Chapter
13

Hydrocarbons and their Halogen Derivatives

Syllabus

Hydrocarbons : Classification, isomerism, IUPAC nomenclature, general methods of preparation, properties and reactions.

Alkanes : Conformations : Sawhorse and Newman projections (of ethane); Mechanism of halogenation of alkanes.

Alkenes : Geometrical isomerism; Mechanism of electrophilic addition; addition of hydrogen, halogens, water, hydrogen halides (Markovnikov's and peroxide effect); Ozonolysis and polymerization.

Alkynes : Acidic character; Addition of hydrogen, halogen water and hydrogen halides; Polymerization.

Aromatic hydrocarbons : Nomenclature benzene-structure and aromaticity, Mechanism of electrophilic substitution; halogenation, nitration, Friedel-Craft's alkylation and acylation, directive influence of functional group in mono-substituted benzene.

Organic Compounds Containing Halogens : General methods of preparation, properties and reaction; Nature of C-X bond; Mechanism of substitution reactions.

Uses: Environmental effects of chloroform, iodoform freons and DDT.

LIST OF TOPICS :

Topic-1
Alkanes, Alkenes and Alkynes

JEE (Main) Previous Year Questions

Multiple Choice Questions

1. A compound 'X' when treated with phthalic anhydride in presence of concentrated H_2SO_4 yields 'Y'. 'Y' is used as an acid/ base indicator. 'X' and 'Y' are respectively.

(1) Anisole, methyl orange
(2) Toluidine, Phenolphthalein
(3) Carbolic acid, Phenolphthalein
(4) Salicylaldehyde, Phenolphthalein

[JEE (Main) – 8th April 2023 - Shift-2]

2. The pair from the following pairs having both compounds with net non-zero dipole moment is:

(1) cis-butene, trans-butene
(2) Benzene, anisidine
(3) CH_2Cl_2, $CHCl_3$
(4) 1,4-Dichlorohenzene, 1,3-Dichlorobenzene

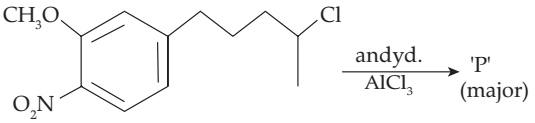
[JEE (Main) – 10th April 2023 - Shift-1]

3. The reaction used for preparation of soap from fat is :

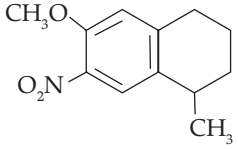
(1) an addition reaction
(2) an oxidation reaction
(3) alkaline hydrolysis reaction
(4) reduction reaction

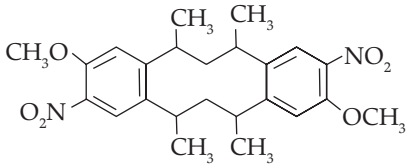
[JEE (Main) – 10th April 2023 - Shift-2]

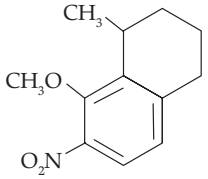
4. The major product 'P' formed in the given reaction is:

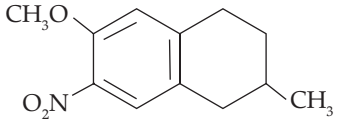


(1)



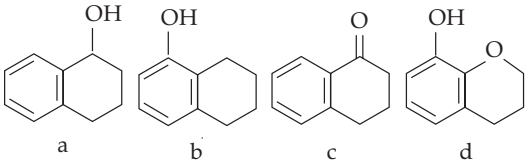
(2) 

(3) 

(4) 

[JEE (Main) – 10th April 2023 - Shift-2]

5. Arrange the following compounds in increasing order of rate of aromatic electrophilic substitution reaction.



(1) c, a, b, d **(2)** d, b, c, a

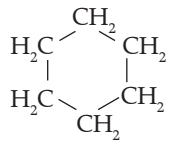
(3) d, b, a, c **(4)** b, c, a, d

[JEE (Main) – 11th April 2023 - Shift-1]

6. In the following reaction 'X' is:

$$CH_3(CH_2)CH_3 \xrightarrow[HCl,\ \Delta]{Anhy.AlCl_3} \underset{\text{major product}}{'X'}$$

(1) $CH_3(CH_2)_4CH_2Cl$

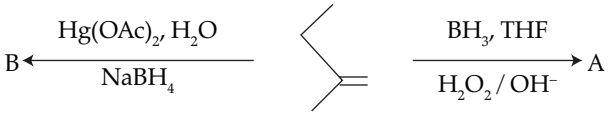
(2) 

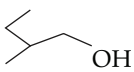
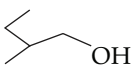
(3) $Cl–CH_2–(CH_2)_4–CH_2–Cl$

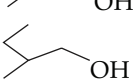
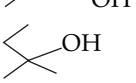
(4) $CH_3CH(CH_3)–(CH_2)_2CH_3$

[JEE (Main) – 13th April 2023 - Shift-1]

7. Find out the major products from the following reaction:



(1) A =  , B = 

(2) A =  , B = 

(3) A = , B =

(4) A = , B =

[JEE (Main) – 24th Jan 2023 - Shift-2]

8. Given below are two statements, one is labelled as Assertion (A) and the other is labelled as Reason (R).

Assertion (A): Benzene is more stable than hypothetical cyclohexatriene

Reason (R): The delocalized π electron cloud is attracted more strongly by nuclei of carbon atoms.

In the light of the above statements, choose Correct answer from the options given below:

(1) Both (A) and (R) are correct and (R) is the correct explanation of (A).

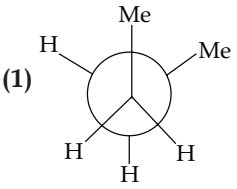
(2) Both (A) and (R) are correct but (R) is NOT the correct explanation of (A).

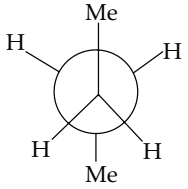
(3) (A) is false but (R) is true.

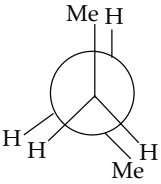
(4) (A) is true but (R) is false.

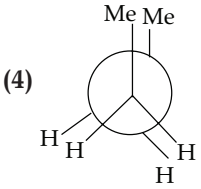
[JEE (Main) – 24th Jan 2023 - Shift-2]

9. Which of the following conformations will be the most stable ?

(1) 

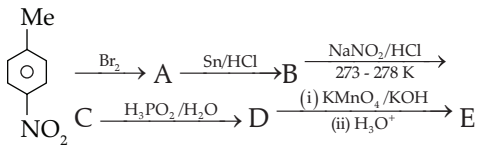
(2) 

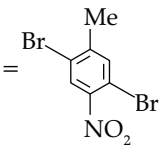
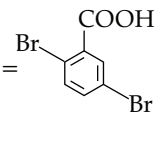
(3) 

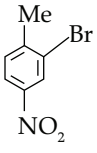
(4) 

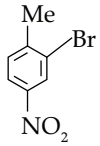
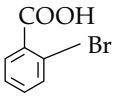
[JEE (Main) – 25th Jan 2023 - Shift-1

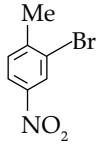
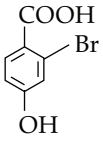
10. Identify the product formed (and *E*).



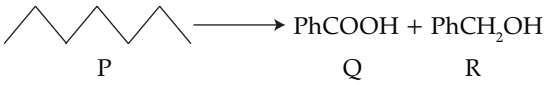
(1) A =  , E = 

(2)  , E = 

(3)  , E = 

(4)  , E = 

[JEE (Main) – 25th Jan 2023 - Shift-1

11. 

The correct sequence of reagents for the preparation of *Q* and *R* is :

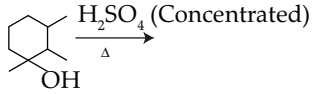
(1) (i) CrO_2Cl_2, H_3O^+; (ii) Cr_2O_3, 770 K, 20 atm; (iii) NaOH; (iv) H_3O^+

(2) (i) $KMnO_4, OH^-$; (ii) Mo_2O_3, Δ; (iii) NaOH; (iv) H_3O^+

(3) (i) Cr_2O_3, 770 K, 20 atm; (ii) CrO_2Cl_2, H_3O^+; (iii) NaOH; (iv) H_3O^+

(4) (i) Mo_2O_3, Δ; (ii) CrO_2Cl_2, H_3O^+; (iii) NaOH; (iv) H_3O^+ **[JEE (Main) – 25th Jan 2023 - Shift-1**

12. Find out the major product from the following reaction.



(1)  **(2)**  **(3)**  **(4)** 

[JEE (Main) – 25th Jan 2023 - Shift-2]

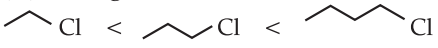
13. The isomeric deuterated bromide with molecular formula C_4H_8DBr having two chiral carbon atoms is:

(1) 2 - Bromo - 2 – deuterobutane
(2) 2 - Bromo-1-deuterobutane
(3) 2 - Bromo - 1 - deutero - 2 – methylpropane
(4) 2 - Bromo −3 – deuterobutane

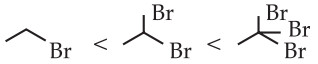
[JEE (Main) – 25th Jan 2023 - Shift-2]

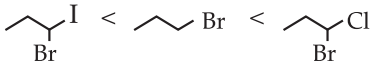
14. Identify the correct order for the given property for following compounds.

(A) Boiling Point:

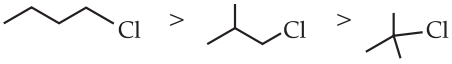


(B) Density: 

(C) Boiling Point: 

(D) Density: 

(E) Boiling Point:



Choose Correct answer from the option given below:

(1) (B), (C) and (D) only
(2) (A), (C) and (D) only
(3) (A), (B) and (E) only
(4) (A), (C) and (E) only

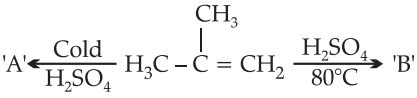
[JEE (Main) – 29th Jan 2023 - Shift-1]

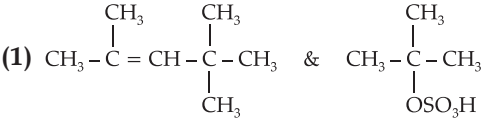
15. The one giving maximum number of isomeric alkenes on dehydrohalogenation reaction is (excluding rearrangement).

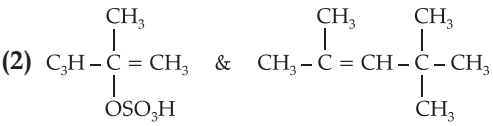
(1) 2–Bromopropane
(2) 2–Bromo–3, 3–dimethylpentane
(3) 1–Bromo–2–methylbutane
(4) 2–Bromopentane

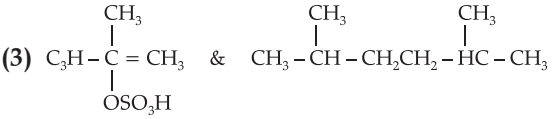
[JEE (Main) – 29th Jan 2023 - Shift-2]

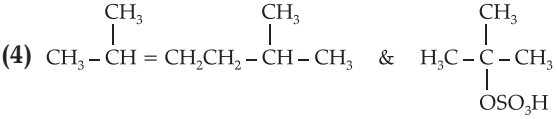
16. The major products ' A' and ' B ', respectively, are:



(1) 

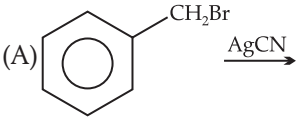
(2) 

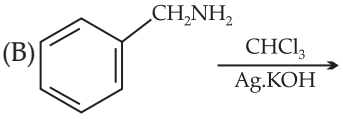
(3) 

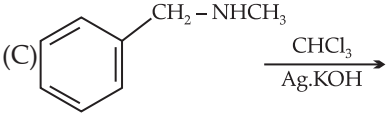
(4) 

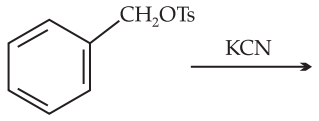
[JEE (Main) – 30th Jan 2023 - Shift-1]

17. Benzyl isocyanide can be obtained by:

(A) 

(B) 

(C) 

(D) 

Choose Correct answer from the options given below:

(1) A and D **(2)** Only B
(3) B and C **(4)** A and B

[JEE (Main) – 30th Jan 2023 - Shift-1]

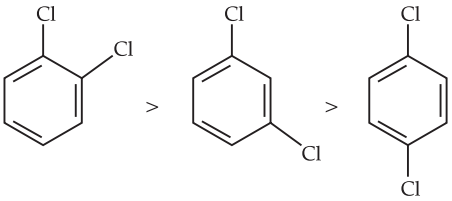
18. Choose the correct set of reagents for the following conversion.

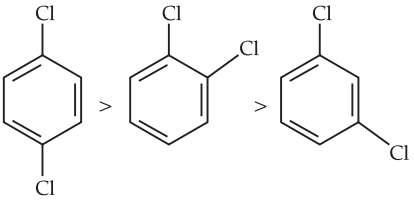
$(Ph-CH=CH-CH_3) \rightarrow$ cis $(Ph-CH=CH-CH_3)$

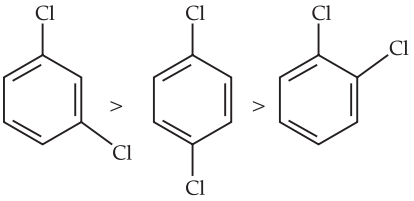
(1) Br_2, aq·KOH, $NaNH_2$, $Na(LiqNH_3)$
(2) Br_2, alc ·KOH, $NaNH_2$, H_2 Lindlar Catalyst
(3) Br_2, aq·KOH, $NaNH_2$, H_2 Lindlar Catalyst
(4) Br_2, alc ·KOH, $NaNH_2$, $Na(LiqNH_3)$

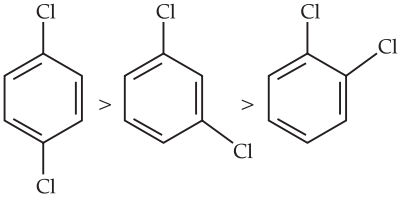
[JEE (Main) – 31th Jan 2023 - Shift-1]

19. The correct order of melting points of dichlorobenzenes is:

(1) 

(2) 

(3) 

(4) 

[JEE (Main) – 31th Jan 2023 - Shift-1]

20. A hydrocarbon 'X' with formula C_6H_8 uses two moles H_2 on catalytic hydrogenation of its one mole. On ozonolysis, 'X' yields two moles of methane dicarbaldehyde. The hydrocarbon 'X' is:

(1) cyclohexa–1, 4–diene
(2) cyclohexa – 1, 3 – diene
(3) 1–methylcyclopenta–1, 4–diene
(4) hexa–1, 3, 5–triene

[JEE (Main) – 31th Jan 2023 - Shift-2]

21. When a hydrocarbon A undergoes complete combustion it requires 11 equivalents of oxygen and produces 4 equivalents of water. What is the molecular formula of A?

(1) C_5H_8 **(2)** $C_{11}H_4$ **(3)** C_9H_8 **(4)** $C_{11}H_8$

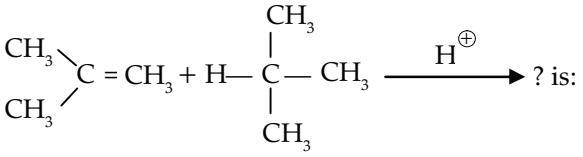
[JEE (Main) – 31th Jan 2023 - Shift-2]

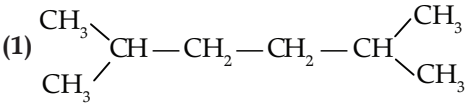
22. Phenol on reaction with dilute nitric acid, gives two products. Which method will be most efficient for large scale separation?

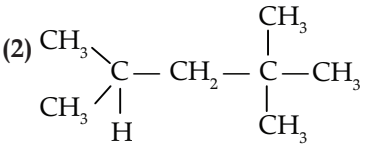
(1) Chromatographic separation
(2) Fractional crystallisation
(3) Steam distillation
(4) Sublimation

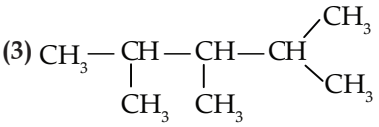
[JEE (Main) – 25th June 2022 - Shift-1]

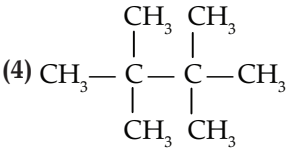
23. The product formed in the following reaction.



(1) 

(2) 

(3) 

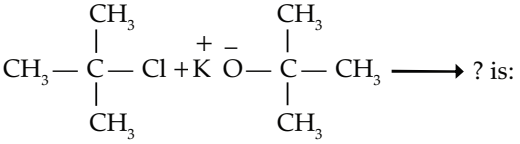
(4) 

24. The IUPAC name of ethylidene chloride is:

(1) 1-Chloroethene **(2)** 1-Chloroethyne
(3) 1,2-Dichloroethane **(4)** 1,1-Dichloroethane

[JEE (Main) – 25th June 2022 - Shift-1]

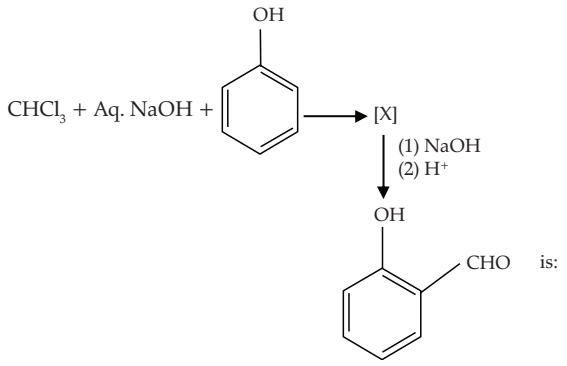
25. The major product in the reaction



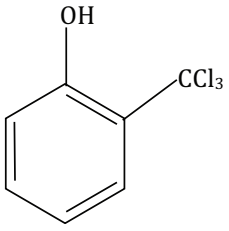
(1) t-Butyl ethyl ether **(2)** 2,2-Dimethyl butane
(3) 2-Methyl pent-1-ene **(4)** 2-Methyl prop-1-ene

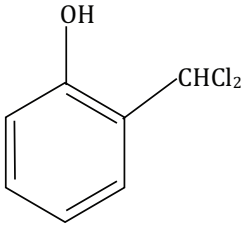
[JEE (Main) – 25th June 2022 - Shift-1]

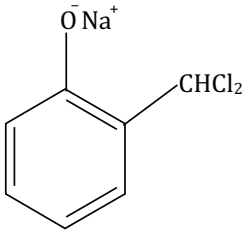
26. The intermediate X, in the reaction:

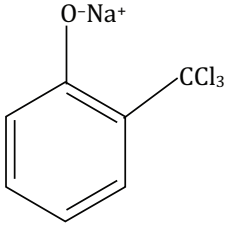


is:

(1) 

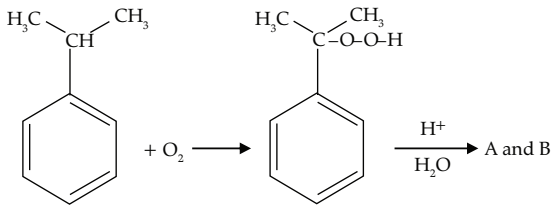
(2) 

(3) 

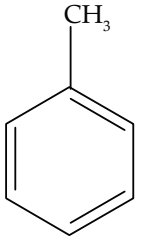
(4) 

[JEE (Main) – 25th June 2022 - Shift-1]

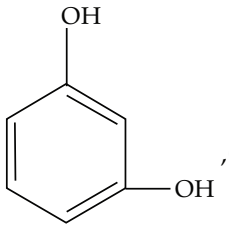
27. In the following reaction:



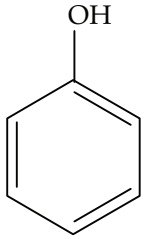
The compounds A and B respectively are:

(1) 

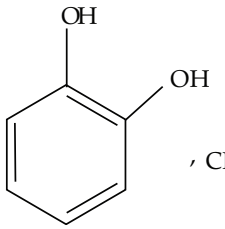
, CH_3COOH

(2) 

, CH_3COCH_3

(3) 

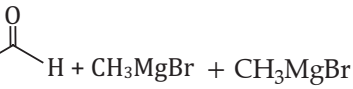
, CH_3COCH_3

(4) 

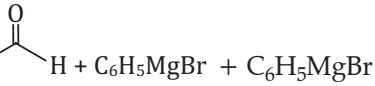
, CH_3COCH_3

[JEE (Main) – 25th June 2022 - Shift-1]

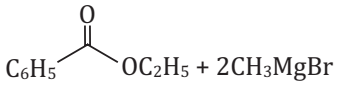
28. Which of the following conditions or reaction sequence will NOT give acetophenone as the major product?

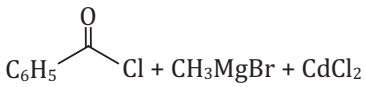
(1) **(a)** 

(b) $Na_2Cr_2O_7$, H^+

(2) **(a)** 

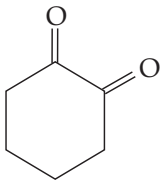
(b) PCC, DCM

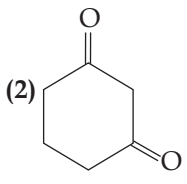
(3) 

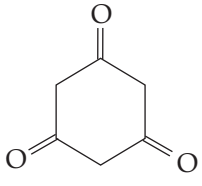
(4) 

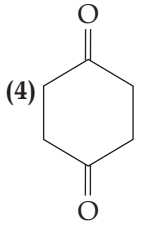
[JEE (Main) – 25th June 2022 - Shift-2]

29. Which will have the highest enol content?

(1) 

(2) 

(3) 

(4) 

30. Which statement is not true with respect to nitrate ion test?

(1) A dark brown ring is formed at the junction of two solutions.

(2) Ring is formed due to nitroferrous-sulphate complex.

(3) The brown complex is $[Fe(H_2O)_5(NO)]SO_4$.

(4) Heating the nitrate salt with conc. H_2SO_4, light brown fumes are evolved.

[JEE (Main) – 26th June 2022 - Shift-1]

31. Oxidation of toluene to benzaldehyde can be easily carried out with which of the following reagents?

(1) CrO_3/acetic acid, H_3O^+

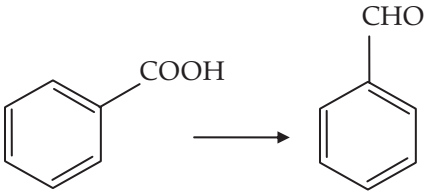
(2) CrO_3/acetic anhydride, H_3O^+

(3) $KMnO_4$/HCl, H_3O^+

(4) CO/HCl, anhydrous $AlCl_3$

[JEE (Main) – 26th June 2022 - Shift-2]

32. The reagent, from the following, which converts benzoic acid to benzaldehyde in one step is:



(1) $LiAlH_4$ **(2)** $KMnO_4$ **(3)** MnO **(4)** $NaBH_4$

[JEE (Main) – 26th June 2022 - Shift-2]

33. 'a' and 'b' respectively are:

(a) $\xrightarrow[(2)\ Zn-H_2O]{(1)\ O_3}$ Ethane-1, 2-dicarbaldehyde + Glyoxal

(b) $\xrightarrow[(2)\ Zn-H_2O]{(1)\ O_3}$ 5-oxohexanal

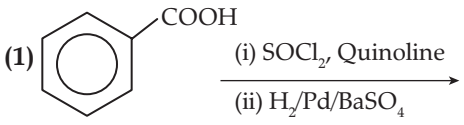
(1) 1-methylcyclohexa-1,3-diene & cyclopentene

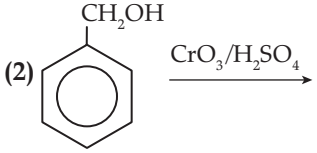
(2) Cyclohexa-1,3-diene & cyclopentene

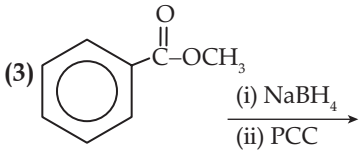
(3) 1-methylcyclohexa-1,4-diene & 1-methylcyclopent-1-ene

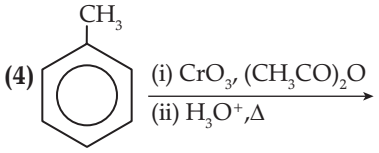
(4) Cyclohexa-1,3-diene & 1-methylcyclopent-1-ene **[JEE (Main) – 27th June 2022 - Shift-1]**

34. Which of the following reactions will yield benzaldehyde as a product?

(1) 

(2) 

(3) 

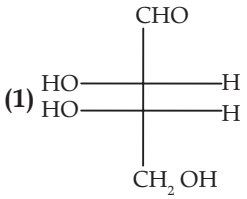
(4) 

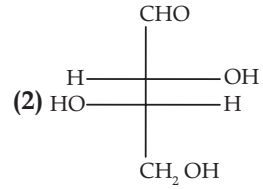
(1) (2) and (3) **(2)** (3) and (4)

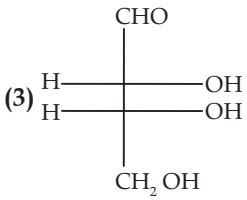
(3) (1) and (4) **(4)** (1) and (3)

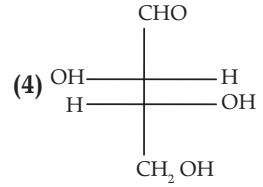
[JEE (Main) – 27th June 2022 - Shift-1]

35. L-Isomer of a compound 'A' $C_4H_8O_4$) gives a positive test with $[Ag(NH_3)_2]^+$. Treatment of 'A' with acetic anhydride yields triacetate derivative. Compound 'A' produces an optically active compound **(B)** and an optically inactive compound **(C)** on treatment with bromine water and HNO_3 respectively. Compound **(A)** is:

(1) 

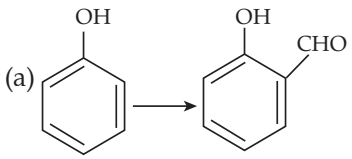
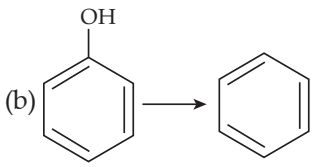
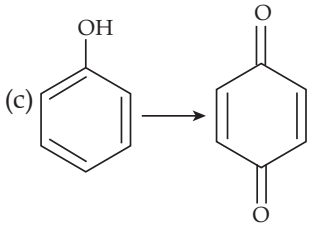
(2) 

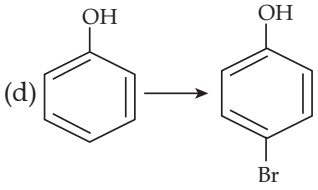
(3) 

(4) 

[JEE (Main) – 27th June 2022 - Shift-1]

36. Match List I with List II.

List-I	List-II
(a) 	**I.** Br_2 in CS_2
(b) 	**II.** $Na_2Cr_2O_7$/ H_2SO_4
(c) 	**III.** Zn

(d) 

IV. $CHCl_3$/ NaOH

Choose Correct answer from the option given below :

(1) a-IV, b-III, c-II, d-I **(2)** a-IV, b-III, c-I, d-II

(3) a-II, b-III, c-I, d-IV **(4)** a-IV, b-II, c-III, d-I

[JEE (Main) – 27th June 2022 - Shift-2]

37. Decarboxylation of all six possible forms of diaminaobenzoic acids $C_6H_3(NH_2)_2COOH$ yield three products A, B and C. Three acids give a product 'A' two acids gives a product 'B' and one give a product 'C'. The melting point of product 'C' is:

(1) 63°C **(2)** 90°C **(3)** 104°C **(4)** 142°C

[JEE (Main) – 27th June 2022 - Shift-2]

38. Which one of the following techniques is not used to spot components of a mixture separated on thin layer chromatographic plate?

(1) I_2 (solid)

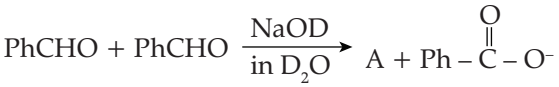
(2) U. V. Light

(3) Visualization agent as a component of mobile phase

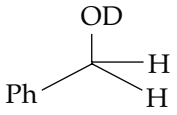
(4) Spraying of an appropriate reagent

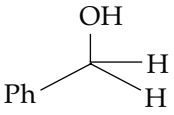
[JEE (Main) – 28th June 2022 - Shift-1]

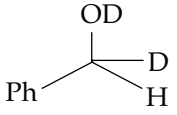
39. The correct structure of product 'A' formed in the following reaction:

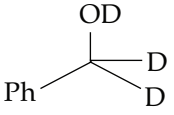


[Ph is – C_6H_5]

(1) 

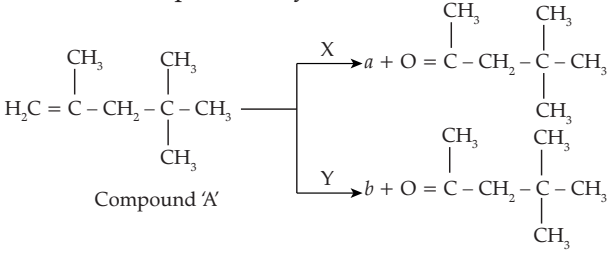
(2) 

(3) 

(4) 

[JEE (Main) – 28th June 2022 - Shift-1]

40. A compound 'A' on reaction with 'X' and 'Y' produces the same major product but different by product 'a' and 'b'. Oxidation of 'a' gives a substance produce by ants.



Compound 'A'

'X' and 'Y' respectively are:

(1) $KMnO_4/H^+$ and dil. $KMnO_4$, 273 K

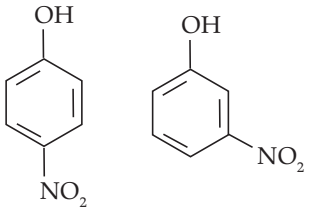
(2) $KMnO_4$(dilute), 273 K and $KMnO_4/H^+$

(3) $KMnO_4/H^+$ and O_3, H_2O/Zn

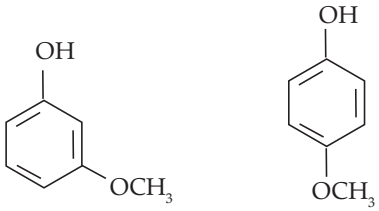
(4) O_3, H_2O/Zn and $KMnO_4/H^+$

[JEE (Main) – 25th July 2022 - Shift-1]

41. Arrange the following in decreasing acidic strength.



(1) **(2)**

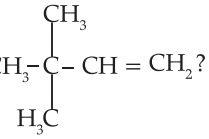


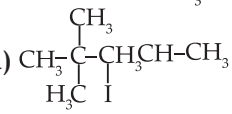
(3) **(4)**

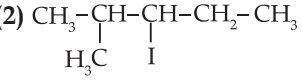
(1) 1>2>3>4 **(2)** 2>1>3>4

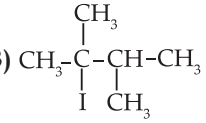
(3) 4>3>1>2 **(4)** 4>3>2>1

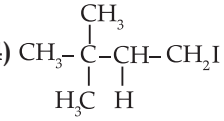
[JEE (Main) – 25th July 2022 - Shift-2]

42. What is the major product formed by HI on reaction with  ?

(1) 

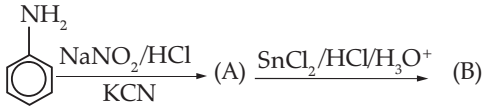
(2) 

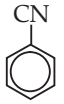
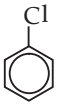
(3) 

(4) 

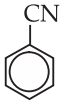
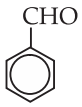
[JEE (Main) – 24th Feb 2021 - Shift-1]

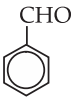
43. 'A' and 'B' in the following reactions are :



(1) (A) :  (B): 

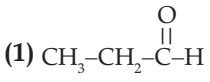
(2) (A) :  (B) : 

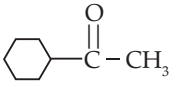
(3) (A) :  (B) : 

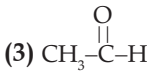
(4) (A) :  (B) : 

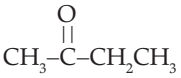
[JEE (Main) – 24th Feb 2021 - Shift-1]

44. Which one of the following carbonyl compounds cannot be prepared by addition of water on an alkyne in the presence of $HgSO_4$ and H_2SO_4 ?

(1) 

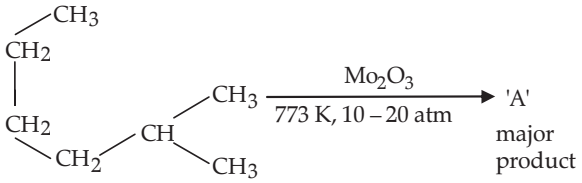
(2) 

(3) 

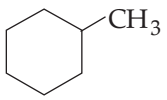
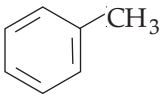
(4) 

[JEE (Main) – 24th Feb 2021 - Shift-2]

45. Identify A in the given chemical reaction.

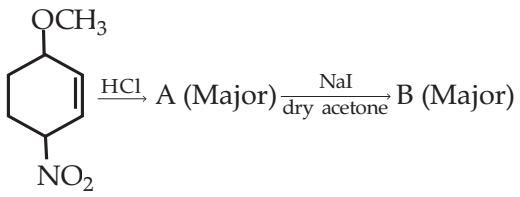


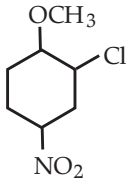
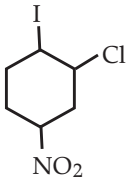
(1)  **(2)** 

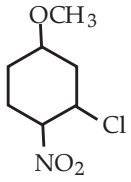
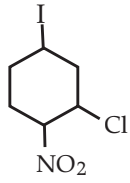
(3)  **(4)** 

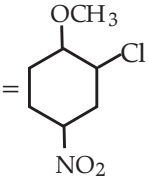
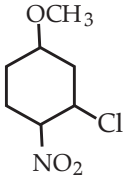
[JEE (Main) – 25th Feb 2021 - Shift-2]

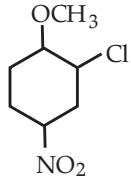
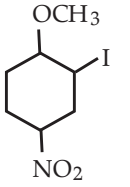
46. Identify A and B in the chemical reaction.



(1) A =  B = 

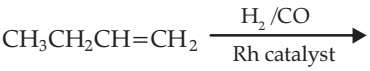
(2) A =  B = 

(3) A =  B = 

(4) A =  B = 

[JEE (Main) – 25th Feb 2021 - Shift-1]

47. The major product of the following reaction is :



(1) $CH_3CH_2CH_2CHO$

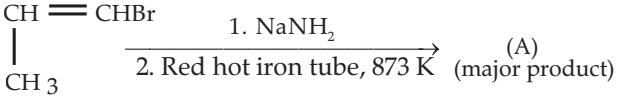
(2) $CH_3CH_2CH{=}CH{-}CHO$

(3) $CH_3CH_2CH_2CH_2CHO$

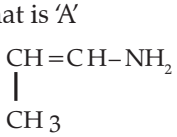
(4) 

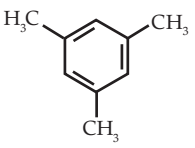
[JEE (Main) – 25th Feb 2021 - Shift-2]

48. For the given reaction :

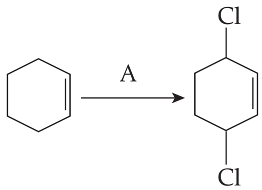


What is 'A'

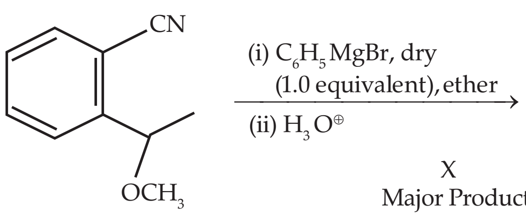
(1)  **(2)** 

(3)  **(4)** $CH_3CH_2CH_2NH_2$

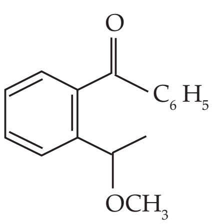
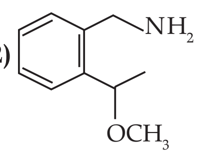
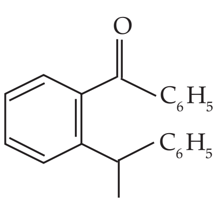
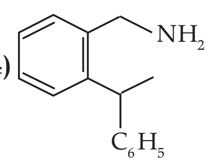
49. Which of the following is Lindlar's catalyst?
(1) Zinc chloride and HCl.
(2) Partially deactivated palladised charcoal.
(3) Sodium and Liquid NH_3.
(4) Cold dilute solution of $KMnO_4$.
[JEE (Main) – 16th March 2021 - Shift-1]

50. 

Identify the reagent(s) 'A' and condition(s) for the reaction.
(1) A = HCl; Anhydrous $AlCl_3$
(2) A = HCl, $ZnCl_2$
(3) A = Cl_2, dark, Anhydrous $AlCl_3$
(4) A = Cl_2; UV light
[JEE (Main) – 16th March 2021 - Shift-2]

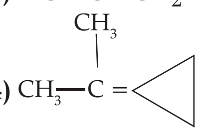
51. 

The structure of X is:

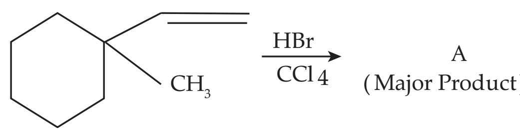
(1) 
(2) 
(3) 
(4) 

[JEE (Main) – 16th March 2021 - Shift-2]

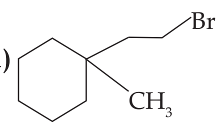
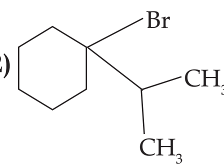
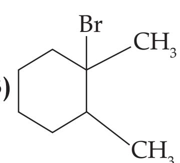
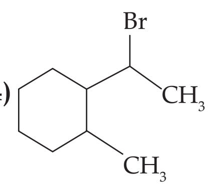
52. Ammonolysis of alkylhalides followed by the treatment with NaOH solution can be used to prepare primary, secondary and tertiary amines. The purpose of NaOH in the reaction is:
(1) To remove basic impurities.
(2) To activate NH_3 used in the reaction.
(3) To increase the reactivity of alkyl halide.
(4) To remove acidic impurities.
[JEE (Main) – 16th March 2021 - Shift-2]

53. An unsaturated hydrocarbon X on ozonolysis gives A. Compound A when warmed with ammonical silver nitrate forms a bright silver mirror along the sides of the test tube. The unsaturated hydrocarbon X is:
(1) $CH_3 - C \equiv C - CH_3$
(2) $CH_3-C(CH_3)=C(CH_3)-CH_3$
(3) $HC \equiv C - CH_2 - CH_3$
(4) 

[JEE (Main) – 16th March 2021 - Shift-2]

54. 

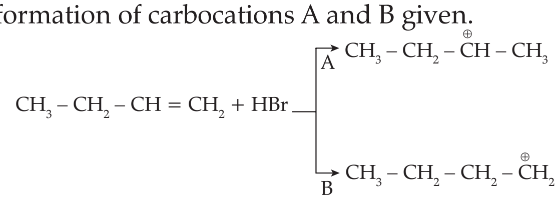
Product "A" in the above chemical reaction is :

(1) 
(2) 
(3) 
(4) 

[JEE (Main) – 17th March 2021 - Shift-1]

55. Given below are two statements :
Statement I : 2 – methylbutane on oxidation with $KMnO_4$ gives 2-methylbutan-2-ol.
Statement II : n-alkanes can be easily oxidized to corresponding alcohols with $KMnO_4$.
Choose the correct option :
(1) Both statement I and statement II are incorrect.
(2) Statement I is correct but statement II is incorrect.
(3) Both statement I and statement II are correct.
(4) Statement I is incorrect but statement II is correct.
[JEE (Main) – 17th March 2021 - Shift-2]

56. Choose the correct statement regarding the formation of carbocations A and B given.

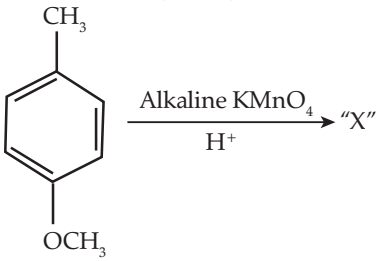


(1) Carbocation A is more stable and formed relatively at faster rate.
(2) Carbocation B is more stable and formed relatively at faster rate.
(3) Carbocation A is more stable and formed relatively at slow rate.
(4) Carbocation B is more stable and formed relatively at slow rate.

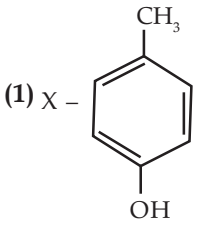
[JEE (Main) – 17th March 2021 - Shift-2]

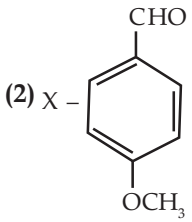
57. Compound with molecular formula C_3H_6O can show :
(1) Both positional isomerism and metamerism
(2) Metamerism
(3) Positional isomerism
(4) Functional group isomerism

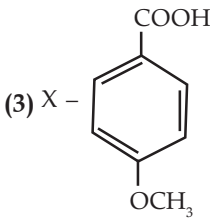
[JEE (Main) – 18th March 2021 - Shift-1]

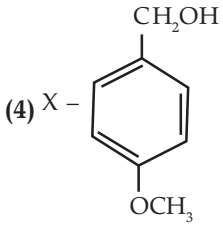
58. 

Considering the above chemical reaction, identify the product "X" :

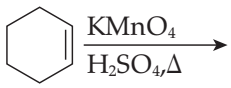
(1) 

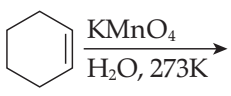
(2) 

(3) 

(4) 

[JEE (Main) – 18th March 2021 - Shift-1]

59. 



For above chemical reactions, identify the correct statement from the following:

(1) compound 'A' is di-carboxylic acid and compound 'B' is diol.
(2) compound 'A' is diol and compound 'B' is di-carboxylic acid.
(3) both compound 'A' and compound 'B' are diols.
(4) both compound 'A' and compound 'B' are di-carboxylic acids.

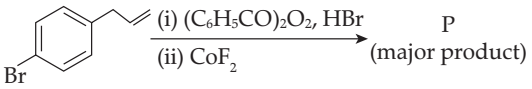
[JEE (Main) – 20th July 2021 - Shift-1]

60. In the given reaction,
2-Bromo-3, 3-dimethyl butane
Product A is :
(1) 2-Hydroxy-3, 3-dimethyl butane.
(2) 2-Ethoxy-2, 3-dimethyl butane.
(3) 2-Ethoxy-3, 3-dimethyl butane.
(4) 1-Ethoxy-3, 3-dimethyl butane

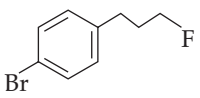
[JEE (Main) – 20th July 2021 - Shift-1]

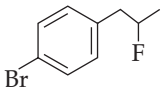
61. Metallic sodium does not react normally with :
(1) Tert-butyl alcohol **(2)** But – 2 – yne
(3) Ethyne **(4)** Gaseous ammonia

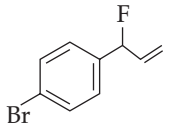
[JEE (Main) – 20th July 2021 - Shift-2]

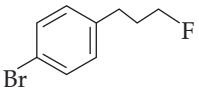
62. 

Major product P of above reaction, is :

(1) 

(2) 

(3) 

(4) 

[JEE (Main) – 20th July 2021 - Shift-2]

63. Which one of the following molecules does not show stereo isomerism ?
(1) 3, 4 – dimethylhex–3–ene
(2) 4 – Methylhex–1–ene
(3) 3 – Methylhex–1–ene
(4) 3 – Ethylhex–3–ene

[JEE (Main) – 22nd July 2021 - Shift-2]

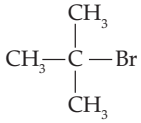
64. An organic compound 'A' C_4H_8 on treatment with $KMnO_4/H^+$ yields compound 'B' C_3H_6O. Compound 'A' also yields compound 'B' an ozonolysis. Compound 'A' is :
(1) But-2-ene
(2) 2-Methylpropene
(3) Cyclobutane
(4) 1-Methylcyclopropane

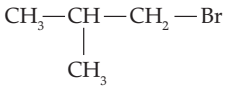
[JEE (Main) – 25th July 2021 - Shift-1]

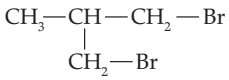
65. Staggered and eclipsed conformers of ethane are:
(1) Enantiomers **(2)** Rotamers
(3) Mirror images **(4)** Polymers

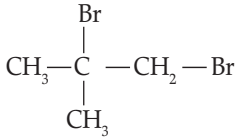
[JEE (Main) – 27th July 2021 - Shift-1]

66. Excess of isobutane on reactions with Br_2 in presence of light at 125°C gives which one of the following, as the major product ?

(1) 

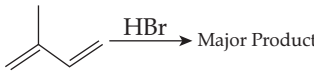
(2) 

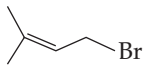
(3) 

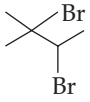
(4) 

[JEE (Main) – 26th Aug 2021 - Shift-1]

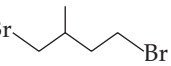
67. The major product formed in the following reactions is :



(1) 

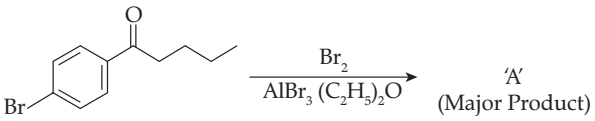
(2) 

(3) 

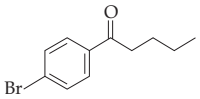
(4) 

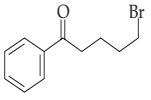
[JEE (Main) – 26th Aug 2021 - Shift-1]

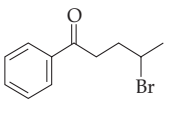
68.

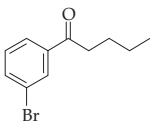


Consider the given reaction, the product A is:

(1) 

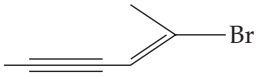
(2) 

(3) 

(4) 

[JEE (Main) – 26th Aug 2021 - Shift-2]

69. Choose the correct name for compound given below :



(1) (4E) – 5 – Bromo – hex – 4 – en – 2 – yne
(2) (2E) – 2 – Bromo – hex – 4 – en – 2 – yne
(3) (4E) – 5 – Bromo – hex – 2 – en – 2 – yne
(4) (2E) – 2 – Bromo – hex – 2 – en – 4 – yne

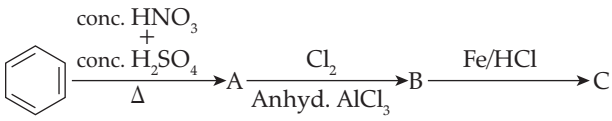
[JEE (Main) – 31st Aug 2021 - Shift-1]

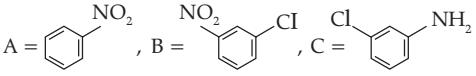
70. Given below are two statements : one is labelled as Assertion (A) and the other is labelled as Reason (R).

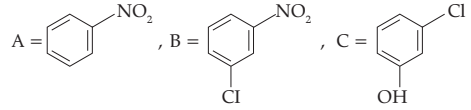
Assertion (A) : Treatment of bromine water propene yields 1 – bromopropan – 2 – ol.
Reason (R) : Attack of water on bromonium ion follows Markovnikov rule and results in 1 – bromopropan – 2 – ol.
In the light of the above statements, choose the most appropriate answer from the options given below.
(1) Both (A) and (R) are true but (R) is NOT the correct explanation of (A).
(2) (A) is false but (R) is true.
(3) (A) is true but (R) is false.
(4) Both (A) and (R) are true and (R) is the correct explanation of (A).

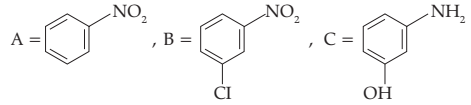
[JEE (Main) – 31st Aug 2021 - Shift-1]

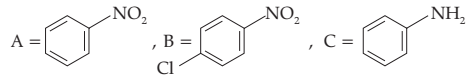
71. Identify correct A, B and C in the reaction sequence given below:



(1) 

(2) 

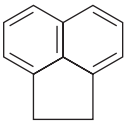
(3) 

(4) 

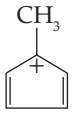
[JEE (Main) – 31st Aug 2021 - Shift-2]

72. Which one of the following compounds is aromatic in nature ?

(1) 

(2) 

(3) 

(4) 

[JEE (Main) – 1st Sep 2021 - Shift-2]

73. The stereoisomers that are formed by electrophilic addition of bromine to trans – but – 2 – ene is /are :

(1) 2 enantiomers
(2) 2 enantiomers and 2 mesomers
(3) 2 identical mesomers
(4) 1 racemic and 2 enantiomers

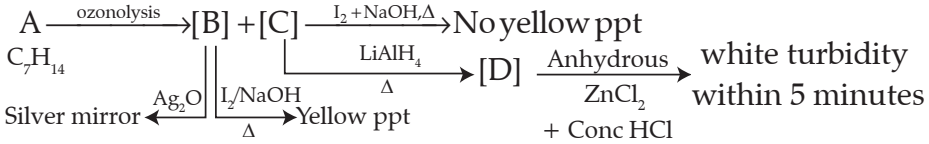
[JEE (Main) – 1st Sep 2021 - Shift-2]

74. Experimentally reducing a functional group cannot be done by which of the following reagents ?

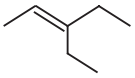
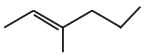
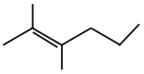
(1) Na/H_2 **(2)** $Pd - C/H_2$
(3) $Pt - C/H_2$ **(4)** Zn/H_2O

[JEE (Main) – 1st Sep 2021 - Shift-2]

75. Consider the following reactions



'A' is

(1)  **(2)**  **(3)**  **(4)** 

[JEE (Main) – 6th Sept 2020 - Shift - 1]

76. Which one of the following alkenes when treated with HCl yields majority of anti Markovnikov product?

(1) $Cl - CH = CH_2$ **(2)** $H_2N - CH = CH_2$
(3) $CH_3O - CH = CH_2$ **(4)** $F_3C - CH = CH_2$

[JEE (Main) – 8th April 2019 - Shift - 2]

ANSWER – KEY

1. (3)	**2. (3)**	**3. (3)**	**4. (1)**
5. (1)	**6. (4)**	**7. (2)**	**8. (1)**
9. (2)	**10. (3)**	**11. (3)**	**12. (4)**
13. (1)	**14. (4)**	**15. (4)**	**16. (2)**
17. (4)	**18. (2)**	**19. (2)**	**20. (1)**
21. (3)	**22. (3)**	**23. (2)**	**24. (4)**
25. (4)	**26. (3)**	**27. (3)**	**28. (3)**
29. (3)	**30. (2)**	**31. (2)**	**32. (3)**
33. (4)	**34. (3)**	**35. (1)**	**36. (1)**
37. (4)	**38. (3)**	**39. (1)**	**40. (4)**
41. (1)	**42. (3)**	**43. (3)**	**44. (1)**
45. (4)	**46. (4)**	**47. (3)**	**48. (3)**
49. (2)	**50. (4)**	**51. (1)**	**52. (4)**
53. (3)	**54. (2)**	**55. (2)**	**56. (2)**
57. (4)	**58. (3)**	**59. (1)**	**60. (2)**
61. (2)	**62. (1)**	**63. (4)**	**64. (2)**
65. (2)	**66. (1)**	**67. (1)**	**68. (4)**
69. (4)	**70. (4)**	**71. (1)**	**72. (1)**
73. (3)	**74. (1)**	**75. (1)**	**76. (4)**

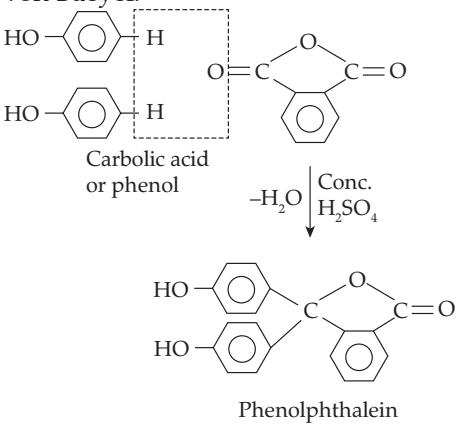
ANSWERS WITH EXPLANATIONS

1. Option (3) is correct.

The reaction between phenol and phthalic anhydride in the presence of sulphuric acid is a well- known reaction for the production of phenolphthalein.

Sulphuric acid in this reaction acts as a dehydrating agent.

Phenolphthalein is renowned as the indicator dye. Phenolphthalein can be synthesized by the condensation of phthalic anhydride with two equivalents of phenol under acidic condition, hence is named as Phenolphthalein by Adolf von Baeyer.



Phenolphthalein

2. Option (3) is correct.

A dipole moment is the product of the magnitude of the charge and the distance between the centers of the positive and negative charges. It is denoted by the Greek letter 'μ'.

Mathematically,

Dipole Moment (μ) = Charge (Q) × distance of separation (r)

It is measured in Debye units denoted by 'D'. 1 D = 3.33564×10^{-30} C.m, where C is Coulomb and m denotes a metre.

The bond dipole moment that arises in a chemical bond between two atoms of different electronegativities can be expressed as follows:

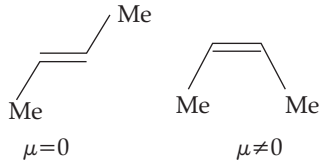
$\mu = \delta.d$

Where: μ is the bond dipole moment,

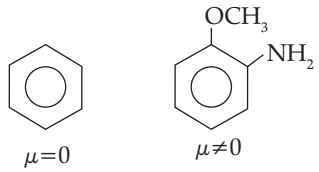
δ is the magnitude of the partial charges δ^+ and δ^-,

And d is the distance between δ^+ and δ^-.

The bond dipole moment (μ) is also a vector quantity, whose direction is parallel to the bond axis. In chemistry, the arrows that are drawn in order to represent dipole moments begin at the positive charge and end at the negative charge.

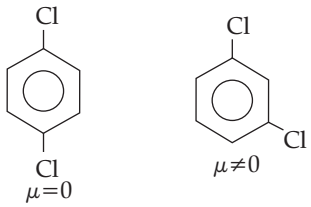
(1) 

$\mu=0$ $\mu\neq0$

(2) 

$\mu=0$ $\mu\neq0$

(3) CH_2Cl_2 $\mu=0$ $CHCl_3$ $\mu\neq0$

(4) 

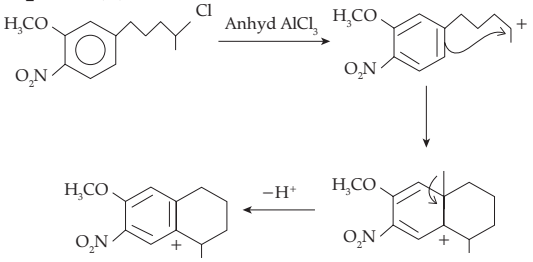
$\mu=0$ $\mu\neq0$

3. Option (3) is correct.

During the preparation of soap, esters of fatty acids are hydrolyzed in the presence of strong bases like NaOH or KOH to give alcohol and soap. This process is known as saponification and the type of reaction used is alkaline hydrolysis reaction.

Ester + base $\rightarrow$ alcohol + soap

4. Option (1) is correct.

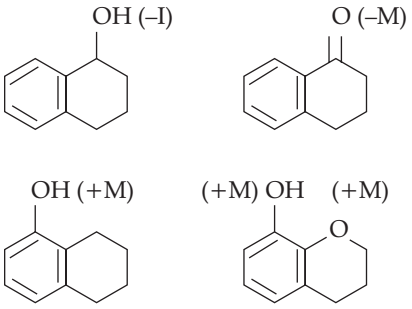


5. Option (1) is correct.

In benzene e^- density is symmetrically distributed all C-atom therefore it readily undergo electrophilic aromatic substitution.

If we attach e^- donating group on benzene ring then its e^- density increases and its rate of electrophilic aromatic substitution increases and if we attach e^- withdrawing group on benzene ring its e^- density decreases which decreases its rate of electrophilic aromatic substitution.

Here,



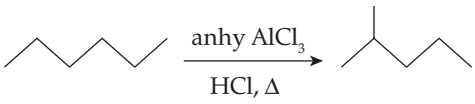
+M group increases the rate of EAS while –I and –M group decreases the rate of EAS.

So correct increasing order of rate of EAS

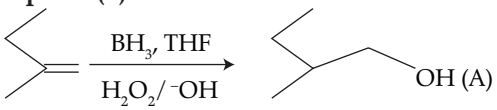
c < a < b < d

6. Option (4) is correct.

When n-alkene heated in the presence of anhy. $AlCl_3$ and HCl gas, formation of isomeric alkane takes place here due to 1,2-methyl shift formation of iso hexane takes place from n-hexane.

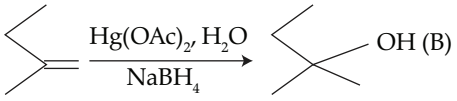


7. Option (2) is correct.



The above reaction addition of water takes place according to anti- Markonikov's Rule

Where the negative part of the reagent attached to that carbon where number of hydrogen atom are more and forms primary alcohol.



In the above reaction addition of water takes place according to Markonikov's Rule where the negative part of the reagent attached to that carbon where number of hydrogen atom are less and forms secondary alcohol.

8. Option (1) is correct.

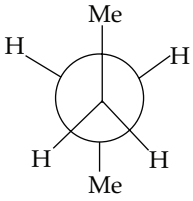
Assertion is true –

Benzere is more stable than hypothetical cyclohexatriene because in benzene . This is due to delocalioation of π e^- s resulting in extra stability.

The delocalised π e^- cloud in bonding molecular orbital of carbon atom which increases the attraction of π e^- towards the nuclei of carbon atoms.

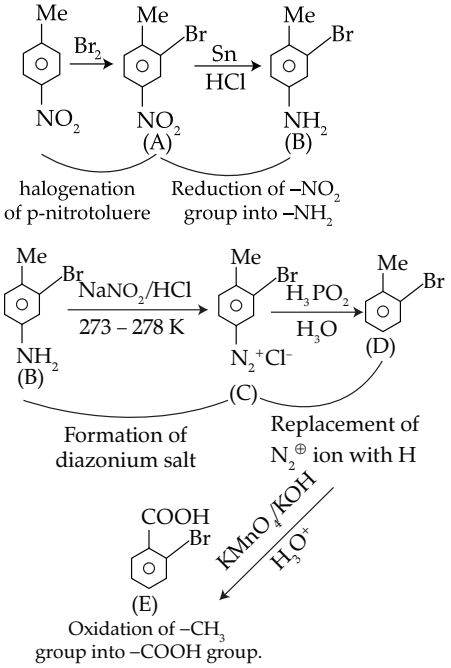
9. Option (2) is correct.

Conformational isomerism is an isomerism in which different structures are formed due to free rotation around carbon — carbon single bond. The structures which are obtained are called conformers of each other and the phenomenon is known as conformational isomerism.

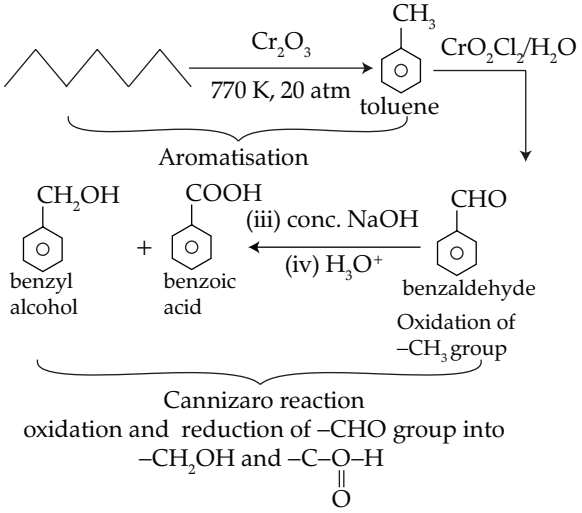


Among the given conformations, the most stable conformer would be one in which bulky groups are present opposite to each other, because such conformer has lowest bond angle and torsional strain and it is called as staggerd-conformer.

10. Option (3) is correct.

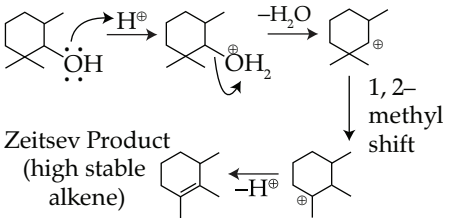


11. Option (3) is correct.



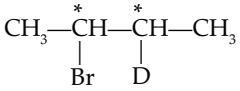
12. Option (4) is correct.

The dehydration of alcohol in presence of concentrated sulphuric acid give rise to an unsaturated compound called alkene. The formation of alkene from alcohol is an example of elimination reaction in which that alkene is formed which is highly substituted.



13. Option (1) is correct.

The structural representation of C_4H_8DBr having two chiral carbon atoms is as follows:



The IUPAC name of the following structure - 2-bromo-3-deuterobutane

14. Option (4) is correct.

The boiling point alkyl halide depends on the following factor–

(a) Size of halogen atom
Boiling point ∝ size of halogen atom

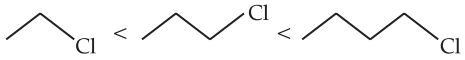
(b) Mass of halogen atom
Boiling point ∝ mass of halogen atom

(c) Number of halogen atom
Boiling point ∝ Number of halogen atom

(d) Branching

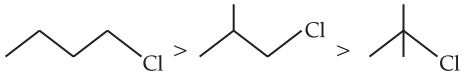
$$\text{Boiling point} \propto \frac{1}{\text{Branching}}$$

(e) Number of C–atom in main chain.
Boiling point ∝ No of c–atom in main chain
Order (A) is correct order, where number of C-atom increases in a main chain



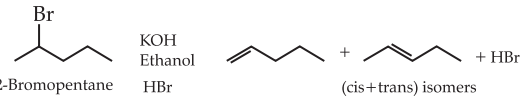
Order (B) is correct, the density of alkyl halide increases with the mass of halogen atom and size of main chain.
Order (C) is correct.
Boiling point ∝ No. of halogen atom.
Order (D) is incorrect the density of alkyl halide increases with the mass of halogen atom and size of main chain.
Order (E) is correct

$$\text{Boiling point} \propto \frac{1}{\text{Branching}}$$

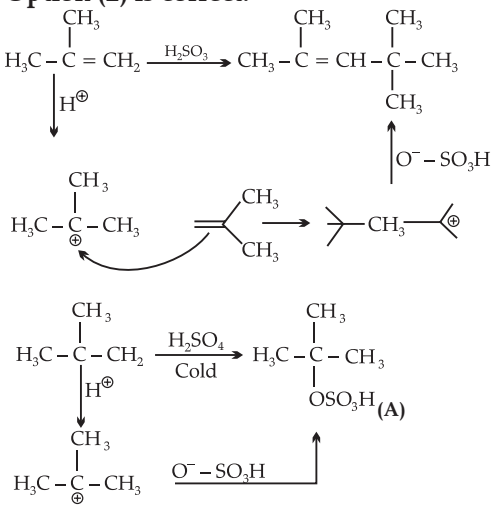


15. Option (4) is correct.

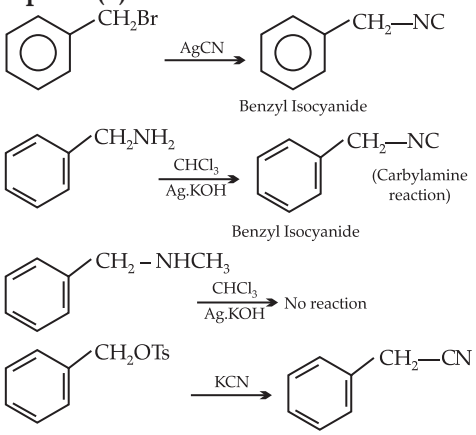
2-Bromopentane gives three alkenes on dehydrohalogenation in the presence of strong base.



16. Option (2) is correct.



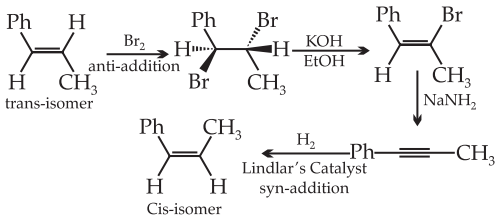
17. Option (4) is correct.



secondary amine will not give carbylamine test.

18. Option (2) is correct.

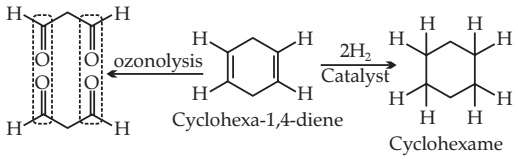
Br_2, alc. KOH, $NaNH_2$, H_2/Lindlar's Catalyst



19. Option (2) is correct.

The p-isomer has a maximum melting point because of its symmetrical structure due to which it can fit into crystal lattice more effectively.

20. Option (1) is correct.



Methane dicarbaldehyde

21. Option (3) is correct.

The combustion of hydrocarbon is:

$$C_xH_y + \left(x + \frac{y}{4}\right)O_2 \rightarrow xCO_2 + \frac{y}{2}H_2O$$

$$\text{Equivalents of Oxygen} = \left(x + \frac{y}{4}\right) = 11$$

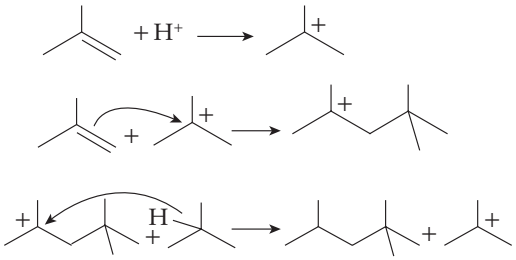
$$\text{Equivalents of Water} = \left(\frac{y}{2}\right) = 4$$

Solving two equations, we get y=8, and x= 9. Thus, the hydrocarbon is C_9H_8

22. Option (3) is correct.

Steam distillation is used to separate temperature-sensitive organic molecule. The organic molecule must be immiscible in water. o-Nitrophenol and p-Nitrophenol can be easily separated by steam distillation. The boiling point of o-nitrophenol is lower than p-nitronitrophenol because of intramolecular H-bonding in former case and intermolecular H-bonding in latter case.

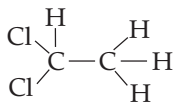
23. Option (2) is correct.



24. Option (4) is correct.

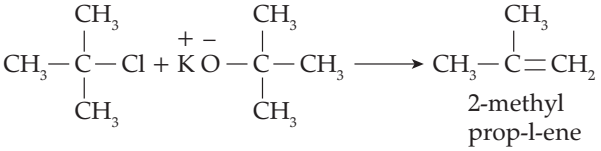
Ethylidene chloride (gem-dihalide) — Ethylene dichloride (vic-dihalide)

The IUPAC name of Ethylidene dichloride 1, 1-dichloroethane.



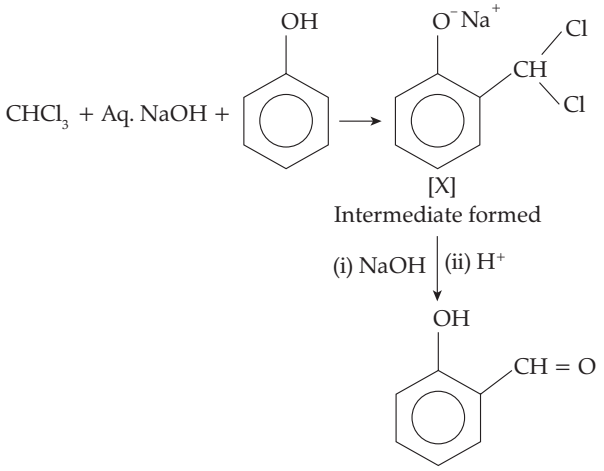
1,1-dichloroethane.

25. Option (4) is correct.



This reaction is elimination reaction.

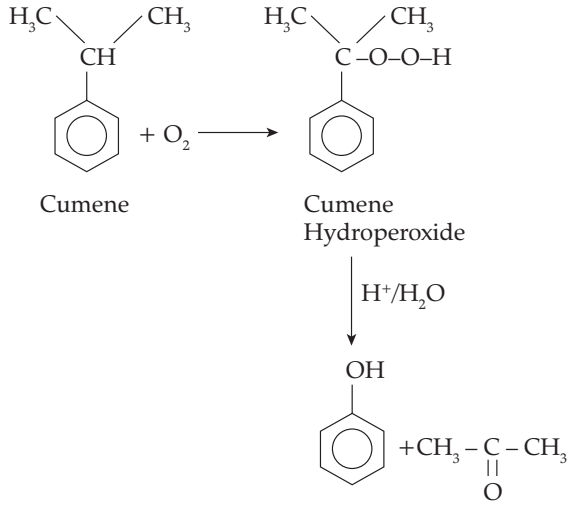
26. Option (3) is correct.



It's a classic Reimer-Tiemann reaction.

27. Option (3) is correct.

To prepare phenol, cumene is oxidised in the presence of air to cumene hydroperoxide.

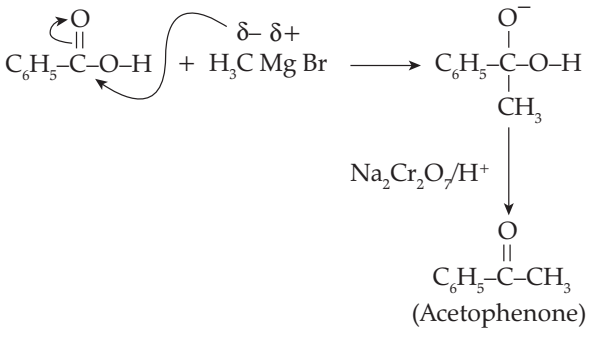


When cumene hydroperoxide is treated with dilute acid to prepare phenol and acetone.

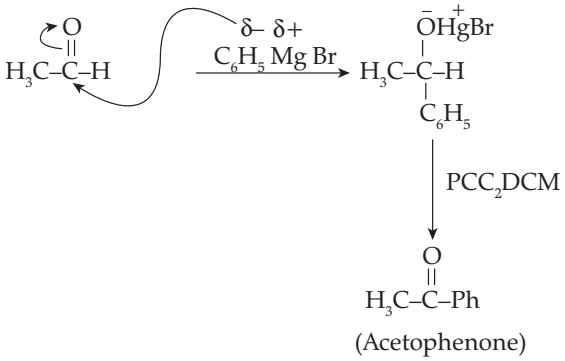
By this method, acetone is obtained in large quantities.

28. Option (3) is correct.

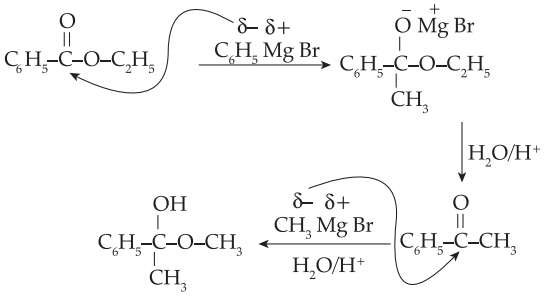
(A)



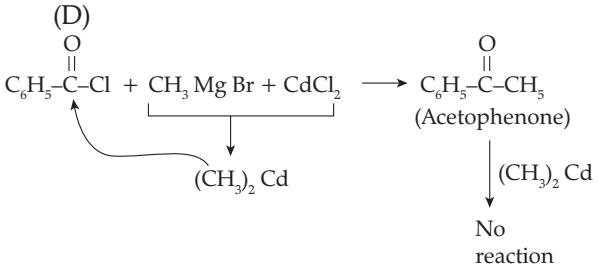
(B)



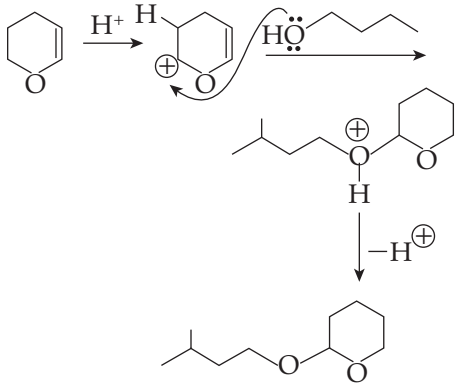
(C)



(D)



29. Option (4) is correct.



30. Option (2) is correct.

$$NO_3^- + H_2SO_4 \rightarrow NO_2$$

Conc. Brown fumes

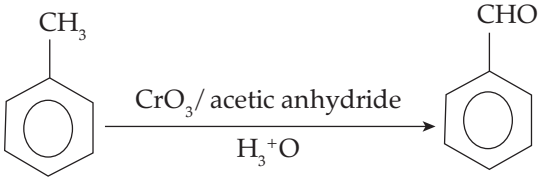
$$NO_3^- + 5H_2 + FeO_4 \xrightarrow{\text{Conc.}H_2SO_4} [Fe(H_2O)_5NO]SO_4$$

(Brown Ring)

Ring is formed due to formation of nitro ferrous sulphate.

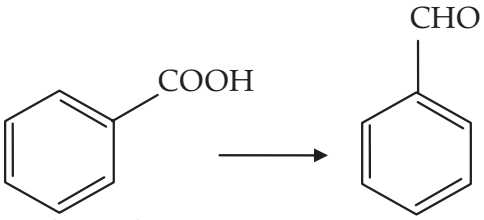
31. Option (2) is correct.

Toluene on reaction with CrO_3 in acetic acid, gives diacetate complex which on acid hydrolysis gives benzaldehyde.

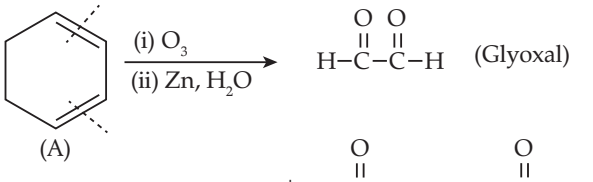


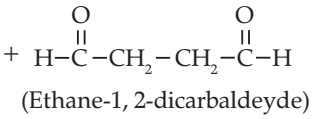
32. Option (3) is correct.

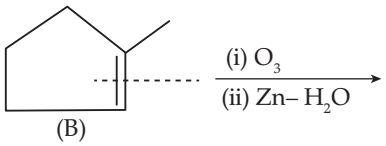
Manganese oxide undergoes oxidation and reduction, which reflects the ease of changing the oxidation state of the manganese ion.

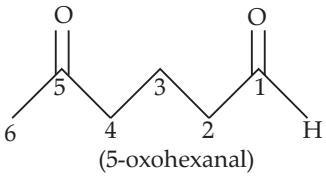


33. Option (4) is correct.

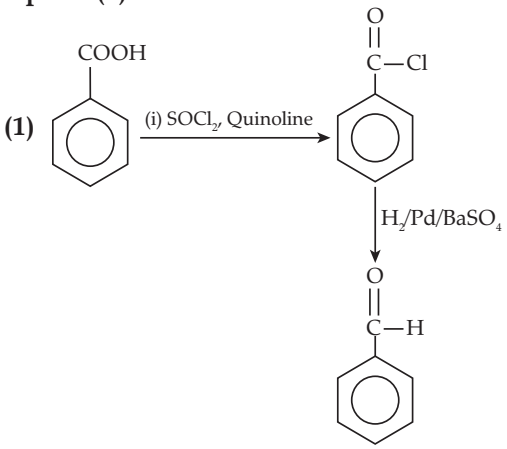


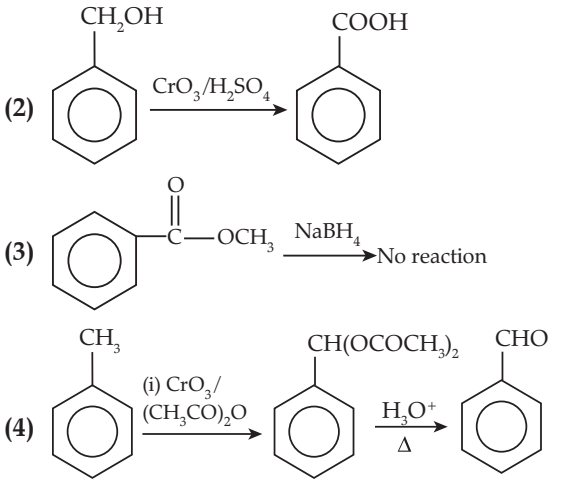






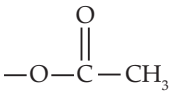
34. Option (3) is correct.





35. Option (1) is correct.

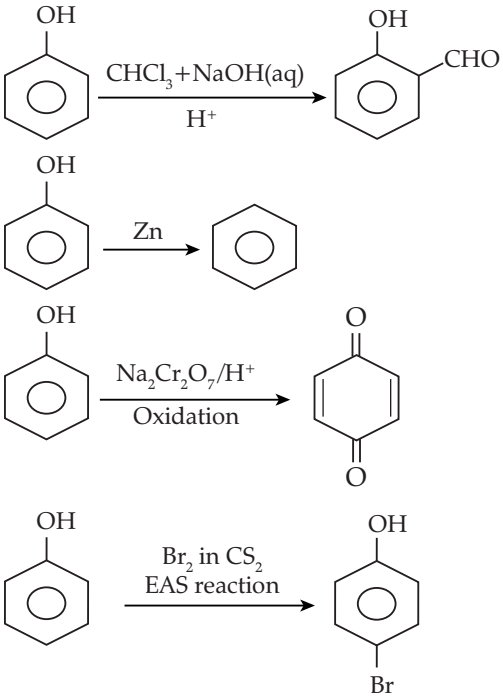
When **(1)** is heated with acetic anhydride, acetylation occurs and –OH group is replaced by:



Hence, triacetate is formed.

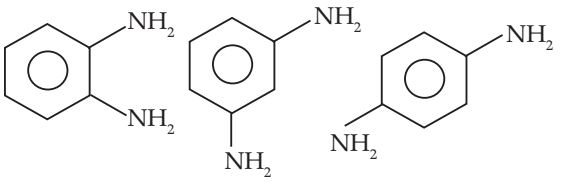
36. Option (1) is correct.

When phenol is treated with chloroform in presence of aqueous NaOH at 340 K to form 2-hydroxyl benzaldehyde or salicylaldehyde. This is known as Reimer-Tiemann reaction.



37. Option (4) is correct.

The decarboxylation of all six possible forms of diaminobenzoic acid $C_6H_3(NH_2)_2COOH$ yields three products A, B and C.



B A C

MP = 257°C 63°C 142°C

38. Option (3) is correct.

Thin layer chromatography (TLC) is another type of adsorption chromatography, which involves separation of substances of a mixture over a thin layer of an adsorbent coated on glass plate.

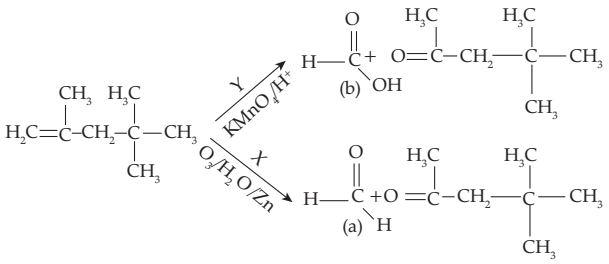
The spots of coloured compounds are visible on TLC plate due to their original colour. The spots of colourless compounds, which are invisible to the eye but fluoresce in ultraviolet light, can be detected by putting the plate under ultraviolet light.

Another detection technique is to place the plate in a covered jar containing a few crystals of iodine. Spots of compounds, which adsorb iodine, will show up as brown spots. Sometimes an appropriate reagent may also be sprayed on the plate.

39. Option (2) is correct.

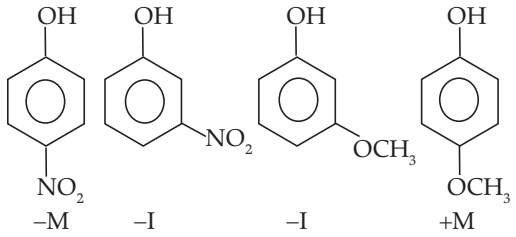
Aromatic compounds are those compounds which contain $6\pi e^-$, cyclic, plannar and complete conjugated system. Here compound A and B are only which satisfying the condition of aromatic compounds.

40. Option (4) is correct.



41. Option (1) is correct.

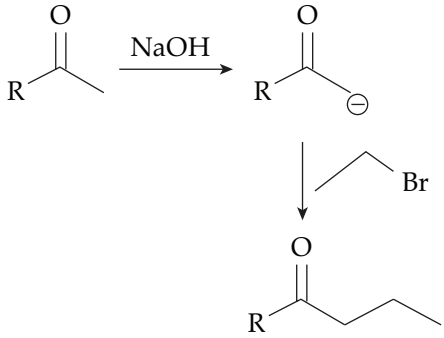
$-NO_2$ group shows –I effect, and –M effect it will withdraw the electron toward itself. This will make ease to release the H^+ ion and the acidic strength will increase. More the number of electron withdrawing group more will be the acid strength. Thus, $-NO_2$ group has more acidic strength than $-OCH_3$ group. $-OCH_3$ group shows –I and +M effect. Thus, it increase electron density when it is attached on para group. Therefore, the correct order of acidic strength is:



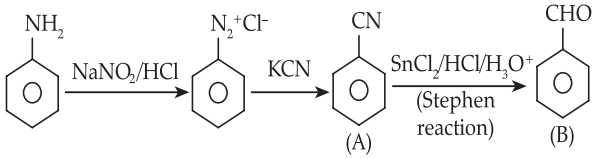
–M –I –I +M

42. Option (3) is correct.

The reaction of carbonyl compound with NaOH forms a carbanion which acts as a nucleophile for the upcoming reactant and forms nucleophilic substituted product.

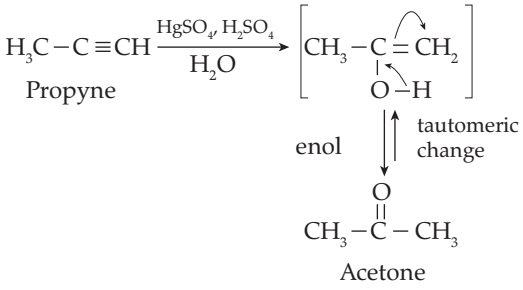


43. Option (3) is correct.

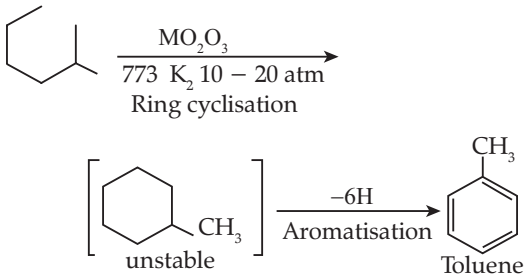


44. Option (1) is correct.

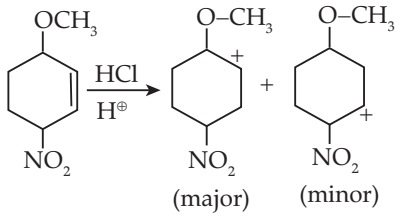
Propionaldehyde (CH_3CH_2–CHO) can not be prepared through Kucherov's reaction. If the alkyne is propyne then through this reaction acetone is formed.



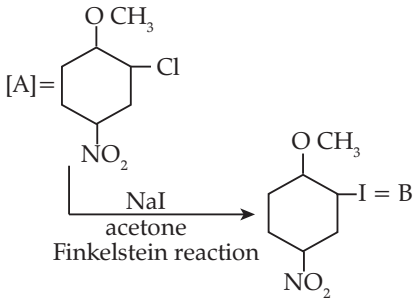
45. Option (4) is correct.



46. Option (4) is correct.



[This carbonation is stable due to close position to more electro negative atom having two pair of nonbonding electronic pair].



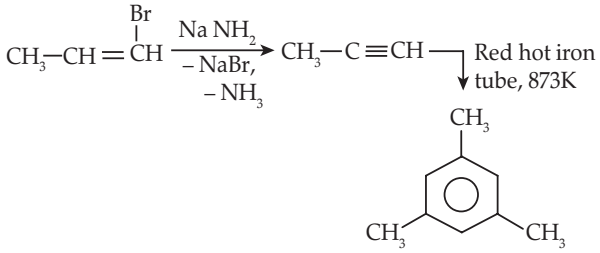
47. Option (3) is correct.

The given reaction is carbonylation of alkene.

$$CH_3 - CH_2 - CH = CH_2 \xrightarrow[\text{Rh Catalyst}]{H_2/CO}$$

$$CH_3CH_3 - CH_2 - CH_2 - CHO$$
$$+ CH_3 - CH_2 - \underset{\displaystyle CHO}{\underset{|}{CH}} - CH_3$$

48. Option (3) is correct.



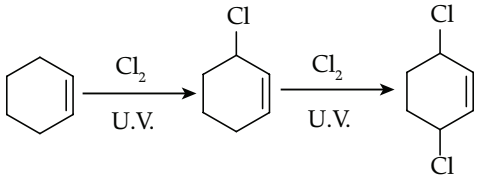
1, 3, 5 – Trimethylbenzene (Mesitylene)

49. Option (2) is correct.

Lindlar's catalyst: $Pd/CaCO_3$ or $BaSO_4$ + $(CH_3COO)_2Pb$ + Quinoline. This catalyst is used to obtain alkene from alkyne with molecular hydrogen.

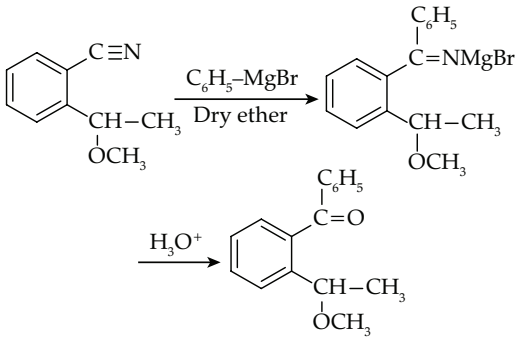
50. Option (4) is correct.

The reaction is known as free radical substitution reaction. In this reaction chlorine gets attached at allylic position with respect to double bond.



51. Option (1) is correct.

The structure of X is:



52. Option (4) is correct.

During ammonolysis of alkylhalides, there is a formation of HX (acid). Therefore, for the removal of there acidic impurities sodium hydroxide (NaOH) is used.

$$R-X \xrightarrow[-HX]{NH_3} R-NH_2 \xrightarrow[-HX]{R-X} R_2NH \xrightarrow[-HX]{R-X} R_3N \xrightarrow{R-X} R_4\overset{\oplus}{N}\,\overset{\ominus}{X}$$

53. Option (3) is correct.

The unsaturated hydrocarbon X is:

$CH_3CH_2C \equiv CH$

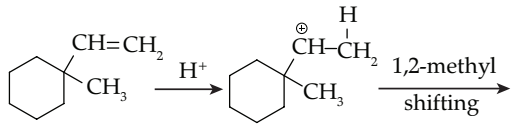
$$CH_3CH_2C{\equiv}CH \xrightarrow{O_3/H_2O} CH_3CH_2COOH + HCOOH$$

$$HCOOH \xrightarrow[\text{Tollens reagent}]{[Ag(NH_3)_2]^+} CO_2 + H_2O + 2Ag$$

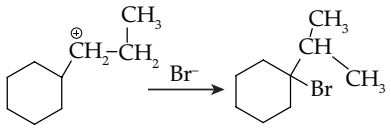
54. Option (2) is correct.

Product "A" is:

1 – bromo – 1 – isopropylcyclohexane



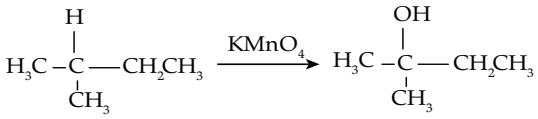
1-methyl-1-vinylcyclohexane



1-bromo-1-isopropylcyclohexane

55. Option (2) is correct.

Alkanes having 3 degree hydrogen can be easily oxidized by $KMnO_4$.



n-Alkanes $\xrightarrow{KMnO_4}$ No reaction

So, statement I is correct but statement II is incorrect.

56. Option (2) is correct.

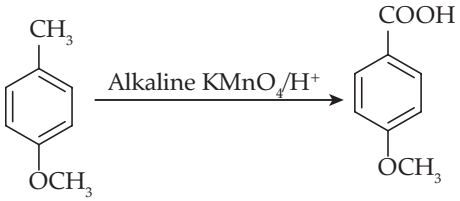
B-carbocation is more stable due to more hyperconjugation and it forms relatively faster rate compared to A.

57. Option (4) is correct.

Degree of unsaturation (DOU) in $C_6H_6O = 1$

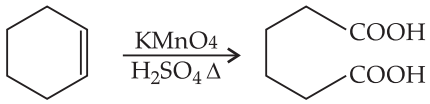
$CH_3 - CH_2 - CHO$ and CH_3COCH_3 are showing functional group isomerism.

58. Option (3) is correct.



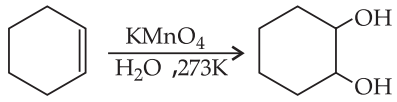
59. Option (1) is correct.

The cyclohexene on heating with $KMnO_4$ in H_2SO_4 undergoes oxidation and oxidative cleavage occur. $KMnO_4$ in acidic medium (in this case H_2SO_4) acts as a strong oxidizing agent. The double bond in cyclohexene breaks down and oxygen atoms are added across the double bond such that dicarboxylic acid is formed. The cyclic structure disappears producing hexane-1, 6-dioic acid or adipic acid.



Adipic acid (A)

Cyclohexene $KMnO_4$ in H_2O at 273 K acts a mild oxidizing agent. The cyclohexene when treated with $KMnO_4$ in H_2O at 273 K will produce a diol by breaking a double bond. The addition of O atoms occur across double bond. The product formed is cyclohexan-1,2-diol.



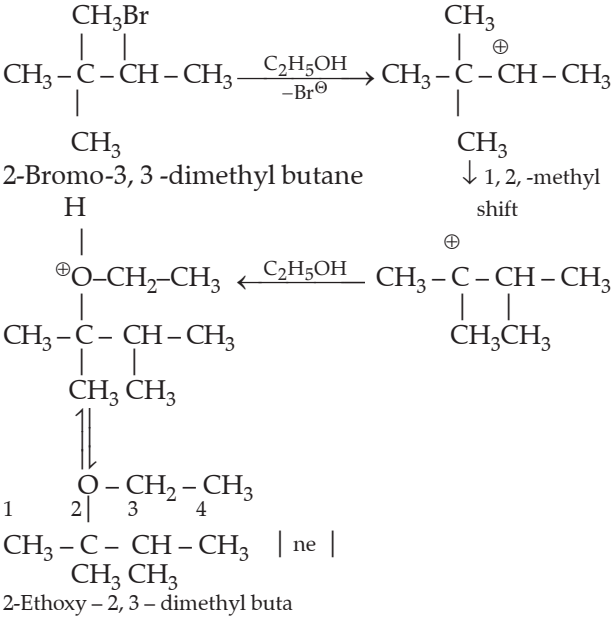
Cyclohexene Cyclohexane-1,2 diol (B)

From the above reactions, it is clear that compound A is dicarboxylic acid and compound B is a diol.

60. Option (2) is correct.

2-Bromo-3,3-dimethyl butane on treatment with first molecule of ethanol, looses bromide ion to produce a secondary carbocation. The secondary carbocation undergoes 1,2-methyl shift so that secondary carbocation is converted to more stable tertiary carbocation.

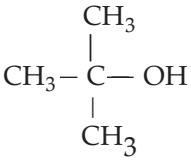
The second molecule of ethanol then reacts with tertiary carbocation results in addition of ethanol on the C atom of tertiary carbocation. The resulting molecule rearranges to produce 2-Ethoxy-2,3-dimethyl butane as a major product.



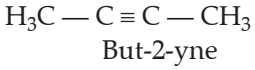
2-Ethoxy – 2, 3 – dimethyl buta

61. Option (2) is correct.

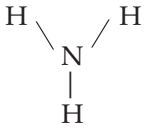
The structure of all 4 compounds is shown below.



Tert-butyl alcohol



But-2-yne



Ethyne Ammonia

Metallic sodium react with tert-butyl alcohol less rapidly. The H atom of tert-butyl alcohol is not easy to replace due to presence of 3 methyl groups on central C atom producing +I effect.

As shown in the above structure of but-2-yne, it does not contain H atom directly bonded to sp hybridized C atom. Hence, it does not contain any acidic H atom and unable to react with metallic sodium.

The ethyne reacts contain 2 acidic proton on sp hybridized C atoms. Thus, ethyne will react with metallic sodium metal with liberation of hydrogen gas.

The reaction between ammonia gas and metallic sodium produces sodamide and hydrogen gas.

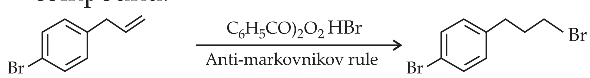
Hence, the metallic sodium does not react normally with But-2-yne.

Hint : Check which of the given compound contain acidic hydrogen atom. Only compound containing acidic H atom will react with metallic sodium.

62. Option (1) is correct.

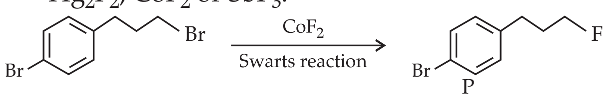
When an alkene reacts with HBr in presence of peroxide, the addition reaction occur through anti Markovnikov mechanism. The peroxides produces free radical which initiate the reaction and addition of bromine occur at terminal C atom.

The addition of Br occur at least substituted C atom, in this case terminal C atom. This is also known as peroxide effect. The double bond is broken due to this addition producing given compound.



1-allyl-4-4 bromobenzene

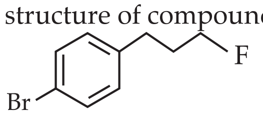
In the next step, compound formed undergoes Swarts reaction. The Swarts reaction is used for preparation of fluorides from chlorides or bromides using heavy metal fluorides like AgF, Hg_2F_2, CoF_2 or SbF_3.



(Major product)

The terminal Br is then replaced by F during Swarts reaction. The leaving group Br, then bonded with metal.

Hence, the structure of compound P is:



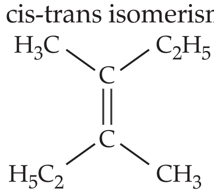
63. Option (4) is correct.

Hint: Draw the structure of each compound and check for cis/trans isomerism. Check whether a C atom is attached to 4 different substituents or not. If yes, then it is an optical isomer.

The stereoisomers are isomers with same molecular formula but, different three dimensional spatial arrangement of the atoms. There are two types of stereoisomers- diastereomers and optical isomers. The cis-trans isomers are example of diastereomers.

Let us check the structure

(1) The 3, 4-Dimethylhex-3-ene contain a double bond in which each C atom is attached to a methyl and ethyl group. Thus,4-Dimethylhex-3-ene exhibit cis-trans isomerism.



3, 4-Dimethylhex-3-ene

(2) The 4-Methylhex-1-ene contain a double bond. The 4th C atom is attached to 4 different substituents thus 4th C atom is a chiral C atoms. Thus, the molecule shows optical isomerism.

$$H_3C - H_2C - \underset{\displaystyle CH_3}{\underset{|}{HC^*}} - CH_2 - CH = CH_2$$

4-methylhex-1-ene

(3) The 3-Methylhex-1-ene contain a single bond and the third C atom is a chiral C atom. Thus, the molecule shows optical isomerism.

$$H_3C - CH_2 - CH_2 - \underset{\displaystyle CH_3}{\underset{|}{HC}} - CH = CH_2$$

3-methylhex-1-ene

(4) The structure of 3-Ethylhex-3-ene is shown below. The molecule does not show either cistrans or optical isomerism.

$$H_3C - H_2C - HC = \underset{\displaystyle CH_2\,CH_3}{\underset{|}{C}} - H_2C - CH_3$$

Hence, the molecule that does not show stereoisomerism is 3-Ethylhex-1-ene.

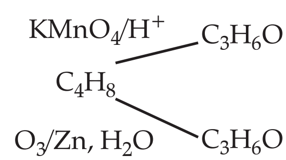
64. Option (2) is correct.

D.U. (Degree of Unsaturation)

$$= \frac{\Sigma n(v-2)}{2} + 1$$

$$= \frac{4(4-2)+8(1-2)}{2} + 1 = 1$$

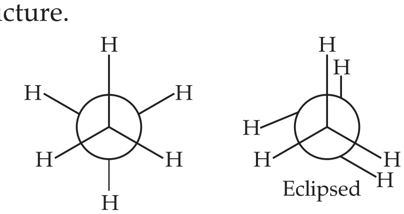
From D.U. it is clear that the molecule either have 1 ring or 1 cycle.



Both C_3H_6O are same So the structure will be as option (1) gives C_2H_4O on ozonolysis while option (3) & (4) do not undergoes ozonolysis.

65. Option (2) is correct.

Staggered and eclipsed conformers of ethane are Rotamers. Due to free rotation around cabon carbon single bond we obtain different structure.

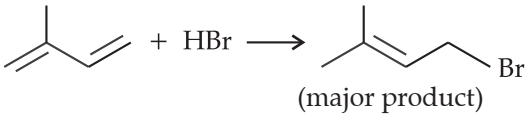


Staggered Eclipsed

66. Option (1) is correct.

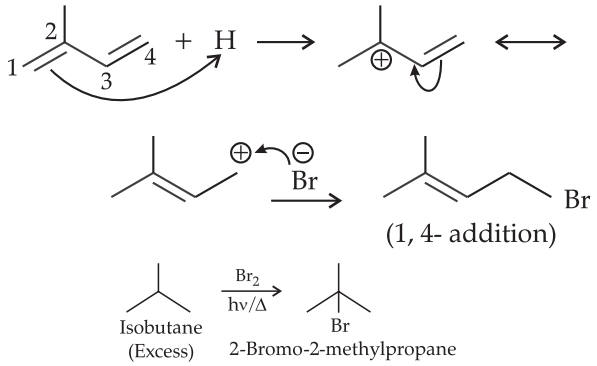
To avoid polybromo product, we can take alkane in excess amount, due to which mono bromo product is formed.

67. Option (1) is correct.



(major product)

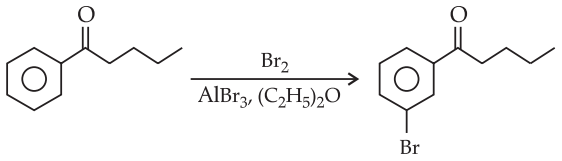
Above reaction is an example of 1, 4-addition reaction of alkadiene. It is feasible at high temperature.



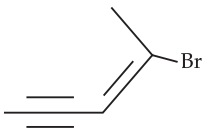
It is a free radical mechanism in which Br can attack on the available sites.

68. Option (4) is correct.

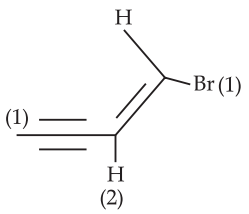
Carbonyl group $(-\overset{\overset{O}{\|}}{C}-)$ is an electron withdrawing group which decreases e^- density at ortho and para position one upcoming electrophile attack at meta position to give *m*–directed product.



69. Option (4) is correct.



According to CIP (Cahn-Ingold-Prelog) rule, priority is assigned to the atom or group of attached to double bond carbon on the basis of atomic number and valency expansion.



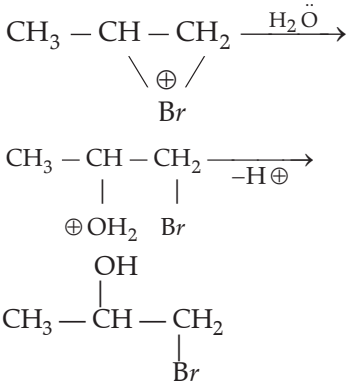
1-highest priority 2. lowest priority according to rule, same priority is on opposite side so it is (E) structure.

(2E) – 2 – Bromohex – 2 – en-4-yne

70. Option (4) is correct.

Assertion is true.

$CH_3 - CH = CH_2 \xrightarrow{Br_2}$

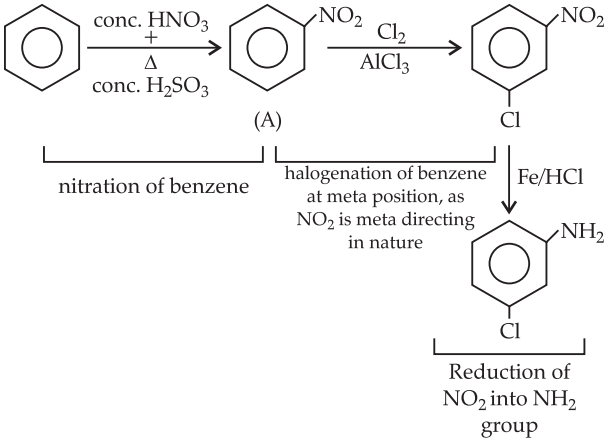


1-Bromo propan-2-ol

Reason is true.

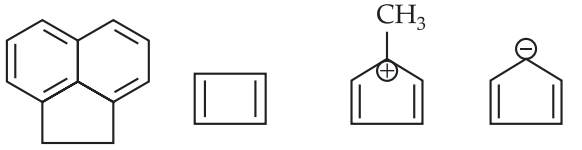
Here, attack of H_2O takes place on bromonium ion and it follows markovnikov's rule. Both assertion & reason is true, and R is correct explanation of Assertion.

71. Option (1) is correct.



72. Option (1) is correct.

Aromatic compounds are those compounds which contain $(4n + 2)\ \pi e^-$ cycle, complete conjugation and cyclic compound.

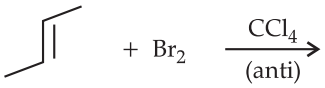


$10\pi\ e^-$	$4\pi\ e^-$	$4\pi\ e^-$	$6\pi\ e^-$
Aromatic	Anti aromatic	Anti aromatic	Aromatic

Option (1) & (2) are correct.

73. Option (3) is correct.

Addition of Br_2/Cl_4 to alkene is an example of electrophillic addition reaction as well as antiaddition. Here, Br -atom attached to alkene are opposite to each other.



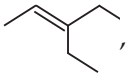
Both product (1) and (2) are identical.

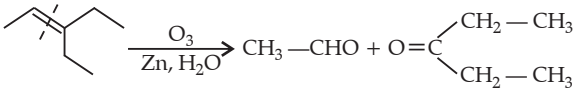
74. Option (1) is correct.

Na/H_2 is not a reducing agent.

75. Option (1) is correct.

$$\text{Double bond equivalent} = \frac{(2\cdot 7+2)-14}{2} = 1$$

If the compound is  , then gives the following reaction.

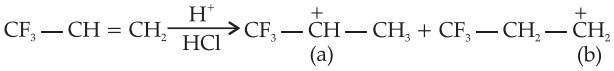


[A] [B] [C]

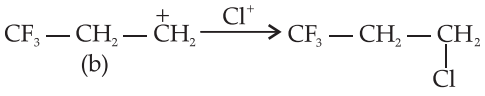
Iodoform Test	+ve	–ve
Tollen's reagent	+ve	–ve

Therefore option (1) is correct.

76. Option (4) is correct.



$-CF_3$ radical have strongest – I effect compare to – **(1)** NH_2 or OCH_3. So, carbocation **(2)** with be more stable than carbocation **(1)** and reacts with Cl^- gives anti Markonikov's product.



Topic-2

Halogen and their derivatives

JEE (Main) Previous Year Questions

Multiple Choice Questions

1. For the reaction

$$RCH_2Br + I^- \xrightarrow[\text{major}]{\text{Acetone}} RCH_2I + Br^-$$

The correct statement is:

(1) The reaction can occur in acetic acid also.

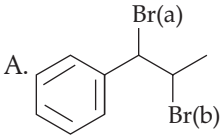
(2) The transition state formed in the above reaction is less polar than the localized anion.

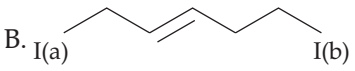
(3) The solvent used in the reaction solvates the ions formed in rate determining step.

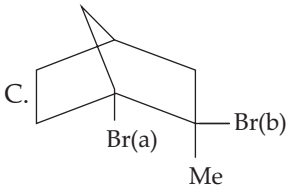
(4) Br^- can act as competing nucleophile.

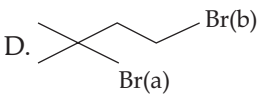
[JEE (Main) – 6th April 2023 - Shift-1]

2. Choose the halogen which is most reactive towards S_N1 reaction in the given compounds. (A, B, C, & D)









(1) A-Br(a) ; B-I(a) ; C-Br(b) ; D-Br(a)

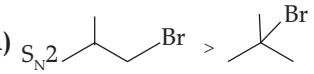
(2) A-Br(b) ; B-I(a) ; C-Br(a) ; D-Br(a)

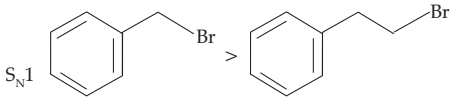
(3) A-Br(b) ; B-I(b) ; C-Br(b) ; D-Br(b)

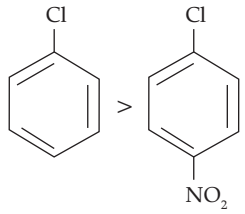
(4) A-Br(a) ; B-I(a) ; C-Br(a) ; D-Br(a)

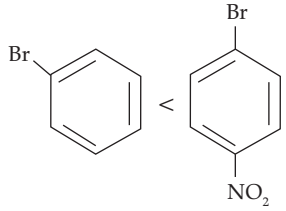
[JEE (Main) – 8th April 2023 - Shift-1]

3. Identify the correct order of reactivity for the following pairs towards the respective mechanism.

(A) 

(B) 

(C) 

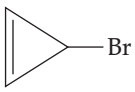
(D) 

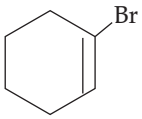
Choose Correct answer from the options given below:

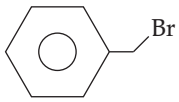
(1) (A), (C) and (D) only
(2) (A), (B) and (D) only
(3) (B), (C) and (D) only
(4) (A), (B), (C) and (D)

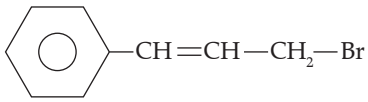
[JEE (Main) – 10th April 2023 - Shift-1]

4. Compound from the following that will not produce precipitate on reaction with $AgNO_3$ is:

(1) 

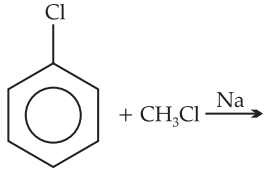
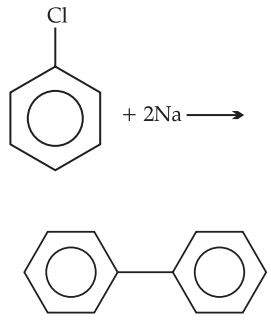
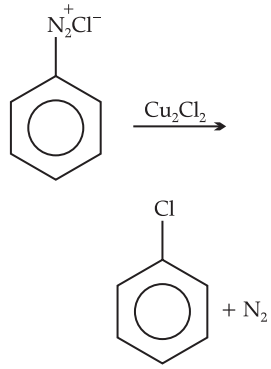
(2) 

(3) 

(4) 

[JEE (Main) – 11th April 2023 - Shift-2]

5. Match List I with List II:

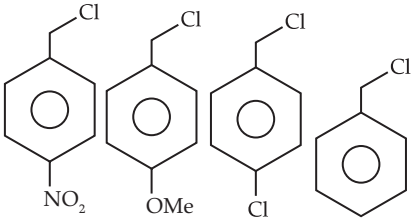
LIST I		LIST II	
A.		I.	Fiting reaction
B.		II.	Wurtz Fiting reaction
C.		III.	Finkelstein reaction
D.	$C_2H_5Cl + NaI \rightarrow C_2H_5I + NaCl$	IV.	Sand Meyer reaction

Choose Correct answer from the options given below:

(1) A – II, B – I, C – IV, D – III
(2) A – IV, B – II, C – III, D – I
(3) A – III, B – II, C – IV, D – I
(4) A – II, B – I, C – III, D – IV

[JEE (Main) – 30th Jan 2023 - Shift-1]

6. Decreasing order towards S_N1 reaction for the following compounds is:



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

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

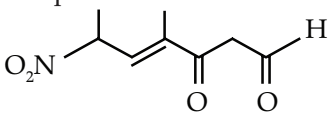
[JEE (Main) – 30th Jan 2023 - Shift-2]

7. In the following halogenated organic compounds the one with maximum number of chlorine atoms in its structure is:

(1) Freon – 12 **(2)** Gammaxene
(3) Chloropicrin **(4)** Chloral

[JEE (Main) – 31th Jan 2023 - Shift-2]

8. The correct IUPAC name of the following compound is:



(1) 4–methyl–2–nitro–5–oxohept–3–enal
(2) 4–methyl–5–oxo–2–nitrohept–3–enal
(3) 4–methyl–6–nitro–3–oxohept–4–enal
(4) 6–formyl–4–methyl–2–nitrohex–3–enal

[JEE (Main) – 26th June 2022 - Shift-2]

9. Which technique among the following, is most appropriate in separation of a mixture of 100mg of p–nitrophenol and picric acid ?
(1) Steam distillation
(2) 2–5 ft long column of silica gel
(3) Sublimation
(4) Preparative TLC (Thin Layer Chromatography)

[JEE (Main) – 26th July 2022 - Shift-1]

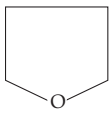
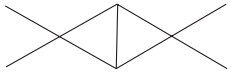
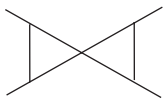
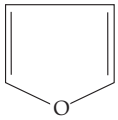
10. The correct decreasing order of priority of functional groups in naming an organic compound as per IUPAC system of nomenclature is:
(1) $-COOH > -CONH_2 > -COCl > -CHO$
(2) $-SO_3H > -COCl > -CONH_2 > -CN$
(3) $-COOR > -COCl > -NH_2 > \diagup\!\!\diagdown C=O$
(4) $-COOH > -COOR > -CONH_2 > -COCl$

[JEE (Main) – 26th July 2022 - Shift-2]

11. In carius method of estimation of halogen, 0.45 g of an organic compound gave 0.36 g of AgBr. Find out the percentage of bromine in the compound.
(Molar masses : AgBr = 188 mol^{-1}; Br= 80 g mol^{-1})
(1) 34.04% **(2)** 40.04% **(3)** 36.03% **(4)** 38.04%

[JEE (Main) – 27th July 2022 - Shift-1]

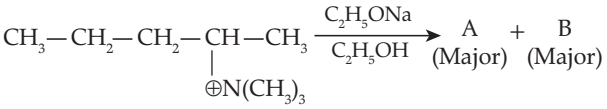
12. Match List – I with List – II.

List – I		List – II
(1)		(I) Spiro compound
(2)		(II) Aromatic compound
(3)		(III) Non–planar Heterocyclic compound
(4)		(IV) Bicyclo compound

Choose Correct answer from the options given below:
(1) (1) – (II), (2) – (I), (3) – (IV), (4) – (III)
(2) (1) – (IV), (2) – (III), (3) – (I), (4) – (II)
(3) (1) – (III), (2) – (IV), (3) – (I), (4) – (II)
(4) (1) – (IV), (2) – (III), (3) – (II), (4) – (I)

[JEE (Main) – 28th July 2022 - Shift-1]

13. Identify the correct statement for the below given transformation.

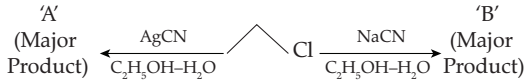


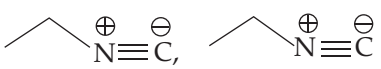
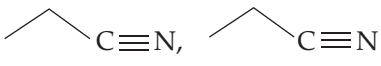
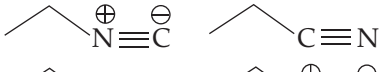
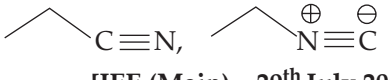
(1) A – $CH_3CH_2CH=CH-CH_3$, B – $CH_3CH_2CH_2CH=CH_2$, Saytzeff products
(2) A – $CH_3CH_2CH=CH-CH_3$, B – $CH_3CH_2CH_2CH=CH_2$, Hofmann products
(3) A – $CH_3CH_2CH_2CH=CH_2$, B – $CH_3CH_2CH=CHCH_3$, Hofmann products
(4) A – $CH_3CH_2CH_2CH=CH_2$, B – $CH_3CH_2CH=CHCH_3$, Saytzeff products

[JEE (Main) – 28th July 2022 - Shift-1]

14. Arrange the following in increasing order of reactivity towards nitration.
A. p–xylene B. bromobenzene
C. mesitylene D. nitrobenzene
E. benzene
Choose Correct answer from the options given below:
(1) C<D<E<A<B **(2)** D<B<E<A<C
(3) D<C<E<A<B **(4)** C<D<E<B<A

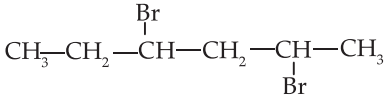
[JEE (Main) – 28th July 2022 - Shift-2]

15. 

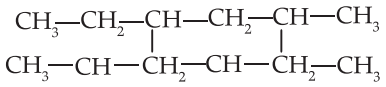
Considering the above reactions, the compound 'A' and compound 'B' respectively are :
(1) 
(2) 
(3) 
(4) 

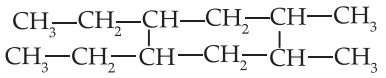
[JEE (Main) – 29th July 2022 - Shift-1]

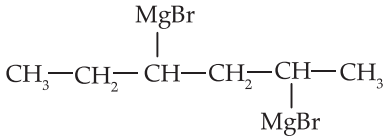
16. The product formed in the first step of the reaction

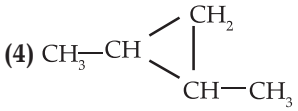


with excess $Mg/Et_2O(Et = C_2H_5)$ is :

(1) 

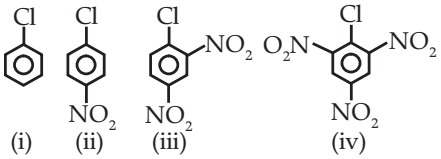
(2) 

(3) 

(4) 

[JEE (Main) – 24th Feb 2021 - Shift-1]

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



(1) (iv) < (i) < (iii) < (ii)

(2) (iv) < (i) < (ii) < (iii)

(3) (i) < (ii) < (iii) < (iv)

(4) (iv) < (iii) < (ii) < (i)

[JEE (Main) – 24th Feb 2021 - Shift-2]

18. What is the correct sequence of reagents used for converting nitrobenzene into *m*-dibromobenzene ?

(1) $\xrightarrow{Sn/HCl} / \xrightarrow{Br_2} / \xrightarrow{NaNO_2} / \xrightarrow{NaBr}$

(2) $\xrightarrow{Sn/HCl} / \xrightarrow{KBr} / \xrightarrow{Br_2} / \xrightarrow{H^+}$

(3) $\xrightarrow{NaNO_2} / \xrightarrow{HCl} / \xrightarrow{KBr} / \xrightarrow{H^+}$

(4) $\xrightarrow{Br_2/Fe} / \xrightarrow{Sn/HCl} / \xrightarrow{NaNO_2/HCl} / \xrightarrow{CuBr/HBr}$

[JEE (Main) – 24th Feb 2021 - Shift-2]

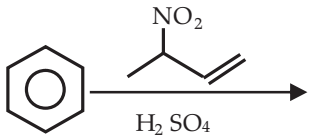
19. Water does not produce CO on reacting with :

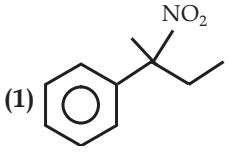
(1) C_3H_8 **(2)** C

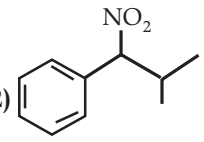
(3) CH_4 **(4)** CO_2

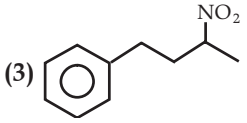
[JEE (Main) – 25th Feb 2021 - Shift-2]

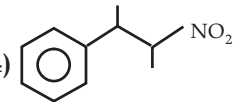
20. The major product of the following reaction is :



(1) 

(2) 

(3) 

(4) 

[JEE (Main) – 25th Feb 2021 - Shift-2]

21. The correct sequence of reagents used in the preparation of 4-bromo-2-nitroethyl benzene from benezene is :

(1) $CH_3COCl/AlCl_3$, $Br_2/AlBr_3$, HNO_3/H_2SO_4, Zn/HCl

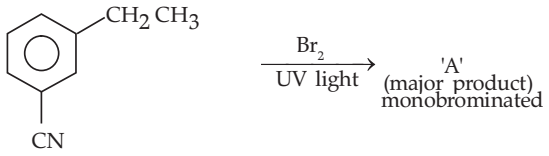
(2) $CH_3COCl/AlCl_3$, Zn-Hg/HCl, $Br_2/AlBr_3$, HNO_3/H_2SO_4

(3) $Br_2/AlBr_3$, $CH_3COCl/AlCl_3$, HNO_3/H_2SO_4, Zn/HCl

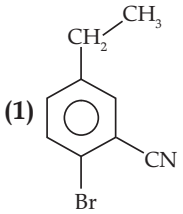
(4) HNO_3/H_2SO_4, $Br_2/AlCl_3$, $CH_3COCl/AlCl_3$, Zn-Hg/HCl

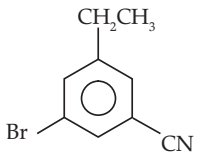
[JEE (Main) – 25th Feb 2021 - Shift-2]

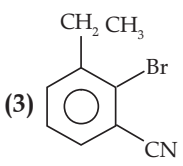
22. For the given reaction :

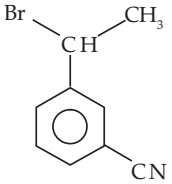


What is 'A' ?

(1) 

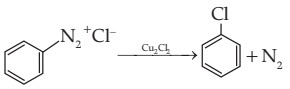
(2) 

(3) 

(4) 

[JEE (Main) – 26th Feb 2021 - Shift-1]

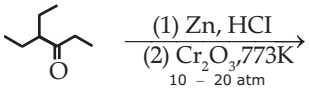
23. Match **List-I** with **List-II.**

List-I	List-II
(a) 	(i) Wurtz reaction
(b) 	(ii) Sandmeyer reaction
(c) $2CH_3CH_2Cl + 2Na \xrightarrow{Ether} C_2H_5 - C_2H_5 + 2NaCl$	(iii) Fittig reaction
(d) $2C_6H_5Cl + 2Na \xrightarrow{Ether} C_6H_5 - C_6H_5 + 2NaCl$	(iv) Gattermann reaction

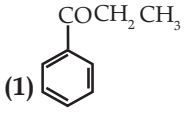
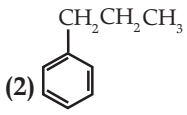
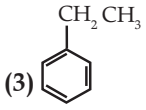
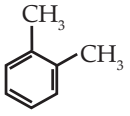
Choose Correct answer from the option given below:

(1) (a)-(ii), (b)-(i), (c)-(iv), (d)-(iii)
(2) (a)-(iii), (b)-(iv), (c)-(i), (d)-(ii)
(3) (a)-(ii), (b)-(iv), (c)-(i), (d)-(iii)
(4) (a)-(iii), (b)-(i), (c)-(iv), (d)-(ii)

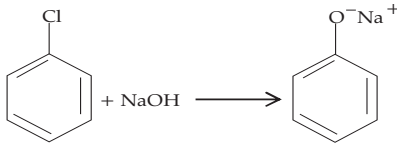
[JEE (Main) – 26th Feb 2021 - Shift-2]

24. 

Considering the above reaction, the major product among the following is:

(1) 
(2) 
(3) 
(4) 

[JEE (Main) – 26th Feb 2021 - Shift-2]

25. 

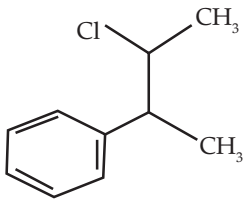
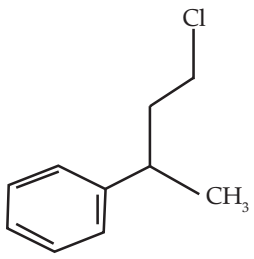
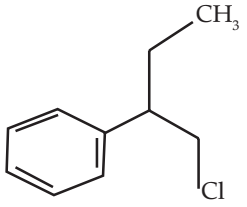
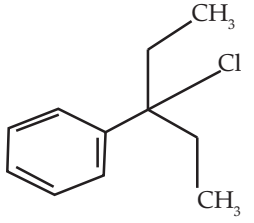
The above reaction requires which of the following reaction conditions ?

(1) 623 K, 300 atm **(2)** 573 K, 300 atm
(3) 573 K, Cu, 300 atm **(4)** 623 K, Cu 300 atm

JEE (Main) – 17th March 2021 - Shift-1]

26. Reaction of Grignard reagent, C_2H_5MgBr with C_8H_8O followed by hydrolysis gives compound "A" which reacts instantly with Lucas reagent to give compound B, $C_{10}H_{13}Cl$.

The compound B is :

(1) 
(2) 
(3) 
(4) 

[JEE (Main) – 18th March 2021 - Shift-1]

27. The species given below that does NOT show disproportionation reaction is :

(1) BrO^-_2 **(2)** BrO^-_4 **(3)** BrO^- **(4)** BrO^-_3

[JEE (Main) – 20th July 2021 - Shift-1]

28. Benzene on nitration gives nitrobenzene in presence of HNO_3 and H_2SO_4 mixture, where :

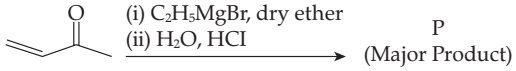
(1) HNO_3 acts as an acid and H_2SO_4 acts as a base.
(2) Both H_2SO_4 and HNO_3 act as a bases.
(3) HNO_3 acts as a base and H_2SO_4 acts as an acid.
(4) Both H_2SO_4 and HNO_3 act as an acids.

[JEE (Main) – 20th July 2021 - Shift-2]

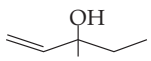
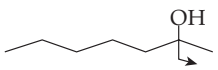
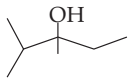
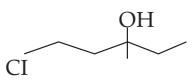
29. In Carius method, halogen containing organic compound is heated with fuming nitric acid in the presence of :

(1) $AgNO_3$ **(2)** HNO_3 **(3)** $BaSO_4$ **(4)** $CuSO_4$

JEE (Main) – 20th July 2021 - Shift-2]

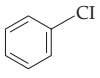
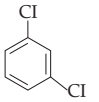
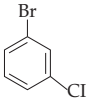
30. 

Consider the above reaction, the major product 'P' is:–

(1) 
(2) 
(3) 
(4) 

JEE (Main) – 25th July 2021 - Shift-1]

31. The correct decreasing order of densities of the following compounds is:

(1) 
(2) 
(3) 
(4) 

(1) (4) > (3) > (2) > (1) **(2)** (3) > (2) > (1) > (4)
(3) (3) > (4) > (1) > (2) **(4)** (1) > (2) > (3) > (4)

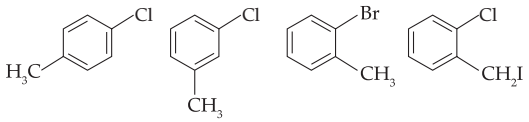
JEE (Main) – 25th July 2021 - Shift-2]

32. The correct sequential addition of reagents in the preparation of 3-nitrobenzoic acid from benzene is :

(1) $Br_2/AlBr_3$, NaCN, H_3O^+, HNO_3/H_2SO_4
(2) HNO_3/H_2SO_4, $Br_2/AlBr_3$, Mg/ether, CO_2, H_3O^+
(3) $Br_2/AlBr_3$, HNO_3/H_2SO_4, Mg/ether, CO_2, H_3O^+
(4) $Br_2/AlBr_3$, HNO_3/H_2SO_4, NaCN, H_3O^+

JEE (Main) – 26th Aug 2021 - Shift-1]

33. Among the following compounds I-IV, which one forms a yellow precipitate on reacting sequentially with (i) NaOH (ii) dil. HNO_3 (iii) $AgNO_3$?

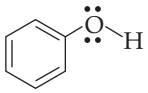


I II III IV

(1) III **(2)** IV **(3)** II **(4)** I

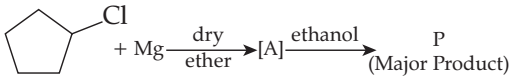
JEE (Main) – 26th Aug 2021 - Shift-1]

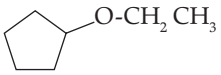
34 Which one of the following compounds is not aromatic?

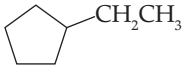
(1) 
(2) 
(3) 
(4) 

JEE (Main) – 26th Aug 2021 - Shift-2]

35. In the following sequence of reaction, P is :

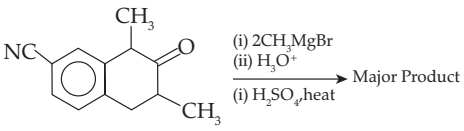


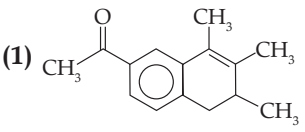
(1) 

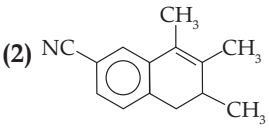
(2) 
(3) 
(4) 

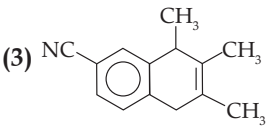
JEE (Main) – 27th Aug 2021 - Shift-1]

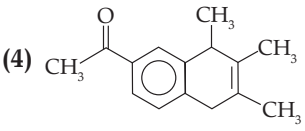
36. Which one of the following is the major product of the given reaction?



(1) 

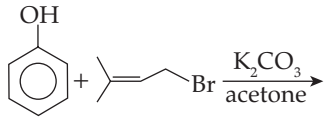
(2) 

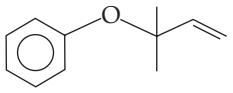
(3) 

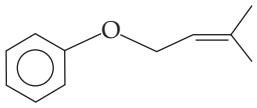
(4) 

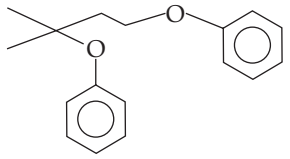
[JEE (Main) – 27th Aug 2021 - Shift-2]

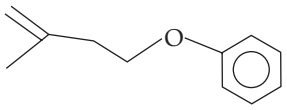
37. The major product of the following reaction, if it occurs by S_N2 mechanism is :



(1) 

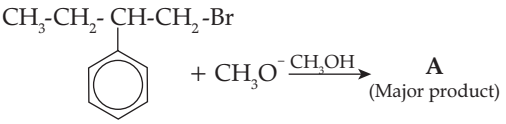
(2) 

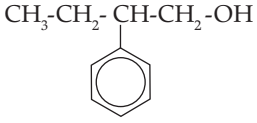
(3) 

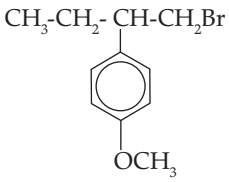
(4) 

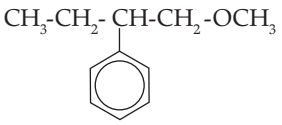
[JEE (Main) – 27th Aug 2021 - Shift-2]

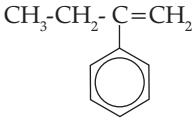
38. The major product **(1)** formed in the reaction given below is :



(1) 

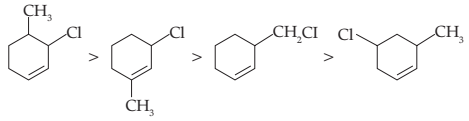
(2) 

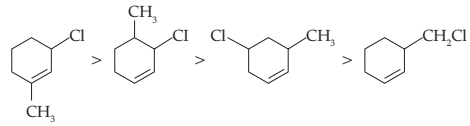
(3) 

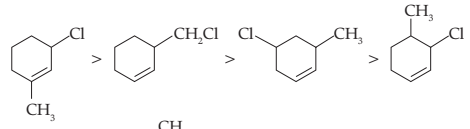
(4) 

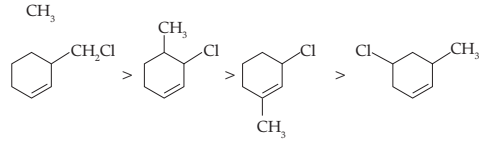
[JEE (Main) – 27th Aug 2021 - Shift-2]

39. The correct reactivity in the given chlorides with acetate in acetic acid is :

(1) 

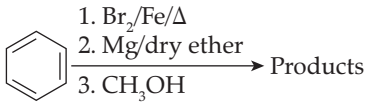
(2) 

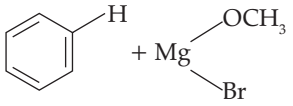
(3) 

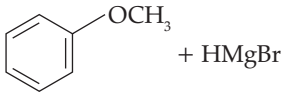
(4) 

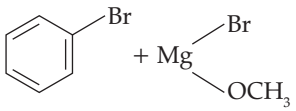
[JEE (Main) – 31st Aug 2021 - Shift-1]

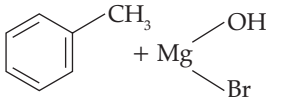
40. For the following sequence of reactions, the correct products are:



(1) 

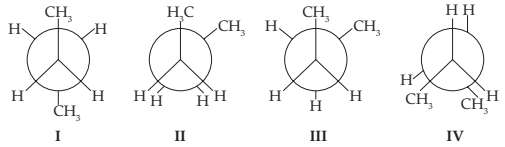
(2) 

(3) 

(4) 

[JEE (Main) – 31st Aug 2021 - Shift-2]

41. Arrange the following conformational isomers of n-butane in order of their increasing potential energy:



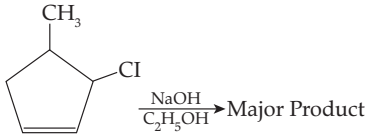
I II III IV

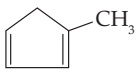
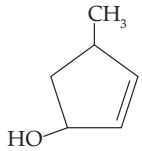
(1) II < III < IV < I **(2)** I < III < IV < II

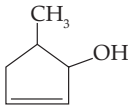
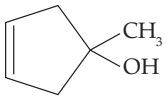
(3) I < IV < III < II **(4)** II < IV < III < I

[JEE (Main) – 31st Aug 2021 - Shift-2]

42. The major product of the following reaction is:



(1)  **(2)** 

(3)  **(4)** 

[JEE (Main) – 31st Aug 2021 - Shift-2]

43. $R - X \rightarrow [R^+]\,[X^-] \xrightarrow{Nu} R - Nu$

Which statement is/are correct for this reaction ?

(i) Polarity of solvent decreases then rate of reaction increases.

(ii) Strong nucleophile is more suitable for their reaction.

(iii) If R is bulky then carbocation become more stable

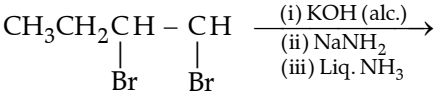
(iv) Racemisation take place in this reaction.

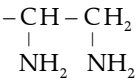
(1) Only (i) and (ii) **(2)** Only (ii) and (iv)

(3) (i), (ii) and (iv) **(4)** Only (iii) and (iv)

[JEE (Main) – 3rd Sept 2020 - Shift - 1]

44. The major product of the following reaction



(1) 

(2) $CH_3 - CH = CH\,CH_2\,NH_2$

(3) $CH_3 - CH = C = CH_2$

(4) $CH_3\,CH_2\,C \equiv CH$

[JEE (Main) –12th Jan 2019 - Shift-2]

ANSWER – KEY

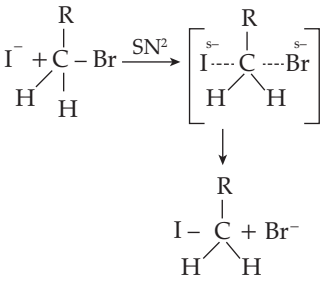
1. (2)	2. (1)	3. (4)	4. (2)
5. (1)	6. (2)	7. (2)	8. (3)
9. (4)	10. (2)	11. (1)	12. (3)
13. (3)	14. (2)	15. (3)	16. (3)
17. (3)	18. (4)	19. (4)	20. (4)
21. (2)	22. (4)	23. (3)	24. (3)
25. (1)	26. (4)	27. (2)	28. (3)
29. (1)	30. (3)	31. (1)	32. (2)
33. (2)	34. (1)	35. (2)	36. (1)
37. (2)	38. (4)	39. (2)	40. (1)
41. (2)	42. (1)	43. (4)	44. (4)

ANSWERS WITH EXPLANATIONS

1. Option (2) is correct.

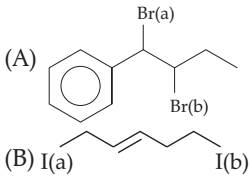
$$RCH_2Br + I^- \xrightarrow{\text{Acetone}} RCH_2I + Br^-$$

The above reaction is an halogen exchange reaction which occurs via S_N2 mechanism as there is a primary halide (RCH_2Br). Thus, the transition state is formed in this reaction is less polar than the localized anion. It is a single step reaction which thus there will be no RDS. Also I^- is a better nucleophile than Br^-.



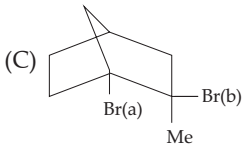
2. Option (1) is correct.

Organic compounds are more reactive towards S_N1, if the carbocation is stable compared to others. Reactivity in reactions depends upon the stability of the carbocation intermediate.

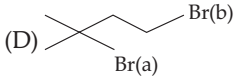


→ Br(a), Becuase formed intermediate carbocation get stable by conjugation with phenyl ring

→ I(a), Becuase formed intermediate carbocation become more stable by conjugation



→ Br(b), Becuase we can't remove Br(a) from bridge head carbon (Bredt's rule



→ Br(a), because formed intermediate 3° carbocation is more stable (stability of carbocation 3° > 2° > 1°)

3. Option (4) is correct.

(A) Steric hindrance (crowding) is the basis of S_N2 reaction.

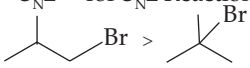
$$\text{Rate of } S_N2 \propto \frac{1}{\text{Steric crowding at 'C' bearing leaving group}}$$

As steric hinderance (crowding) increases, rate of S_N2 reaction decreases.

Note : The order of reactivity towards S_N2 reaction for alkyl halides is:

Methyl > Primary halides (1°) > (2°) > Tertiary halides(3°)

S_N2 → for S_N2 Reaction 1° > 2° > 3°

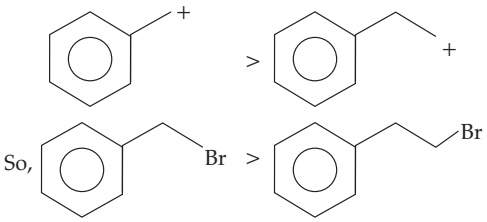


(B) Reactivity of S_N1 reaction depends on the stability of the carbocation formed. Higher the stability of carbocation, higher will be its reactivity.

Stability of carbocation follows the order,

Tertiary > Secondary > Primary

(B) S_N1 → reactivity × Stability of Carbocation formed



The rate of electrophilic substitution depends on the nature of the substituent already present in the benzene ring.

(C) If the substituent is *o/p* directing (activating groups) then the rate of substitution increases. If it is meta directing (deactivating groups) then the rate of substitution decreases. Electron-withdrawing groups destabilize the carbocation intermediate of electrophilic aromatic substitution. All activating substituents increase the rate of electrophilic aromatic substitution and are ortho-para directors.

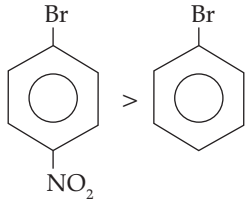
Electrophilic Substitution reaction

$$\text{rate} \propto \frac{1}{EWG}$$

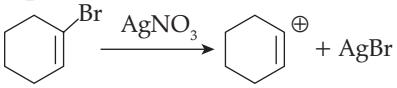
The presence of nitro group ($-NO_2$) at ortho/para positions increase the reactivity of haloarenes towards nucleophilic substitution reaction.

This is because nitro group ($-NO_2$) at *o/p* positions withdraw the electrons from the benzene ring which facilitates the attack of the nucleophile. The negative charge in the carbanion formed at o/p positions with respects to halogen atom is stabilized by the presence of nitro groups ($-NO_2$) and resonance respectively.

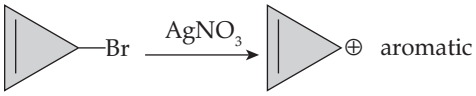
(D) Nueleophilic substitution: rate × no. of EWG attached at benzene

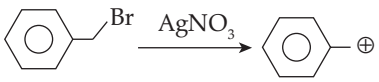


4. Option (2) is correct.

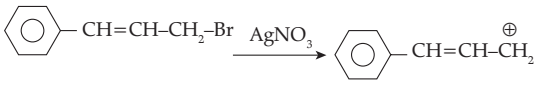


The above reaction do not takes place as we obtained unstable vinyl carbocation. While in other case stable carbocation is formed.



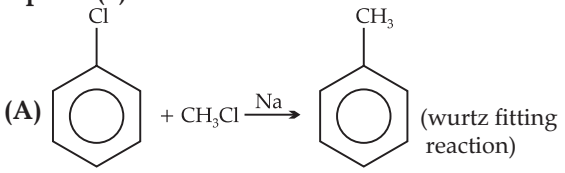


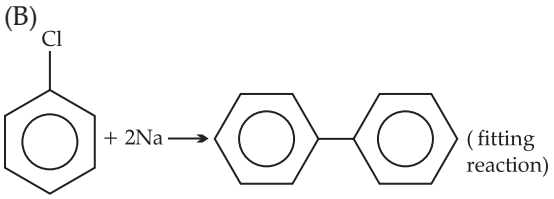
Benzylic carbocation

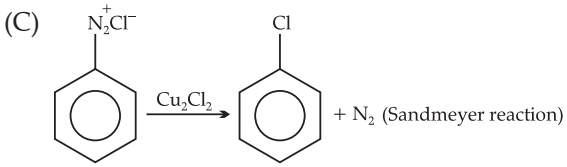


allylic carbocation

`5. Option (1) is correct.





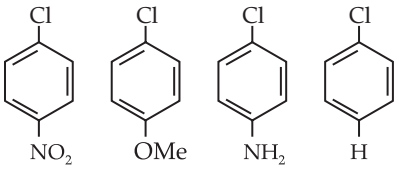


(D) $C_2H_5Cl + NaI \rightarrow C_2H_5I + NaCl$

Finkelstein reaction

6. Option (2) is correct.

The reactivity order of the given aryl halides towards S_N1 reaction will be decided by the stability of their corresponding carbocations.



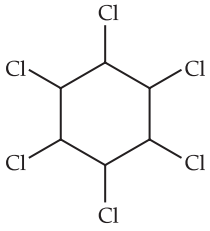
(a) (b) (c) (d)

The benzyl carbocation is stabilised by resonance. The presence of $-NH_2$ group at the p–position promotes the resonance stabilisation due to +R effect. The –OMe group also promotes but to a lesser extent due to higher electronegativity of O–atom than N– atom. The $-NO_2$ group opposes the resonance stabilisation due to its –R effect.

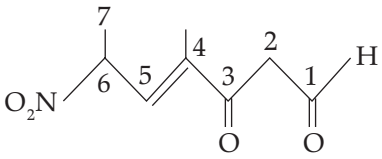
∴ The correct order is $b > d > c > a$.

7. Option (2) is correct.

Gammaxene has six chlorine atoms per molecule.



8. Option (3) is correct.



The maximum number of carbon atom in the main chain is 7, so the root word for the main chain is hept. Similarly the major functional group present in the given molecule is –CHO whose suffix is "–al".

The IUPAC name of the given molecule is 4-methyl-6-nitro-3-oxohept-4-enal

9. Option (4) is correct.

The polarity of Solvent has been related to R_f value of nitro compounds. 100 mg p-nitro-phenol and picric acid have different R_f value on silica gel plate

∴ Preparative TLC is best to separate 100 mg of para nitrophenol and picric acid.

10. Option (2) is Correct.

The correct decreasing order of priority of functional group in naming of organic compounds as per IUPAC system of nomenclature is:-

$$-SO_3H > -\overset{\overset{O}{\|}}{C}-Cl > -\overset{\overset{O}{\|}}{C}-NH_2 > -CN$$

11. Option (1) is correct.

Given:

Mass of organic compound = 0.45 gm

Mass of AgBr obtained = 0.36 gm

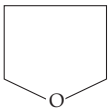
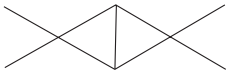
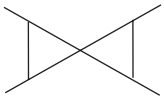
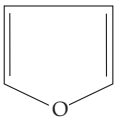
Formula used:

$$\text{Mass of bromine} = \frac{\text{mass of AgBr obtained} \times \text{molar mass of bromine}}{\text{molar mass of AgBr}}$$

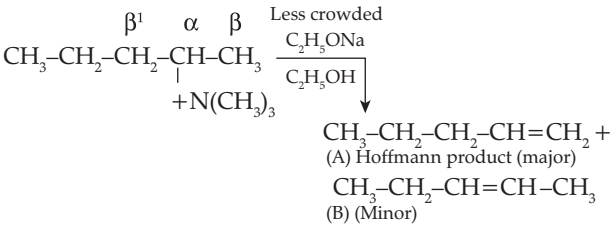
$$\text{Mass of bromine} = \frac{0.36 \times 80}{188} = 0.1532 \text{ gm}$$

$$\%\ \text{of bromine in compound} = \frac{0.1532 \times 100}{0.45} = 34.04\%$$

12. Option (3) is correct.

List – I	List – II
(A) 	Non–planar Heterocyclic compound
(B) 	Bicyclo compound
(C) 	Spiro compound
(D) 	Aromatic compound

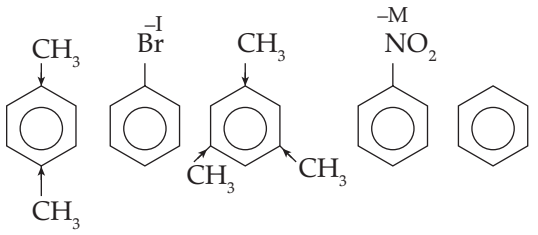
13. Option (3) is correct.



In this reaction major product Pent-1-ene and minor product Pent-2-ene formed.

14. Option (2) is correct.

D<B<E<A<C



A. p-xylene $-CH_3$ is activating group for nitration

B. bromobenzene –Br is deactivating group

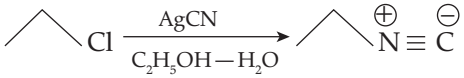
C. mesitylene $-CH_3$ is activating group

D. nitrobenzene $-NO_2$ is a strong deactivating group

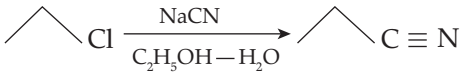
E. benzene –NO group present

15. Option (3) is correct.

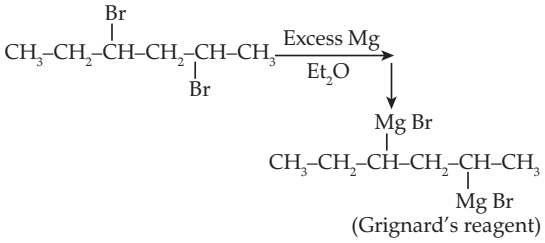
The bond between AgCN is not just same, it will not easily broke as the bond between C and N in AgCN is triple bond . AgCN is mainly covalent in nature and nitrogen is free to donate electron pair forming isocyanide as the main product.



NaCN contains both ionic and covalent bonds. NaCN is present in the form of Na^+ and CN^- ions which form ionic bonds. The cyanide ion contains covalent bonds between C and N atoms.



16. Option (3) is correct.

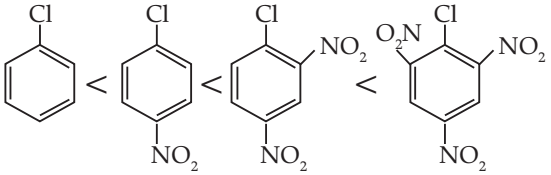


17. Option (3) is correct.

A few specially substituted benzenes do undergo reaction towards nucleophilic substitution. The nitro group is electron withdrawing group and ring deactivating.

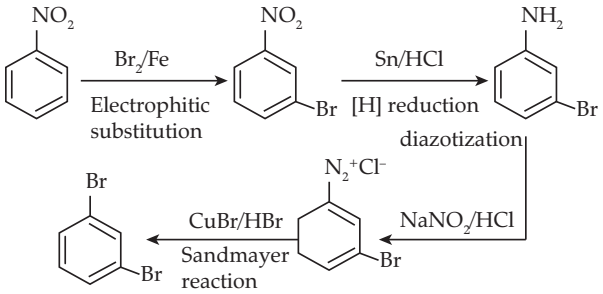
Greater the number of such groups at O & P positions w.r.t. the halogen more reactive is the haloarene towards nuclephilic attack.

Hence, the order towards nucleophilic substitution is



18. Option (4) is correct.

From nitrobenzene to *m*–dibromobenzene can be prepared by maintaining the sequence of reaction as follows.

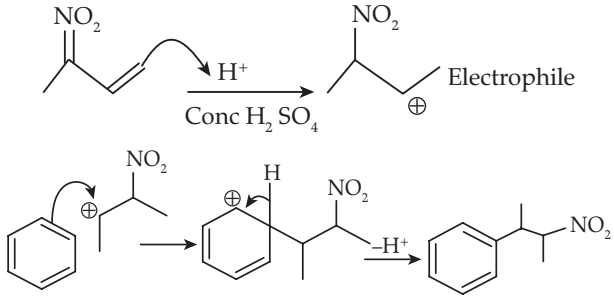


19. Option (4) is correct.

When CO_2 reacts with H_2O forms carbonic acids.

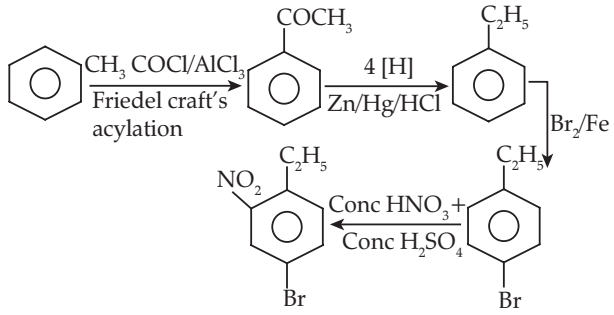
$CO_2 + H_2O \rightarrow H_2CO_3$

20. Option (4) is correct.



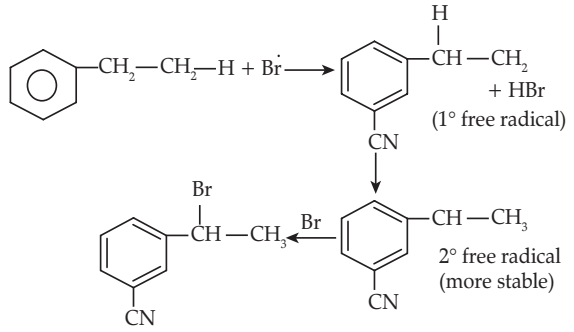
21. Option (2) is correct.

4–bromo–2–nitro ethyl benzene can be prepared by the following reactions.

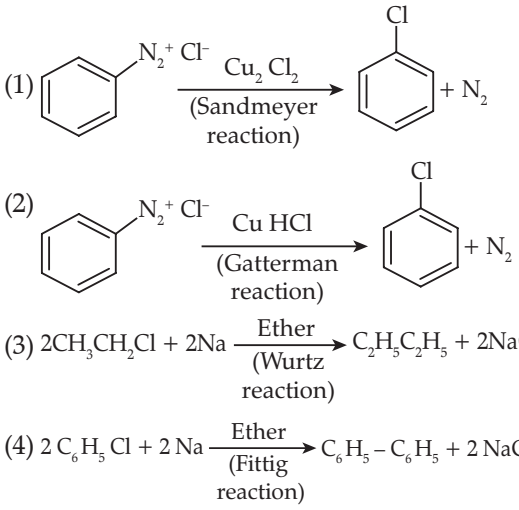


22. Option (4) is correct.

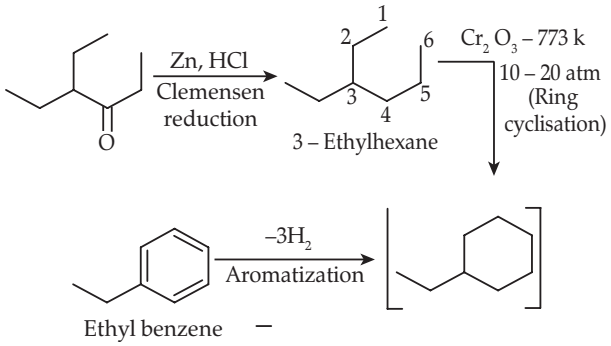
$$Br_2 \xrightarrow[\text{UV light}]{h\nu} Br + Br$$



23. Option (3) is correct.

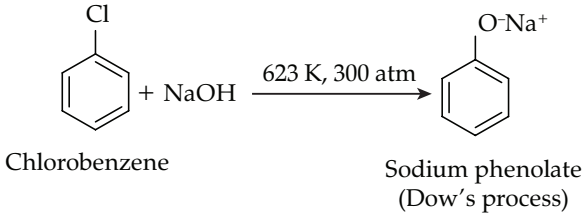


24. Option (3) is correct.

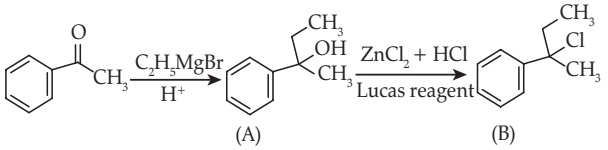


25. Option (1) is correct.

The reaction conditions required for the following reaction is : 623 K, 300 atm



26. Option (4) is correct.



27. Option (2) is correct.

A disproportionation reaction refers to the redox reaction in which simultaneous oxidation and reduction of same species of one oxidation state takes place to give two species with two different oxidation states. It is also known as dismutation reaction.

The condition for disproportionation reaction is that the element should exhibit atleast 3 different oxidation states and the element must be less stable in a particular oxidation state from which it can undergo both oxidation and reduction to produce species with relatively stable oxidation state.

The oxidation states of Br in BrO_2^-, BrO_4^-, BrO^- and BrO_3^- are +4, +7, +1 and +5 respectively. The highest oxidation state of bromine is +7.

Out of above species, BrO_4^- does not undergo disproportion since in this anion, bromine is already present in the highest oxidation of +7 and hence cannot be further oxidized.

All the remaining species will undergo disproportionation as they contain bromine in oxidation state lower than that of +7 oxidation state.

Hence, the species that does NOT show disproportionation reaction is BrO_4^-.

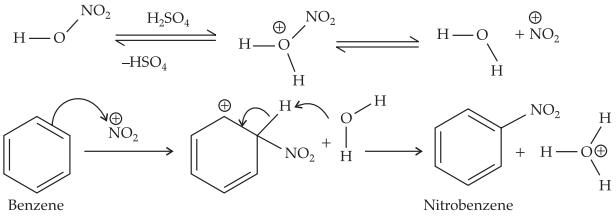
28. Option (3) is correct.

The nitration of benzene is an example of electrophilic substitution reaction.

Nitration of benzene occur when one (or more) of the hydrogen atoms on the benzene ring are replaced by a nitro group.

During the reaction, benzene is treated with a mixture of concentrated nitric acid and concentrated sulphuric acid at a temperature not exceeding 50°C for about 30 minutes, producing a yellow oily liquid, nitrobenzene.

The mechanism of the reaction is shown below.



The mechanism shows that, the sulphuric acid acts a source of proton for nitric acid thus producing an electrophile, nitronium ion, NO_2^+. The nitronium ion which is a base acts as an electrophile.

Therefore, during nitration of benzene HNO_3 acts as a base and H_2SO_4 acts as an acid.

Hint : The nitration of benzene takes place by reaction benzene with the mixture of HNO_3 and H_2SO_4. The sulphuric acid provides proton to protonate HNO_3. The HNO_3 provides electrophile NO_2^+ ion.

29. Option (1) is correct.

In Carius method, an organic compound is heated with fuming nitric acid in presence of silver nitrate in presence of silver nitrate in a tube, known as Carius tube.

The halogens present in organic compound will react with silver nitrate to produce corresponding silver halide. The C and H present in the compound will get oxidized to give carbon dioxide and water respectively.

The different silver halides will produce different coloured precipitate.

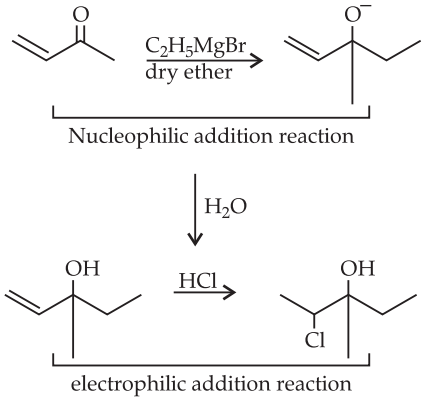
$$Cl^-(aq) \xrightarrow{AgNO_2} AgCl\downarrow_{ppt} \text{ white}$$

$$Br^-(aq) \xrightarrow{AgNO_2} AgBr\downarrow_{ppt} \text{ pale yellow}$$

$$I^-(aq) \xrightarrow{AgNO_2} AgNO_3\ AgI\downarrow_{ppt} \text{ Dark yellow}$$

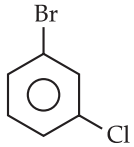
In Carius method, halogen containing organic compound is heated with fuming nitric acid in the presence of $AgNO_3$.

30. Option (3) is correct.



31. Option (1) is correct.

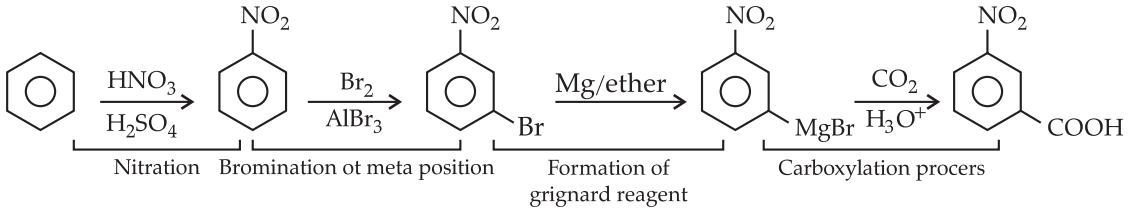
The density of the compound depends on the molar mass, higher the molar mass higher is the density from the given option:



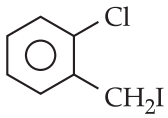
Having highest value of density.

So, correct option is 4 > 3 > 2 > 1.

32. Option (2) is correct.



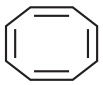
33. Option (2) is correct.



Removal of I^- forms AgI (yellow ppt). In other reaction, formation of halide ion is difficult because they are directly attached with stable aromatic ring.

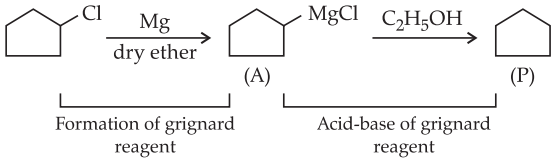
34. Option (1) is correct.

According to Huckel's rule, those species are aromatic which contain $(4n + 2)\pi\ e^-$, cyclic, conjugated and planar in structure.

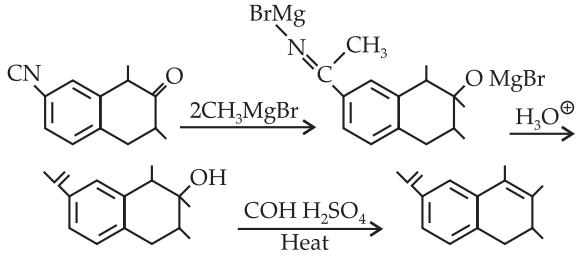


This molecule contains $8\pi\ e^-$ which do not satisfy Huckel Rule.

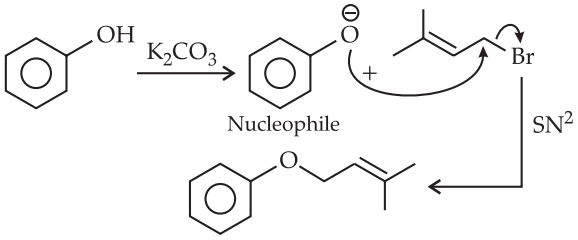
35. Option (2) is correct.



36. Option (1) is correct.



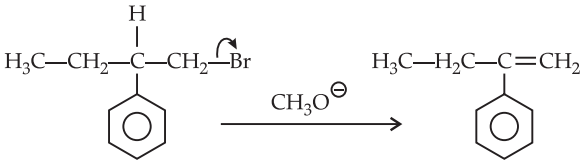
37. Option (2) is correct.



Here, attacking of nucleophile takes place on less hindered site.

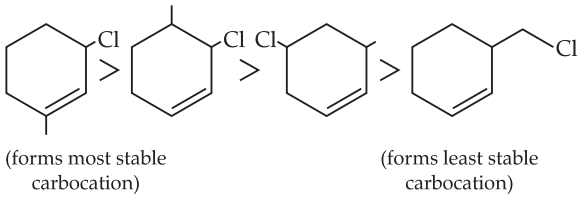
38. Option (4) is correct.

CH_3O^- is a strong base which tries to abstract H^+ ion from the reactant molecule to obtain alkene as a major product.

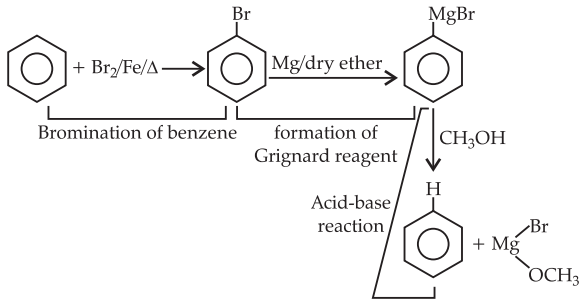


39. Option (2) is correct.

The given reactivity order belongs to S_N1 because acetate ion is a weak nucleophile which mainly attacks on carbocation. Here the reactivity of alkyl halide is given on the basis of carbocation stability. Higher the stability of carbocation, higher will be the rate of S_N1.



40. Option (1) is correct.



41. Option (2) is correct.

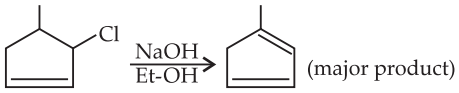
Stability order : I > III > IV > II because it is more stable due to less repulsion. The potential energy of structure (II) is high due to eclipsed structure while the potential energy of structure (i) is low due to staggered form.

So, the order of potential energy is:

$$I < III < IV < II$$

42. Option (1) is correct.

A mixture of NaOH & C_2H_5OH is called alcoholic NaOH which is a strong base and given E^2 reaction with alkyl halide to form alkene as a major product.

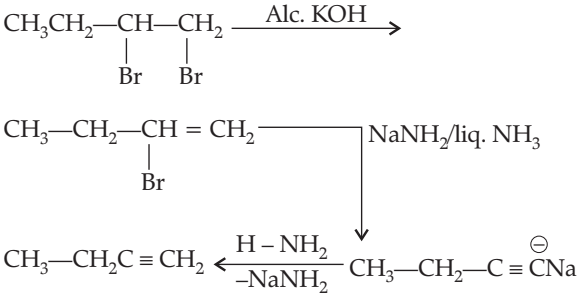


43. Option (4) is correct.

The given reaction follows S_N1 reaction mechanism. We know that for S_N1 reaction the order of alkyl halide is 3°> 2°> 1° and in S_N1 reaction racemisation takes place. Therefore the correct option is (d).

44. Option (4) is correct.

In first step HBr is eliminated by alcoholic KOH but in the second step HBr elimination can only be possible by using strong base like $NaNH_2$ liquid NH_3. In the last step Na-salt of acetylide is protonated which gives alkyne compound.



Integer Type Questions (Chapter Based)

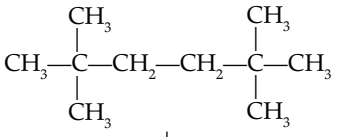
1. Maximum number of isomeric monochloro derivatives which can be obtained from 2, 2, 5, 5 tetramethylhexane by chlorination is _____.

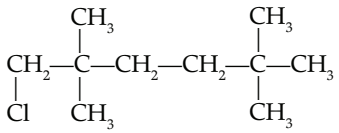
[JEE (Main) – 24th Jan 2023 - Shift-2]

Sol. Correct answer is [3].

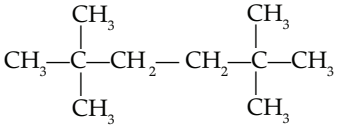
The number of isomeric morochloro derivatives which can be obtained from 2,2,5,5- tetramethyl hexane by chlorination are (3)

Structure of 2,2,5,5 – tetramethyl hexane





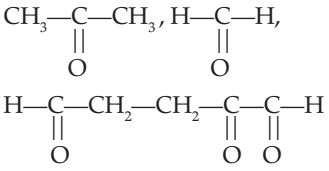
No Chiral carbon. So only only 1 product is obtained.



One chiral carbon is there. So two enantiomers would be obtained.

Total number of products including isomers = 3

2. 17mg of a hydrocarbon (M.F. $C_{10}H_{16}$) takes up 8.40 mL of the H_2 gas measured at 0°C and 760 mm of Hg. Ozonolysis of the same hydrocarbon yields:



The number of double bond/s present in the hydrocarbon is_____

[JEE (Main) – 29th Jan 2023 - Shift-1]

Sol. Correct answer is [3].

Molar Mass of Hydrocarbon = 10 (C) × 12 +16 (H) × 1

= 120 + 16=136 g

Mass of hydrocarbon = 17 mg

$= 17 \times 10^{-3}$ g

Number of moles of Hydrocarbon

$$(\text{M. F. } = C_{10}H_{16}) = \frac{\text{mass}}{\text{Molar Mass}}$$

$$= \frac{17 \times 10^{-3}\,\text{g}}{136} = 1.25 \times 10^{-4}$$

Moles of H_2 gas can be calculated by using ideal gas equation

PV = nRT

P = 760mm Hg = 1atm

V = 8. 40 mL = 8.4×10^{-3} L

T = 0^0C =273 K

$$R = 0.0821\ \frac{L \times atm}{K \times mol}$$

$$n = \frac{PV}{RT} = \frac{1atm \times 8.4 \times 10^{-3} L}{0.0821 \frac{L \times atm}{Kmol} \times 273K}$$

$n = 3.75 \times 10^{-4}$ mole

$$\text{No. of double bond} = \frac{\text{No of mol of } H_2}{\text{No. of mol of hydrocarbon}}$$

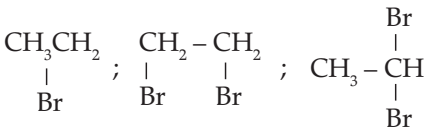
$$= \frac{3.75 \times 10^{-4}}{1.25 \times 10^{-4}} = 3$$

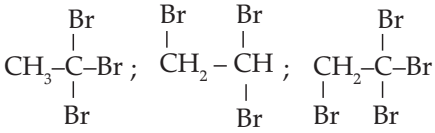
3. Number of bromo derivatives obtained on treating ethane with excess of Br_2 in diffused sunlight is _____

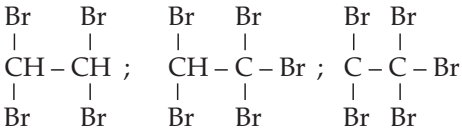
[JEE (Main) – 6th April 2023 - Shift-1]

Sol. Correct answer is [9].

Different bromo derivatives that are obtained on treating ethane with excess of Br_2 in diffused sunlight is



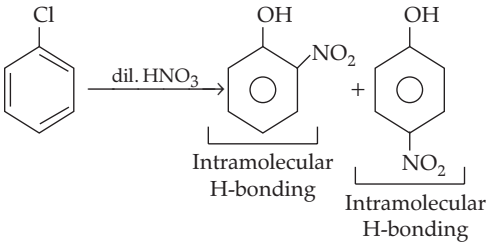


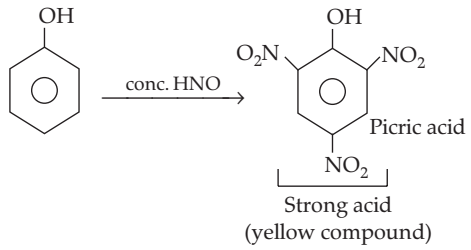


4. Compound 'P' on nitration with dil. HNO_3 yields two isomers **(1)** and (B). These isomers can be separated by steam distillation. Isomers **(1)** and **(2)** show the intramolecular and intermolecular hydrogen bonding respectively. Compound (P) on reaction with conc. HNO_3 yields a yellow compound 'C', a strong acid. The number of oxygen atoms is present in compound 'C' _____.

[JEE (Main) – 26th June 2022 - Shift-1]

Sol. Correct answer is [7].





Compound (P) on reaction with conc. HNO_3 yields a yellow compound 'C' a strong acid. The number of oxygen atoms is present in compound 'C' is 7

5. BeO reacts with HF in presence of ammonia to give [A] which on thermal decomposition produces [B] and ammonium fluoride. The oxidation state of Be in [A] is _____.

[JEE (Main) – 27th June 2022 - Shift-2]

Sol. Correct answer is [+2].

The total number of electrons that an atom either gains or loses to form a chemical bond with another atom is called oxidation number.

$BeO + 4HF + 2NH_3 \rightarrow (NH_4)[BeF_4] \rightarrow BeF_2 + NH_4F$

In BeF_2, Oxidation state of Be is +2

6. 0.25g of an organic compound containing chlorine gave 0.40 g of silver chloride in Carius estimation. The percentage of chlorine present in the compound is _____

[in nearest integer] (Given: Molar mass of Ag is 108 g mol^{-1} and that of Cl is 35.5 g mol^{-1})

[JEE (Main) – 27th June 2022 - Shift-2]

Sol. Correct answer is [40].

Weight of organic compound = 0.25 g

AgCl = 0.40 g

% of chlorine =

$$\frac{\text{molar mass of Cl}}{\text{molar mass of AgCl}} \times \frac{\text{weight of AgCl}}{\text{weight of organic compound}} \times 100$$

$$= \frac{35.5}{143.5} \times \frac{0.4}{0.25} \times 100$$

$$= 39.58 \approx 40\%$$

7. In the estimation of bromine, 0.5 g of an organic compound gave 0.40 g of silver bromide. The percentage of bromine in the given compound is _____ % (nearest integer)

(Relative atomic masses of Ag and Br are 108u and 80u, respectively)

[JEE (Main) – 28th June 2022 - Shift-1]

Sol. Correct answer is [34].

Given mass of an organic compound = 0.5 gm

Mass of silver bromide = 0.40 gm

Formula used:

$$\%\text{ of Br} = \frac{\text{molar mass of Br}}{\text{molar mass of AgBr}} \times \frac{\text{weight of AgBr}}{\text{weight of organic compound}}$$

$$\%\text{ of Br} = \frac{80}{188} \times \frac{0.4}{0.5} \times 100$$

$$\%\text{ of Br} = 34\%$$

8. While estimating the nitrogen present in an organic compound by Kjeldahl's method, the ammonia evolved from 0.25g of the compound neutralized 2.5 mL of 2 M H_2SO_4. The percentage of nitrogen present in organic compound is _____.

[JEE (Main) – 25th July 2022 - Shift-1]

Sol. Correct answer is [56].

NH_3 gas is neutralized by 2.5 mL of 2M H_2SO_4

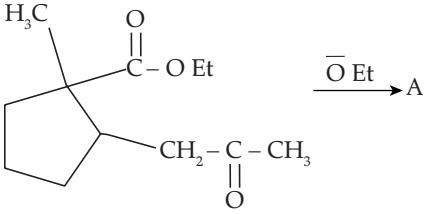
$\therefore$ Moles of NH_3 neutralized = $2.5 \times 2 \times 2$ millimole = 10×10^{-3} moles

$\therefore$ Weight of N present in compound will be
$= 10 \times 10^{-3} \times 14 = 0.14$ g

$\therefore$ % of 'N' in compound

$$= \frac{0.14}{0.25} \times 100 = 56\%$$

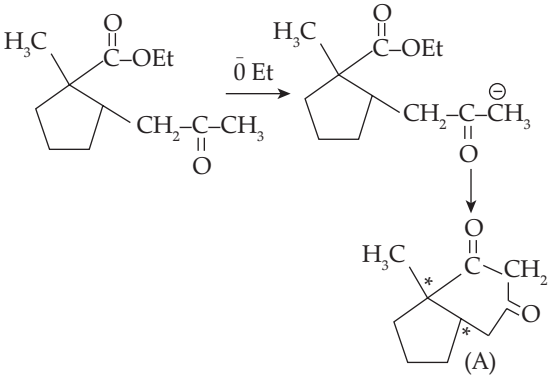
9. In the given reaction:



(Where Et is $-C_2H_5$)

The number of chiral carbon/s in product A is _____. **[JEE (Main) – 25th July 2022 - Shift-1]**

Sol. Correct answer is [2].



In this compound, there are two chiral carbon.

10. The number of non-ionisable protons present in the product B obtained from the following reaction is _____.

$C_2H_5OH + PCl_3 \rightarrow C_2H_5Cl + A$

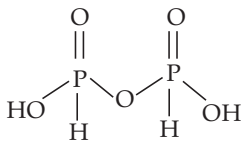
$A + PCl_3 \rightarrow B$

[JEE (Main) – 25th July 2022 - Shift-1]

Sol. Correct answer is [2].

$C_2H_5OH + PCl_3 \rightarrow C_2H_5Cl + H_3PO_3$

$H_3PO_3 + PCl_3 \rightarrow H_4P_2O_5 + HCl$



The number of non-ionisable proton = 2

11. In bromination of propyne, with bromine 1, 1, 2, 2-tetrabromopropane in 27% yield. The amount of 1, 1, 2, 2-tetrabromopropane obtained from 1 g of Bromine in this reaction is _____ $\times 10^{-1}$g. (Nearest integer)

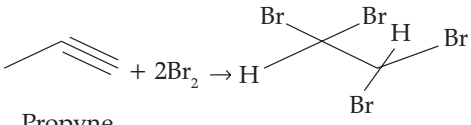
[JEE (Main) – 29th July 2022 - Shift-1]

Sol. Correct answer is [3].

1 mole of propyne reacts with 2 mole of bromine to form 1 mole of 1,1,2,2-tetrabromopropane. In this reaction, two molecules of bromine are added to carbon carbon triple bond.

2 mol Br_2 produce 1 mol (1, 1, 2, 2- tetrabromopropane

So,



Propyne

1, 1, 2, 2-tetrabromopropane
27% yield
MM= 360 g/mol

1 mol Br_2 produce

= (1/2) mole tetrabromopropane

1 g Br_2 is given

Mole of Br_2 = (1/160) mol

Amount of tetrabromopropane formed

$$= \left(\frac{1}{160}\right) \times \frac{1}{2} \times 360 \times \left(\frac{27}{100}\right) = 0.3037 \text{ g}$$

$= 3.037 \times 10^{-1}$ g

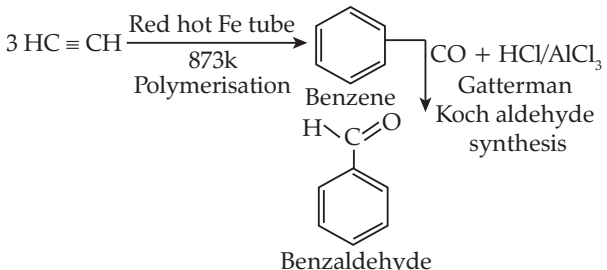
12. Consider the following chemical reaction.

$$HC \equiv CH \xrightarrow[(2)CO+HCl/AlCl_3]{(1)\text{Red hot Fe tube, } 873K} \text{Product}$$

The number of sp^2 hybridized carbon atom(s) present in the product is ..... .

[JEE (Main) – 25th Feb. 2021 - Shift-1]

Sol. Correct answer is [7].



Benzaldehyde

Therefore, total no. of sp^2 hybridized
Atom = 6 sp^2 (in benzene ring)
+ 1 sp^2 (in – CHO group)
= 7

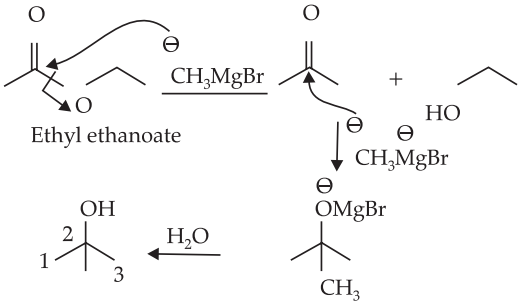
13. To synthesise 1.0 mole of 2-methylpropan-2-ol from ethylethanoate _____ equivalents of CH_3MgBr reagent will be required. (Integer value) **JEE (Main) – 20th July 2021 - Shift-1]**

Sol. Correct answer is [2].

The ethyl ethanoate reacts with 1 mole of CH_3MgBr, Grignard reagent to acetone and

ethanol. The Grignard reagent attaches carbonyl C in ethyl ethanoate and simultaneous breaking of second oxygen atom from the ester occur.

In the next step, second mole of Grignard reagent reacts with acetone, in which Grignard reagent attacks carbonyl C atom and an addition reaction takes place to produce an adduct. The adduct on further hydrolysis yields 2-methylpropan-2-ol.



2 – Methylporpan - 2 ol

To synthesise 1.0 mole of 2-methylpropan-2-ol from ethylethanoate 2 equivalents of CH_3MgBr reagent will be required.

14. The number of acyclic structural isomers (including geometrical isomers) for pentene are _____.

[JEE (Main) – 22nd July 2021 - Shift-2]

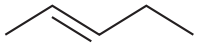
Sol. Correct answer is [6].

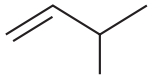
Hint : The acyclic structures of pentene means only chain structures, not ring structure.

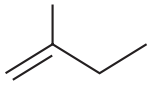
The molecular formula of pentene is C_5H_{10} and there is a presence of one double bond in the molecule.

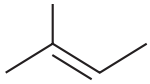
The different acyclic structures of pentene, including geometrical isomers are:

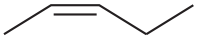
(1)  Pent-1-ene

(2)  Trans-Pent-2-ene

(3)  3-Methyl But-1-ene

(4)  2-Methyl But-1-ene

(5)  2-Methyl But-2-ene

(6)  cis-Pent-2-ene

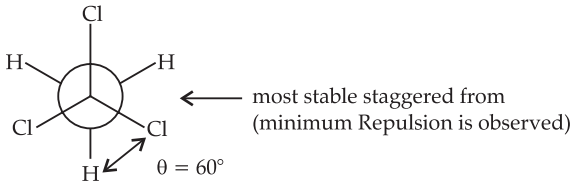
There are total 6 isomers. The structures of isomers are obtained by arranging C atoms in different manner, in a straight chain or in branched manner.

Final Answer: The number of acyclic structural isomers (including geometrical isomers) for pentene are 6.

15. The dihedral angle in staggered form of Newmann projection of 1, 1, 1-Trichloro ethane is_____ degree. (Round off to the nearest integer)

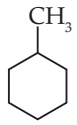
[JEE (Main) – 27th July 2021 - Shift-2]

Sol. Correct answer is (60°).

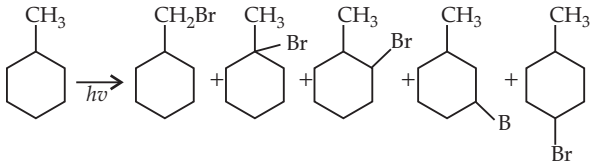


Most stable staggered form (minimum repulsion is observed).

16. How many types of alkyl bromide can be produced from mono bromination of 'X'?



Sol : Correct answer is [5]



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