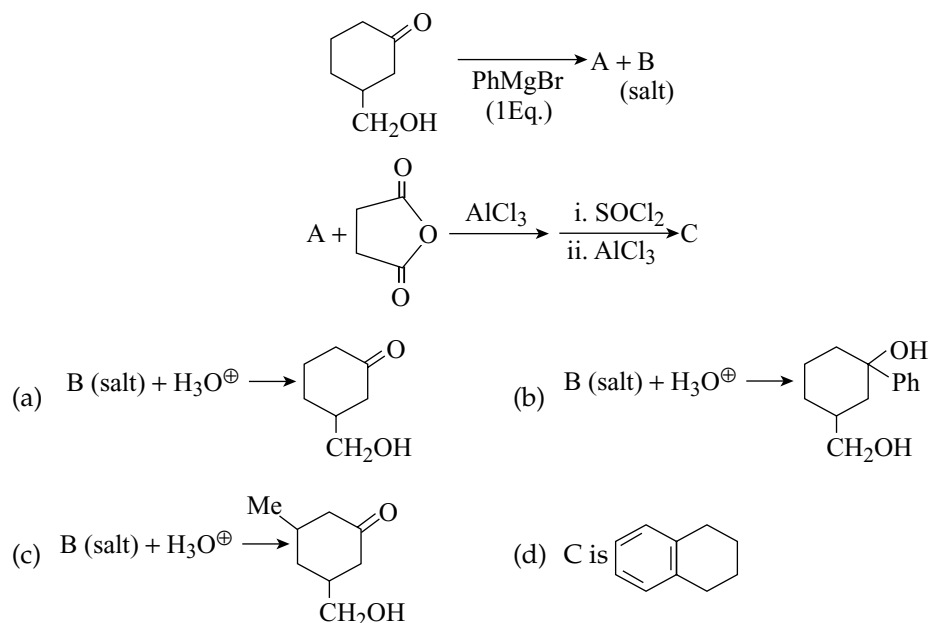
15. Which has equal carbon-carbon bond length?



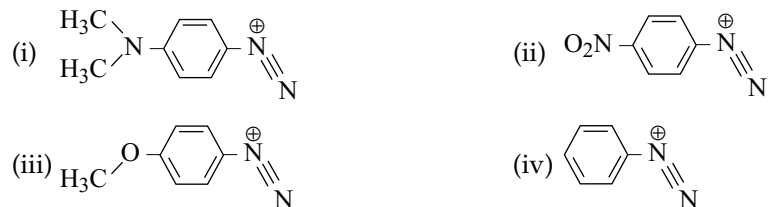
16. Product of the reaction is



17. For the following reaction, correct options are

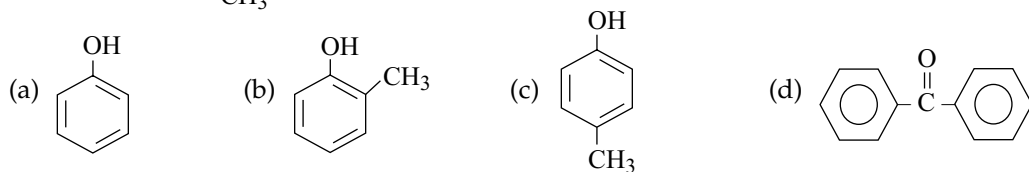
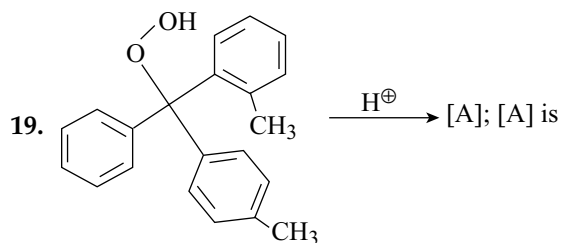


18. Consider the following ions

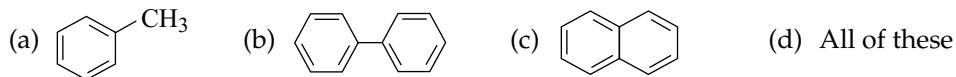


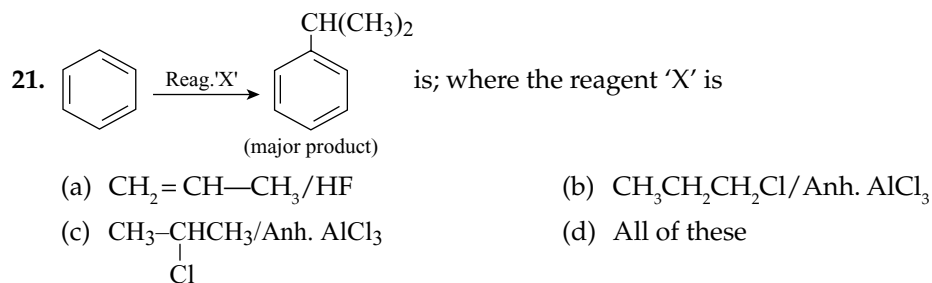
The reactivities of these ions in azo-coupling reactions (under similar conditions) will be such that

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

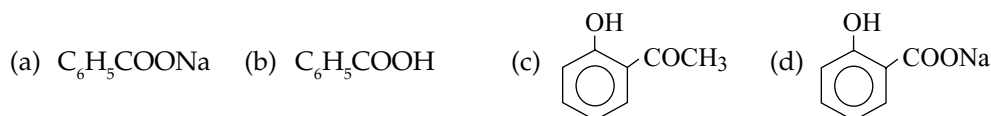
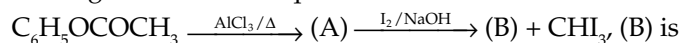


20. Which of the following is/are more reactive towards nitration than benzene?

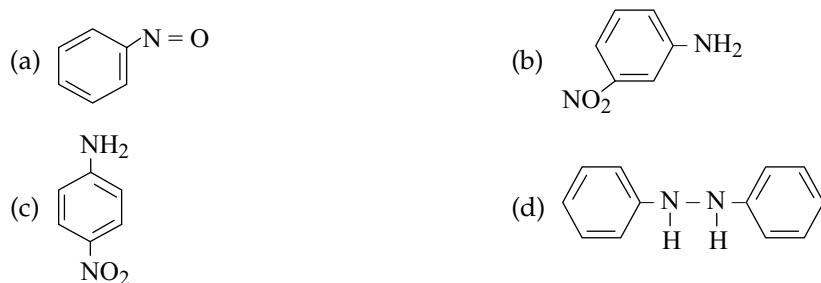
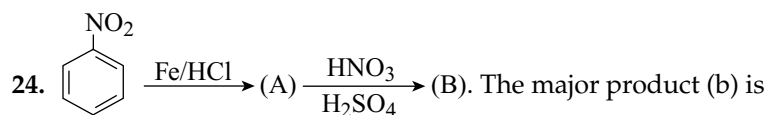
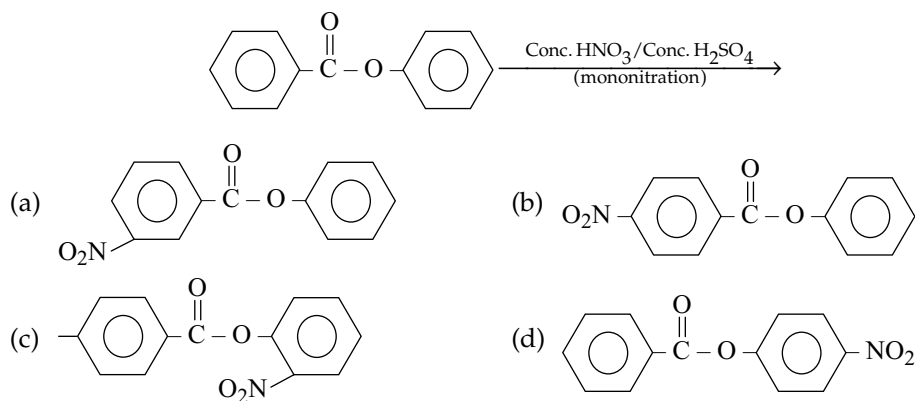




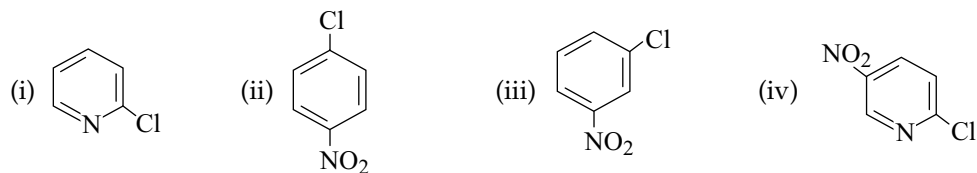
22. In the given reaction sequence



23. The major product formed in the reaction is

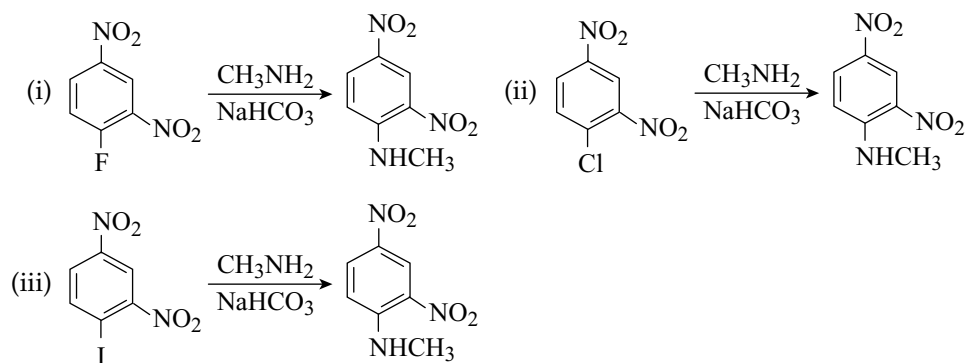


25. Arrange the following in the order of their nucleophilic substitution reaction



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

26. For the following reaction



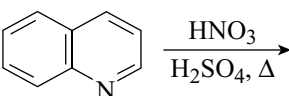
Correct order of reactivity

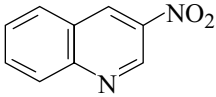
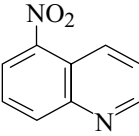
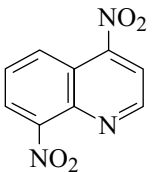
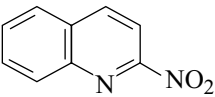
- (a) $i = ii = iii$ (b) $i > ii > iii$ (c) $i < ii < iii$ (d) $ii > iii > i$

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

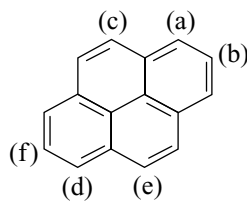
- (i) $C_6H_5CH_3$ (ii) C_6H_6 (iii) C_6H_5Br
 (iv) $C_6H_5NR_3^+$ (v) $C_6H_5NMe_2$

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

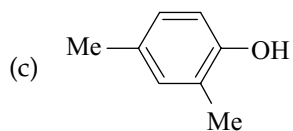
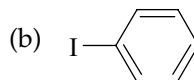
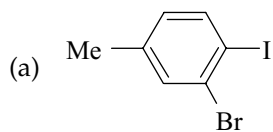
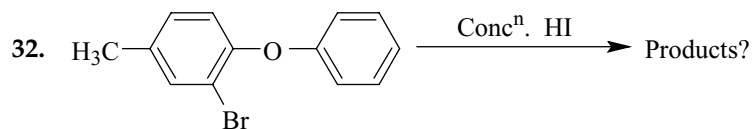
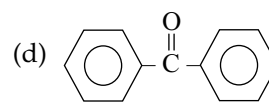
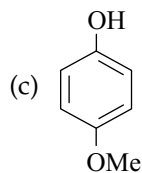
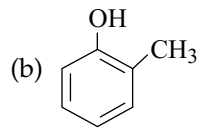
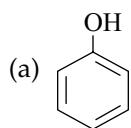
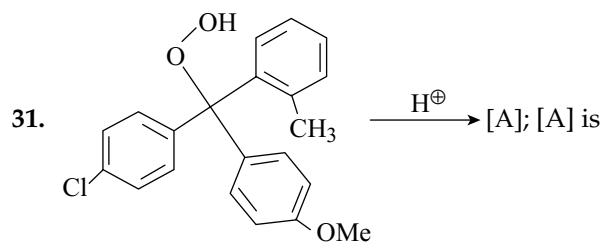
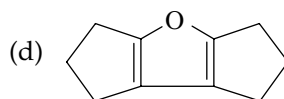
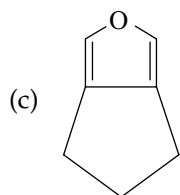
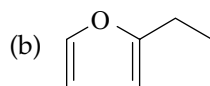
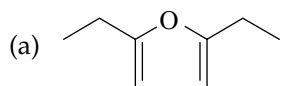
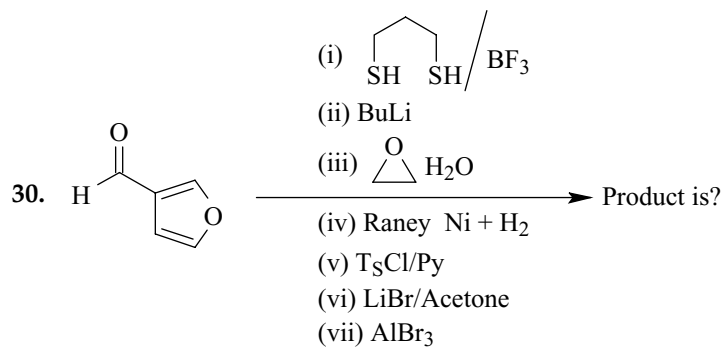
28. Identify the product 

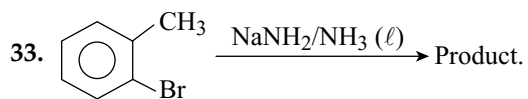
- (a)  (b) 
 (c)  (d) 

29. Which centre (s) more reactive towards EAS in the given molecule?

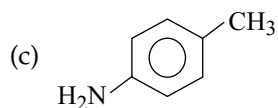
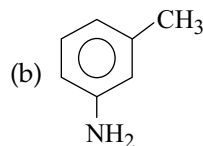
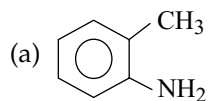


- (a) a (b) d (c) c (d) e



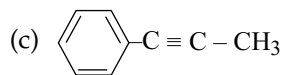
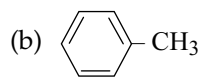
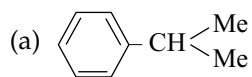


Product is



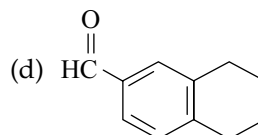
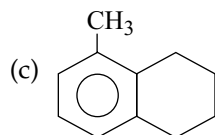
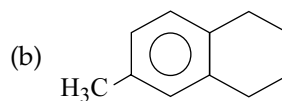
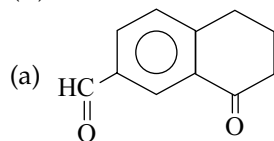
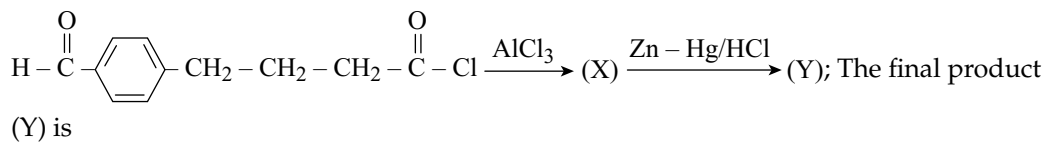
(d) Mixture of (a) and (b)

34. Which compound on oxidation with acidified KMnO_4 solution gives benzoic acid?

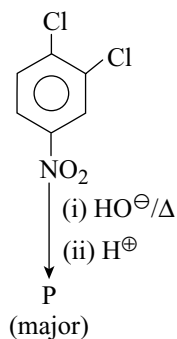


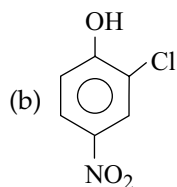
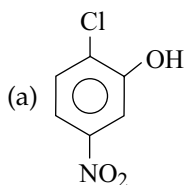
(d) All of these

35. In the given reaction



36. Based on the following reaction, the major product would be

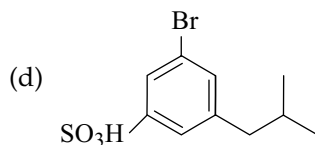
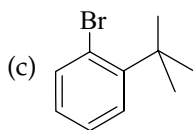
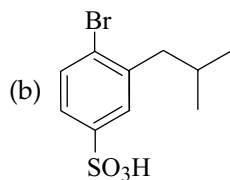
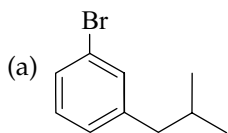
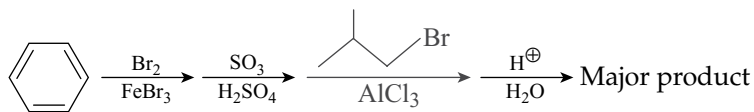




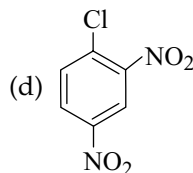
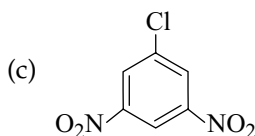
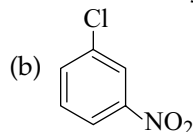
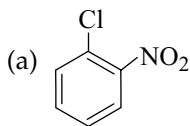
(c) Both in equal proportions

(d) None of these

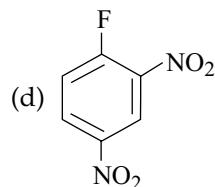
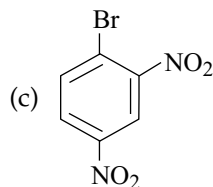
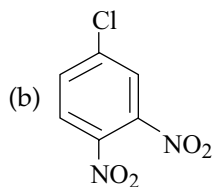
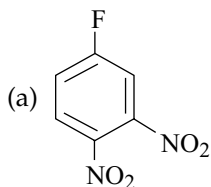
37. Give the major product from the following reaction sequence



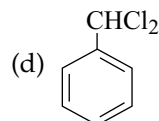
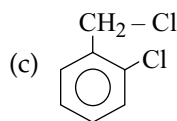
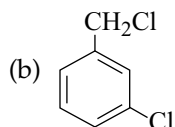
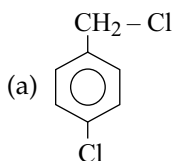
38. Which one of the following compounds will be most readily hydrolyzed in aqueous alkali?

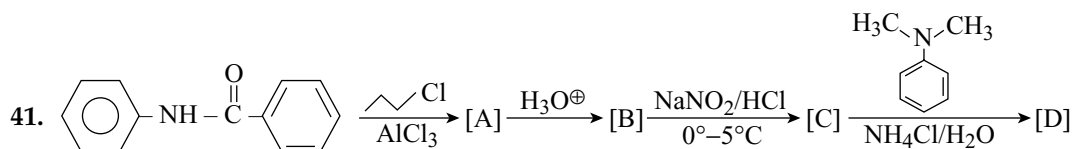


39. Which of the following is most reactive towards the reaction with NaOMe?



40. An aromatic compound 'A' $C_7H_6Cl_2$, gives AgCl on boiling with alcoholic $AgNO_3$ solution and yields C_7H_5OCl on treatment with NaOH. 'A' on oxidation gives monochloro benzoic acid which affords only one mononitro derivative. The compound 'A' is

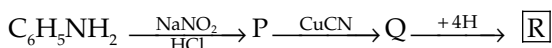
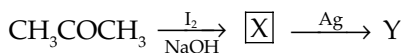
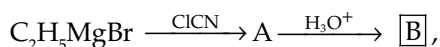




Product [D] is

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

42. Identify B, X and R respectively in the following sequence of reactions



- (a) $\text{C}_2\text{H}_5\text{COOH}$, CHI_3 , $\text{C}_6\text{H}_5\text{CH}_2\text{NH}_2$ (b) $\text{C}_2\text{H}_5\text{COOH}$, CH_3I , $\text{C}_6\text{H}_5\text{COOH}$
 (c) $\text{C}_2\text{H}_5\text{CH}_2\text{NH}_2$, CH_3I , $\text{C}_6\text{H}_5\text{COOH}$ (d) $\text{C}_2\text{H}_5\text{COOH}$, $\text{C}_2\text{H}_5\text{I}$, $\text{C}_6\text{H}_5\text{CONH}_2$

43. p-nitrotoluene on further nitration gives

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

44. Which of the following structures correspond to the product expected, when excess of toluene reacts with CH_2Cl_2 in presence of anhydrous AlCl_3 ?

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

45. In the sulphonation, acetylation and formylation of benzene the group of effective electrophiles would be

- (a) $\text{SO}_3^\oplus$, $\text{CH}_3\text{C}\equiv\text{O}^\oplus$, $\text{HCO}^\oplus$ (b) SO_3 , $\text{CH}_3\text{C}\equiv\text{O}^\oplus$, $\text{HCO}^\oplus$
 (c) SO_3 , CH_3CHO , $\text{CO} + \text{HCl}$ (d) HSO_3 , CH_3CO , HCO

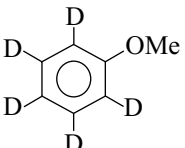
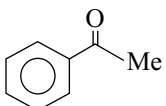
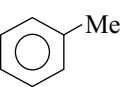
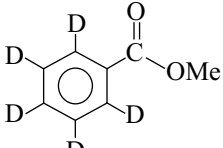
46. When benzene is heated with acetic anhydride in the presence of anhydrous aluminium chloride at 80°C, the product formed is?

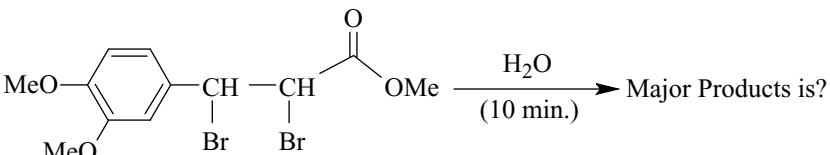
- (a) Benzoic acid (b) Benzophenone
(c) Acetophenone (d) Ethyl phenyl ketone

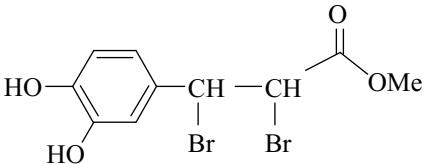
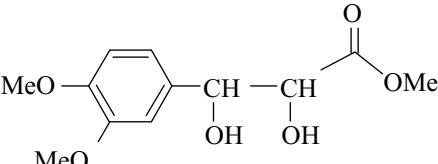
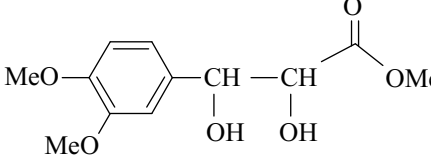
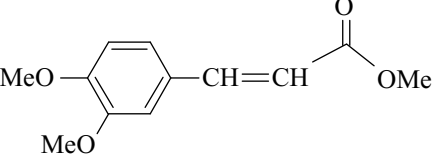
47. Which of the following is not the structural formulae of benzene?

- (a)  (b)  (c)  (d) None of these

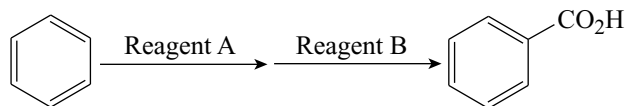
48. Most reactive towards nitration is

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

49.  Major Products is?

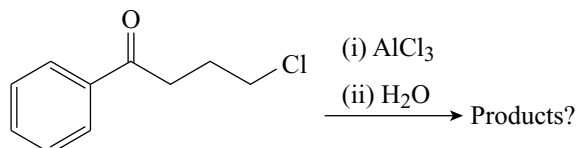
- (a)  (b) 
(c)  (d) 

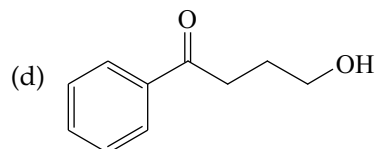
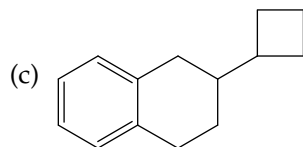
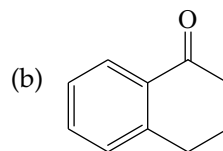
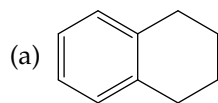
50. What reagents (conditions) are needed for the following reaction?



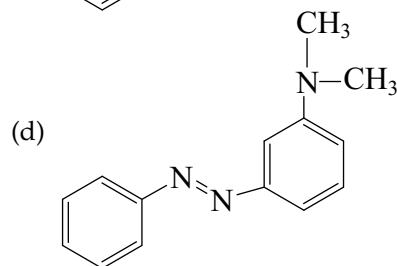
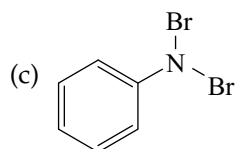
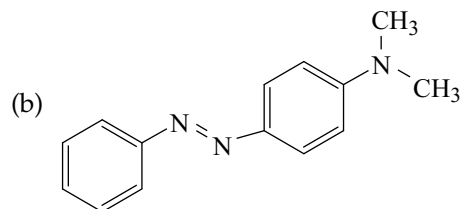
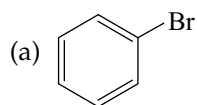
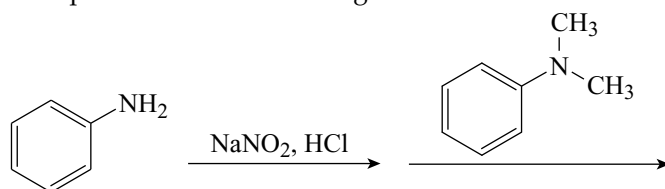
- (a) reagent A: $\text{CH}_3\text{COCl}/\text{AlCl}_3$; reagent B: $\text{Sn}, \text{HCl}, \text{heat}$
(b) reagent A: $\text{CH}_3\text{CH}_2\text{Cl}/\text{AlCl}_3$; reagent B: $\text{KMnO}_4, \text{heat}$
(c) reagent A: $\text{CH}_3\text{COCl}/\text{AlCl}_3$; reagent B: $\text{H}_2\text{NNH}_2, \text{KOH}, \text{H}_2\text{O}, \text{heat}$
(d) reagent A: $\text{HNO}_3, \text{H}_2\text{SO}_4$; reagent B: $\text{Sn}, \text{HCl}, \text{heat}$

51. What could be the product for the following reaction?

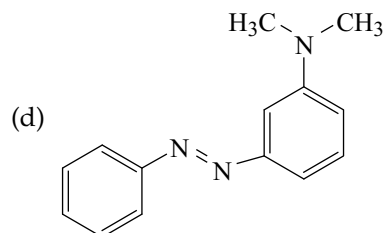
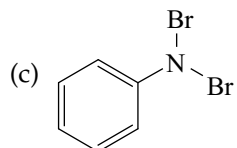
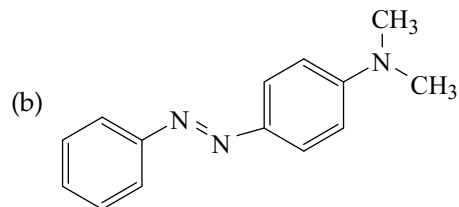
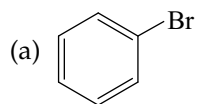
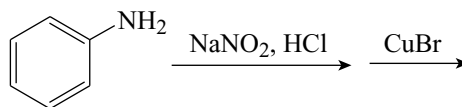




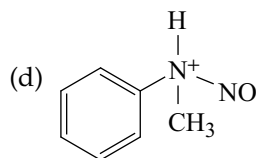
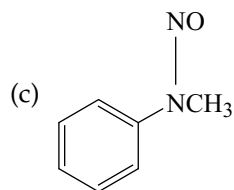
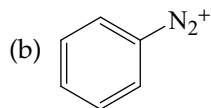
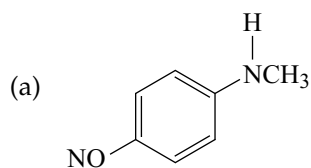
52. What could be the product for the following reaction?



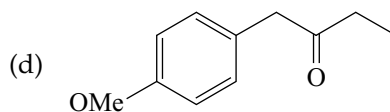
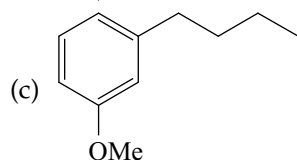
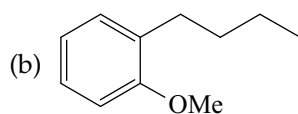
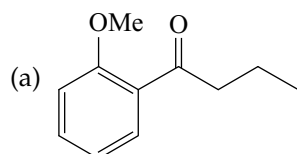
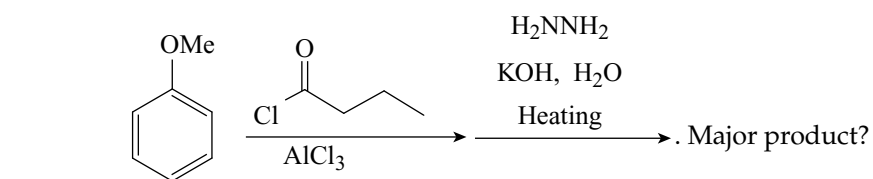
53. What could be the product for the following reaction?



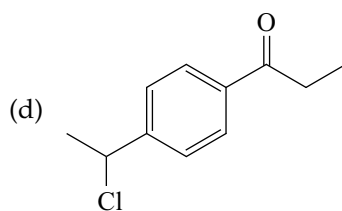
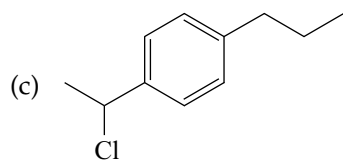
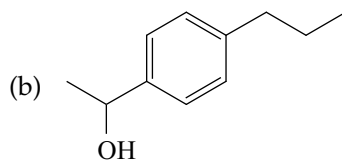
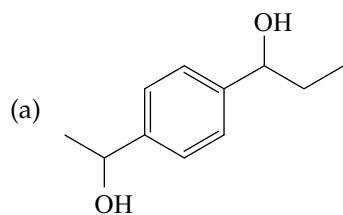
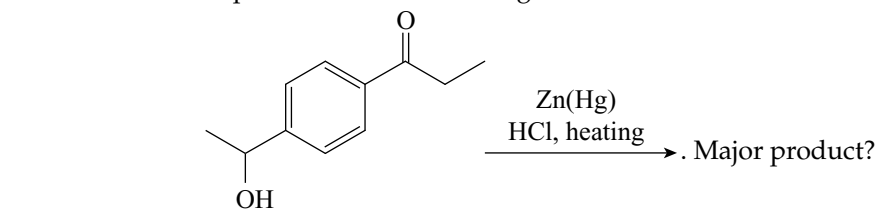
54. What could be the product for the following reaction $\text{Ph}-\text{NH}-\text{Me} \xrightarrow[\text{HCl}]{\text{NaNO}_2}$?



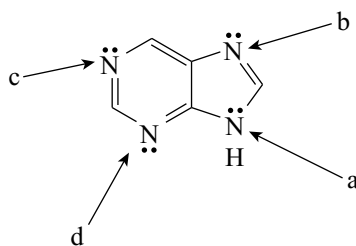
55. What could be the major product for the following reaction?



56. What could be the product for the following reaction?

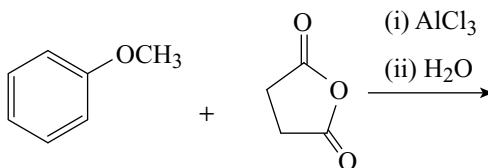


57. For the following compound, which nitrogen is most apt to be protonated?



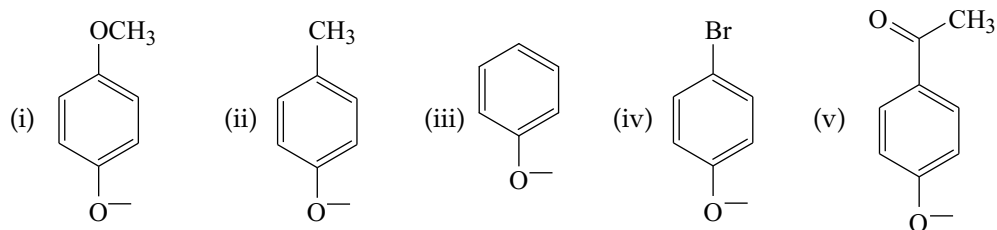
- (a) Nitrogen indicated by arrow 'a' (b) Nitrogen indicated by arrow 'b'
 (c) Nitrogen indicated by arrow 'c' (d) Nitrogen indicated by arrow 'd'

58. What could be the product for the following reaction?



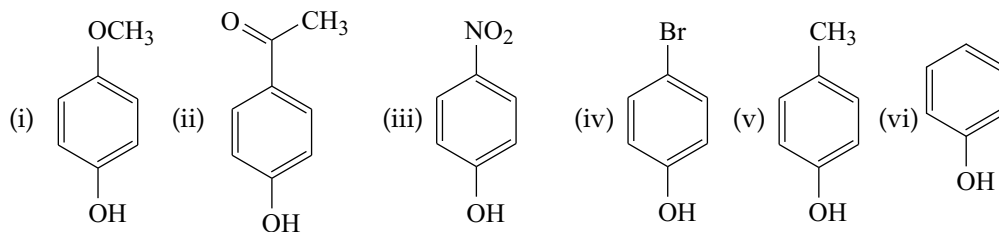
- (a)
- (b)
- (c)
- (d)

59. What is the correct order of decreasing basicity for the following anions (from the most to the least)?



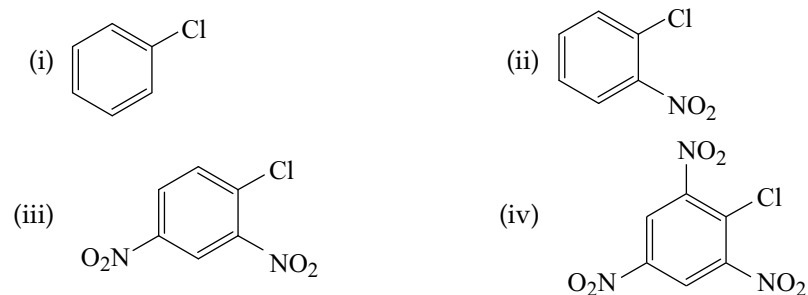
- (a) i > ii > iii > iv > v (b) i > ii > iii > v > iv
 (c) i > ii > iv > iii > v (d) v > iv > iii > ii > i

60. What is the correct order of decreasing acidity for the following phenol and phenol derivatives (from the most to the least)?



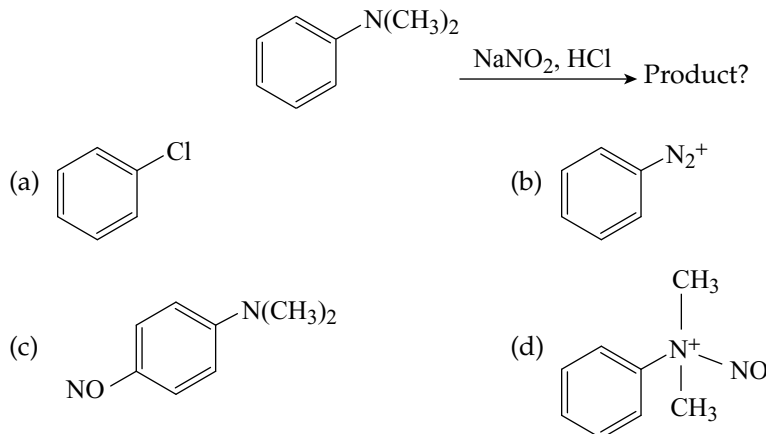
- (a) $i > ii > iii > iv > v > vi$ (b) $ii > iii > iv > vi > v > i$
 (c) $iii > ii > iv > vi > v > i$ (d) $ii > iii > iv > vi > i > v$

61. What is the correct order of decreasing reactivity (fastest to slowest) toward nucleophilic aromatic substitution for the following compounds?

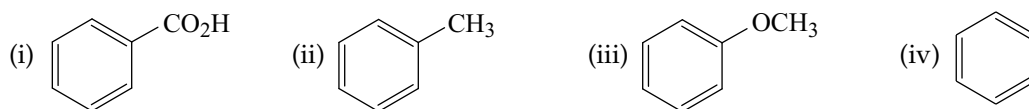


- (a) $i > ii > iii > iv$ (b) $ii > iii > iv > i$ (c) $iii > ii > iv > i$ (d) $iv > iii > ii > i$

62. What could be the product for the following reaction?

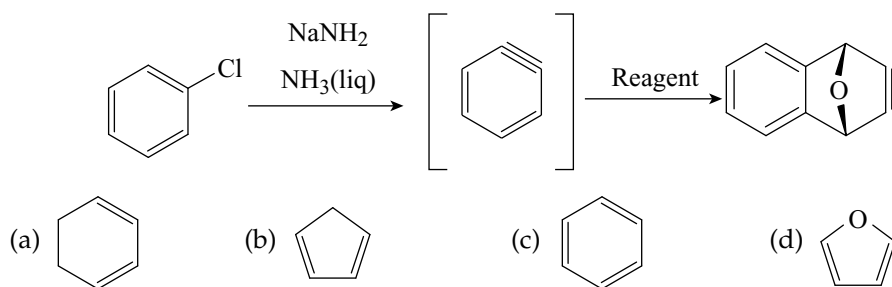


63. What is the correct order of decreasing reactivity (fastest to slowest) toward electrophilic aromatic substitution for the following compounds?

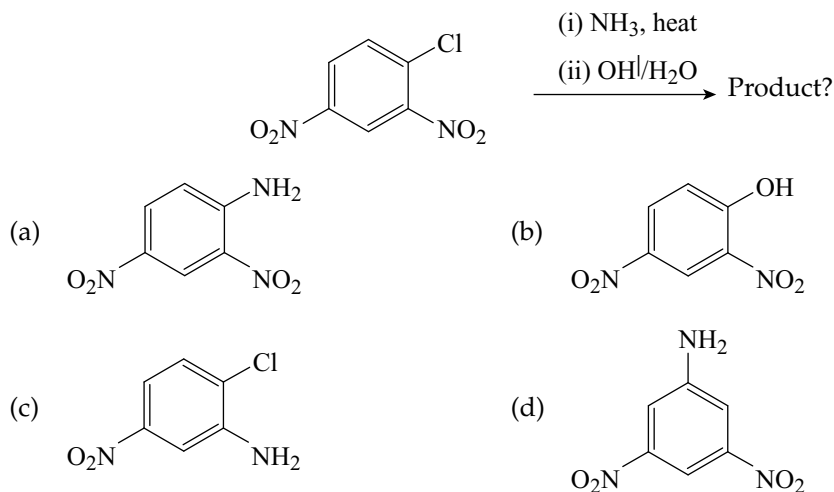


- (a) $i > ii > iii > iv$ (b) $ii > i > iv > iii$
 (c) $iii > ii > iv > i$ (d) $iv > iii > ii > i$

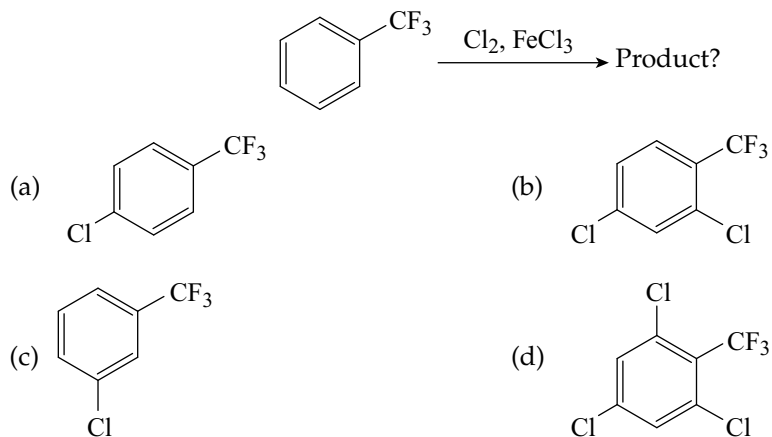
64. What could be the reagent for the following reaction?



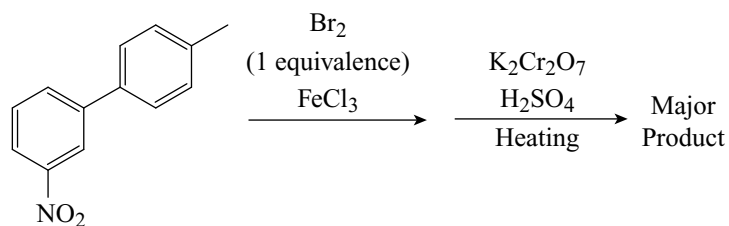
65. What could be the product for the following reaction?



66. Which could be the major product of the following reaction?



67. Which could be the major product of the following reaction?





(d) iv



69.

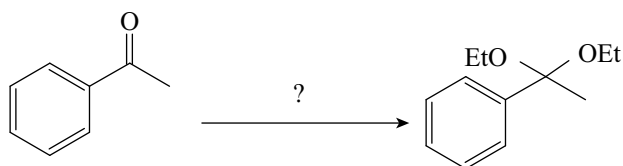


_____ increasing _____
basicity



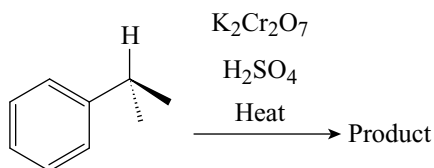
_____ increasing _____
basicity

70. What could be the reagent and reaction condition for the following transformation?



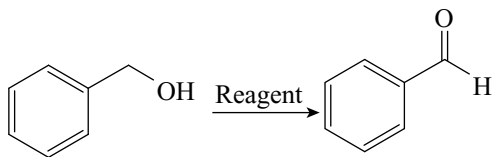
- (a) ethanol, NaOH (b) ethanol, H⁺
 (c) methanol, NaOH (d) methanol, H⁺

71. What could be the product for the following reaction?



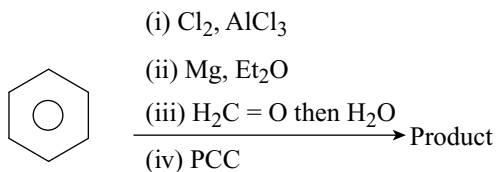
- (a) (b)
 (c) (d)

72. What could be the reagent to complete the following reaction?



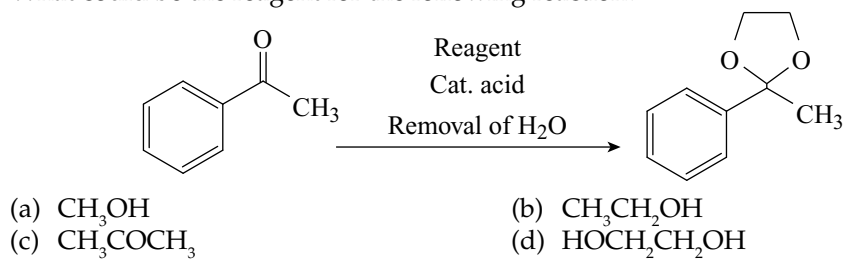
- (a) HCrO₄ (b) K₂Cr₂O₇ (c) PCC in dried CH₂Cl₂ (d) OsO₄

73. What could be the product for the following reaction?

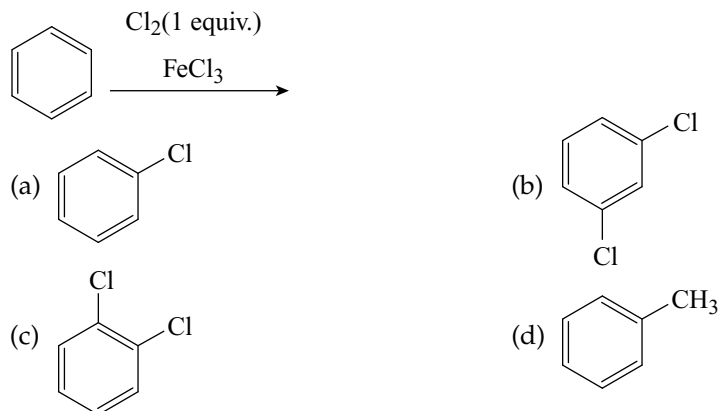


- (a) (b)
 (c) (d)

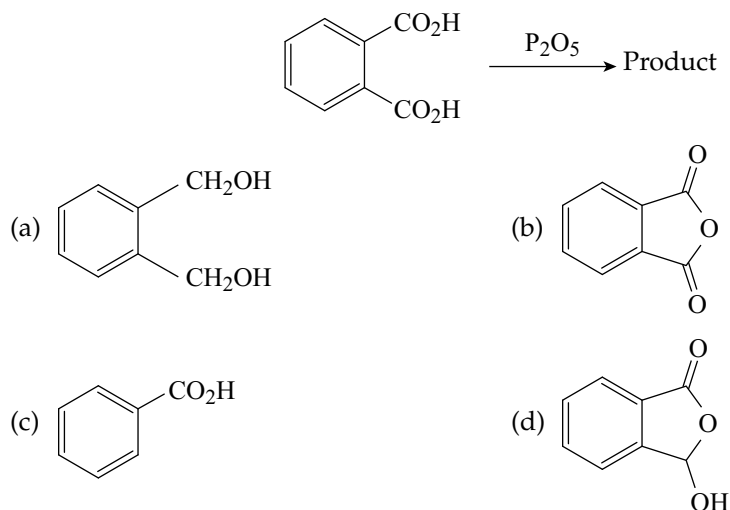
74. What could be the reagent for the following reaction?



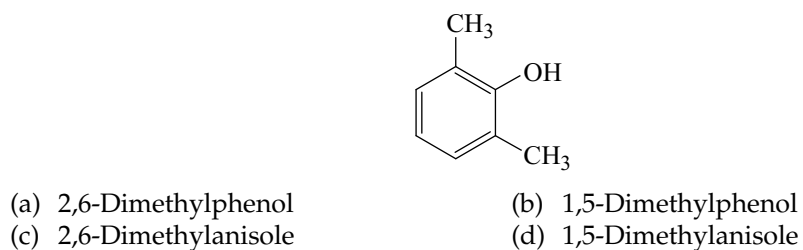
75. What is the expected product for the following reaction?



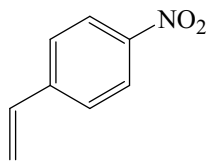
76. What could be the product for the following reaction?



77. What is the name of the following compound?

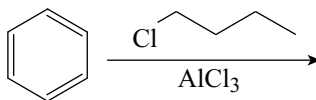


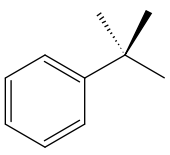
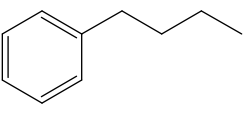
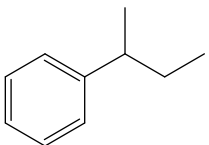
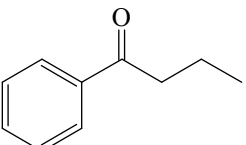
78. What is the name of the following compound?



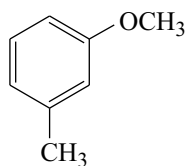
- (a) p-aminotoluene (b) p-nitrotoluene
(c) p-nitrostyrene (d) 3-aminostyrene

79. What should be the major product for the following reaction?



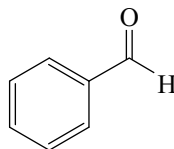
- (a)  (b) 
(c)  (d) 

80. What is the name of the following compound?



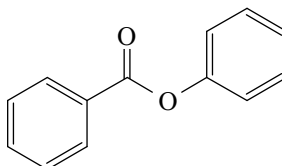
- (a) p-methylphenol (b) m-methylphenol
(c) o-methylanisole (d) m-methylanisole

81. What is the name of the following compound?



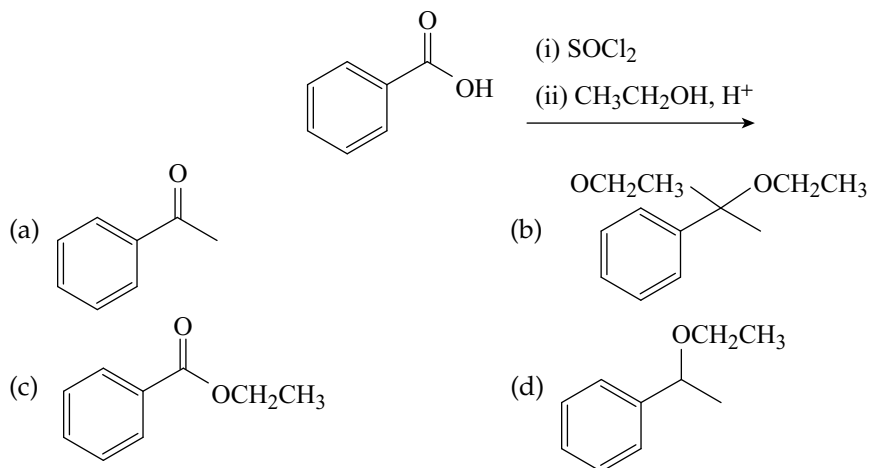
- (a) benzylcarbonyl (b) benzaldehyde
(c) phenylaldehyde (d) phenylketone

82. What is the name of the following compound?



- (a) benzyl phenoate (b) phenyl benzoate
(c) benzyl benzoate (d) phenyl phenoate

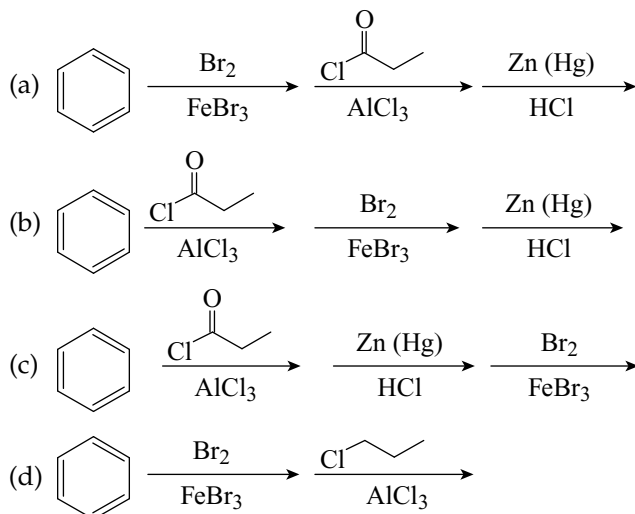
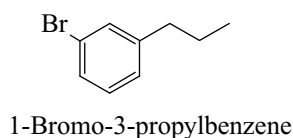
83. What could be the product for the following reaction?



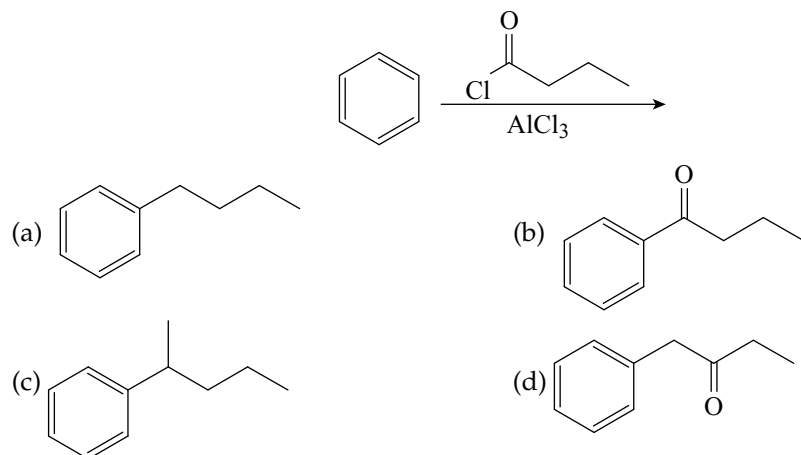
84. Which of the following structures is benzoic acid?



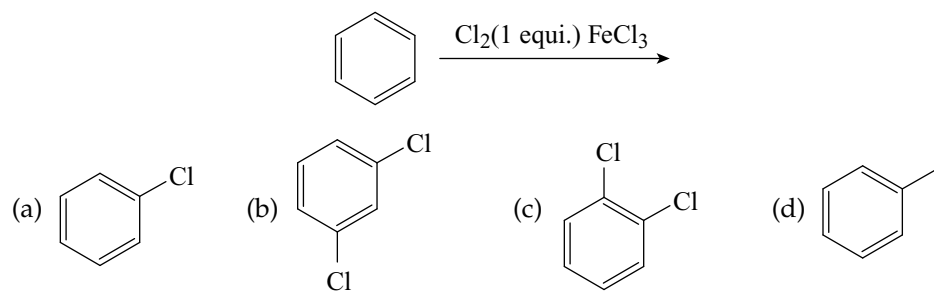
85. Which of the following reaction sequences would be the best for synthesizing the compound, 1-bromo-3-propylbenzene?



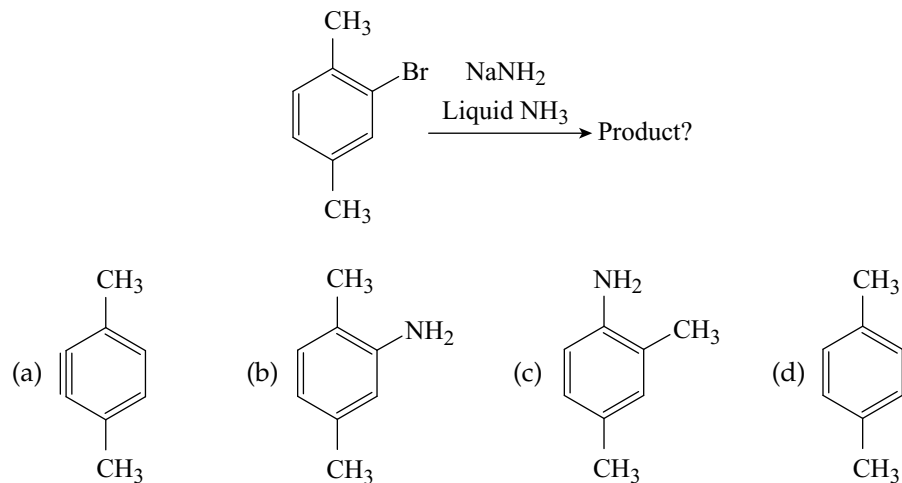
86. What is the expected product for the following reaction?



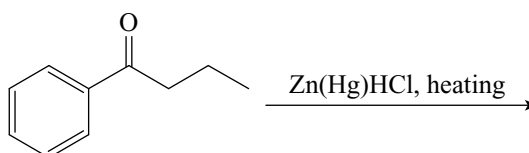
87. What is the expected product for the following reaction?

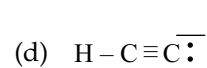
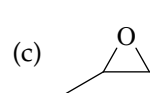
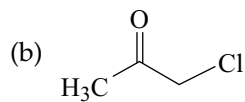
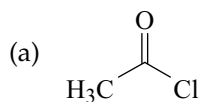
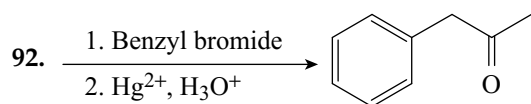
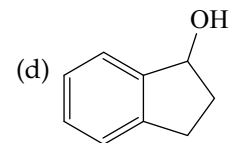
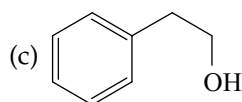
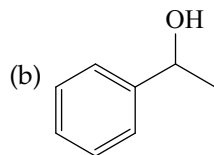
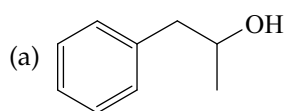
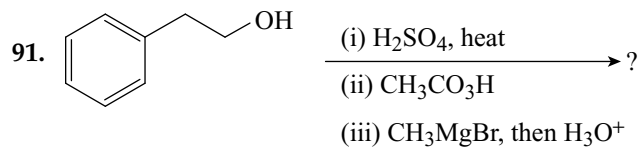
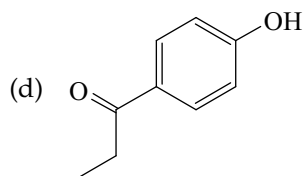
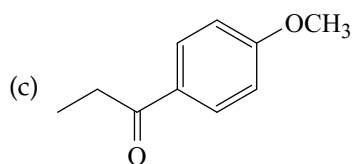
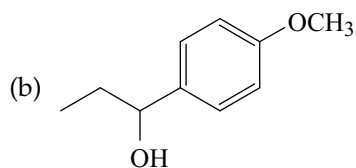
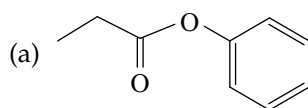
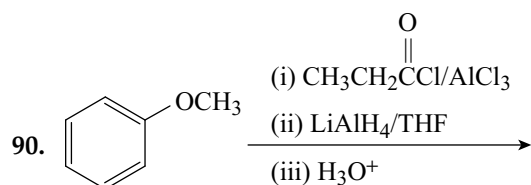
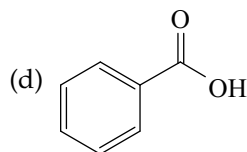
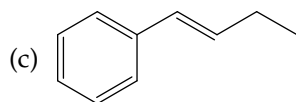
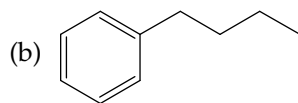
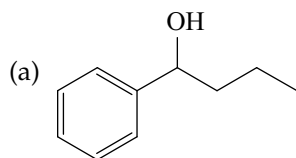


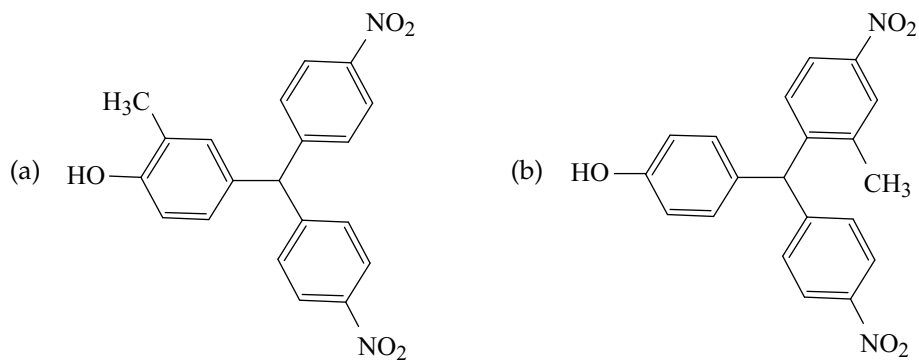
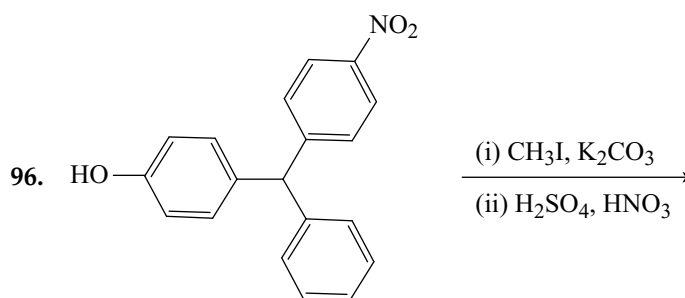
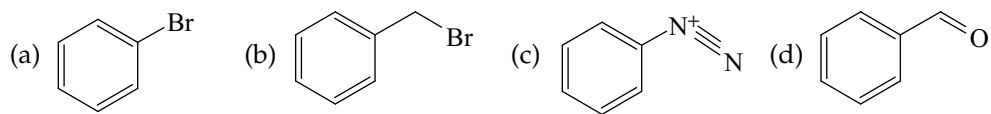
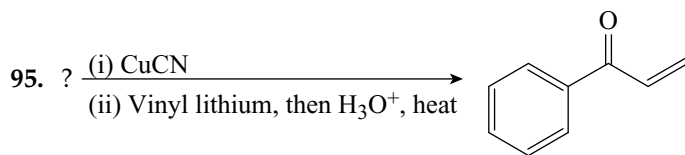
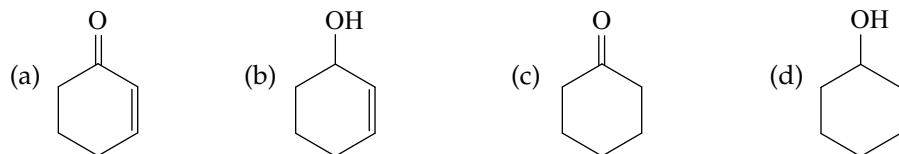
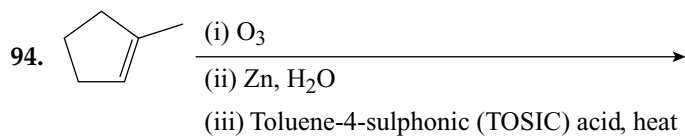
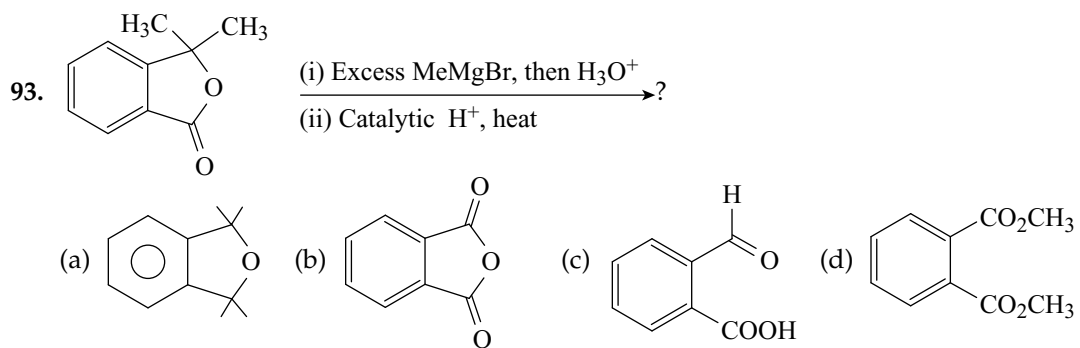
88. What could be the product for the following reaction?

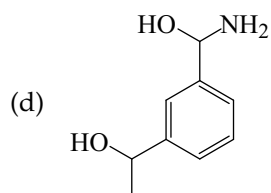
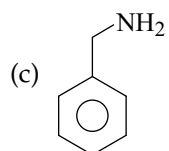
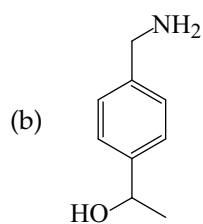
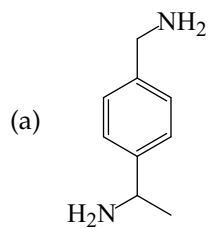
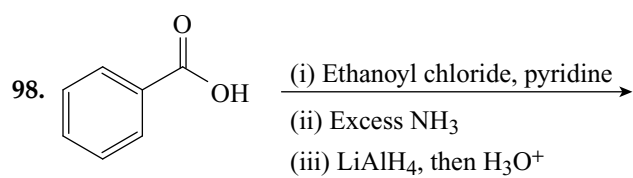
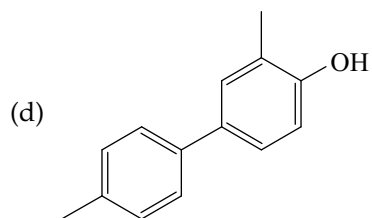
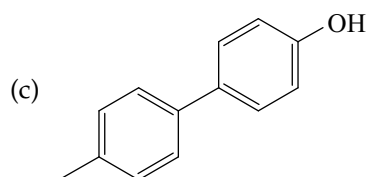
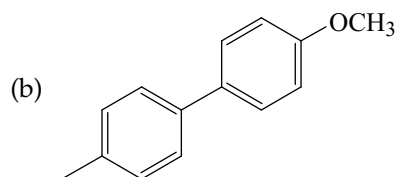
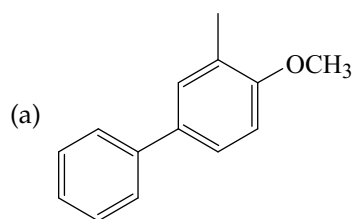
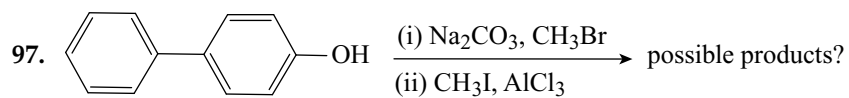
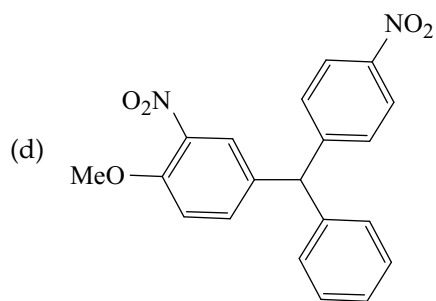
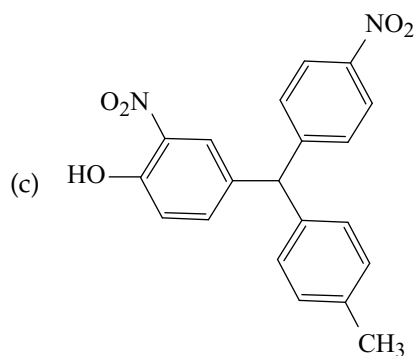


89. What could be the product for the following reaction?





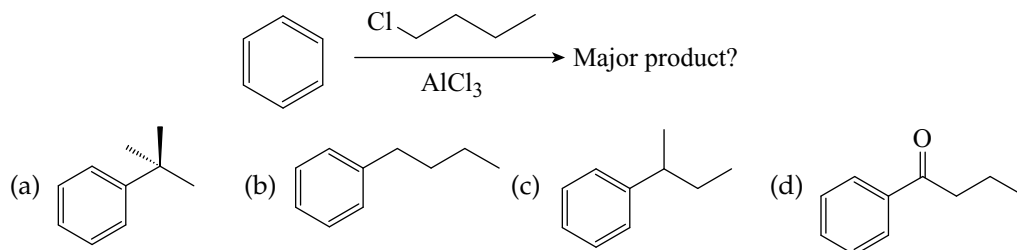




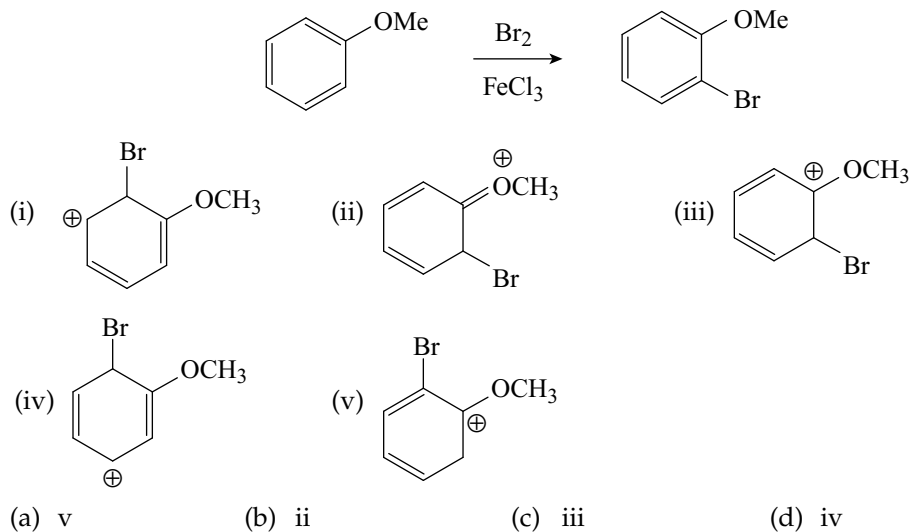
LEVEL 2

Single and Multiple-choice Type

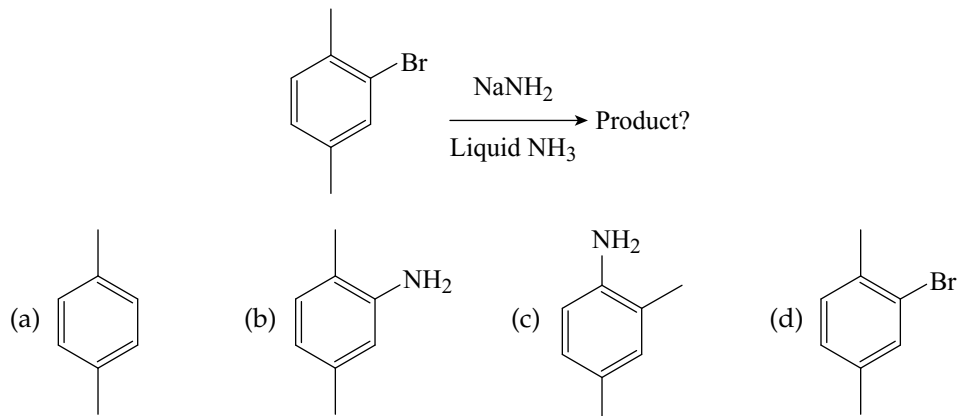
1. What should be the major product for the following reaction?



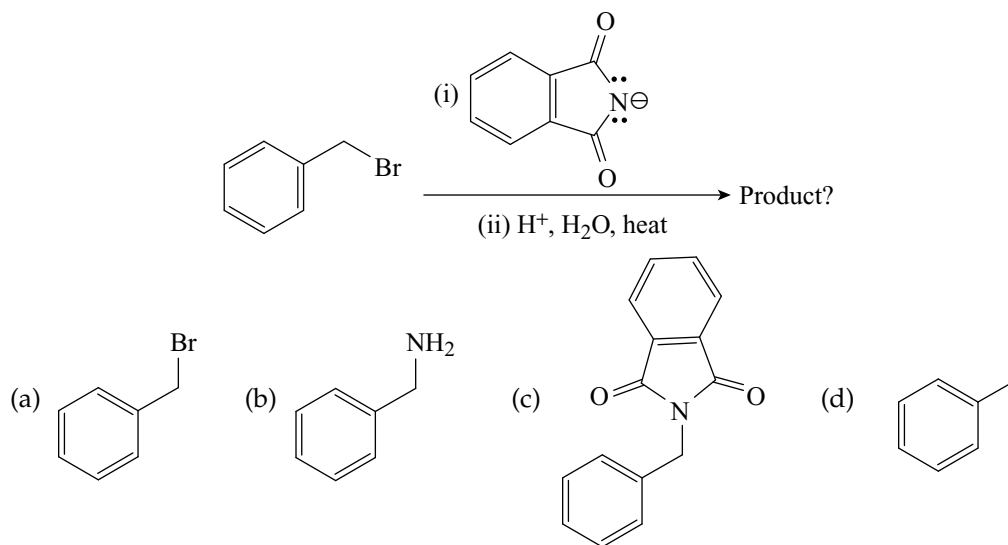
2. Which of the following is not the resonance structure of intermediate from the listed electrophilic aromatic substitution?



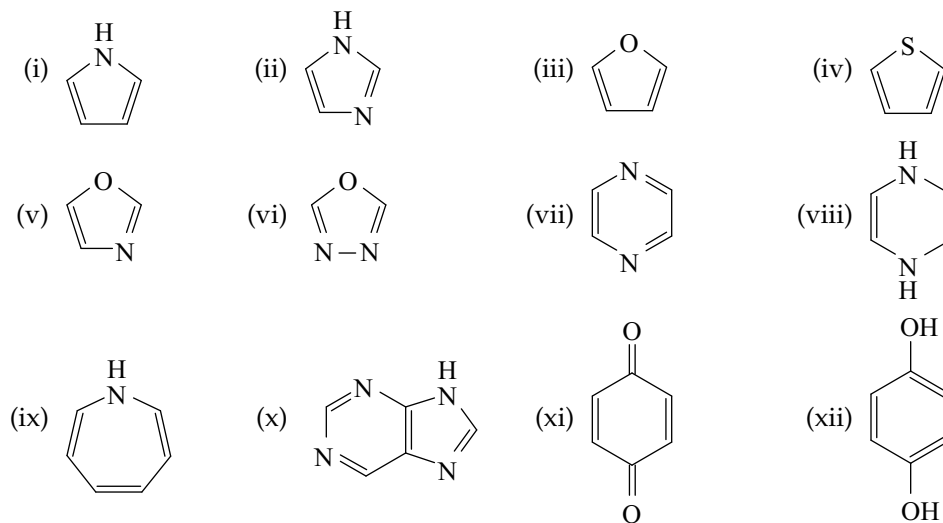
3. What could be the product for the following reaction?



4. What could be the product for the following reaction?



5. Which of the following compounds are aromatic compounds?



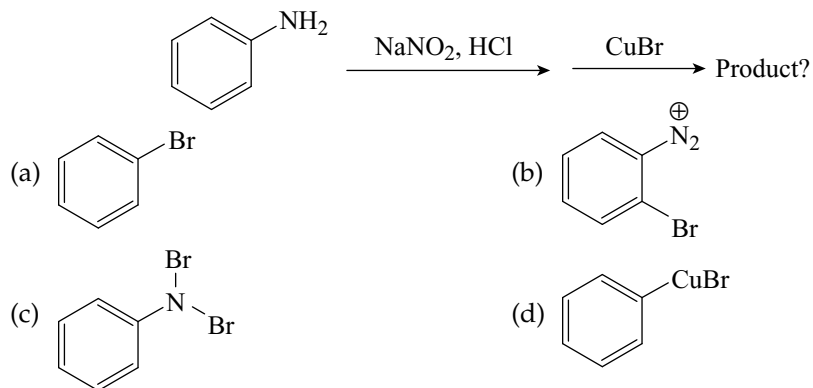
(a) i, ii, iii, iv, v, vi, viii, x, xii

(b) i, ii, iii, v, vii, viii, ix, x, xii

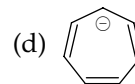
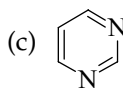
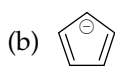
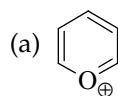
(c) i, ii, iii, vi, viii, x, xi, xii

(d) i, ii, iii, iv, v, vi, vii, x, xii

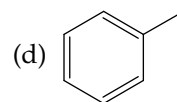
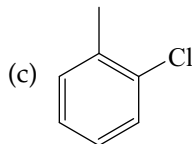
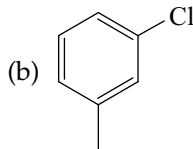
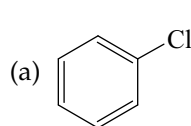
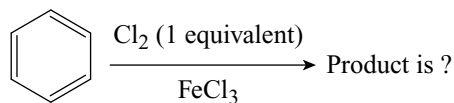
6. What could be the product for the following reaction?



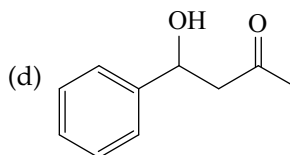
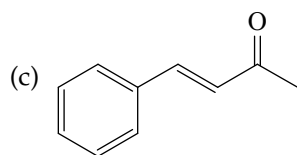
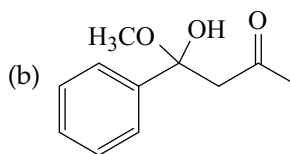
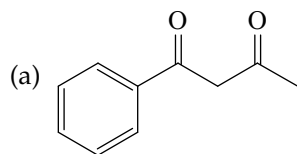
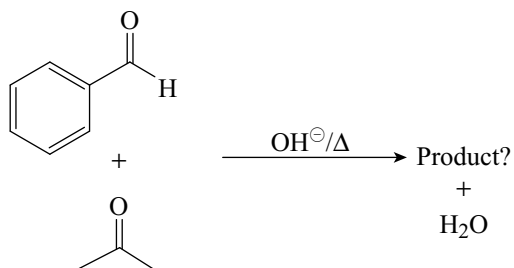
7. Which one of the following compounds is antiaromatic?



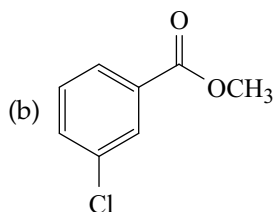
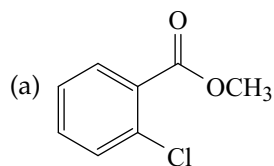
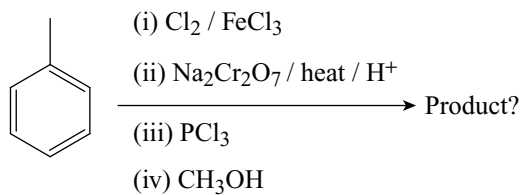
8. What is the expected product for the following reaction?

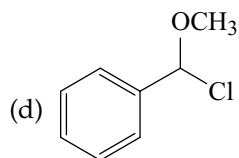
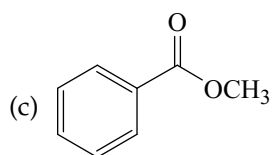


9. What could be the product for the following reaction?



10. What could be the product for the following reaction?





11. What could be the product for the following reaction?

(i) $\text{Cl}_2, \text{AlCl}_3$

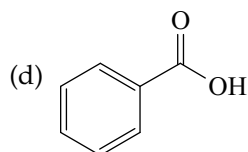
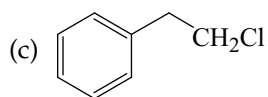
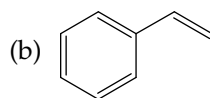
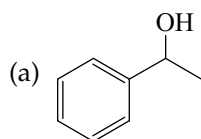
(ii) $\text{Mg}, \text{Et}_2\text{O}$

(iii) 

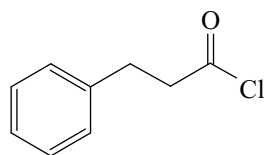
(iv) H^+/Δ



Product?



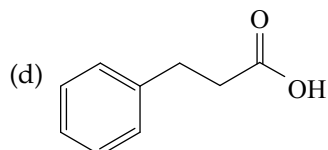
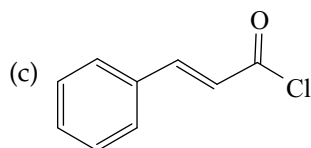
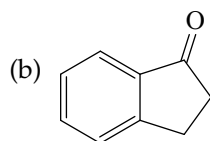
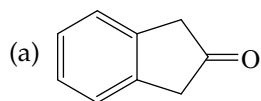
12. What could be the product for the following reaction?



(i) AlCl_3

(ii) H_2O

Product?



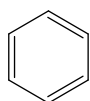
13. What could be the product for the following reaction?

(i) $\text{Cl}_2, \text{AlCl}_3$

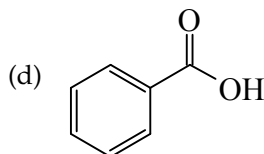
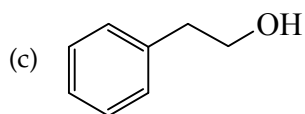
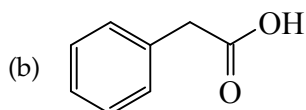
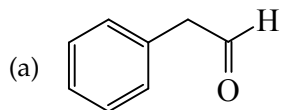
(ii) $\text{Mg}, \text{Et}_2\text{O}$

(iii)  then H_2O

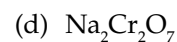
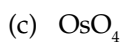
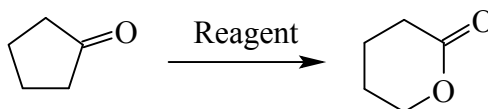
(iv) $\text{K}_2\text{Cr}_2\text{O}_7, \text{H}^+$
room temp



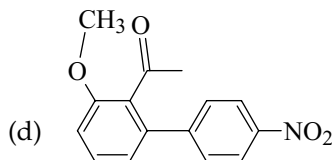
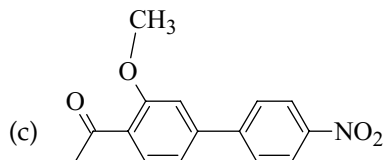
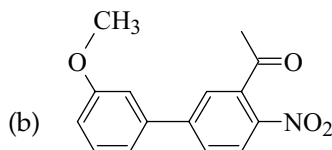
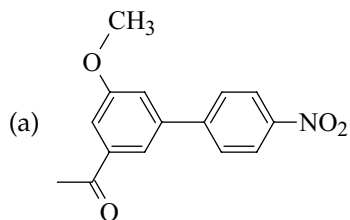
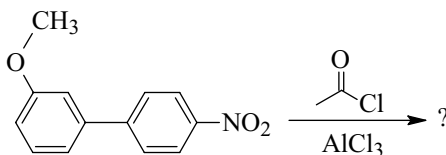
Product?



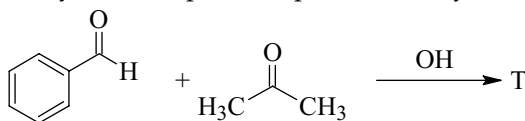
14. What could be the reagent for the following reaction?



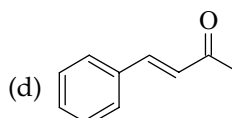
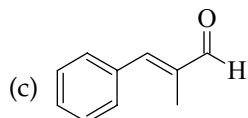
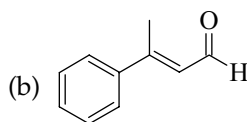
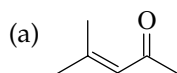
15. Which of the indicated compounds would be the major product in the following Friedel Crafts reaction?



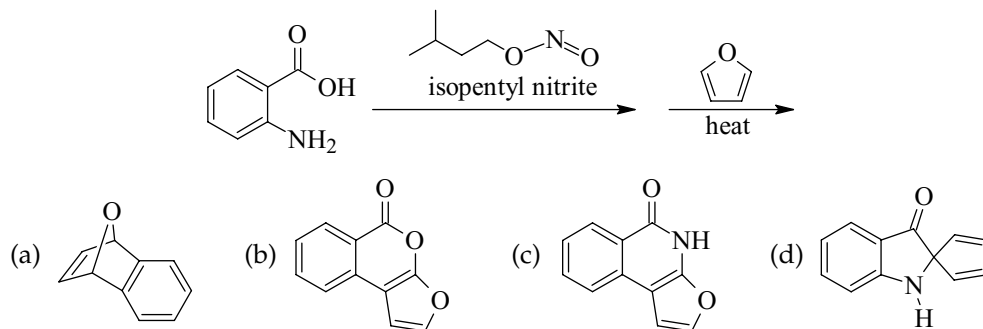
16. The following reaction yields compound T predominately.



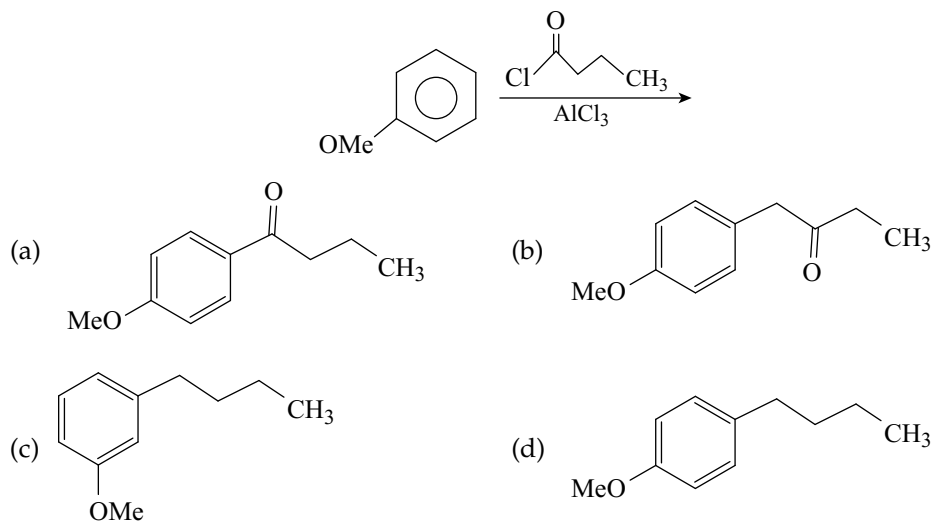
Predict the main product T.



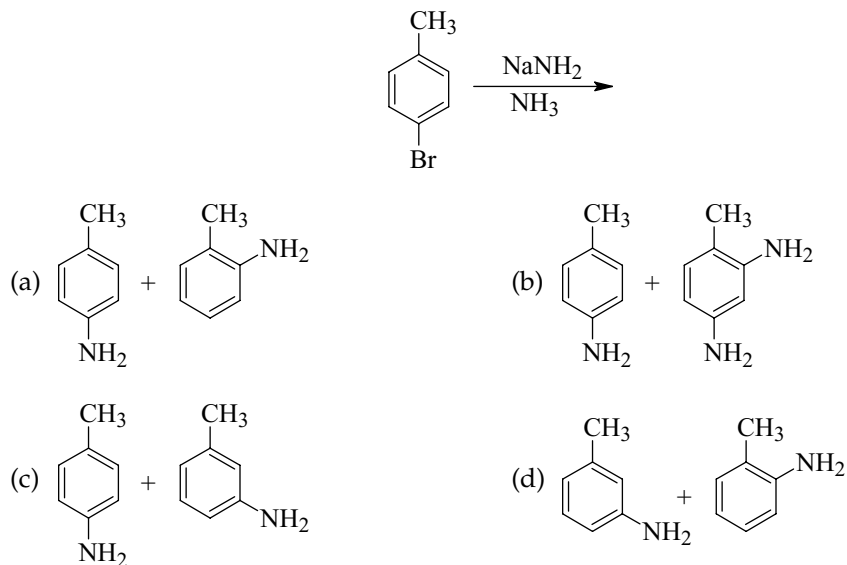
17. The compound isopentyl nitrite is a source of NO^+ ions and will react with an amine to generate a diazonium cation. Predict the product of the following reaction sequence.



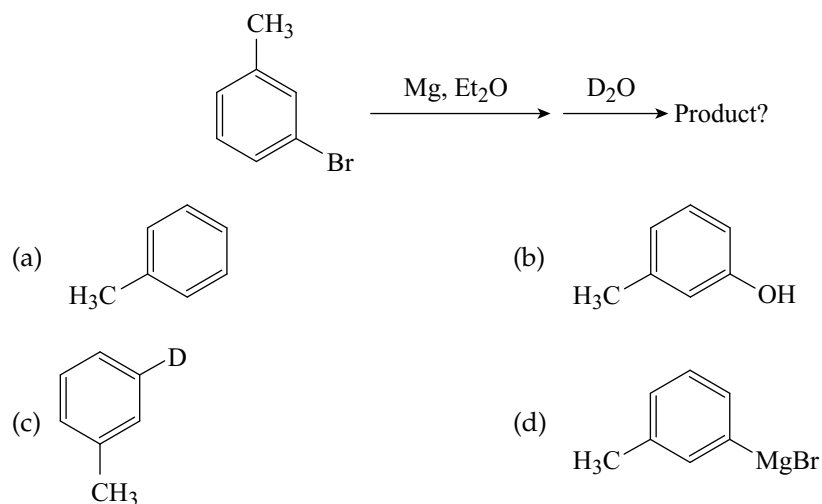
18. What could be the major product for the following Reaction?



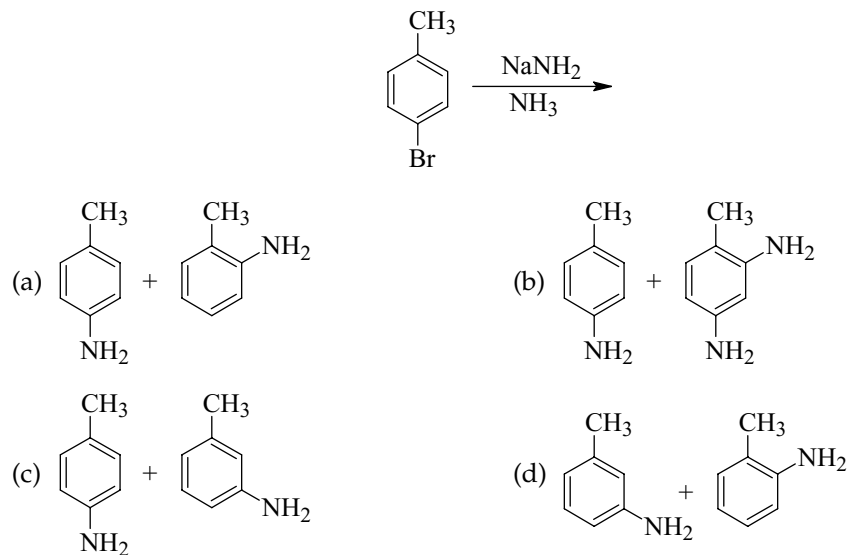
19. The following reaction gives two main products. Identify the products.



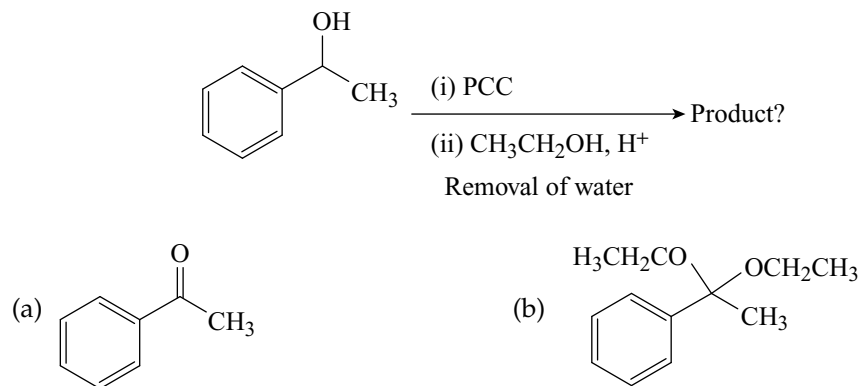
20. What could be the product for the following reaction?

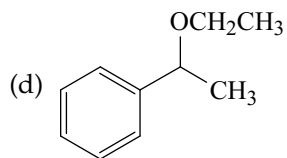
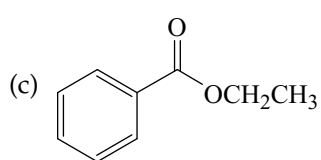


21. The following reaction gives two main products. Identify the products.

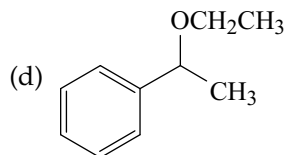
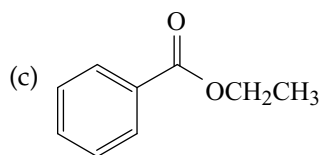
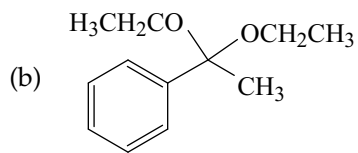
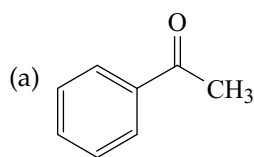
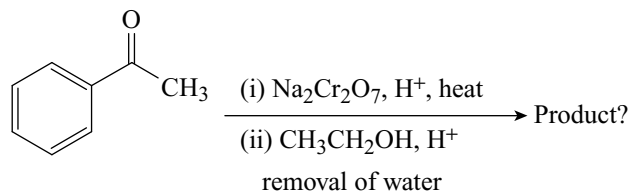


22. What could be the product for the following reaction?

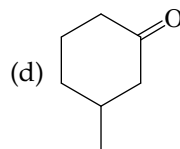
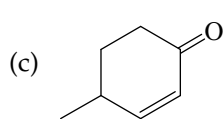
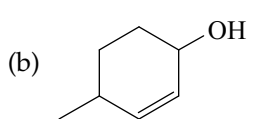
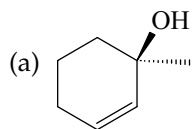
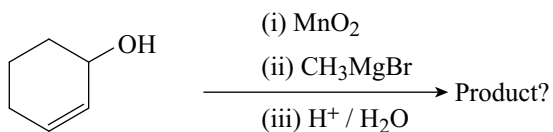




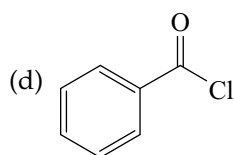
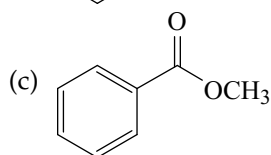
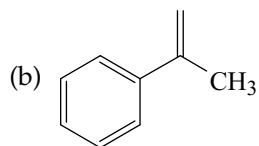
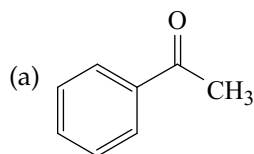
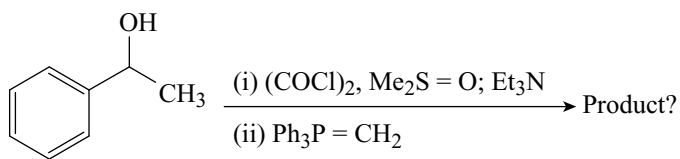
23. What could be the product for the following reaction?



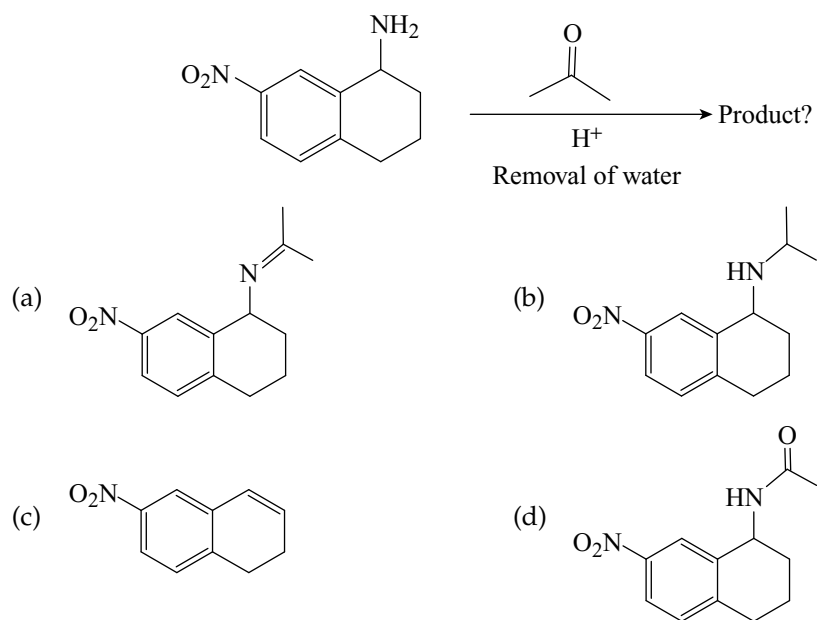
24. What could be the product for the following reaction?



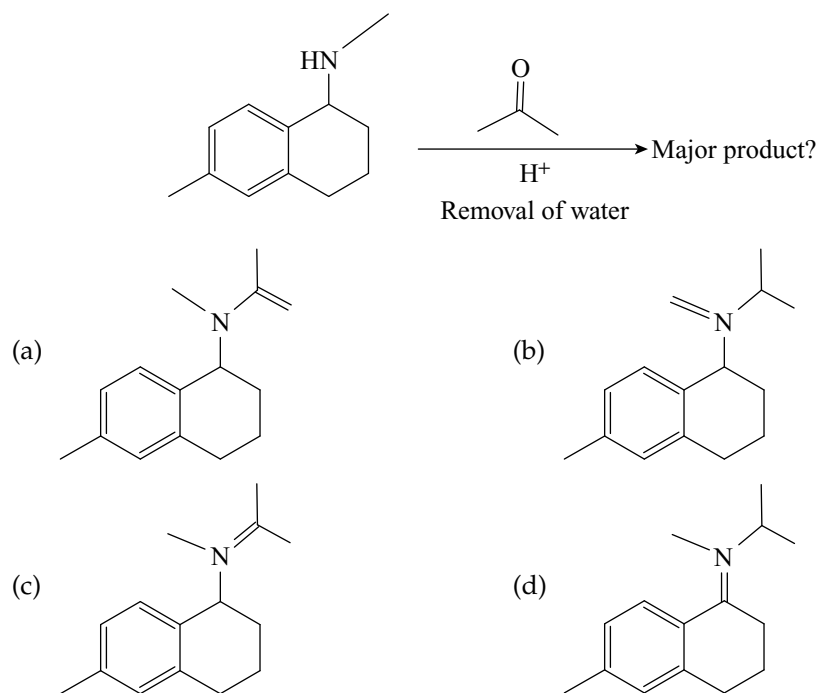
25. What could be the product for the following reaction?



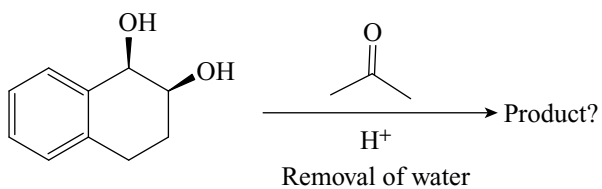
26. What could be the product for the following reaction?

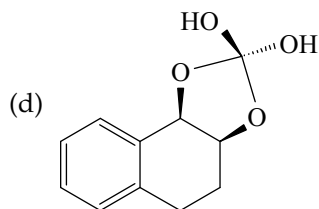
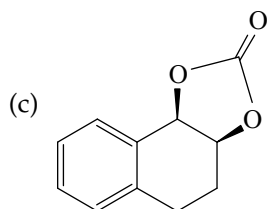
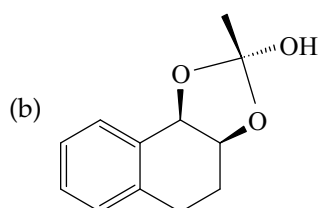
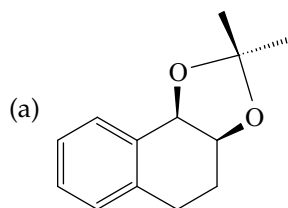


27. What could be the major product for the following reaction?

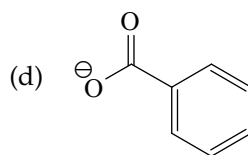
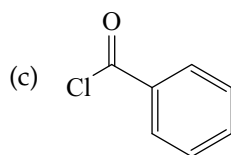
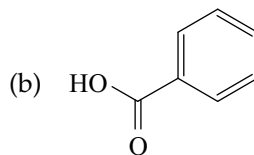
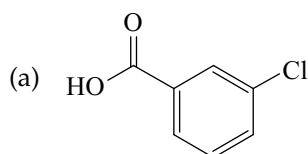
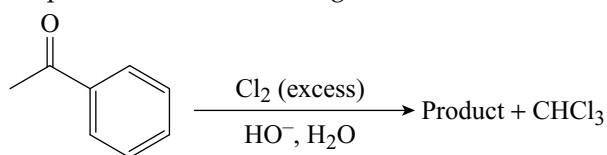


28. What could be the product for the following reaction?

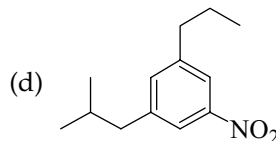
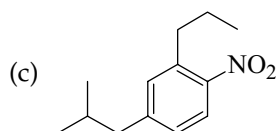
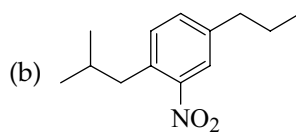
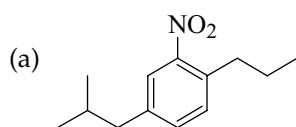
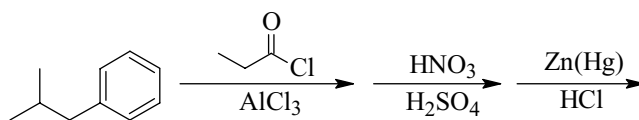




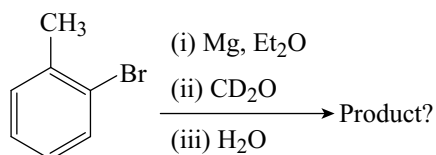
29. What could be the product for the following reaction?

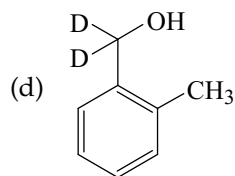
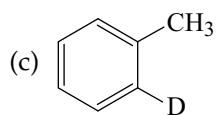
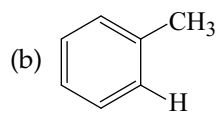
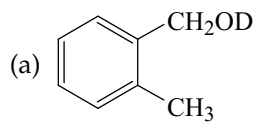


30. Predict the product of the following reaction sequence.

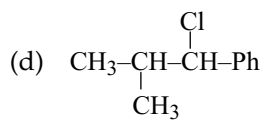
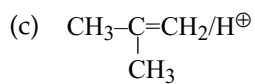
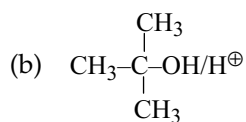
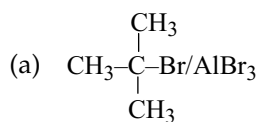
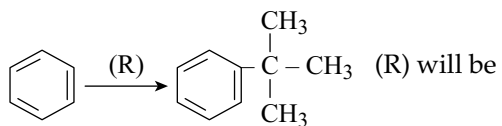


31. What could be the product for the following reaction?

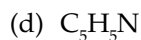
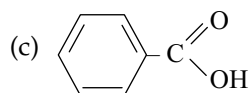
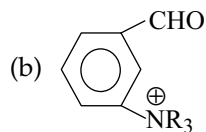
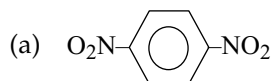




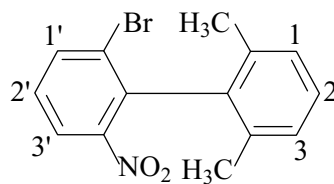
32. For the given reaction:



33. Which of the following compound will not give Friedel-Crafts reaction?



34. In the given reaction, electrophilic substitution will take place readily at the carbon?



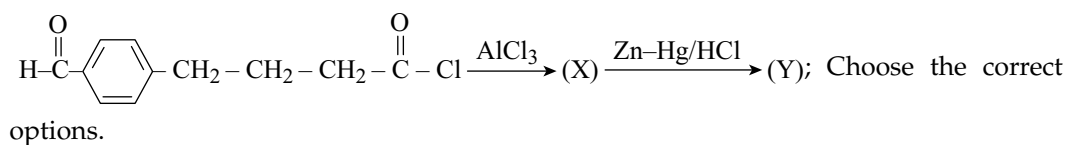
(a) 1'

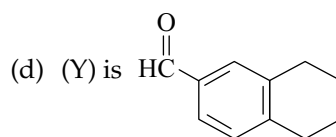
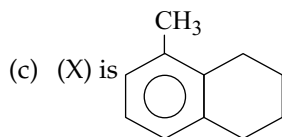
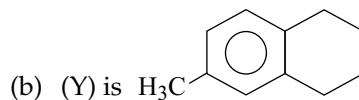
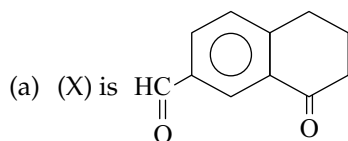
(b) 1

(c) 3

(d) 3'

35. In the given reaction

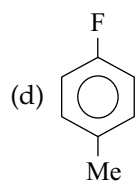
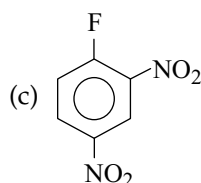
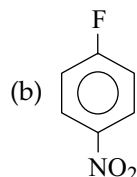
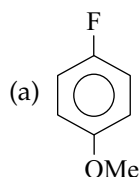




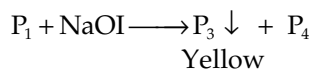
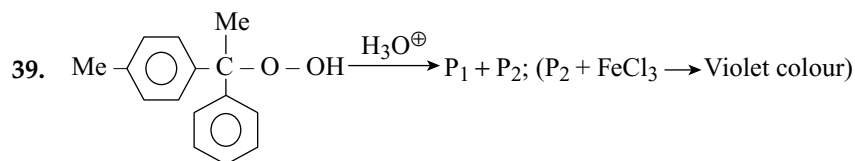
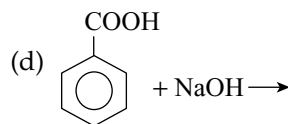
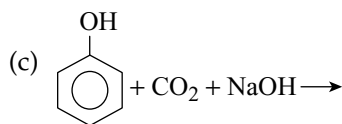
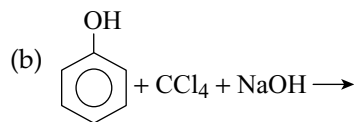
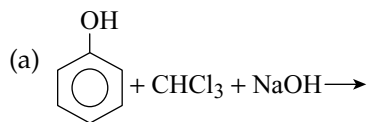
36. The type of substitution reactions of benzenoid hydrocarbons are

- (a) elimination (b) electrophilic
(c) nucleophilic (d) free radical

37. Among the following compounds, which liberates F^- on reaction with MeO^- ?



38. Among the following reactions, which form salicylic acid (after acidification)?



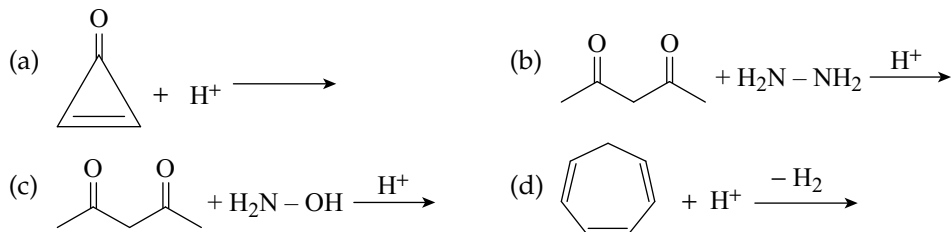
Correct statement for the above sequence is

- (a) P_3 on reaction with Ag gives acetylene
(b) P_4 on reaction with sodalime gives toluene
(c) P_4 on reaction with sodalime gives benzene
(d) P_1 on reaction with 2,4-DNP gives yellow compound

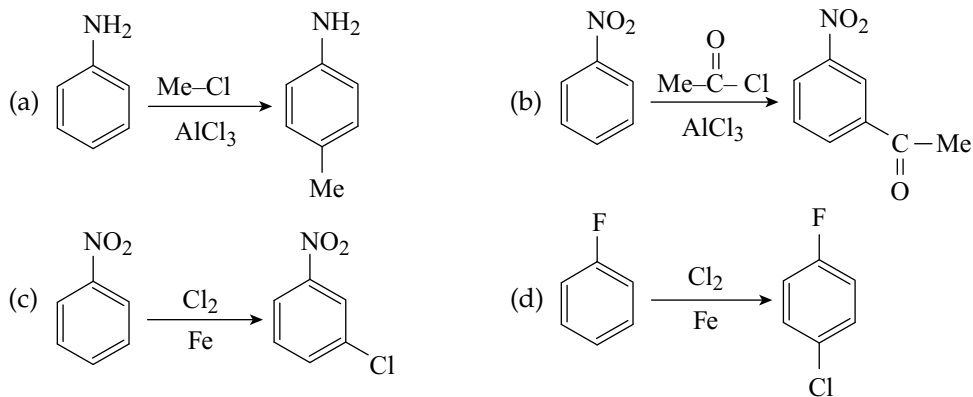
40. Identify compounds which are unstable at room temperature.



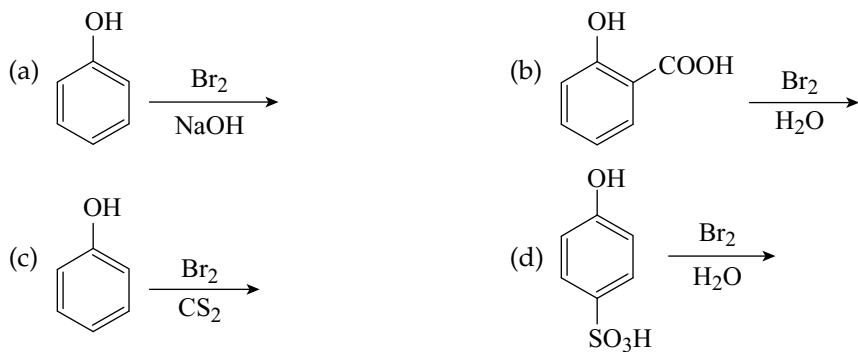
41. Identify reactions which give aromatic product.



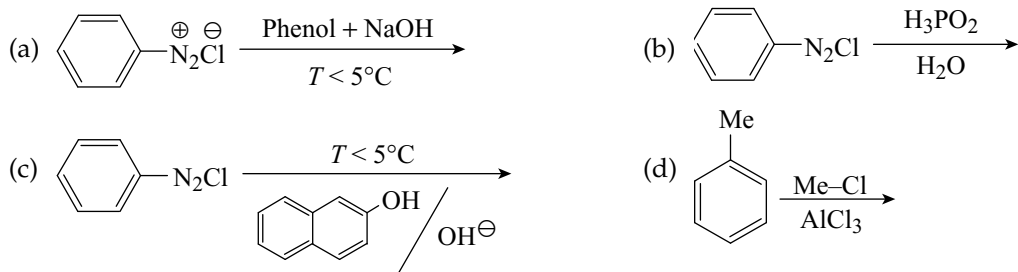
42. Identify reactions which are not feasible.



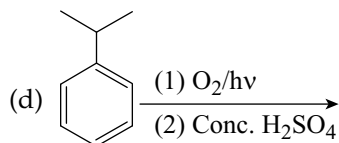
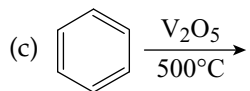
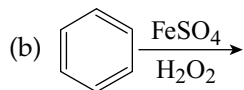
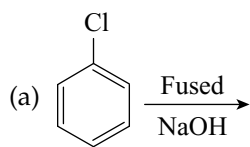
43. Identify reactions that give tribromo substituted product.



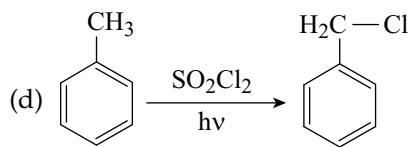
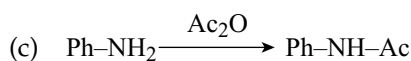
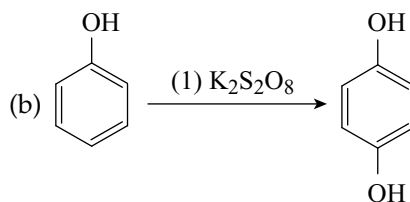
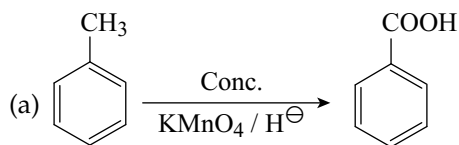
44. Identify coupling reactions.



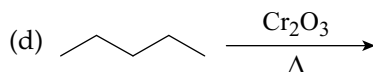
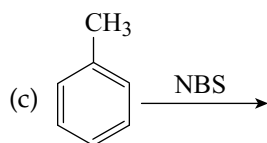
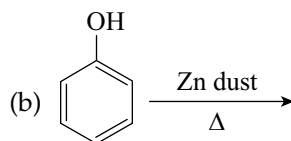
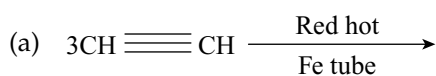
45. Identify reactions which give phenol product.



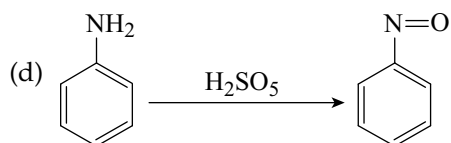
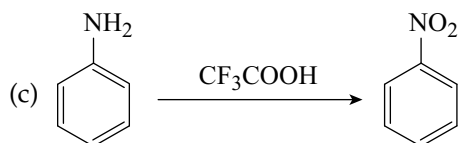
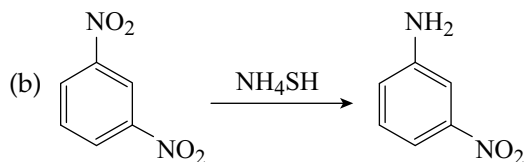
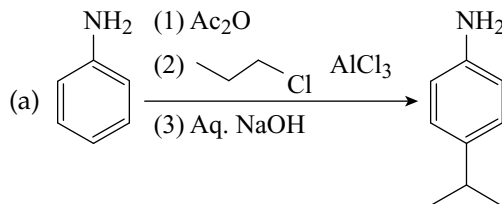
46. Identify correctly matched reactions with their products.



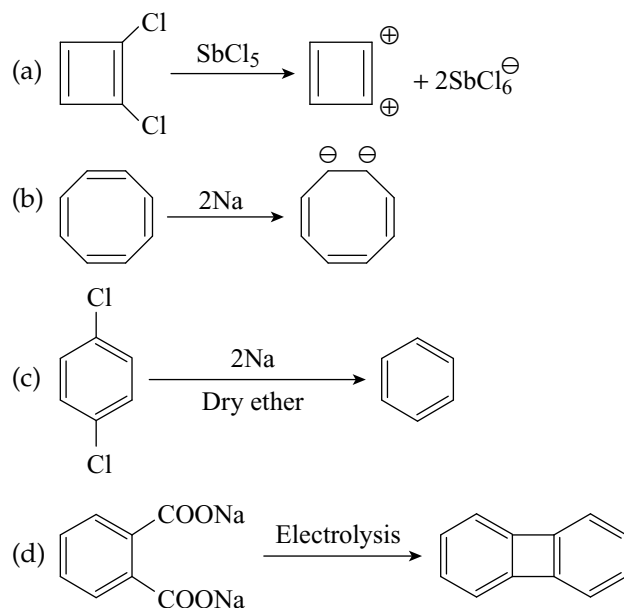
47. Identify method of preparation of benzene.



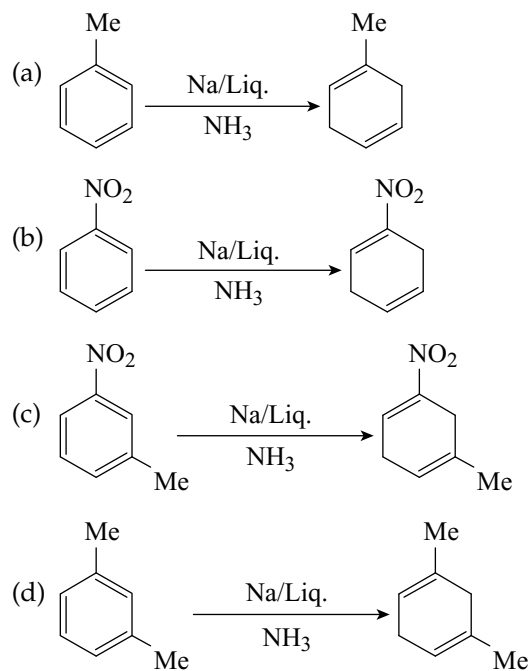
48. Identify correctly matched reactions with their products.



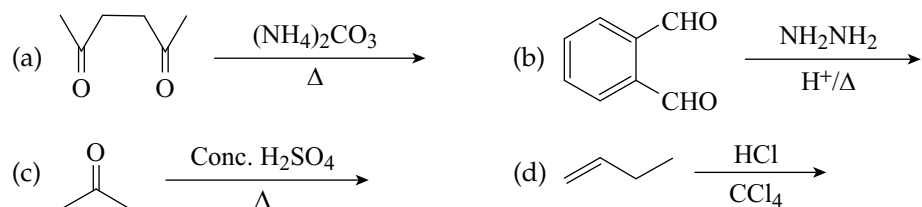
49. Identify correctly matched reactions with their products.



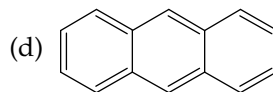
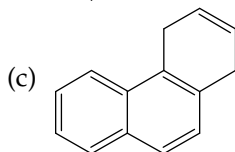
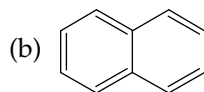
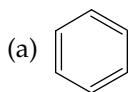
50. Identify correctly matched reaction with their products.



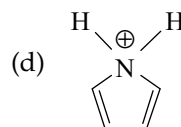
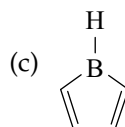
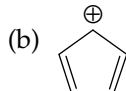
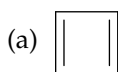
51. Identify reactions that give aromatic products.



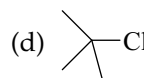
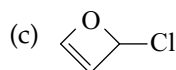
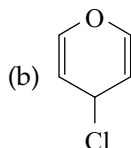
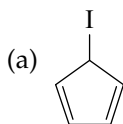
52. Annealation takes place in which of the following compounds?



53. Which of the following is an anti-aromatic compound?



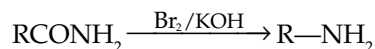
54. Which compound does not give SN' /solvolysis reaction?



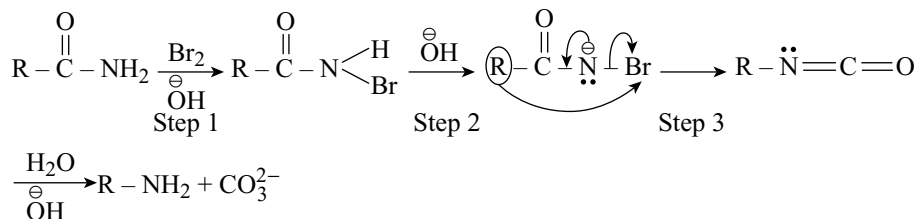
Comprehension Type

Passage 1

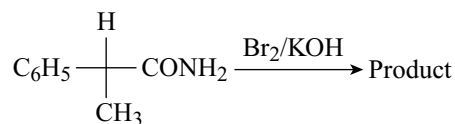
The conversion of an amide into an amine with one carbon atom less by the action of alkaline hydrohalite is known as Hofmann bromamide rearrangement:



The most important feature of the reaction is the rearrangement of N-bromamide anion to isocyanate:



55. The product of the reaction



Product amine will be

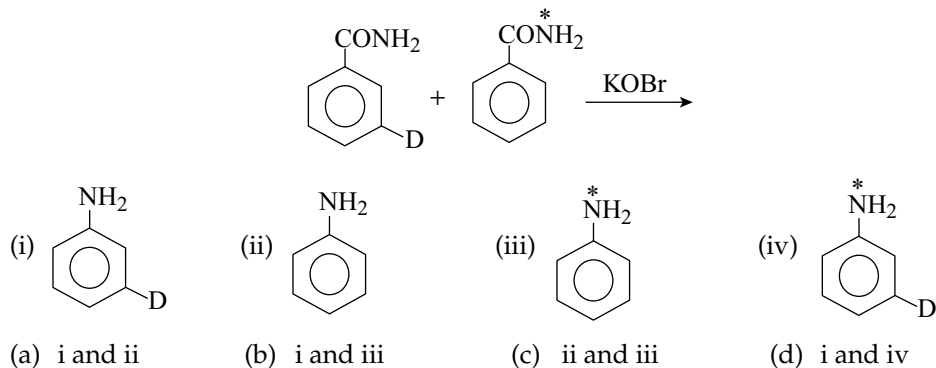
(a) S-amine

(b) R-amine

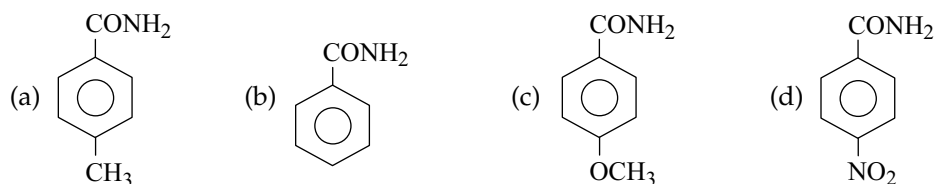
(c) 50:50 mixture of (+) and (−) amine

(d) 30:70 mixture of (+) and (−) amine

56. Predict the product in the following reaction

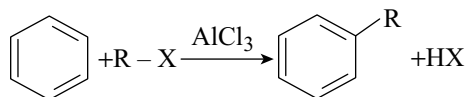


57. Which of the following can undergo Hofmann bromamide reaction most easily?



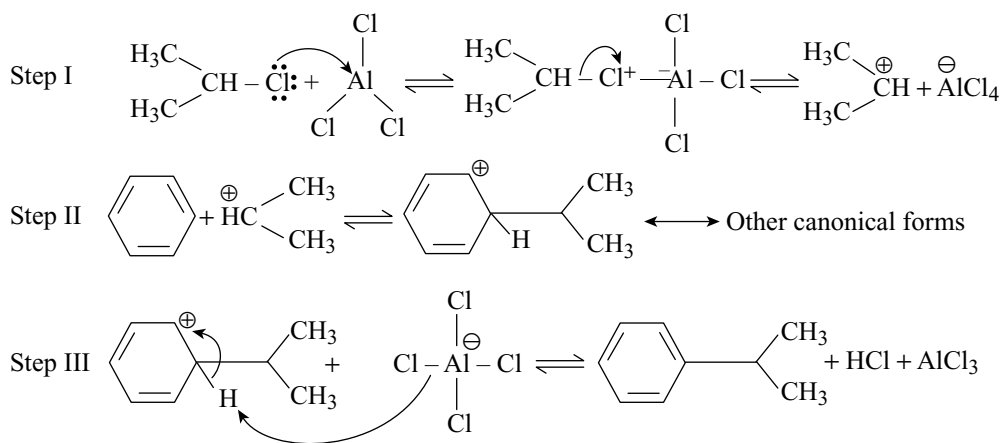
Passage 2

A general equation for a Friedel-Crafts alkylation reaction is the following

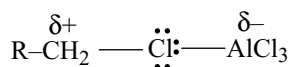


Alkyl halides by themselves are insufficiently electrophilic to react with benzene. Further, AlCl_3 serves as a Lewis acid catalyst to enhance the electrophilicity of the alkylating agent. The mechanism for the reaction is shown in the following steps

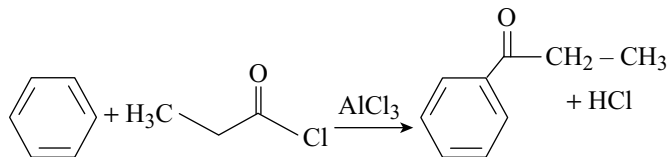
Mechanism for the reaction:



With R-X is a primary halide, the carbon halogen bond is nearly broken and one in which the carbon atom has a considerable +ve charge.



this complex acts as the electrophile. The Friedel-Crafts acylation reaction is an effective means of introducing an acyl group into an aromatic ring. The reaction is often carried out by treating the aromatic compound with an acyl halide.

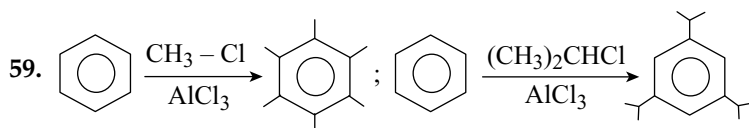


58. Consider the following statements for the given reaction

- (i) The Friedel-Crafts reaction is an electrophilic aromatic substitution.
- (ii) First step of the reaction is the rate-determining step.
- (iii) Second step of the reaction is the rate-determining step.
- (iv) Third step is an acid-base reaction.

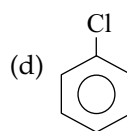
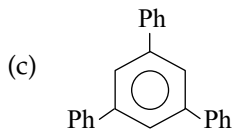
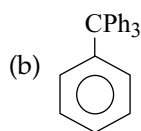
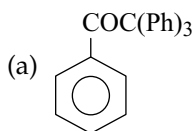
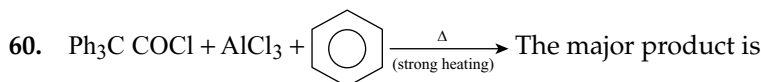
Now, of these statements

- (a) i and ii are correct
- (b) i, ii and iii are correct
- (c) i, iii and iv are correct
- (d) i, ii, iii and iv are correct



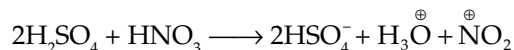
What is the reason for trisubstituted product in the second case?

- (a) less positive inductive effect
- (b) more steric effect
- (c) less hyperconjugation
- (d) more mesomeric effect

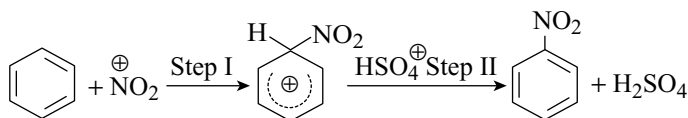


Passage 3

Nitration of benzene or any aromatic system is done by treating it with a mixture of Conc. HNO_3 and Conc. H_2SO_4 (called nitrating mixture). These two acids react together according to the equation given below, to form nitronium ion which act as an electrophile:



$\text{NO}_2^{\oplus}$ ion, an electrophile then attacks benzene or any aromatic system to accomplish nitration in the following two steps with arenium ion as the reaction intermediate:

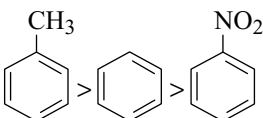
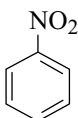


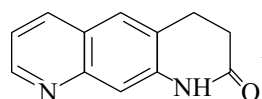
The direct nitration of aniline or phenol with nitrating mixture gives very poor yield of nitro product because benzene ring attached to $-\text{NH}_2$ or $-\text{OH}$ group is very sensitive to oxidation and major part of aniline or phenol is oxidized to give a black tar mass that contains mainly

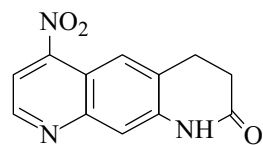
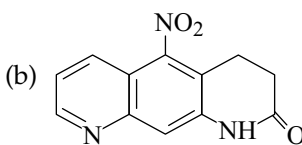
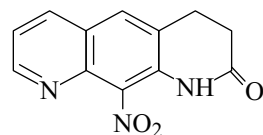
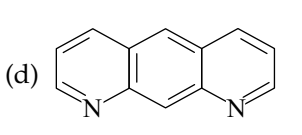
benzoquinone, $\text{O}=\text{C}_6\text{H}_4=\text{O}$. Although $-\text{NH}_2$ group is o/p-orienting, m-nitro derivative is also formed. The ring is protected from oxidation by acetylating $-\text{NH}_2$ group before subjecting it to nitration. After nitration, product is hydrolyzed to get deacetylated product (o- and p-nitro derivatives). Nitration of phenol is carried out by Dil. HNO_3 . It is believed that nitrous acid (present as an impurity) interacts with HNO_3 to give nitrosonium ion, an electrophile which reacts with phenol to give o- and p-nitrosophenol, the latter being the principal product, according to the same mechanism as that of nitration mentioned above. Nitrosophenol is then oxidized by HNO_3 to nitrophenol while HNO_3 is itself reduced to HNO_2 .

61. Regarding the nitration of phenol with Dil. HNO_3 as described above, the incorrect statement is
- HNO_3 acts as an acid and also as an oxidant.
 - Nitrous acid acts as a base.
 - The reaction intermediate is an arenium ion.
 - Amount of HNO_2 goes on decreasing with the progress of nitration.

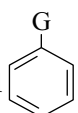
62. Correct statement is/are

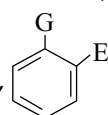
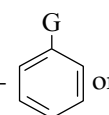
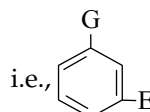
- (a) Rate of nitration is in the order:  >  > 
- (b) Rate of nitration of benzene and that of hexa deuterated benzene occur almost at the same rate
- (c) By increasing the concentration of acids ($\text{HNO}_3 + \text{H}_2\text{SO}_4$), the rate of nitration increases
- (d) All of the above

63.  $\xrightarrow[\text{HNO}_3]{\text{H}_2\text{SO}_4}$ Major product is:

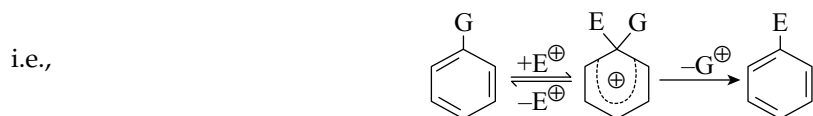
- (a)  (b) 
- (c)  (d) 

Passage 4

It is very well known that when a compound  reacts with an electrophile then we either get

ortho- or para-substituted product, i.e.,  +  or we get a meta-substituted product, i.e., .

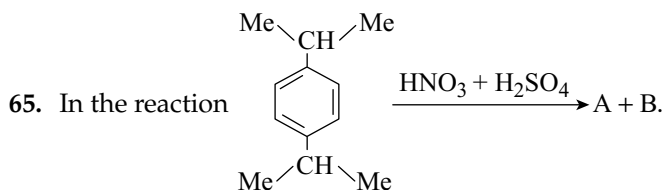
This depends on the electron-releasing or electron-withdrawing power of the group, i.e., +R/-R or +M/-M effect of group G. There is another theory that is the electrophile attacks the ring carbon where the substituent G is already attached.



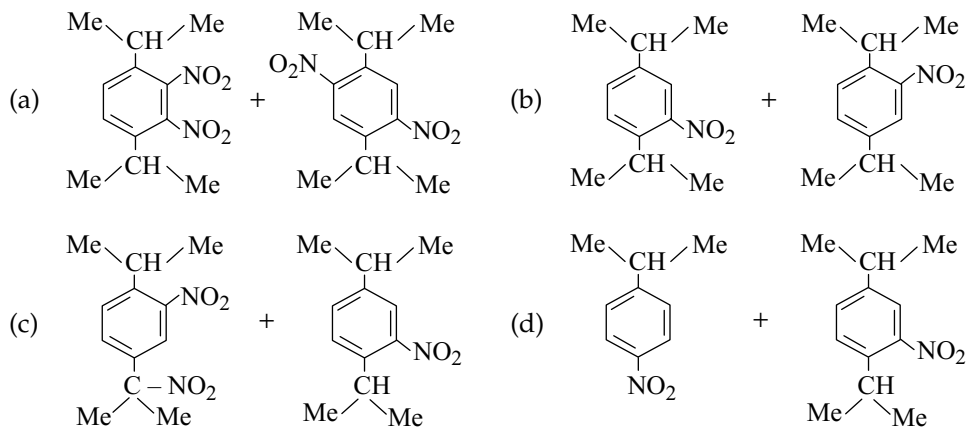
This is called ipso substitution reaction.

64. The factor which is expected to promote ipso substitution is

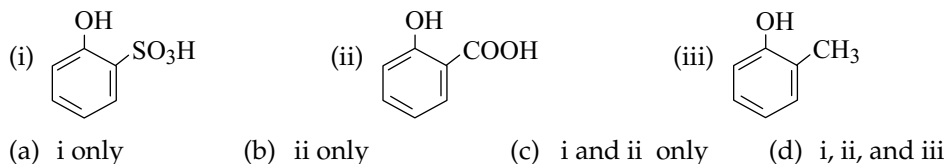
- The group G should be a strong electron withdrawing group
- A group which is highly electron withdrawing should be attached at ortho or para position with respect to the group G
- The group G should leave as G^+ easily, i.e., G^+ should be highly stable
- The group G should leave easily, i.e., G^+ should be highly unstable



A and B are respectively



66. In which of the following can you expect ipso addition?

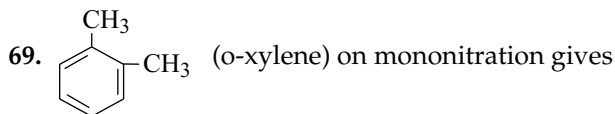
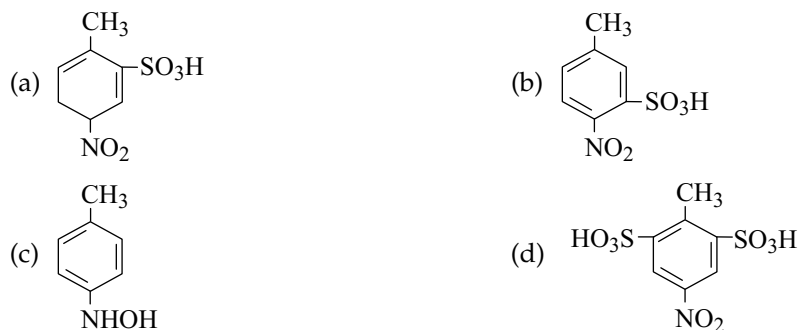
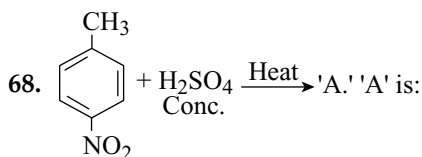
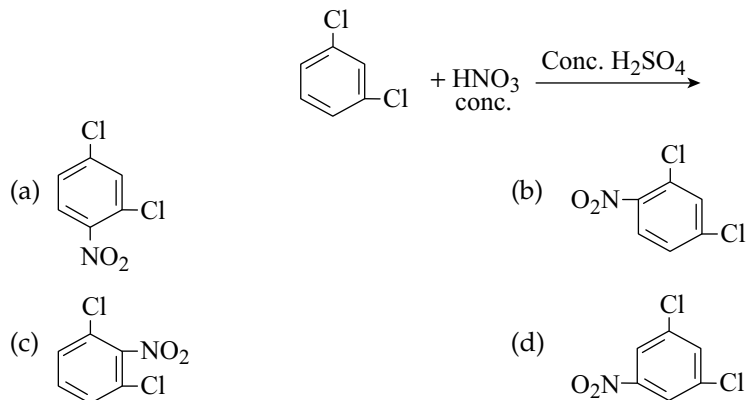


Passage 5

When a second substituent is introduced in benzene ring, it is directed by group already present on benzene ring. Electron-releasing groups are activating, therefore o and p-directing, whereas electron-withdrawing groups are deactivating, therefore m-directing. Halogens, although they are electron withdrawing due to -I effect but still o- and p-directing due to +R effect. -N=O

group is also deactivating but o- and p-directing due to presence of lone pair of electrons like halogens it shows +R effect. When a third substituent is introduced into a disubstituted product, the o-isomer gives two, the m-isomer gives three while p-isomer gives only one product. This method is called Korner's method. The major product is formed such that it has minimum steric hindrance.

67. Which of the following is not formed at all?



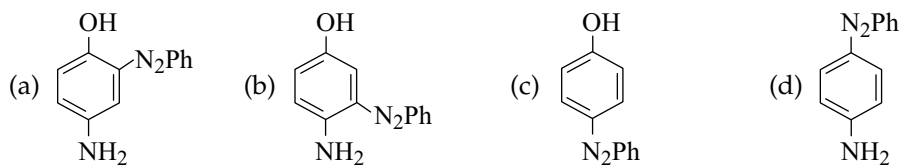
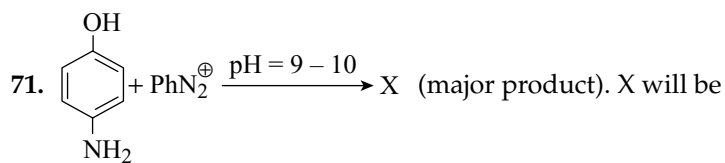
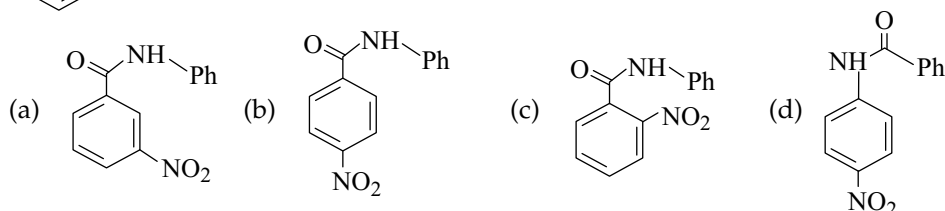
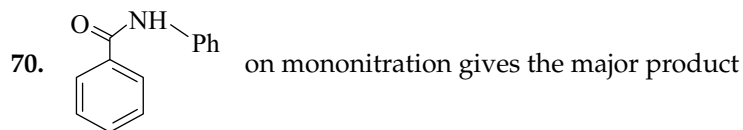
- (a) two products (b) three products (c) one product (d) four products

Passage 6

When a mono substituted benzene derivative, $\text{C}_6\text{H}_5\text{Y}$, undergoes further electrophilic substitution, e.g., nitration, the incoming substituent may be incorporated at the o-, m- or p- position and the overall rate at which substitution takes place may be faster or slower than with benzene itself. It has been observed that substitution occurs so as to yield either predominantly the m-isomer or a mixture of o- and p-isomers, in the former case the overall rate of attack is always

slower than on benzene itself, in the latter case the overall rate of attack is usually faster than on benzene itself. This is due to electronic effects that Y can exert.

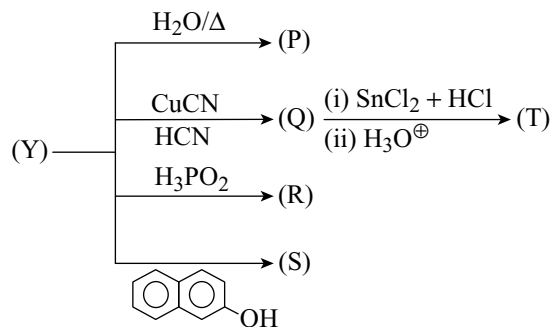
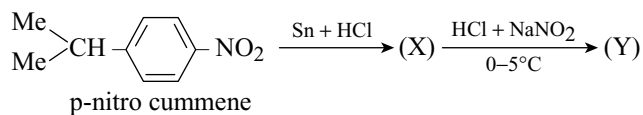
Substituent, Y is thus classified as m- or o-/p-directing; if the substituent induces faster overall attack than on benzene itself then the substituent is said to be activating, if slower then deactivating.



72. Which among the following will give highest yield of p-isomer during nitration?

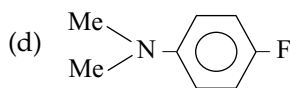
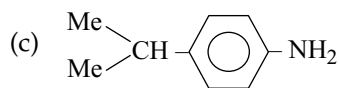
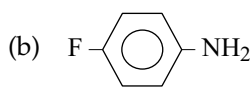
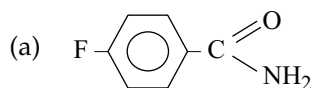


Passage 7



For the given reaction sequence, answer the following

73. (Y) $\xrightarrow[\Delta]{\text{HBF}_4}$ $\xrightarrow[\Delta]{\text{KMnO}_4/\text{H}^+}$ $\xrightarrow[\text{H}_2\text{SO}_4]{\text{N}_3\text{H}}$ Final product; final product is



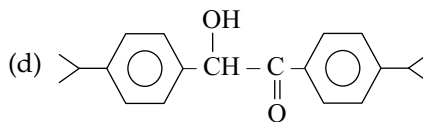
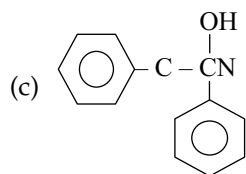
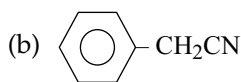
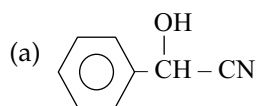
74. (R) $\xrightarrow[\text{(ii) NaOH + I}_2]{\text{(i) CH}_3\text{COCl/AlCl}_3}$ (A) + (B) $\downarrow$
Yellow ppt.

(A) $\xrightarrow[\text{(ii) SOCl}_2]{\text{(i) H}_2\text{O/H}^+}$ Product (L)
(iii) (R)/AlCl₃
(iv) H⁺, Δ

The correct statement about the product (L) is

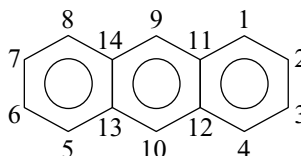
- (a) Product (L) on reaction with Tollen's reagent gives silver mirror
- (b) Product (L) on reaction with H₂N-NH₂/OH⁻, Δ gives diphenyl methane
- (c) Product (L) on reaction with HCN gives a compound which contains a chiral centre
- (d) All of these

75. Compound (T) $\xrightarrow[\text{KCN}]{\text{Alc.}}$ Product is



Passage 8

Consider the aromatic anthracene molecule, C₁₄H₁₀, shown in the figure:



Approximate calculation of the π-bond order for C-C bonds yield the following results

Bond	π-bond order
1-2	0.738
1-11	0.535
2-3	0.586
9-11	0.606
11-12	0.485

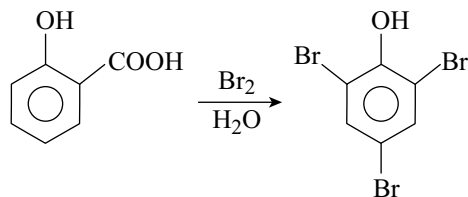
Also, considering the electron displacement effect in combination with bond order data, answer the following questions.

76. Which of the following carbon is most likely to be attacked by an electrophile (NO_2^+ in acetic anhydride at $15-20^\circ\text{C}$)?
- (a) C-1 (b) C-9
(c) C-2 (d) C-11
77. Which of the following C-C bond has least percentage of single bond character?
- (a) C_1-C_2 (b) C_1-C_{11}
(c) $\text{C}_{11}-\text{C}_{12}$ (d) C_2-C_3
78. Which of the following (C-C) bonds are shortest and longest respectively?
- (a) 11-12 and 1-2 (b) 1-2 and 11-12
(c) 9-11 and 1-2 (d) 2-3 and 9-11

Passage 9

Benzene gives electrophilic substitution reaction with strong electrophilic. The leaving group of this reaction is H in the form of $\text{H}^\oplus$, $-\text{COOH}$ in the form of CO_2 and $-\text{SO}_3\text{H}$ in the form of SO_2 . The reaction is known as aromatic electrophilic substitution (ArSE) reaction.

79. Benzene can be obtained by
- (a) Conc. HNO_3 /Conc. H_2SO_4 /Benzene
(b) NO_2BF_4 /Benzene
(c) NO_2ClO_4 /Benzene
(d) Phenol/Zn
80. Consider the following statements
- (i) Benzene reacts with electrophile to form reaction intermediate known as cyclohexadienyl cation.
(ii) Formation of carbon-electrophilic bond is rate-determining step in ArSE reaction.
(iii) Breaking of C - H bond is rate-determining step
(iv) Sulphonation of benzene is a reversible reaction
- The correct statements from the above are
- (a) i, ii, iii and iv (b) i, ii and iv
(c) i, iii and iv (d) ii, iii and iv
81. In the given reaction

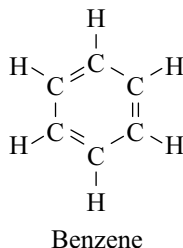


The leaving group(s) in the form of electrophile is

- (a) $2\text{H}^\oplus$ only (b) One $\text{H}^\oplus$ and one CO_2
(c) $2\text{H}^\oplus$ and one CO_2 (d) One CO_2 only

Passage 10

Based on the Lewis structure of benzene



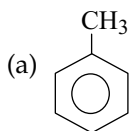
82. What is the bond angle for each H-C-C and each C-C-C on benzene?
(a) 120° and 120° (b) 109.5° and 120° (c) 120° and 109.5°
(d) 180° and 120° (e) None of these
83. What one of the following is the best description for the overall shape of benzene molecule?
(a) Linear (b) Triangular (c) Tetrahedron
(d) Planar (e) Goofy

Matrix Type

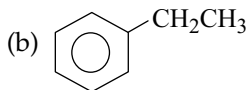
84. Match the columns.

Column I (alkene)

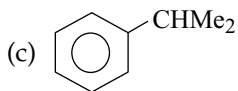
Column II (o/p ratio in nitration)



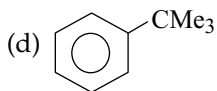
(p) 0.22



(q) 0.92



(r) 1.57



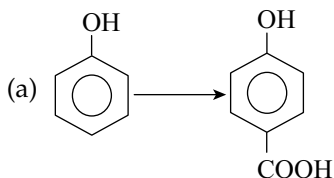
(s) 0.48

85. Match the columns.

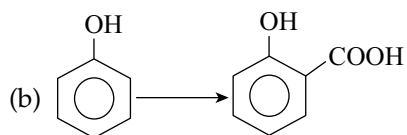
Column I

Column II

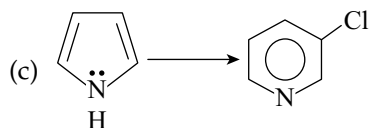
(reagents used for the desired product in major amount)



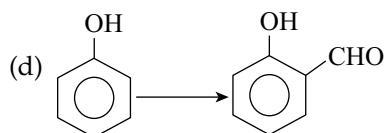
(p) $\text{CHCl}_3/\text{NaOH}$



(q) CCl_4/NaOH



(r) NaOH followed by CO_2

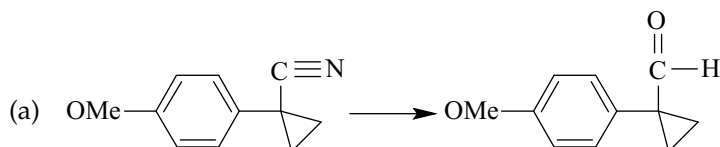


(s) KOH followed by CO_2

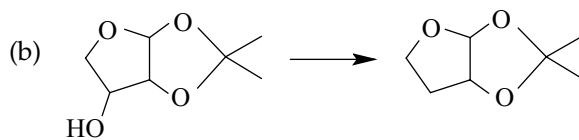
86. Identify reaction correct match with its reagent

Reaction

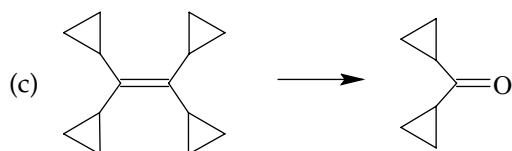
Reagent



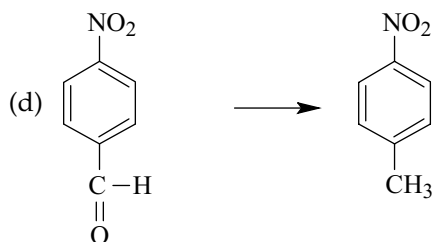
(p) $\text{DIBAL-H}/\text{H}_3\text{O}^+$



(q) $\text{T}_5\text{Cl}/\text{LAH}$



(r) O_3/Zn

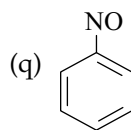
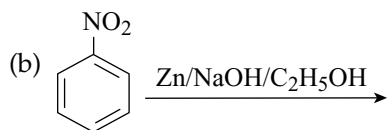
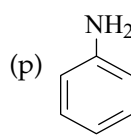
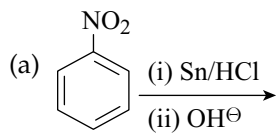


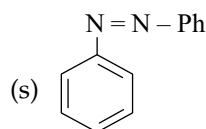
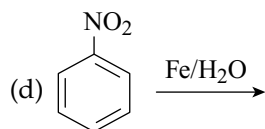
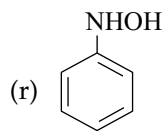
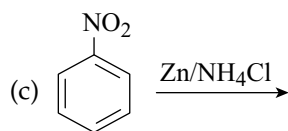
(s) $\text{Zn-Hg}/\text{HCl}$

87. Match the reduction in **Column I** with their products listed in **Column II**.

Column I

Column II





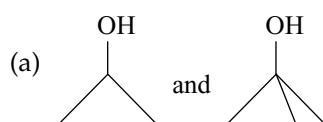
88. Match the processes in **Column I** with properties in **Column II**.

Column I

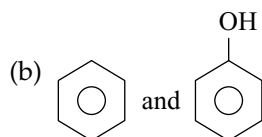
(pair of compounds)

Column II

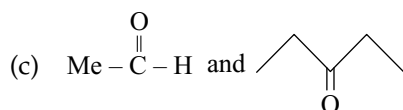
(reagent used to distinguish pair of compounds)



(p) $\text{Br}_2/\text{H}_2\text{O}$ test



(q) Tollen's reagent



(r) Iodoform test



(s) Lucas reagent

(t) Ammonical cuprous chloride

89. Match the **Column I** with **Column II**.

Column I

Column II

(a) Toluene

(p) On oxidation by KMnO_4 in acid medium gives benzoic acid

(b) Cumene

(q) Used in the manufacture of phenol

(c) Benzene

(r) Symmetrical trimethyl benzene

(d) Mesitylene

(s) On oxidation ($\text{V}_2\text{O}_5/\text{O}_2$) at $250-450^\circ\text{C}$ gives maleic anhydride

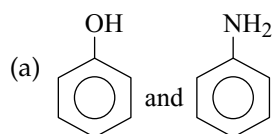
90. Match the columns.

Column I

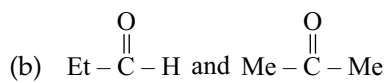
Column II

(pair of compounds)

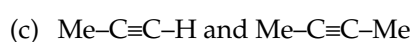
(reagents used for identification)



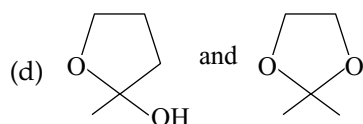
(p) $\text{Br}_2 + \text{H}_2\text{O}$ test



(q) $\text{CHCl}_3 + \text{NaOH}$ test



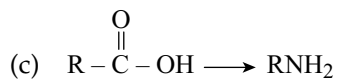
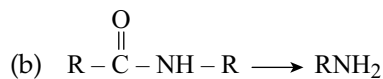
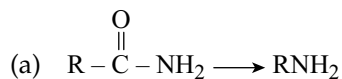
(r) Iodoform test



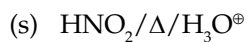
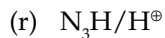
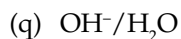
(s) Tollen's reagent

91. Match the columns.

Column I (reaction)

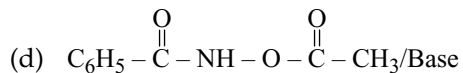
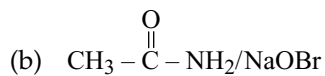
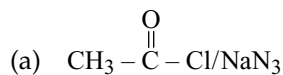


Column II (reagents)



92. Match the columns.

Column I (pair)



Column II

(p) Lossen rearrangement

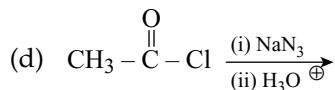
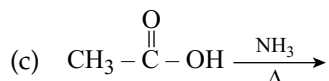
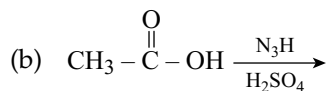
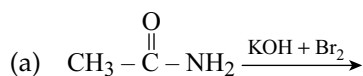
(q) Schmidt rearrangement

(r) Hofmann rearrangement

(s) Curtius rearrangement

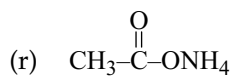
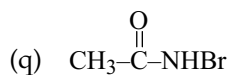
93. Match the **Column I** with **Column II**.

Column I



Column II

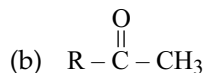
(Intermediate/Product)



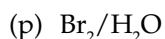
94. Match **Column I** with **Column II**.

Column I (elements/compounds)

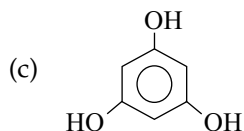
(a) Halogens



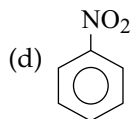
Column II (tests)



(q) Baker-Mulliken test



(r) Iodoform test



(s) Beilstein test

95. Match **Column I** with **Column II**.

Column I [name of reaction]

- (a) Haloform reaction
- (b) Aldol addition
- (c) Wittig reaction
- (d) Hofmann bromamide reaction

Column II [substrate(s) of reaction]

- (p) α -methyl carbonyl compound
- (q) Acid amide
- (r) Aldehyde
- (s) Halide and carbonyl

96. **Column I (reaction)**

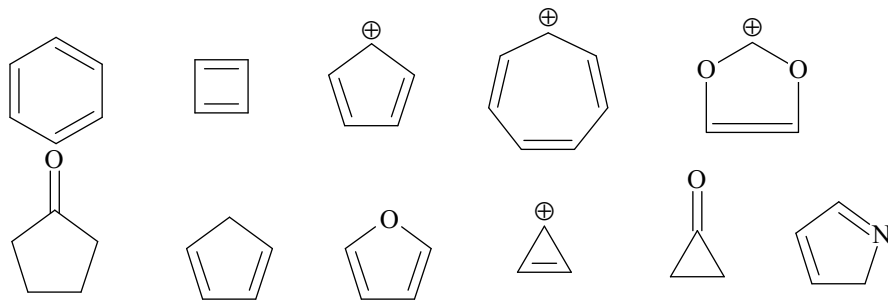
- (a) Wurtz reaction
- (b) Dehydration of alcohol with Conc. H_3PO_4
- (c) Kolbe's electrolysis
- (d) Diazotisation

Column II (intermediate)

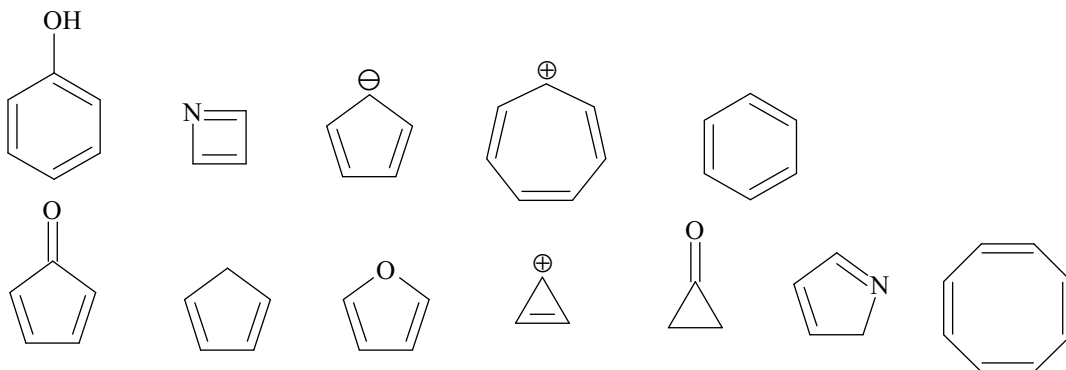
- (p) Carbocation
- (q) Electrophile (excluding free radicals)
- (r) Free radical
- (s) Carbanion
- (t) N_2 gas liberated in intermediate step

Integer Type

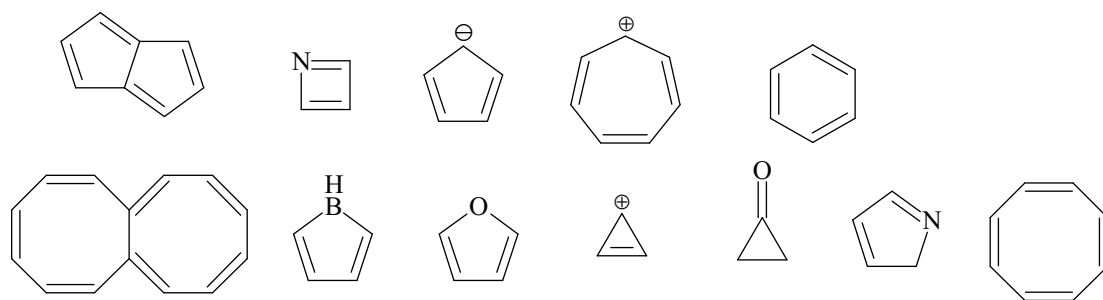
97. Identify compounds which are aromatic.



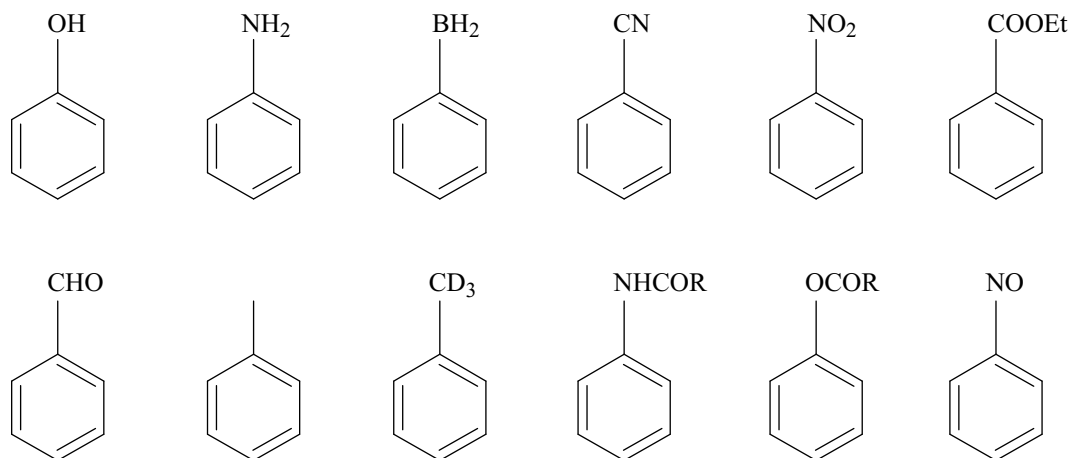
98. Identify compounds which are nonaromatic.



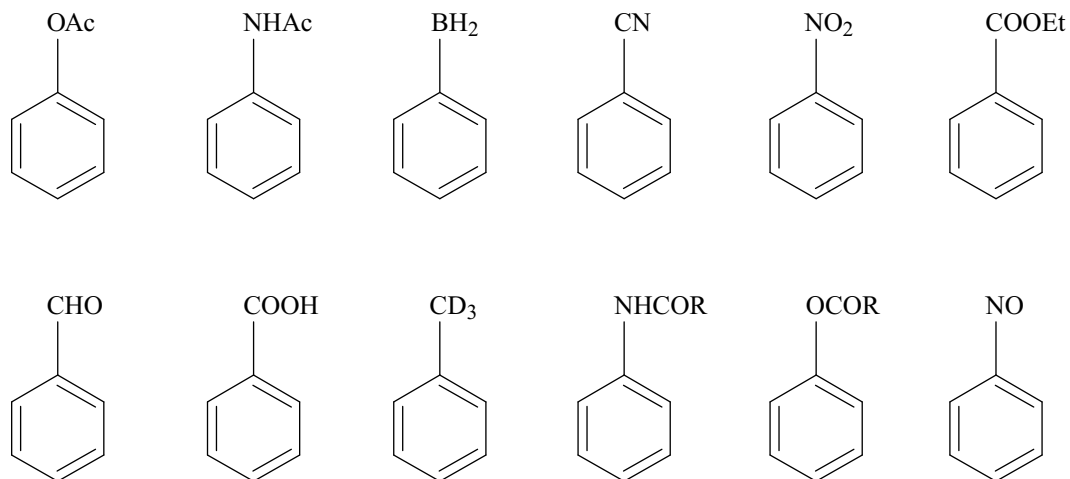
99. Identify compounds which are antiaromatic.



100. Identify compounds which react faster than benzene in ArSE reaction?



101. Identify compounds which react slower than benzene in ArSE reaction?



Answer Keys

LEVEL 1

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
b	b	c	c	c	b	a	a	c	b	c	c	c	c	b
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
b	a	b	c	d	d	d	d	b	d	b	c	b	cd	b
31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
c	b	d	d	b	b	c	d	d	a	b	a	a	d	b
46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
c	b	a	b	b	b	b	a	c	b	c	b	d	a	c
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
d	c	c	d	a	c	a	ac	c	b	a	c	d	d	a
76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
b	a	c	c	d	b	b	c	a	b	b	a	b	b	b
91	92	93	94	95	96	97	98							
b	d	a	a	c	d	ab	c							

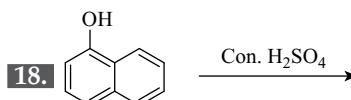
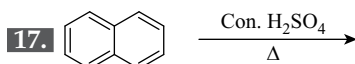
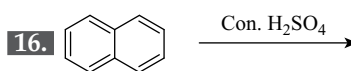
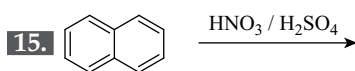
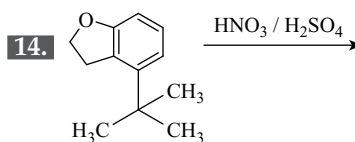
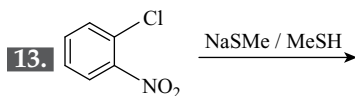
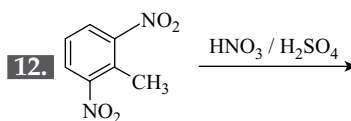
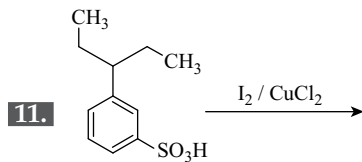
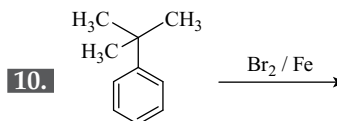
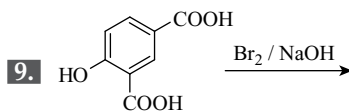
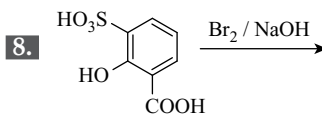
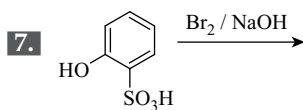
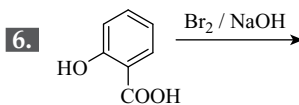
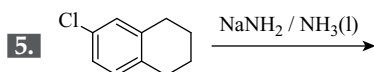
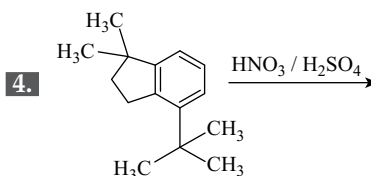
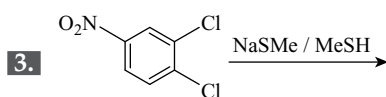
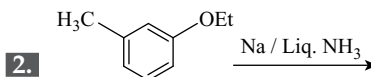
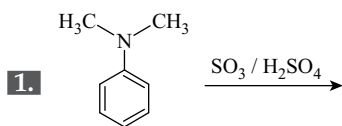
LEVEL 2

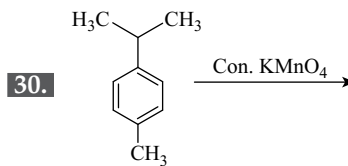
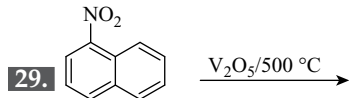
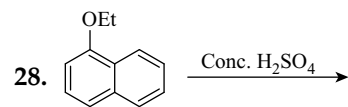
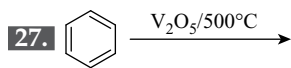
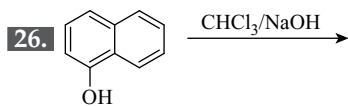
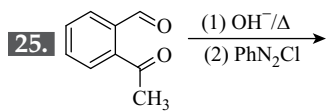
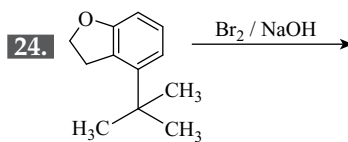
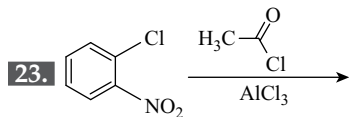
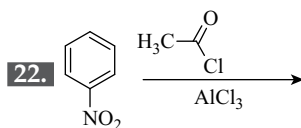
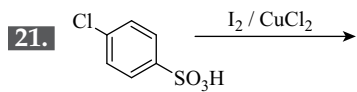
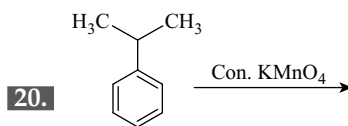
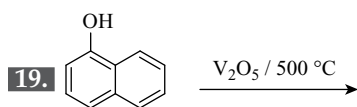
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WORKBOOK EXERCISES

EXERCISE 1

Identify complete reaction sequence

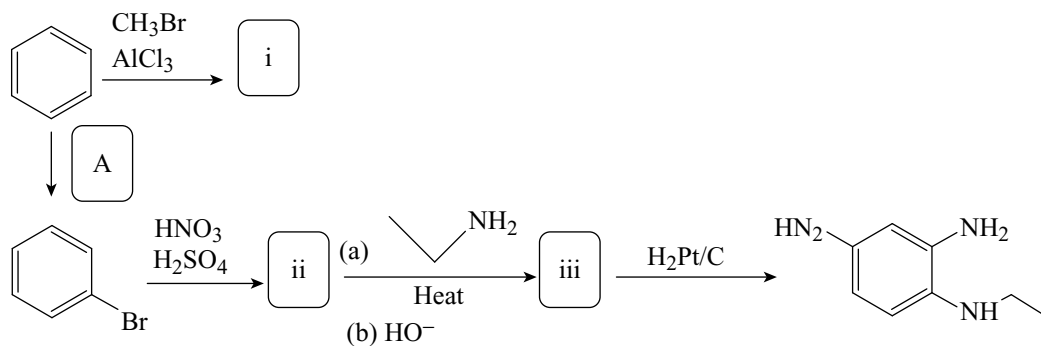




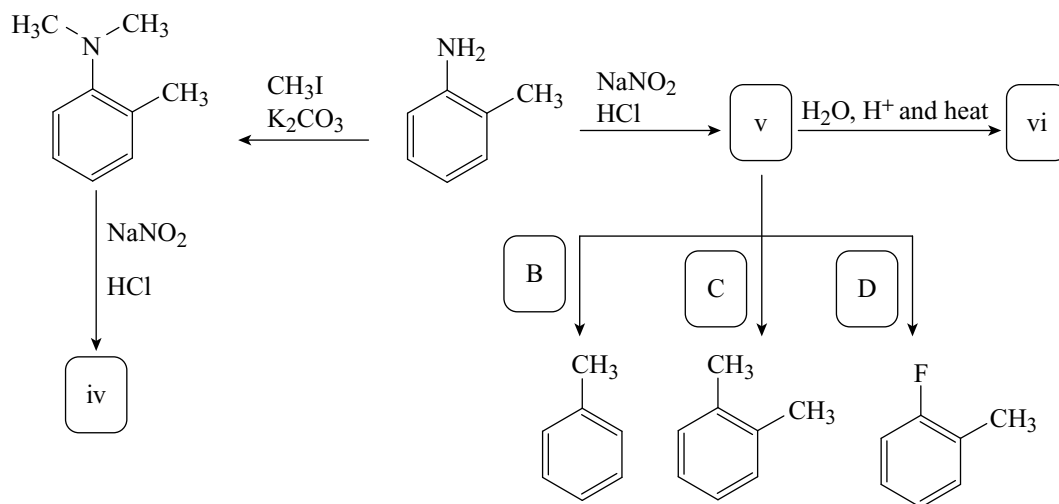
EXERCISE 2

Identify reagent used and intermediate products in the following conversion.

A. Multiple-step synthesis

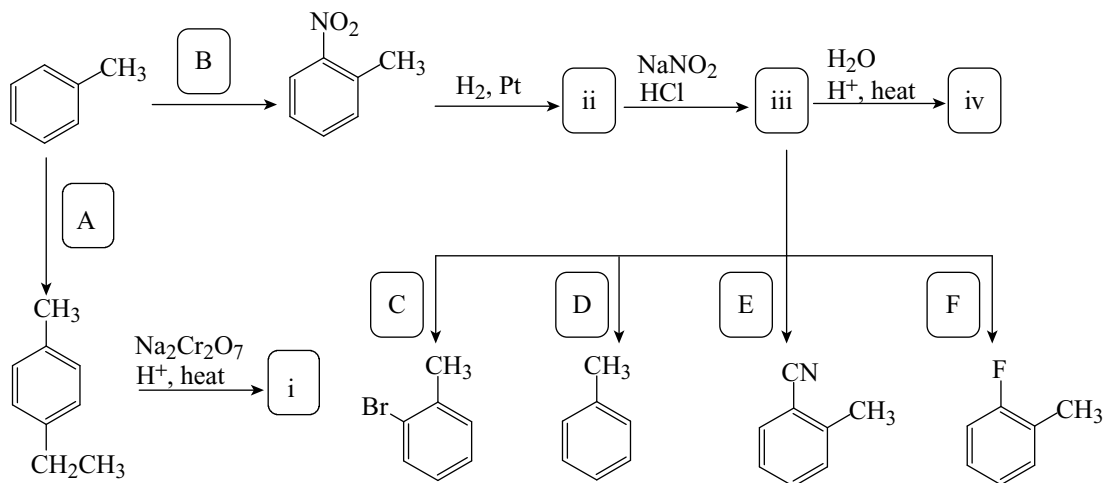


B. Multiple-step synthesis



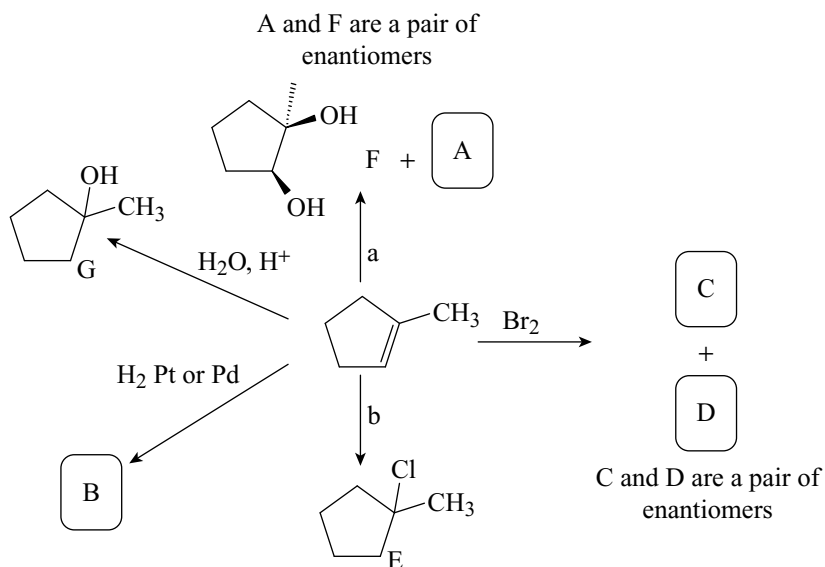
EXERCISE 3

Identify reagent used and intermediate products in the following conversion.



EXERCISE 4

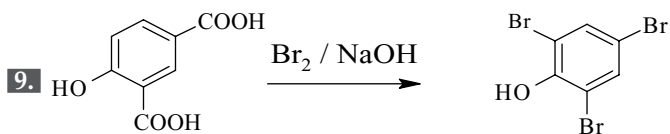
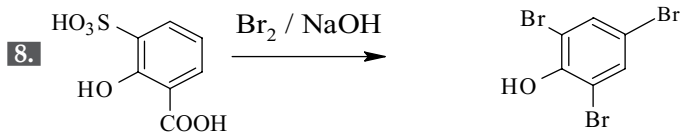
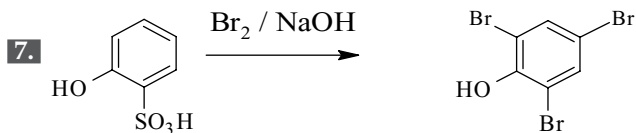
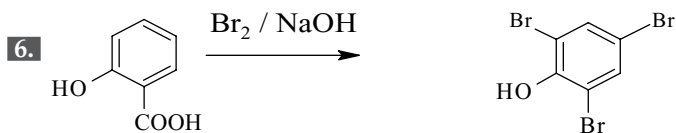
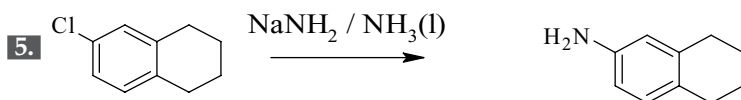
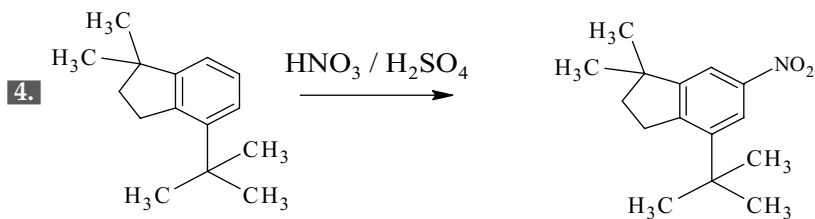
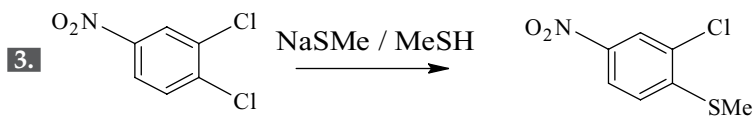
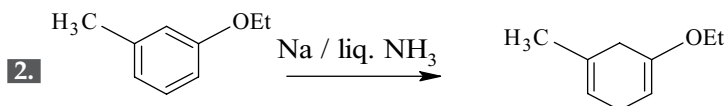
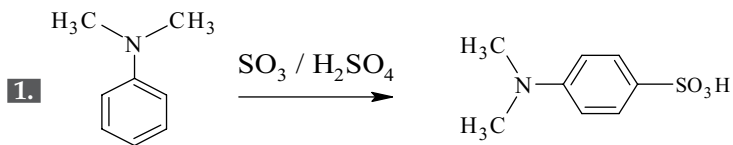
Identify reagent used and intermediate products in the following conversion.

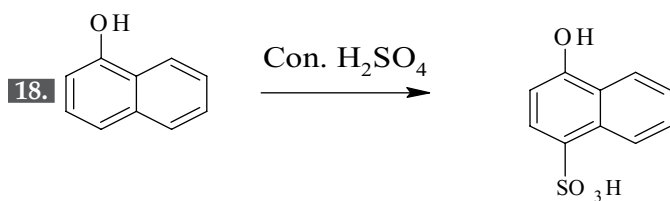
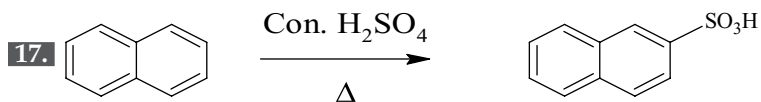
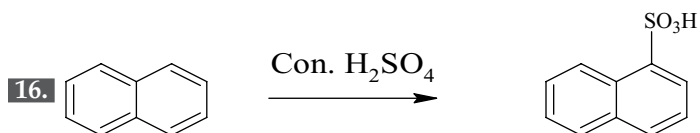
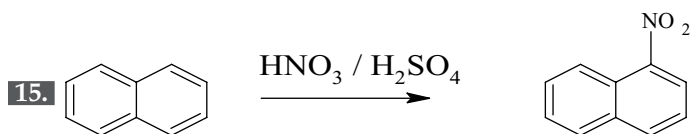
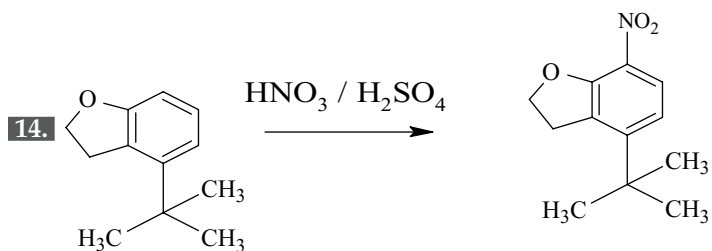
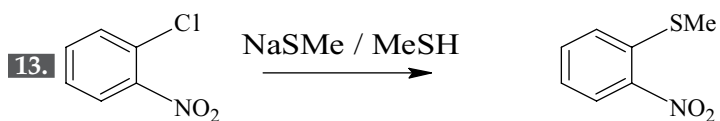
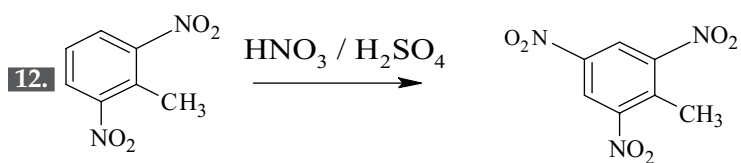
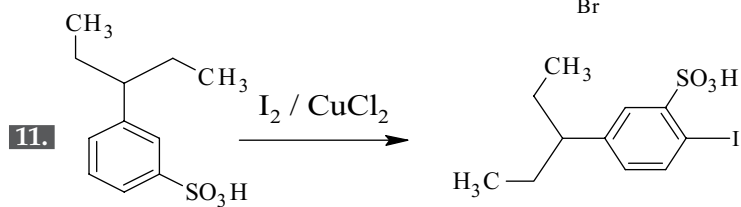
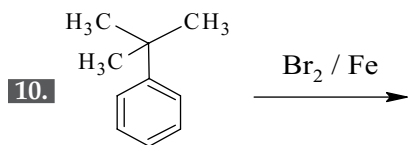


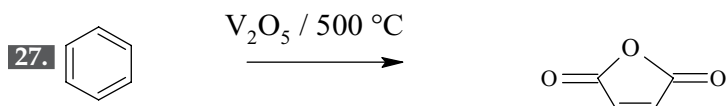
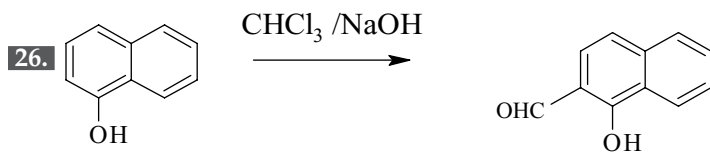
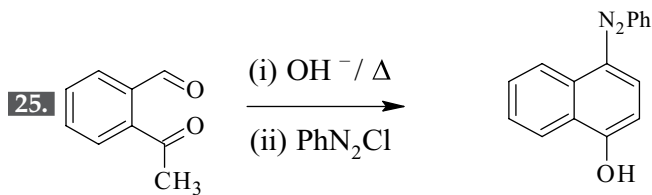
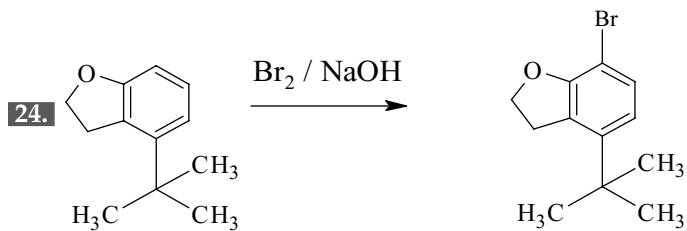
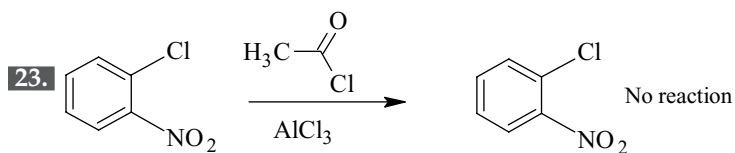
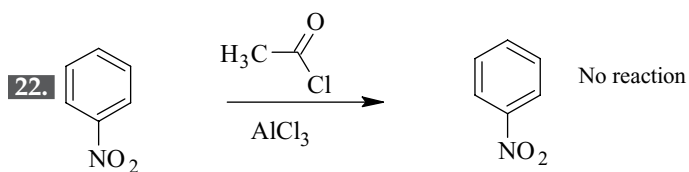
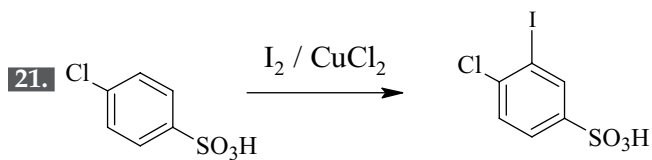
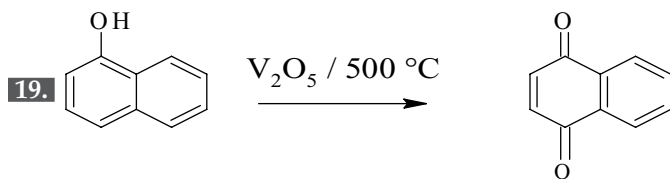
SOLUTION FOR WORKBOOK EXERCISES

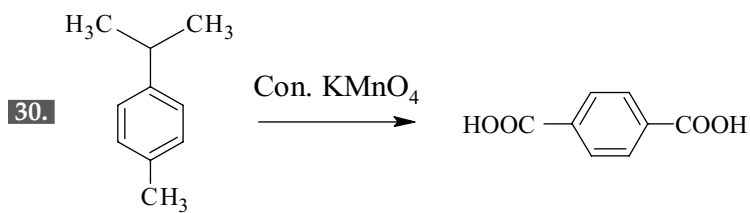
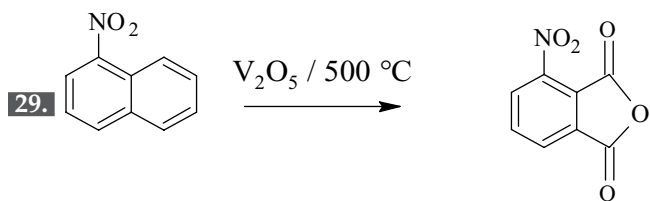
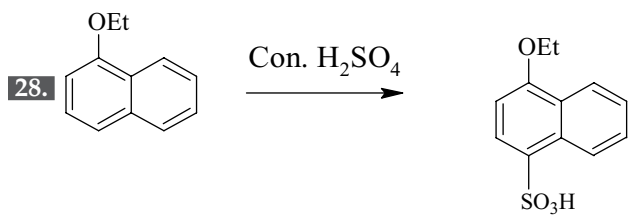
EXERCISE 1

Identify complete reaction sequence.



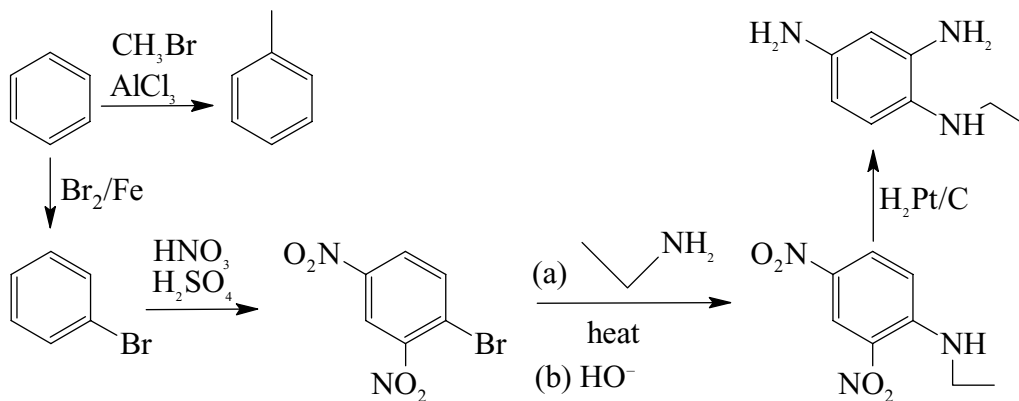




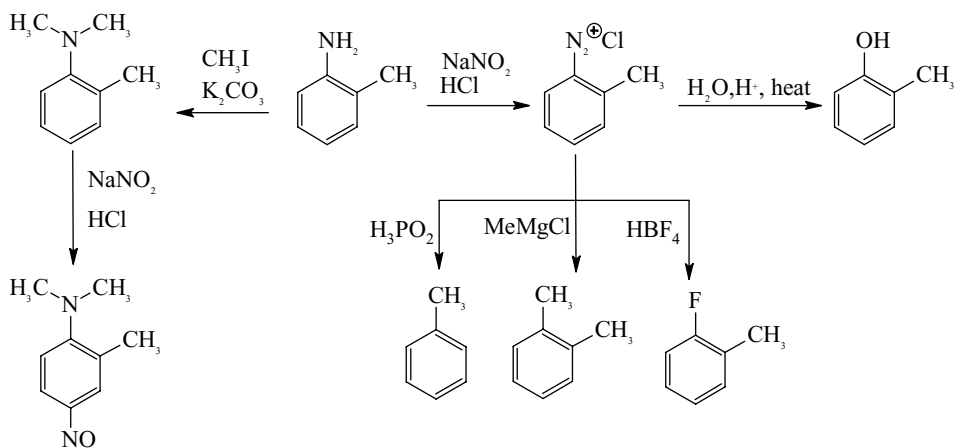


EXERCISE 2

A. Multiple-step Synthesis

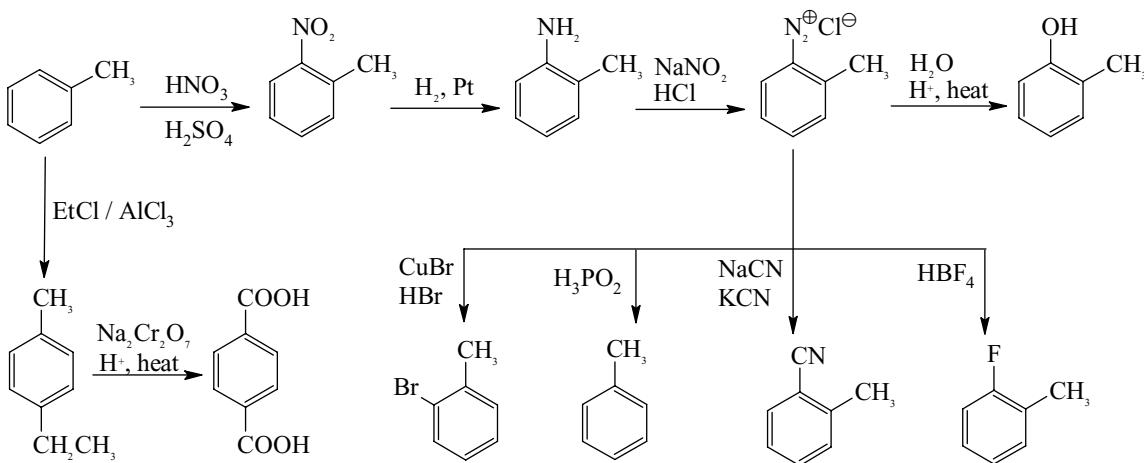


B. Multiple-step Synthesis



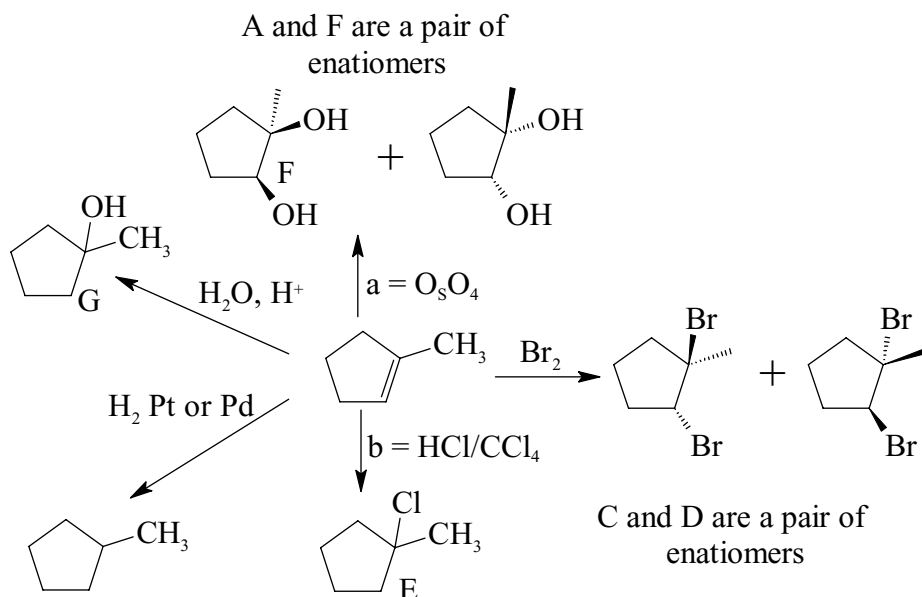
EXERCISE 3

Identify reagent used and intermediate products in following conversion.



EXERCISE 4

Identify reagent used and intermediate products in following conversion.



Reaction Mechanism Chart

