

(C) II > I > III > IV (D) III > II > I > IVSol. (A) More are the number of α -hydrogen present in the alkyl group attached to the benzene ring more pronounced will be the hyperconjugation and the benzene ring will be more electron rich and easily be attacked by an electrophile. α -hydrogen in $-CH_3$, $-CH_2 - CH_3$, $-CH(CH_3)_2$ and $-C(CH_3)_3$ respectively are three, two one and zero.



Ex.6 In which of the following reaction t-butylbenzene is formed :

- (A) Benzene + t-butyl chloride $\xrightarrow{\text{AlCl}_3}$
- **(B)** Benzene + $(CH_3)_2C = CH_2 \xrightarrow{BF_3.HF}$
- (C) Benzene + t-butyl alcohol $\xrightarrow{H_2SO_4}$

(D) All of these

Sol.

(**b**)
$$\bigoplus_{i=1}^{CH_3} + CH_3 - CH_3 - CH_3 + HCl$$

$$\bigoplus_{i=1}^{CH_3} + CH_3 - CH_3 + HCl$$

$$\bigoplus_{i=1}^{CH_3} + CH_3 - CH_2 - CH_3 + CH_3 - CH_3 + CH_3 - CH_3 + CH_$$

Which of the following reactions of benzene does not account for the three 'C=C' bonds in the molecule-**Ex.** 7 [a] Benzene + Br₂ $\xrightarrow{\text{FeBr}_3}$ bromobenzene + HBr

[b] Benzene + HNO₃ \longrightarrow nitrobenzene + H₂O [c] Benzene + 3O₃ \longrightarrow Triozonide

[d] Benzene + $3H_2 \xrightarrow{Ni}$ cyclohexane (A) a,c (B) b, d

(D) a, b

(D) a and b are the electrophilic substitution reactions and do not account for the C=C bond reaction. Sol.

(C) b, c, d

- Ethylbenzene + $Cl_2 \xrightarrow{\text{Light}} (main)$ compound is : **Ex. 8**
 - (A) o- & p- Chloroethylbenzene
 - (B) 1 Chloroethylbenzene
 - (C) 2–Chloroethylbenzene
 - (**D**) m–Chloroethylbenzene

Sol. (B)
$$\bigvee_{C_{2}H_{5}}$$
 $\stackrel{C_{1}}{\longrightarrow}$ $\stackrel{CH_{7}-CH_{3}}{\longrightarrow}$
Ex. 9 $\oint_{-CH_{3}} \frac{KMnO_{4}}{\Delta} \land A \frac{Soda Lime}{\Delta} B$
Compound B is :
(A) Toluene (B) Benzene (C) Cresol (D) Benzaldehyde
Sol. (B)



Ex. 10 Toluene may be prepared by : (A) Toluic acid (B) Cresol (C) Toluene sulphonic acid (D) All the above Sol. (D) Toluene may be prepared by all the above compounds described earlier. Ex. 11 Chlorination of toluene in the presence of light and heat followed by treatment with aqueous NaOH gives : (A) o-Cresol (B) p-Cresol (C) 2, 4-Dihydroxy toluene (D) Benzoic acid (**D**) $C_6H_5CH_3 \xrightarrow{Cl_2} C_6H_5CH_2Cl \xrightarrow{Cl_2} C_6H_5CH_2Cl_2 \xrightarrow{Cl_2} C_6H_5CCl_3$ NaOH NaOH NaOH NaOH $C_6H_5CH_2OH C_6H_5CHO C_6H_5CHO$ Sol. Ex. 12 Formation of which of the following compound confirms the unsaturation character of benzene : (A) Cyclohexane (B) Gammexane

- (C) Triozonide (D) All the above
- Sol. (D) Formation of all the three compounds are the result of addition reaction. Hence confirm the unsaturation nature of benzene.





3

14.	Which among the follo (A)–Cl	wing is deactivating group. (B)-OR	(C)-NH ₂	(D)-NHR									
15.	Which of the following (A) -NH ₂	is not o, p-directing group (B)-OH	(C) –X(halogens)	(D)-CHO									
16.	The reagent used for Fr (A) Dry ether	iedel-Craft's reaction is : (B) AlCl ₃	(C) Anhydrous AlCl ₃	(D) $P_{2}O_{5}$									
17.	Chlorobenzene is $0,p-d$	irecting in electrophilic sub	ic substitution reaction. The directing influence is explaned by (C) +M of Cl (D) +I of Ph										
18.	In the compound C_6H_5Z which of the following is predominatly ortho/para directing ? (A) $Z = -NO_2$, — Cl, — OH (B) $Z = -OMe$, — CN, — NH ₂ (C) $Z = -NHCOCH_3$, — Cl, — COOH (D) $Z = -NHCOCH_3$, — CH ₃ , — Br												
19.	The compound with molecular formula C_8H_{10} which with give two isomers on electrophilic substitution with Cl FeCl ₃ or with HNO_3/H_2SO_4 is (A) p-Dimethyl benzene (C) o-Dimethyl benzene (D) Ethyl benzene												
20.	Which one of the following will undergo meta substitution on monochlorination ?(A) Ethoxy ethane(B) Chlorobenzene(C) Ethyl benzoate(D) Phenol												
21.	Nitration of toluene takes place at (A) o-position (C) p-position(B) m-position (D) Both o-and p-positions												
22.	In which reaction, poly $(A) \bigcirc + CH_3COC$	substitution takes place : $COCH_3$ $COCH_3$ CH											
	(B) O+CH ₃ Cl-	\rightarrow											
	(C) \bigcirc + HNO ₃ $-$	$I_2SO_4 \rightarrow \bigcirc \bigcirc \bigcirc \bigcirc$											
	$(\mathbf{D}) \bigcirc + \mathrm{H}_2 \mathrm{SO}_4 -$	→ O											
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-CH₃



25. The given product can not be formed by which set of reactants in the presence of AlCl₃ catalyst ?



O ĆH³









- (A) It forms only one type of monosubstituted product
- (B) There are three carbon-carbon single bonds and three carbon-carbon double bonds
- (C) The heat of hydrogenation of benzene is less than the theoretical value
- (D) The bond angle between the carbon-carbon bonds is 120°



- 34. Most common reactions of benzene (aromatic hydrocarbon) and its derivatives are :
 (A) Electrophilic addition reactions
 (B) Electrophilic substitution reactions
 (C) nucleophilic addition reactions
 (D) Nucleophilic substitution reactions
- **35.** The major product of the given reaction is :



36. A particular form of Tribromobenzene (X) forms three mononitrotribromobenzene. The structure of the compound (X) is





37.

38.







43. Identify the product in following reaction ?



- 44. Anisole can be prepared by the action of methyl iodide on sodium phenate. The reaction is called
 - (A) Fittig reaction
 - (B) Etard reaction
 - (C) Wurtz reaction
 - **(D)** Williamson reaction
- **45.** The major product of the following reaction is

$$(A) \bigoplus_{\substack{C \to C \to C \to G}} CH_3 \longrightarrow_{\substack{C \to G \to G}} CH_3 \bigoplus_{\substack{C \to G \to$$

47. Which of the following not gives effervescence with NaHCO₃?
(A) Phenol
(B) Benzoic acid
(C) 2, 4-dinitrophenol
(D) 2, 4,6-trinitrophenol



46.





56. In a reaction of aliline a coloured product C was obtained



The structure of C would be





57. The product of the following reaction is :











AROMATIC HYDROCARBON





72. Identify the product in the following reaction ?



- 73. Replacement of chlorine from chlorobenzene to give phenol requires drastic conditions but chlorine of 2, 4-dinitrochlorobenzene is readily replaced because
 - (A) NO_2 makes the electron rich ring at ortho- and para-positions
 - **(B)** NO_2 withdraws electrons at meta position
 - (C) NO_2 donates electrons at meta position
 - (D) NO₂ withdraws electrons from ortho- and para-position
- 74. Which of the following compound gives fastest S_N^2 Ar reaction ?







- (C) Deactivates the ring towards nucleophilic substitution
- (D) Deactivates the ring towards electrophilic substitution
- 78. The reation of toluene with Cl_2 in presence of FeCl₃ gives 'X' and reaction in presence of light gives 'Y' Thus, 'X' and 'Y' are :
 - (A) X = Benzyl chloride, Y = m –chlorotoluene
 - (B) X = Benzal chloride, Y = o chlorotoluene
 - (C) X = m-chlorotoluene, Y = p –chlorotoluene
 - (D) X = o- and p-chlorotoluene, Y = Trichloromethyl benzene
- 79. An organic compound is treated with $AgNO_3$, a white ppt is obtained the compound may be

 $\overline{}$



80. Which steps is used to produce 1–Chloro–3–ethylbenzene









88.
$$(\bigcirc + CH_2 = CHCH_2CI \xrightarrow{AICI_3} (i) BH_3.THF} (ii) H_2O_2/OH^- \rightarrow P$$

The compound 'P' is :
(A) $(\bigcirc CH_2-CH=CH_2$
(B) $(\bigcirc CH_2-CH_2-CH_2-CH_2-OH$
(C) $(\bigcirc D)$
(D) $(\bigcirc D)$



89. Give the product of the following reactions :



90. Aniline when diazotized in cold and then treated with dimethyl aniline gives a coloured product. Its structure would be :

(A)
$$(CH_3)_2N$$
 $-N=N$
(B) $(CH_3)_2N$ $-N=N$
(C) CH_3NH $-N=N$ $NHCH_3$
(D) CH_3 $-N=N$ $-NH_2$

91. To get 2,4, 6 tribromobenzoic acid from aniline the correct sequence of reagents is :

(A)
$$\xrightarrow{Br_2}_{H_2O} \xrightarrow{H_3O^{\oplus}}_{H_2O}$$
 (i) $NaNO_2 / HCl,0^{\circ}C$
(ii) $CuCN$
(B) $\xrightarrow{H_3O^{\oplus}/H_2O}_{\Delta} \xrightarrow{Br_2}_{H_2O} \xrightarrow{(i) NaNO_2 / HCl,0^{\circ}C}_{(ii) CuCN}$
(C) $\xrightarrow{(i) NaNO_2 / HCl,0^{\circ}C}_{(ii) CuCN} \xrightarrow{H_3O^{\oplus}/H_2O}_{\Delta} \xrightarrow{Br_2}_{H_2O}$
(D) $\xrightarrow{Br_2}_{H_2O} \xrightarrow{(i) NaNO_2 / HCl,0^{\circ}C}_{(ii) CuCN} \xrightarrow{H_3O^{\oplus}/H_2O}_{\Delta}$

92.

Which of the following pair of compounds can be seperated by aq. NaHCO3?(A) Phenol & benzyl alcohol(B) Benzoic acid & Picric acid(C) p-Nitrophenol & p-Methoxyphenol(D) Resorcinol & o-Cresol

93. Observe the following reaction, and select the correct option



94.

Compare the properties of two isomeric products x and y formed in the following reaction.



Option	AcidStrength	H ₂ O Solubility	Volatility	Melting Point
(A)	y > x	y > x	x>y	y > x
(B)	x > y	x > y	y > x	x>y
(C)	y > x	x > y	y > x	y > x
(D)	x > y	y > x	x>y	y > x

- **95.** In the diazotisation of aniline with sodium nitrite and hydrochloric acid, an excess of hydrochloric acid is used primarily to :
 - (A) suppress the concentration of free aniline available for coupling
 - (B) suppress hydrolysis of phenol
 - (C) insure a stoichiometric amount of nitrous acid
 - (D) neutralize the base liberated
- 96.An organic compound with molecular formula C_7H_8O dissolves in NaOH and gives a characteristic colour with
FeCl₃. On treatment with bromine, it gives a tribromoderivative, $C_7H_5OBr_3$. The compound is :
(A) Benzyl alcohol(B) o-Cresol(C) m-Cresol(D) p-Cresol
- 97. Which of the following compounds will give instant turbidity with HCl + ZnCl₂ (A) Isopropyl alcohol (B) Ethyl alcohol (C) Benzyl alcohol (D) Neopentyl alcohol
 98. Aniline can be obtained by reduction of nitrobenzene with (A) Fe/HCl (B) Sn/HCl
 - (A) Fe / HCl
 (C) Electrolytic reduction under weakly acidic conditions
- 99. Which of the following is correct about the following compound
 (A) All the C-C bond length are same.
 (B) C₁-C₂ bond length is shorter than C₂-C₃ bond length.
 - (C) $C_1 C_2$ bond length is shorter than $C_2 C_3$ bond length. (C) $C_1 - C_2$ bond length is greater than $C_2 - C_3$ bond length.
 - (**D**) All the C-C bond length are equal to C-C bond length of benzene.



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(D) All.

(Naphthalene)





102. Aromatic diazonium group can be replaced by various groups/atoms. In this context, match list I with list II and select the correct answer using the codes given below the lists

L	ist I			List II											
(React	ion/ rea	nction ty	pe)			(Replacement)									
(a) H ₃ PO ₂							(1) Hydrogen								
(b) Sandmeyer reaction							(2) Hydroxyl group								
(c) Boiling with water							(3) Aryl group								
(d) Got	mberg r	reaction					(4) Chloride								
Codes	: a	b	с	d				а	b	с	d				
(A)	4	3	2	1			(B)	1	4	2	3				
(C)	1	2	3	4			(D)	2	3	4	1				

- 103. Aniline reacts with to yield as the final product
 - (A) Aqueous bromine, 2-bromoaniline
 - (B) Aqueous bromine, 2, 4, 6-tribromoaniline
 - (C) chloroform/KOH, phenyl cyanide
 - (D) acetyl chloride, benzanilide
- **104.** Acid hydrolysis of methyl isocyanide gives
 - (A) CH₃NH₂+CH₃COOH (C) CH₃NH₂+HCOOH

(B) CH₃NH₂+CH₃CH₂COOH
(D) HCOOH



101.

- **105.** Which of the following is correct :
 - (A) The rate of sulfonation regarding electrophilic substitution is $K_{C_6H_6} > K_{C_6D_6} > K_{C_6T_6}$

(B)
$$CH_3$$

 CH_3-Cl m-Xylene (major)

(C) Rate of the reaction of following with $AlCl_3/\Delta$ is



- (D) All are correct.
- 106. The reagents and the reaction conditions used in the formation of benzene diazonium chloride from aniline are :
 (A) NaNO₂, aq. HCl, 60°C
 (B) dil. HCl, 0–5°C
 (D) NaCl, aq. HCl, 20°C
 (D) NaNO₂, aq. HCl, 0–5°C
- 107. Hydrazobenzene on treatement with H₂SO₄ gives
 (A) Azobenzene
 (C) Azoxybenzene
 - (B) Benzidine(D) Azobenzene-4-sulphonic acid
- 108. A positive carbylamine test is not given by :
 (A) N, N-dimethylaniline
 (C) 2-Methyl-4-ethylaniline
- (B) 2, 4-Dimethylaniline(D) p-Methylbenzyl amine
- 109. $\bigcirc + R C Cl \xrightarrow{anhy. AlCl_3} \bigcirc C R + HCl$

The electrophile involved in this Friedal-craft reaction is resonance stablized, which of the following is true ?

- (A) The cannonical form having positive charge on carbon is main contributor.
- (B) The cannonilal form having positive charge on oxygen is main contributor
- (C) Both contributer equally
- (D) None of these
- 110.
 Toluene by Etard's reaction gives :

 (A) ortho-cresol
 (B) benzoic acid

 (C) benzyl alcohol
 (D) benzaldehyde

 111.
 The nitration of benzene is :

 (A) Electrophilic addition
 (B) Electrophilic substitution

 (C) Nucleophilic addition
 (D) Nucleophilic substitution
- 112.In which of the following compounds the C H bond dissociation energy is lowest ?(A) Toluene(B) Benzene(C) n-pentane(D) 2, 2-dimethyl propane







AROMATIC HYDROCARBON





- Halogenation of benzene in presence of AlCl₃ (anhy.) is :
 (A) nucleophilic substitution
 (B) nucleophilic addition
 (C) electrophilic substitution
 (D) free radical substitution
- 15. Which of the following structures correspond to the product expected, when excess of C_6H_6 reacts with CH_2Cl_2 in presence of anhydrous AlCl₃?





- **16.** Select the incorrect statement among the following :
 - (A) benzene undergoes predominantly electrophilic substition reactions
 - (B) toluene is more easily sulphonated than benzene
 - (C) benzene reacts with CCl_4 in the presence of anhydrous AlCl₃ to give triphenyl methyl chloride
 - (D) benzene reacts with chlorine (Cl_2) in presence of light to give benzyl chloride
- 17. Identify the correct order of reactivity in electrophilic substitution reactions of the following compounds:



18.

. The structure of Wheland intermediate obtained after the attack of Br⁺ on anilinium ion is :



19. Conjugation of electron withdrawing groups, e.g., —CHO, —C—R, —C=N, —NO₂ activates nucleophilic attack in halobenzene. The order of reactivity of these groups is :

$$(A) -NO_{2} > -C \equiv N > -C - H > -C - R > -C - OR$$

$$(A) -NO_{2} > -C \equiv N > -C - H > -C - R > -C - OR$$

$$(B) -C - H > -C - R > -C - OR > -C \equiv N > -NO_{2}$$

$$(C) -C \equiv N > -NO_{2} > -C - H > -C - R > -C - OR$$

$$(C) -C \equiv N > -NO_{2} > -C - H > -C - R > -C - OR$$

$$(D) -C - H > -NO_{2} > -C \equiv N > -C - OR > -C - R$$



	Part # II	>>	[Assertion & Reason Type Questions]
	Each questic (A) Statemer (B) Statemer (C) Statemer (D) Statemer (E) Both Sta	on has 5 choices nt-1 is true, State nt-1 is true, State nt-1 is true, Stat nt-1 is false, Sta tements are fals	s (A), (B), (C), (D) and (E) out of which only one is correct. ment-2 is true and Statement-2 is correct explanation for Statement-1 ment-2 is true and Statement-2 is not correct explanation for Statement-1 ement-2 is false tement-2 is true se
1.	Statement-1 Statement-2	Benzene dia N ₂ gas lost d	zonium chloride does not give tests for nitrogen by lassigne method. luring heating.
2.	Statement-1 Statement-2	Benzene for The attackin	ms benzene sulphonic acid with fuming H_2SO_4 at high temperature. In species is SO_3 .
3.	Statement-1 Statement-2	: Benzene read : Benzene sho	cts with CH_3COCI to give chlorobenzene. wws an electrophilic substitution reaction with CH_3COCI .
4.	Statement-1 Statement-2	: Nitrobenzen : Nitrobenzen	e does not undergo Friedel Craft alkylation. e is used as solvent in laboratory and industry.
5.	Statement-1 Statement-2	p-Anisidine i -OCH ₃ group	is weaker base than aniline. o in anisidine exerts -R effect.
6.	Statement-1 Statement-2	: 4-nitropheno : Phenols is a v	l is more acidic than 2, 4, 6 trinitrophenol. weaker acid than carbonic acid.
7.	Statement-1 Statement-2	: [10] Annules Steric intera	ne is not aromatic though it contains Huckel number of π -electrons. ction between internal hydrogens makes it non-planar.
8.	Statement-1 Statement-2	Nitration ofThe methyl s	toluene is easier than benzene. group in toluene is electron-releasing.
9.	Statement-1 Statement-2	: Nitrating mix	xture used for carrying out nitration of benzene consists of conc. $HNO_3 + conc.H_2SO_4$. of H_2SO_4 , HNO_3 acts as base and produces NO_2^+ ions.
10.	Statement-1 Statement-2	: Reimer-Tien product. : Benzene sho	nann reaction of phenol with CCI_4 in NaOH at 340 K gives salicylic acid as the major ws electrophilic substitution reaction.
11.	Statement-1 Statement-2	 Alcohols are Alcohols un oxygen. 	e easily protonated than phenols. dergo intermolecular hydrogen bonding due to the presence of highly electronegative
12.	Statement-I	: Tropylium ca	ation is aromatic in anture.
	Statement-I	I : The only pr	roperty that determines its aromatic behavior is its planar structure.
13.	Statement-I	: In nitration l	H_2SO_4 is used as sulphonating agent.

Statement-III : Benzene has multicentre π -bonding.



- Statement-I : C₂H₅ is a meta-directing group.
 Statement-II : The groups which direct the incoming group to meta position are called meta-directing groups.
- Statement-I: Most o-, p -directing substitution are deactivating.
 Statement-II: o-, p-directors have at least one lone pair of non-bonding electrons.
- Statement-I: Nitrobenzene does not undergo Friedel-Craft's reaction.
 Statement-II: Nitrogroup is a deactivating group.
- Statement-I: The rate of nitration of benzene is less than hexa deutero benzene.
 Statement-II: Deuterium is an isotope of hydrogen.
- 18. Statement-I : Benzene on heating with conc. H_2SO_4 gives benzene sulphonic acid which when heated with superheated steam under pressure gives benzene.

Statement-II : Sulphonation is a reversible process.

Statement-I: Chlorination of ethyl benzene with Cl₂ in prescence of heat and light nearly yield 1-chloro-1-phenyl ethane as major product.

Statement-II: The reaction occurs through intermediate formation of the radical $C_6H_5CH - CH_3$.

20. Statement-I: Benzene reacts with n-propyl chloride in presence of $AlCl_3/\Delta$ to give isopropyl benzene. Statement-II: Benzene undergoes electrophilic substitution readily.







4. Match the column I with column II.

NO.

Column-I (Compounds)



NO

5. Match the column I with column II.

Column-I

- (A) Cyclic conjugated polyenes with presence of anhydrous AlCl₃
- (B) Dichlorobenzene
- (C) Friedel crafts reaction
- (D) Meta directing group
- Part # I

[Comprehension Type Questions]

Comprehension #1





Column-II

(orientation of attacking electrophile)

(p) Meta position with respect to $-NO_2$

(q) ortho with respect to methyl group

(r) only one mono substituted product

(s) meta with respect to $-CH_3$

Column-II

(p) Arenes and alkyl halides in $(4n + 2) \pi$ -electrons

- (q) Aromatic compounds
- (r) Delocalization of π -electrons
- (s) Deactivates the ring towards electrophilic substition

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1. Which of the following compound is 'P'?

2.

3.



Comprehension #2

In aromatic compounds the electrophilic substitution take place at the position where most stable σ -complex is formed.

Nitration of Napthalene occurs almost exclusively in the 1 or α – position





So on the basis of stability of σ -Complex, we can find out the position of incoming electrophile.







The $-NO_2$ group in an aromatic ring deactivates the ortho and para positions for an electrophilic attack. When $-NO_2$ group is present at ortho or para positions of a leaving group (**Nucleofuge**) it activates the ring for nucleophilic attack. The reduction of $-NO_2$ group by metal in acid causes its reduction to $-NH_2$ group and then the ring becomes strongly activated for a electrophilic attack. The strong activation of $-NH_2$ group is moderated by its acylation with CH₃COCl to - NHAc group. Deacylation is carried out by hydrolysis with H_3O^+ or OH⁻. The ring alkylation by using RX/AlX₃ is not possible in presence of $-NO_2$ or $-NH_2$ group but is possible in presence of -NHAc group.

1. The product (G) is :







Comprehension #4

It is not always easy to predict the position of attack on multiply substituted benzene. If the benzene ring bears different ortho/para directing group at the 1 and 4 positions, the position of further substitution is not immediately clear. Sometimes steric effects determine the outcome. In other cases, electronic factors determine the outcome, and further reaction will be at the position activated by the more strongly activating group.

Some substituens are so strongly activating that no catalyst is needed, and it is often difficult to stop substitution after mono substitution. Mild conditions are needed to restrict the reaction to mono-substitution.

It is possible to reduce the activity such groups (by side chain reaction) so that the reaction can be stopped after mono substitution then and again by a side chain reaction the original group is restored. Effective use can sometimes be made of removable blocking groups on the ring.

1. Which of the following synthesis could be done in the ring step ?





2. Which of the following is the correct major product ?







Which of the following side chain reaction/s can be used to reduce the activity of strongly activating groups like —OH ?
 (A) benzoylation
 (B) acetylation
 (C) both of the above
 (D) none of the above

Comprehension #5

The typical reaction of benzene and other aromatic compounds are electrophilic substitution. Presence of electron donating group activates the ring towards electrophilic substitution, while presence of electron withdrawing group deactivates the ring towards electrophilic substitution but at the same time activates the ring towards nucleophilic substitution. Some groups are predominantly meta-directing and all of these are deactivating. Except halogen, most of the o-and p-directing groups are activating groups.

1.
$$\underbrace{C_{2}H_{3}Cl,AlCl_{3}}_{\Delta} \rightarrow (A) \text{ major.}$$

A is trisubstituted benzene. The structure of A is :







(D) all of them

(C)

Br

CH-CH₃

Br

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Comprehension #6

A third group is least likely to enter between two groups in the meta relationship. This is the result of steric hindrance and increases in importance with the size of the groups on the ring and with the size of the attacking species. When a Meat-directing group is meta to an ortho-para directing group, the incoming group primarily goes ortho th the meta directing group rather than para.

1. Chlorination of m-chloro nitro benzene gives :



3



3. Write the nitration product in the following compound ?



4. Ph–Li reacts readily with (I) but does not add to (II) why?



5. An aromatic electrophilic substitution reaction with NaNO₂ / HCl will be observed in how many compound out of following :



6. Give the products in following reactions :



8.

9.

OH

7.

 \rightarrow product is a dye used in acid base titration sketch it and give mechanism.

The products of following sequence of reactions are :

 H^+

 \cap

0

NO

$$\underbrace{\operatorname{Br}_{2}^{2}}_{(1)} \xrightarrow{\operatorname{Br}_{2}^{2}/\operatorname{Fe}} \operatorname{F} \xrightarrow{\operatorname{Sn}^{2}/\operatorname{HCl}} \operatorname{G} \xrightarrow{\operatorname{NaNO}_{2}^{2}/\operatorname{HCl}} \operatorname{H} \xrightarrow{\operatorname{H}_{2}O^{2}/\Delta} \operatorname{H} \xrightarrow{(4)} \operatorname{I}$$

CH₃

- **10.** Write the structure of schiff base of aniline when react with benzaldehyde.
- **11.** Predict the mononitration products of the following compounds.

$$(a) \bigcirc NO_{2} (b) \bigcirc CI (c) \bigcirc Br (d) \bigcirc CH (e) \bigcirc$$

12. o-HOOC $-C_6H_4 - CH_2 - C_6H_5 \xrightarrow{\text{SOCl}_2} (X) \xrightarrow{\text{anhydrous}} (Y) \xrightarrow{Zn - Hg} (Z) \text{ Identify 'Z'} :$

13.
$$AICl_3 / AI_2O_3 / A \rightarrow Y \xrightarrow{HOCl / H^{\oplus}} Z \xrightarrow{NaOH} W.$$
 Product 'W' is

- 14. Benzene and [10]– annulene both have $(4n + 2) \pi$ -electron in ring and all bonds are conjugated even then only benzene is aromatic explain.
- **15.** Explain why the following systems are not aromatic ?

(ii)

CH2

16. Nitration of the following compound
$$CH_3 \longrightarrow N \bigoplus O$$
 gives :

17. $(C_{8}H_{7}CI) \xrightarrow{Br_{2}/CCI_{4}} Y$ (white solid) X Oxidation m-Chlorobenzoic acid Oxidation KMnO_{4}/OH
(C_{8}H_{5}CI) Z H_{3}O^{+}Hg^{+2} (C_{8}H_{7}CIO) W

Identify X, Y, Z and W and write the reactions :

18.

$$(C_{10}H_8) + H_2 \xleftarrow{Pt, heat}{(T)} (C_{10}H_{10}) \xleftarrow{H_2SO_4/}{(S)} (C_{10}H_{12}O) \xleftarrow{H_2/Pt}{(C_{10}H_{10}O_3} (C_{10}H_{12}O) \xleftarrow{H_2/Pt}{(C_{10}H_{10}O_3)} (C_{10}H_{10}O_3) (C_{10}$$

Write the structures of unknowns :



19. Give the products in following reactions :

(a)
$$(a) \xrightarrow{CI} (1 \text{ NaOH}) (1 \text{ mol.}) \land$$



20. Compound (A) (C_7H_7Cl) reacts with aqueous KOH solution at room temperature and gives compound (D) (C_7H_8O) . Another isomer (B) gives only one mononitration product on treatment with HNO₃ + H₂SO₄ mixture. Isomer (C) gives compound (E) $(C_7H_5O_2Cl)$ on heating with KMnO₄ solution. (E) gives 3-chloro-4-nitrobenzoic acid as the major product on nitration. Identify the compound A to E.

(b)

21. 2, 4-Dinitrochlorobenzene is converted into picric acid using two paths. Which path, do you think, gives better result ?



22. How many compounds will decolorises Br_2/H_2O .



- 23. Two isomeric compounds, X and Y are isolated from oil of bay leaf, both are found to have the formula $C_{10}H_{12}O$. Both are insoluble in water, dilute acid and dilute base. Both give positive test with dilute KMnO₄ and Br₂/CCl₄. Upon vigrous oxidation, both yield anisic acid, p-CH₃OC₆H₄COOH. Catalytic hydrogenation of X and Y converts into the same compound Z(C₁₀H₁₄O). What are the possible structure of **X**, **Y** and **Z**.
- 24. Give the products of the following reaction.



25. (1) Cl₂/Fe HNO₃+H₂SO₄ HNO₃+H₂SO₄ NaOH/
$$\Delta$$
 HNO₃/H₂SO₄

Identify the product.

- 26. An organic aromatic compound (A) on treatment with $CHCl_3$ and KOH gives (B) and (C), both of which, in turn, give the same compound (D) when distilled with zinc dust. Oxidation of (D) yields (E) of the formula $C_7H_6O_2$. The sodium salt of *(E)* on heating with soda lime gives *(F)* which can also be obtained by distilling (A) with zinc dust. Identify compound (A) to (F).
- 27. An aromatic compound 'X' having molecular formula C_7H_8O . It has 4 isomers (excluding X). 'X' doesn't give H_2 gas with Na metal.

(a) 'Y' doesn't give neutral FeCl₃ test but liberate H₂ gas with Na-metal.

(b) 'Z' gives neutral FeCl₃ test & on further mono-bromination on benzene ring it can form two products. Identify X, Y & Z

28. Observe following reaction and determine Ture / False for following statements 1, 2 & 3.



(i) If aromatic ring I have $-NO_2$ group then rate of reaction will increase (ii) If aromatic ring II have $-NO_2$ group then rate of reaction will increase (iii) In this reaction wheland intermeidate will form

29.
$$(\bigcup_{i=1}^{N_{2}^{*}} Ci^{i} + Cu_{2}Cl_{2} - Conc. HCl \rightarrow Chlorobenzene} + N_{2} + N_{2} + Chlorobenzene + Chlorobenzene + Chlo$$







6. Phenol, when it first reacts with concentrated sulphuric acid and then with concentrated nitric acid, gives :

[AIEEE-2008]

[AIEEE-2010]

(A) o-nitrophenol (B) p-nitrophenol

(C) nitrobenzene

(D) 2,4,6-rinitrobenzene

- 7. Toluene is nitrated and the resulting product is reduced with tin and hydrochloric acid. The product so obtained is diazotised and then heated with cuprous bromide. The reaction mixture so formed contains : [AIEEE-2008]
 (A) mixture of o- and p-dibromobenzenes
 (B) mixture of o- and p-bromoanilines
 (C) mixture of o- and m-bromotoluenes
 (D) mixture of o- and p-bromotoluenes
- 8.

In the chemical reactions the compounds 'A' and 'B' respectively are :

 NH_2 $\xrightarrow{\text{NaNO}_2} \mathbf{A} \xrightarrow{\text{HBF}_4} \mathbf{B}$



AROMATIC HYDROCARBON





AROMATIC HYDROCARBON



+91-9350679141

8.

11.

-



9. Amongst the compounds given, the one that would form a brilliant colored dye on treatment with NaNO₂ in dilute HCl followed by addition to an alkaline solution of β -naphthol is : [JEE-2011]



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

[JEE (Advance)-2013]





^{13.} In the following reaction sequences V and W are respectively :

[JEE (Advance)-2013]







14. Among the following the number of reaction(s) that produce(s) benzaldehyde is

[JEE (Advance)-2015]



15. The major product U in the following reactions is

0°C



 $\frac{\text{NH}_2}{\text{NaNO}_2, \text{HCl}} \mathbf{V} \xrightarrow{\text{OH}} \mathbf{W}$



AROMATIC HYDROCARBON

[JEE (Advance)-2015]







17. In the following reactions, the product S is





18. Compound X is





OH

(D)

(D) СОН

19. The major compound Y is



CH3

[JEE (Advance)-2016]

CH₃

CH,

20. The correct statement(s) about the following reastion sequence is(are)

Cumene
$$(C_9H_{12}) \xrightarrow{i) O_2} \mathbf{P} \xrightarrow{CHCl_3/NaOH} \mathbf{Q} \text{ (major)} + \mathbf{R} \text{ (minor)}$$

$$Q \xrightarrow{\text{NaOH}}{PhCH_Br} S$$

(A) R is steam volatile

- (B) Q gives dark violet coloration with 1% aquesou FeCl₂ solution
- (C) S gives yellow precipitate with 2, 4-dinitrophenylhydrazine
- (D) S gives dark violet coloration with 1% aqueou FeCl, solution
- 21. The product(s) of the following reaction sequence is(are)





22.

Among the following, reaction(s) which gives(give) tert-butyl benzene as the major product is(are)

[JEE (Advance)-2016]





[JEE (Advance)-2016]

PARAGRAPH (23-24)

Treatment of compound O with $KMnO_4/H^+$ gave P, which on beating with ammonia gave Q. The compound Q on treatment with $Br_2/NaOH$ produced R. On strong heating, Q gave S, which on further treatment with ethyl 2-bromopropanoate in the presence of KOH followed by acidification, gave a compound T.



Columns 1, 2 and 3 contain starting materials, reaction conditions, and type of reactions, respectively.

Column I	Column 2	Column 3	[JEE (Advance)-2017]
(I) Toluene	(i) NaOH/Br ₂	(P) Condensa	tion
(II) Acetophenone	(ii) Br ₂ /hv	(Q) Carboxyla	tion
(III) Benzaldehyde	(iii) (CH ₃ CO) ₂ O/CH ₃ COO	K (R) Substituti	on
(IV) Phenol	(iv) NaOH/CO ₂	(S) Haloform	
The only CORRECT	Combination in which the reaction proce	eeds through radical mech	anism is
(A) (IV) (i) (Q)	(B) (III) (ii) (P) (C) (II))(iii)(R) (D)(I) (ii) (R)
For the synthesis of	benzene acid, the only CORRECT comb	vination is	
(A) (II) (i) (S)	(B) (I) (iv) (Q) (C) (IV	/)(ii)(P) (D)(III) (iv) (R)
The only CORRECT	Combination that gives two different car	boxylic acid is	

27.The only CORRECT combination that gives two different carboxylic acid is(A) (IV) (iii) (Q)(B) (II) (iv) (R)(C) (I) (i) (S)(D) (III) (iii) (P)



25.

26.

28. The reaction (s) leading to the formation of 1,3,5-trimethlbenzene is (are)

[JEE (Advance)-2018]



PARAGRAPH (29-30)

Treatment of benzene with CO/HCl in the presence of anhydrous AlCl₃ /CuCl followed by reaction with Ac₂O/NaOAc gives compound X as the major product. Compound X upon reaction with Br_2/Na_2CO_3 , followed by heating at 473 K with moist KOH furnishes Y as the major product . Reaction of X with H_2/Pd -C, followed by H_3PO_4 treatment gives Z as the major product. [JEE (Advance)-2018]

29. The compound Y is







+91-9350679141



3

15. Which of the following groups are meta-directing :

(A)—NH₂ (B)—OH

 $(C) - NO_2$

(D)—CN

SECTION - III : ASSERTION AND REASON TYPE

These questions contains, Statement-I (assertion) and Statement-II (reason).

- (A) Statement-I is True, Statement-II is True ; Statement-II is a correct explanation for Statement-I
- (B) Statement-I is True, Statement-II is True ; Statement-II is NOT a correct explanation for Statement-I
- (C) Statement-I is True, Statement-II is False.
- (D) Statement-I is False, Statement-II is True.
- Statement-I : C₂H₅ is a meta-directing group.
 Statement-II : The groups which direct the incoming group to meta position are called meta-directing groups.
- 17. **Statement-I**: Tropylium cation is aromatic in anture.



Statement-II : The only property that determines its aromatic behavior is its planar structure.

Statement-I : Benzene on heating with conc. H₂SO₄ gives benzene sulphonic acid which when heated with superheated steam under pressure gives benzene.
 Statement-II : Sulphonation is a reversible process.

SECTION - IV : COMPREHENSION TYPE

Read the following comprehensions carefully and answer the questions.

Comprehension #1

The typical reaction of benzene and other aromatic compounds are electrophilic substitution. Presence of electron donating group activates the ring towards electrophilic substitution, while presence of electron withdrawing group deactivates the ring towards electrophilic substitution but at the same time activates the ring towards nucleophilic substitution. Some groups are predominantly meta-directing and all of these are deactivating. Except halogen, most of the o-and p-directing groups are activating groups.

19.
$$\underbrace{C_{2}H_{5}Cl,AlCl_{3}}_{\Delta} \rightarrow (A) \text{ major.}$$

A is trisubstituted benzene. The structure of A is :



(B) C_2H_5 H_5C_2 (B) C_2H_5 C_2H_5 (CH₂CH₂CH₂CH₂CH₃ (D) C_2





$$(i) \underline{\text{NBS,CCl}_4, hv} \\ (ii) \underline{\text{Br}_2 / \text{FeBr}_3} (X)$$

X represents mixture of organic compounds. The mixture does not contain.





 $\left[\right]$



SECTION - V : MATRIX - MATCH TYPE

SECTION - VI : SUBJECTIVE TYPE

23. Write the structure of the products formed in the following S_E reactions :



24. Indicate the position of the electrophile in the following compounds :



25. Indicate the compound which can be nitrated most easily :





ANSWER KEY

EXERCISE - 1

1. C 2. C 3. B 4. C 5. A 6. A 7. D 8. B 9. A 10. A 11. B 12. A 13. A 14. A 15. D 16. C 17. C 18. D **19.** C **20.** C **21.** D **22.** B 23. A, C24. B 25. C 26. A 27. C 28. A 29. D **30.** A **31.** B 32. A 33. B 34. B 35. D 36. B 37. A 38. D 39. B 48. A 49. A 50. B 51. A 40. A 41. B 42. C 43. D 44. D 45. C 46. D 47. A 52. B 56. B 57. D 58. D 59. D 60. C 53. D 54. C 55. A 61. C 62. A 63. B 64. D 65. B 66. A 67. D 68. B 69. A 70. C 71. D 72. A 74. B 75. B 76. A 77. D 78. D 73. D 79. C 80. A 81. B 82. A 83. B 84. C 85. C 86. C 87. B 88. C 89. A 90. A 91. D 92. C 93. D 94. D 95. A 96. C 97. C 98. D 99. B 100. D 101. A 102. B 103. B 104. C 105. D 106. D 107. B 108. A 109. A 110. D 111. B 112. A

EXERCISE - 2 : PART # I

1. A,B,C,D 3. A,C,D 5. B,C 6. A,C,D 7. A,B,D 9. A, D 2. B,C,D **4.** B,C 8. C,D **10.** A,B,C 12. A,B,D 13. A,B,D 14. C 15. D 16. C,D 17. C 18. B 11. A 19. A

PART # II

1. A 2. A 3. D 4. B 5. C 6. D 7. A 8. A 9. A 10. B 11. B 12. C 13. D 14. D 15. D 16. A 17. D 18. A 19. A 20. B

EXERCISE - 3 : PART # I

1. $A \rightarrow (p,q,r), B \rightarrow (p,q,r,s), C \rightarrow (p,q,r,s), D \rightarrow (p,r,t)$

- 2. $A \rightarrow (q,r), B \rightarrow (q,s), C \rightarrow (p,r), D \rightarrow (q,s)$
- 3. $A \rightarrow (r), B \rightarrow (s), C \rightarrow (p), D \rightarrow (q)$
- 4. $A \rightarrow (q,r), B \rightarrow (p,r), C \rightarrow (q,p), D \rightarrow (p)$
- 5. $A \rightarrow (q,r), B \rightarrow (q,r,s), C \rightarrow (p), D \rightarrow (s)$

PART # II

Comprehension #1:	1.	С	2.	В	3.	А		
Comprehension # 2 :	1.	С	2.	А	3.	В	4.	В
Comprehension #3:	1.	В	2.	В	3.	С		
Comprehension #4:	1.	С	2.	D	3.	С		
Comprehension # 5 :	1.	А	2.	В	3.	А		
Comprehension # 6 :	1.	А	2.	D	3.	В	4.	С

EXERCISE - 5 : PART # I

1. C 2. A 3. D 4. C 5. A 6. A 7. D 8. C 9. D 10. A 11. B 12. B 13. D 14. A 15. B

PART # II

1. 7-bromo-1, 3, 5-cycloheptatriene on ionisation gives tropylium ion **||** which is aromatic & highly stable, but

ionisation of 5-bromo-1, 3-cyclopentadiene gives 1, 3-cyclopentadienyl cation () which is anti aromatic & unstable. (non existent)

CЦ

- **2.** A
- 3. A
- 4. (A) Due to presence of $p-NO_2$ group, (- I, -m group) the S_N^2 Ar reaction is accelerated (due to stabilization of intermediate carbanion). In the second case NO₂ can not exert its m effect to stabilize the carbanion.

5.	(A) H_2SO_4 (conc.),		(B) Br ₂ ,		$(C) NO_2^{\oplus}$,				(D) $O_2N \rightarrow O_2N$ NO2) ₂ (T.N.T. = Trinitrotoluene)					
6. B18. C29. C	7. A 19. D 30. A	8. A 9. 20. B, C	C 10 21.B	A,B,C,D 22. B, C, D	11. 23.	B,D A		12. 24.	B B	13. 25.	A D	14. 26.	4 A	15. 27.	B D	16. 28.	A A,	17. B, D	А

MOCK TEST

1. C **2.** B **3.** C **4.** D **5.** B **6.** D **7.** B **8.** B **9.** A **10.** A **11.** C **12.** B,C **13.**A,C,D **14.** A,B,D **15.** C,D **16.** D **17.** C **18.** A **19.** A **20.** B **21.** A **22.** $A \rightarrow (q,r), B \rightarrow (p,r), C \rightarrow (q,p), D \rightarrow (p)$

