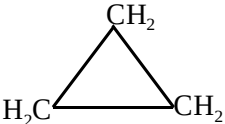
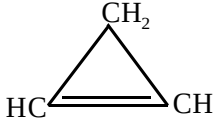
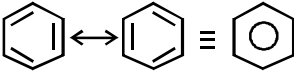


● Classification of Hydrocarbons

Simple organic compounds having only carbon and hydrogen are called hydrocarbons. Their is classification as follows :

Hydro carbon	Type	Characteristic	General formula	Bond	Example
Alkane	acyclic	saturated	$C_n H_{2n+2}$	$C - C$	$CH_3 - CH_2 - CH_3$ propane
	cyclic	saturated	$C_n H_{2n}$	$C - C$	 cyclo propane
alkene	acyclic	unsaturated	$C_n H_{2n}$	$C = C$	$CH_3 - CH = CH_2$ propene
	cyclic	unsaturated	$C_n H_{2n-2}$	$C = C$	 cyclo propene
alkyne	acyclic	unsaturated	$C_n H_{2n-2}$	$C \equiv C$	$CH_3 - C \equiv CH$ propyne
arene	cyclic	specific unsaturation	$C_n H_{2n-6m}$	alternate $C - C$ and $C = C$	 Benzene

● Classification of carbon atoms in hydrocarbon

- Carbon connected with one other carbon is called primary (1°) carbon.
- Carbon connected with two other carbon is called secondary (2°) carbon.
- Carbon connected with three other carbon is called tertiary (3°) carbon.
- Carbon connected with four other carbon is called quaternary (4°) carbon.

- Which of the following is a saturated hydrocarbon ?
 (A) Propene (B) Benzene (C) Cyclohexane (D) Acetylene
- Which of the following is isomer of cyclo alkene ?
 (A) cyclo alkane (B) alkyne (C) alkene (D) arene
- What is the general formula of cyclic alkene ?
 (A) $C_n H_{2n+2}$ (B) $C_n H_{2n-2}$ (C) $C_n H_{2n}$ (D) $C_n H_{2n+1}$
- Which of the following substance contains tertiary carbon ?
 (A) Propane (B) n – butane (C) 2 – Methyl propane (D) Methane

5. Which of the following compound is only acyclic ?
 (A) alkane (B) alkene (C) alkyne (D) arene
6. Which hydro carbon has 4° carbon ?
 (A) isobutane (B) n-hexane (C) neopentane (D) n-butane
7. In which of the following hydro carbon compound all four types of carbon (1°, 2°, 3°, 4°) are present ?
 (A) 2, 3-dimethyl butane (B) 2, 2 dimethyl butane
 (C) neo pentane (D) 2, 2, 3 trimethyl pentane
8. How many tertiary carbon atoms are present in 2, 3 dimethyl butane ?
 (A) 1 (B) 2 (C) 3 (D) 4
9. Number of 1°, 2°, and 3° hydrogen atoms present in neopentane are respectively.
 (A) 0, 12, 6 (B) 12, 2, 0 (C) 6, 2, 0 (D) 12, 1, 1
10. is example of alkyne.
 (A) C₅H₈ (B) C₈H₁₆ (C) C₉H₁₈ (D) C₇H₁₆

Answers : 1. (C), 2. (B), 3. (B), 4. (C), 5. (C), 6. (C), 7. (D), 8. (B), 9. (B), 10. (A)

● **General information, Nomenclature and isomerism in alkane**

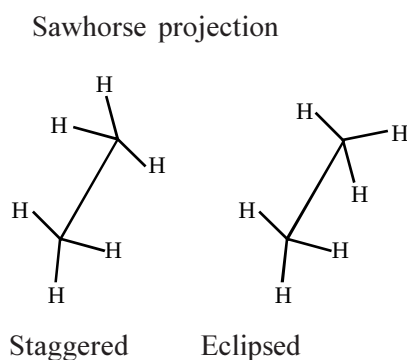
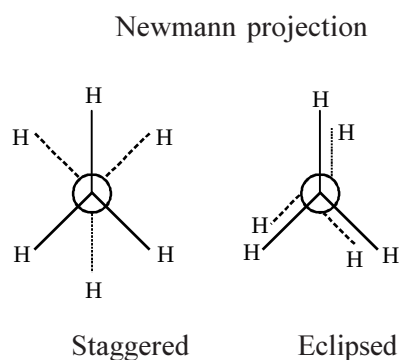
● **General Information :**

- sp³ hybridization and tetrahedral shape.
- C – C and C – H bond length 154 and 112 pm.respectively
- H – C – H bond angle 109° 28'
- **Nomenclature :** Refer Unit : 20
- **Isomerism :**

In alkane chain isomerism and conformational isomerism is observed. Out of which chain isomerism is discussed in unit 20.

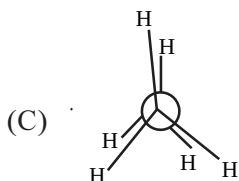
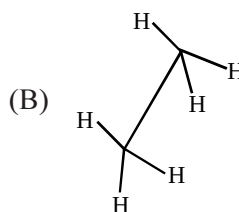
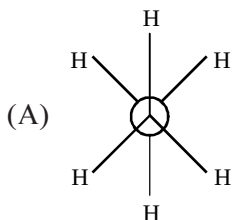
Conformational isomerism : In alkane C – C single bond can rotate along with its bond axis. As a result hydrogen or atoms connected with both carbon can arranged at different distance and various spatial arrangement become possible. These are known as conformer isomers or rotamers. Out of these two isomers **staggered** and **eclipsed** are important other isomers are in between two out of which **skew** or **gauche** is also important one.

Two conformer of ethane are as follows :



- In staggered structure hydrogen of both carbon are arranged far from each other hence repulsion is less so it is more stable. (dihedral angle 180°)
- In eclipsed structure hydrogen of both carbon are arranged closer (in diff plane) from each other hence, repulsion is more so stability is less (dihedral angle 0°)
- Out of staggered and eclipsed, staggered is more stable.
- Stability order for conformers of butane is as follows :
Staggered (anti) > Skew or Gauche > Partially eclipsed > Fully eclipsed
- In cyclohexane chair and boat conformers are observed out of which chair conformer is more stable.

11. In alkane compound C – H bond length and, H – C – H bond angle is respectively.
(A) 112 pm 120° (B) 112 pm, $109^\circ 28'$ (C) 154 pm, $109^\circ 28'$ (D) 135 pm, 180°
12. Which of the following is the structure of isobutyl group ?
(A) $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{CH}_2 -$ (B) $\text{CH}_3 - \underset{\text{CH}_3}{\text{CH}} - \text{CH}_2 -$
(C) $\text{CH}_3 - \underset{|}{\text{CH}} - \text{CH}_2 - \text{CH}_3$ (D) $(\text{CH}_3)_3 - \text{C} -$
13. Which sentence is incorrect with reference to isopentane ?
(A) It has three methyl group. (B) It has only one – CH_2 group.
(C) It has one – $\underset{|}{\text{CH}}$ group . (D) It has one quaternary carbon
14. Which of the following compound has isopropyl group ?
(A) 3, 3–dimethyl pentane (B) 2, 2, 3, 3–tetramethyl pentane
(C) 2–methyl pentane (D) 2, 2, 3–tri methyl pentane
15. Acidic saturated hydrocarbon has molar mass 72 gm/mol then how many isomers are possible for it ?
(A) 2 (B) 4 (C) 5 (D) 3
16. C – H bond length is least in
(A) C_2H_2 (B) C_2H_4 (C) C_2H_6 (D) $\text{C}_2\text{H}_2\text{Br}_2$
17. Which of the following is staggered conformer of ethane ?



(D) None of the three.

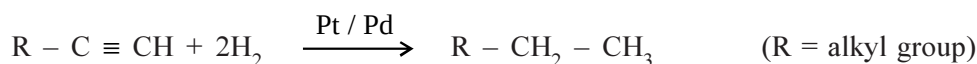
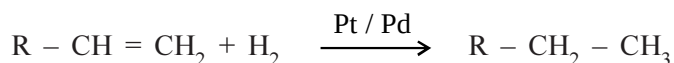
18. Out of four conformer of n-butane which one is most stable ?
 (A) eclipsed (B) partially eclipsed (C) staggered (D) gauche
19. Which structure of cyclo hexa triene is most stable ?
 (A) chair (B) boat (C) half chair (D) plannar
20. In which of the following cyclic structure maximum strain is observed ?
 (A) Cyclohexane (B) Cyclo pentane (C) Cyclo butane (D) Cyclo propane

Answers : 11. (B), 12. (B), 13. (D), 14. (C), 15. (D), 16. (C), 17. (A), 18. (C), 19. (D), 20. (D)

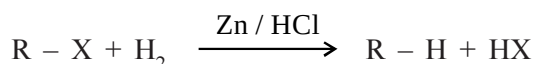
● **Preparation and properties of alkane**

● **Preparation :**

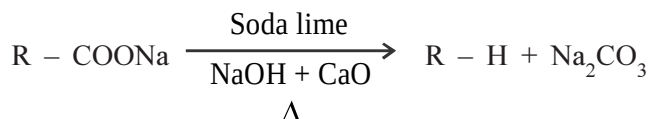
By hydrogenation of alkene and alkyne



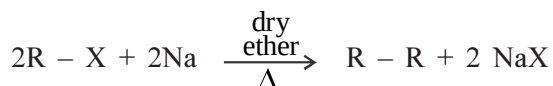
● Reduction of alkyl halide



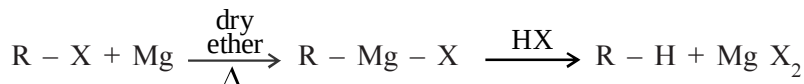
● By decarboxylation of sodium salt of carboxylic acid



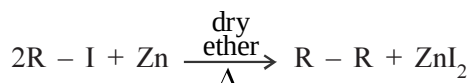
● Wurtz reaction



● Grignard reaction

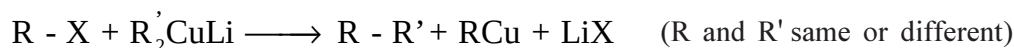


● Frankland reaction

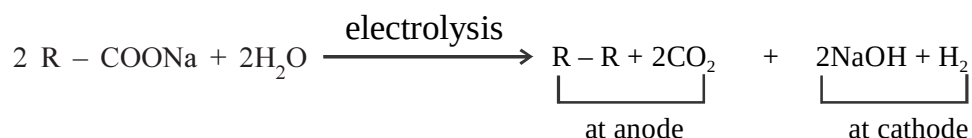


● By reduction of carbocyclic acid, aldehyde ketone and alcohol alkane is formed.

● Correy-house reaction



- Kolbe's electrolytic method

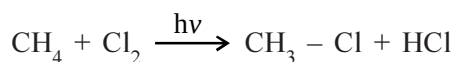


- **Physical properties**

- Alkane having C_1 to C_4 are gaseous, C_5 to C_{17} are liquid C_{18} or more than C_{18} are solids.
- In alkane series or number of carbon increases boiling point increases.
- As alkane is nonpolar insoluble in water but in non polar solvent like benzene it is soluble.
- In alkane boiling point decreases from $1^\circ \rightarrow 2^\circ \rightarrow 3^\circ$.

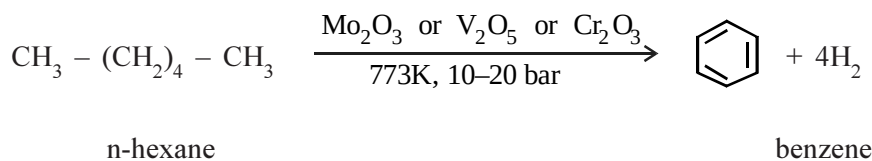
- **Chemical properties**

- **Halogenation** : Reactivity order $\text{F}_2 > \text{Cl}_2 > \text{Br}_2 > \text{I}_2$.

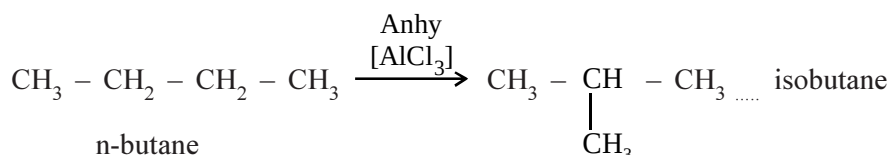


- **Reaction with steam** : $\text{CH}_{4(g)} + \text{H}_2\text{O}_{(g)} \xrightarrow[\Delta]{\text{Ni}} \underbrace{\text{CO}_{(g)} + \text{H}_{2(g)}}_{\text{water gas}}$

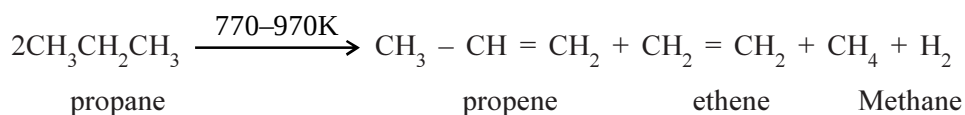
- **Arromatization** :



- **Isomerization** :



- **Racking** :



- **Nitration** : $\text{CH}_4 + \text{HNO}_3 \longrightarrow \text{CH}_3\text{NO}_2 + \text{H}_2\text{O}$
- Methane Nitro methane

- **Sulphonation** : $\text{C}_6\text{H}_{14} + \text{H}_2\text{SO}_4 \xrightarrow{675\text{K}} \text{C}_6\text{H}_{13} - \text{SO}_3\text{H} + \text{H}_2\text{O}$
- hexane hexane sulphonic acid

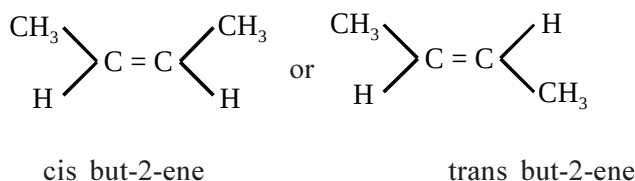
- **Oxidation** : $\text{CH}_{4(g)} + 2\text{O}_{2(g)} \xrightarrow{\Delta} \text{CO}_{2(g)} + 2\text{H}_2\text{O}_{(g)} + \text{heat}$

21. Conversion of but-1-ene into but-2-ene is done by reacting it with
 (A) Pd / H₂ (B) Zn / HCl (C) Sn / HCl (D) Zn – Hg
22. By which method propane can be obtained from propene ?
 (A) Wurtz reaction (B) Grignard reaction
 (C) Catalytic hydrogenation (D) Frankland reaction
23. In preparation of propane from propyne hybridization of carbon changes from
 (A) sp² to sp (B) sp² to sp³ (C) sp to sp³ (D) sp³ to sp
24. By which reaction butane can be prepared from ethyl chloride in one step ?
 (A) Wurtz reaction (B) Frankland reaction (C) Hydrogenation (D) Grignard reaction
25. Preparation of methane can be done by
 (A) hydrogenation (B) water reaction (C) decarboxylation (D) all the given
26. By which method alkene having same no of carbon can be prepared from halo alkane ?
 (A) Wurtz reaction (B) Grignard reaction (C) reduction (D) both (B) and (C)
27. Kolbe's electrolysis of sodium acetate gives
 (A) methane (B) ethane (C) ethene (D) acetic acid
28. has highest boiling point.
 (A) n-hexane (B) n-pentane
 (C) 2-methyl butane (D) 2, 2-dimethyl propane
29. Boiling point of neopentane is more than
 (A) iso pentane (B) n-pentane (C) butane (D) n-hexane
30. Benzene obtained from n-hexane by reaction.
 (A) isomerism (B) Cracking (C) rearrangement (D) cyclization
31. Kerosene is a mixture of
 (A) alkanes (B) aromatic compounds (C) alcohols (D) CO + H₂
32. Which compound gives methane by reaction with water ?
 (A) Al₄C₃ (B) CaC₂ (C) VC (D) SiC
33. For following conversion CH₃CH₂COOH → CH₃CH₂CH₃ which reagent is appropriate ?
 (A) LiAlH₄ (B) Sodalime (C) Red P / HI (D) Zn / HCl
34. Halogenation of alkane is example of which of the following ?
 (A) Electrophilic substitution (B) Nucleophilic substitution
 (C) Free radical substitution (D) addition reaction
35. Which paraffin is solid at room temperature ?
 (A) C₃H₈ (B) C₈H₁₈ (C) C₄H₁₀ (D) C₂₀H₄₂

Answers : 21. (A), 22. (C), 23. (C), 24. (A), 25. (C), 26. (D), 27. (B), 28. (A), 29. (C), 30. (D), 31. (A), 32. (A), 33. (C), 34. (C), 35. (D)

● **General information, Nomenclature and isomerism of alkene**

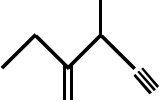
- sp^2 hybridization and trigonal planar shape
- C – C and C – H bond length 134 and 110 pm respectively
- H – C – H bond angle $116^\circ 6'$ and C – C – H bond angle $121^\circ 7'$
- **Nomenclature** : Refer Unit : 20
- **Isomerism** : Alkene has position isomerism, chain isomerism and geometrical isomerism position isomerism is discussed in unit 20.
- **Geometrical isomerism** : In some alkene compounds though their molecular and structural formula are same but atoms or groups arranged differently in space in different direction. Which is called geometrical isomerism. Geometrical isomers shown by cis and trans.
- This isomerism is observed in planar molecule having C = C.
- Due to restricted rotation around C = C geometrical isomerism arises.
- Two isomers of but-2-ene are as follows :



- Geometrical isomerism is observed in compounds like ab C = C ab, ab C = C ad ab C = C de but it is not observed in the compounds like ab C = C bb or aa C = Cab type of compounds.
- cis isomer is polar while trans isomer is non-polar.
- cis isomer has greater solubility in water than trans isomer.

36. In ethene C = C and C – H bond length is respectively.
 (A) 134, 112 (B) 154, 112 (C) 134, 110 (D) 139, 110
37. Shape of ethene molecule is
 (A) linear (B) tetrahedral (C) octahedral (D) trigonal planar
38. IUPAC name of $(\text{CH}_3)_2 \cdot \text{CH} - \text{CH} = \text{CH} - \text{CH} = \text{CH}$ is

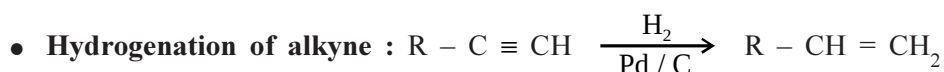
$$\begin{array}{c}
 | \\
 \text{CH} - \text{CH}_3 \\
 | \\
 \text{C}_2\text{H}_5
 \end{array}$$
 (A) 2, 7-dimethyl nona 3, 5-diene (B) 2, 7-dimethyl octa-3, 5-diene
 (C) 2-ethyl 7-methyl octa-3, 5-diene (D) 7-methyl non-3-ene

39. IUPAC name of  is
- (A) 4-ethyl 3-methyl pent-4-en-1-yne (B) 2-ethyl 4-methyl pent-1-en-4-yne
(C) 4-ethyl 3-Methyl pent-1-yne-4-ene (D) 2-ethyl 3-methyl pent-4-yne-1-ene
40. Which compound shows geometrical isomerism ?
(A) butane (B) but-1-ene (C) but-2-ene (D) but-2-yne
41. Number of possible alkene isomers of C_4H_8 is
(A) 2 (B) 3 (C) 4 (D) 5
42. In which of the following compound carbon has sp and sp^2 hybridization.
(A) propene (B) propyne
(C) propadiene (D) none
43. Hybridization of carbon atoms buta 1, 3-diene is type.
(A) sp, sp^2, sp^3 (B) sp^2, sp^3 (C) sp, sp^2 (D) Vöík sp^2
44. How many alkene isomers of C_5H_{10} are possible ?
(A) 7 (B) 5 (C) 4 (D) 6
45. Number of isomers of $C_2H_2Br_2$ is
(A) 1 (B) 2 (C) 3 (D) 0

Answers : 36. (C), 37. (D), 38. (A), 39. (B), 40. (C), 41. (C), 42. (C), 43. (D), 44. (D), 45. (C)

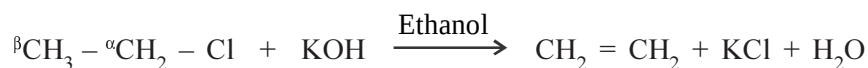
● **Preparation and properties of alkene**

(I) Preparation :

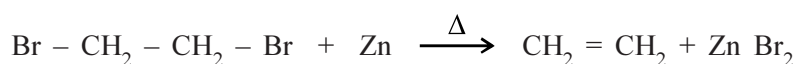


Lindler's catalyst

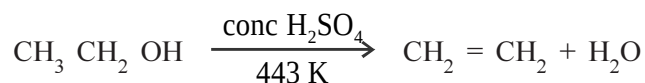
● **Dehydrohalogenation of alkylhalide (β - elimination reaction) :**



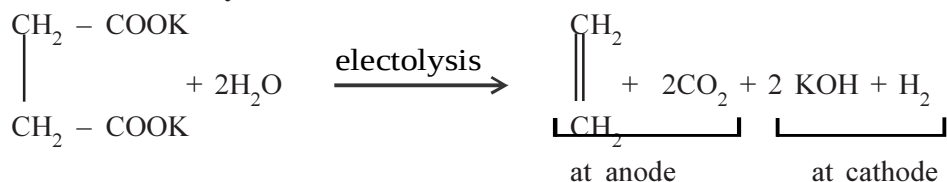
● **From vicinal dihalide :**



● **Dehydration of alcohol :**



• **Kolbe's electrolysis method :**



(II) Physical properties :

- Boiling point of alkyne is more than corresponding alkane due to polar nature.
- Boiling point of cis isomer is more than trans isomer.
- Melting point of trans alkene is more than cis isomer.
- Insoluble in water but soluble in organic solvent.
- In isomers boiling point decreases from $1^\circ \rightarrow 2^\circ \rightarrow 3^\circ$.

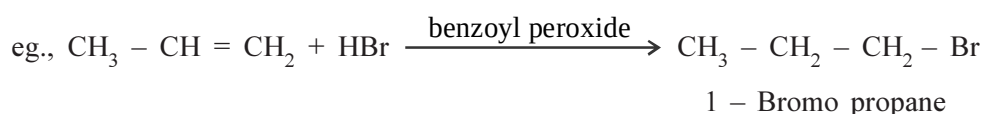
(III) Chemical Properties :

Due to π -bond alkene shows following additional reactions :

- Hydrogenation : $\text{CH}_2 = \text{CH}_2 + \text{H}_2 \xrightarrow[\Delta]{\text{Pt / Pd}} \text{CH}_3 - \text{CH}_3$
- Halogenation : $\text{CH}_2 = \text{CH}_2 + \text{X}_2 \longrightarrow \text{X} - \text{CH}_2 - \text{CH}_2 - \text{X}$ where, X = Cl, Br, I
- Hydrohalogenation :
 - (a) Symmetric alkene $\text{CH}_2 = \text{CH}_2 + \text{HX} \longrightarrow \text{CH}_3 - \text{CH}_2 - \text{X}$ (X = Cl, Br, I)
 - (b) Asymmetric alkene : $\text{CH}_3 - \text{CH} = \text{CH}_2 + \text{HX} \longrightarrow \text{CH}_3 - \underset{\text{X}}{\text{CH}} - \text{CH}_3$ 2-halo propane

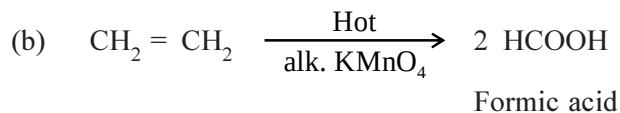
Note : Hydrohalogenation of asymmetric alkene follows Markovnikoff rule : As per this rule negative part of reagent. Combine with ethylenic carbon having less number of hydrogen.

- (c) Reaction of asymmetric alkene with HBr in presence of peroxide catalyst follows anti Markovnikoff rule. In this reaction negative part of reagent ($\bar{\text{X}}$) combines with ethylenic carbon having more number of hydrogen.

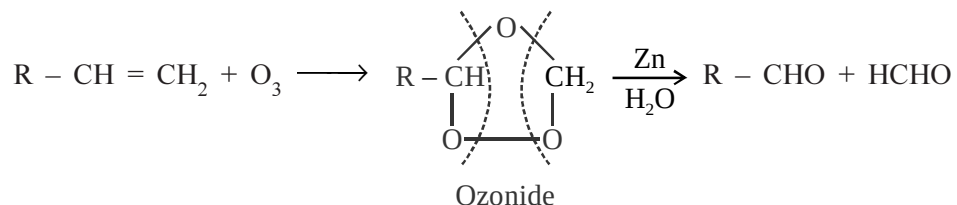


- This reaction do not take place with HCl or HI.
- Hydration : $\text{CH}_2 = \text{CH}_2 + \text{H}_2\text{O} \xrightarrow{\text{dil H}_2\text{SO}_4} \text{CH}_3 - \text{CH}_2 - \text{OH}$
 $\text{CH}_3 - \text{CH} = \text{CH}_2 + \text{H}_2\text{O} \xrightarrow{\text{dil H}_2\text{SO}_4} \text{CH}_3 - \underset{\text{OH}}{\text{CH}} - \text{CH}_3$ (Markovnikoff)
- Oxidation : (a) $\text{CH}_2 = \text{CH}_2 \xrightarrow[\text{alk. KMnO}_4]{\text{Cold}} \begin{array}{c} \text{CH}_2 - \text{CH}_2 \\ | \quad | \\ \text{OH} \quad \text{OH} \end{array}$
 ethylene glycol

During this reaction pink colour of KMnO_4 disappear it is known as Bayer's test for unsaturation.



● **Ozonolysis :**

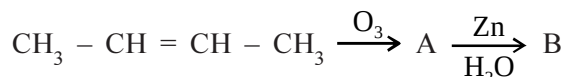


46. Which major product is obtained on reaction of chloro ethene with alcoholic KOH ?
 (A) ethane (B) ethene (C) ethanol (D) ethyne
47. $\text{CH}_3 - \underset{\text{Br}}{\text{CH}} - \text{CH}_2 - \text{CH}_3 \xrightarrow[\text{KOH}]{\text{alcoholic}}$ major product.
 (A) butane (B) but-1-ene (C) but-2-ene (D) butyne
48. Lindlar's catalyst is mixture of what ?
 (A) $\text{Ni} + \text{H}_2$ (B) Pt / H_2 (C) $\text{Pd} + \text{Pt}$ (D) $\text{Pd} + \text{charcoal}$
49. Which substance can form alkene by elimination reaction ?
 (A) haloalkane (B) dihaloalkane (C) alcohol (D) all
50. Which compound on heating with Zn gives but-2-ene ?
 (A) 2, 3-dibromobutane (B) 1, 2-dibromobutane
 (C) but-2-yne (D) None
51. is the gas which removes colour of basic KMnO_4 produced by reaction between ethyl iodide and alcoholic KOH.
 (A) C_2H_6 (B) C_2H_4 (C) C_2H_2 (D) CH_4
52. Preparation of alkene from vicinal dihalide known as
 (A) decarboxylation (B) dehydrohalogenation (C) dehalogenation (D) dehydrogenation
53. Product of $\text{CH}_3 - \underset{\text{OH}}{\overset{\text{CH}_3}{\text{C}}} - \text{CH}_3 \xrightarrow[\Delta]{\text{H}_2\text{SO}_4}$ is.
 (A) propene (B) but - 1 - ene (C) propanol (D) 2-methyl propene
54. $\text{CH}_3 - \text{CH}_2 - \text{CH} = \text{CH}_2 + \text{HBr} \longrightarrow \dots\dots\dots$
 (A) $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{CH}_3$ (B) $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{CH}_2 - \text{Br}$
 (C) $\text{CH}_3 - \text{CH}_2 - \underset{\text{Br}}{\text{CH}} - \text{CH}_3$ (D) $\text{CH}_3 - \text{CH}_2 - \text{C} \equiv \text{CH}$

55. $\text{CH}_2 = \text{CH} - \text{Cl} + \text{HCl} \longrightarrow \dots\dots$
 (A) $\text{CH}_3 - \text{CH}_2 - \text{Cl}$ (B) $\text{CH}_3 - \text{CHCl}_2$ (C) $\begin{array}{c} \text{CH}_2 - \text{CH}_2 \\ | \quad | \\ \text{Cl} \quad \text{Cl} \end{array}$ (D) $\text{CH} \equiv \text{CH}$
56. product is obtained on reaction between 2-methyl prop-1-ene and HBr in presence of benzoyl peroxide.
 (A) $\text{CH}_3 - \underset{\text{CH}_3}{\text{CH}} - \text{CH}_2\text{Br}$ (B) $\text{CH}_3 - \overset{\text{Br}}{\underset{\text{CH}_3}{\text{C}}} - \text{CH}_3$
 (C) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{Br}$ (D) $\text{CH}_3 - \text{CH}_2 - \underset{\text{Br}}{\text{CH}} - \text{CH}_3$
57. For the reaction of which of the following compounds Markonikoff rule is useful ?
 (A) $\text{C}_2\text{H}_4 + \text{HCl}$ (B) $\text{C}_3\text{H}_6 + \text{Br}_2$
 (C) $\text{C}_3\text{H}_6 + \text{HBr}$ (D) $\text{C}_2\text{H}_4 + \text{I}_2$
58. $\text{R} - \text{CH}_2 - \text{CH} = \text{CH}_2 + \text{ICl} \longrightarrow$
 (A) $\text{R} - \text{CH}_2 - \underset{\text{Cl}}{\text{CH}} - \text{CH}_2 - \text{I}$ (B) $\text{R} - \text{CH}_2 - \underset{\text{I}}{\text{CH}} - \text{CH}_2 - \text{Cl}$
 (C) $\text{R} - \text{CH}_2 - \underset{\text{I}}{\text{CH}} = \text{CH}_2$ (D) $\text{R} - \text{CH} = \text{CH} - \text{CH}_2 - \text{I}$
59. In presence of peroxide alkene do not give anti Markovnikoff reaction with HCl or HI because
 (A) both are highly ionic.
 (B) one is oxidising agent other is reducing agent.
 (C) In both case one step is endothermic.
 (D) In both case all the steps are endothermic.
60. Major product of reaction between 3-phenyl propene with HBr is
 (A) $\text{C}_6\text{H}_5\text{CH}_2\text{CH}(\text{Br})\text{CH}_3$ (B) $\text{C}_6\text{H}_5\text{CH}(\text{Br})\text{CH}_2\text{CH}_3$
 (C) $\text{C}_6\text{H}_5\text{CH}_2\text{CH}_2\text{CH}_2\text{Br}$ (D) $\text{C}_6\text{H}_5\text{CH}(\text{Br})\text{CH} = \text{CH}_2$
61. Which of the following compound do not give reaction with HBr according to Markovnikoff rule.
 (A) Propene (B) but-1-ene (C) but-2-ene (D) pent-2-ene
62. isobutene + HBr $\xrightarrow{(\text{C}_6\text{H}_5\text{CO})_2\text{O}_2} \dots\dots$
 (A) 3° butyl bromide (B) isobutyl bromide
 (C) 3° butyl alcohol (D) isobutyl alcohol
63. Butene from butane can be formed by reaction with
 (A) $\text{Zn} - \text{HCl}$ (B) $\text{Sn} - \text{HCl}$ (C) $\text{Zn} - \text{Hg}$ (D) Pd / H_2

64. Propene on reaction with HI gives isopropyl iodide not n-propyl iodide because
- (A) Reaction takes place by more stable carbonium ion.
 (B) Reaction takes place by more stable free radical.
 (C) Reaction takes place by more stable carbonium ion.
 (D) none of the above.

65. Identify B in the following reaction sequence :



- (A) $2\text{CH}_3\text{CHO}$ (B) $2\text{CH}_3\text{COCH}_3$ (C) $2\text{CH}_3\text{COOH}$ (D) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_3$

Answers : 46. (B), 47. (C), 48. (D), 49. (D), 50. (A), 51. (B), 52. (C), 53. (D), 54. (C), 55. (B), 56. (A), 57. (C), 58. (A), 59. (C), 60. (B), 61. (C), 62. (B), 63. (D), 64. (A), 65. (A)

● **General Information, Nomenclature and isomerism of alkyne**

- General information : sp hybridization and linear shape.
- $\text{C} \equiv \text{C}$ and $\text{C} - \text{H}$ bond length 120 and 106 pm respectively.
- Bond angle 180°
- **Nomenclature** : Refer Unit : 20
- **Isomerism** : In alkyne position, chain and ring chain isomerism is observed.

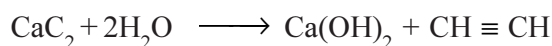
66. Compound with which of the following bond is most reactive ?
 (A) $\text{C} - \text{C}$ (B) $\text{C} = \text{C}$ (C) $\text{C} \equiv \text{C}$ (D) All
67. In which of the following compound all atoms are linearly bonded ?
 (A) Propane (B) Propene (C) Propyne (D) All
68. Hybridization of second carbon in buta 1, 2-diene is
 (A) sp (B) sp^2 (C) sp^3 (D) dsp^2
69. Triple bond between two carbon in alkyne is formed by
 (A) 1 sigma 2 pi (B) 1 pi 2 sigma (C) 3 sigma (D) 3 pi
70. IUPAC name of $(\text{CH}_3)_3\text{C} - \text{C} \equiv \text{C} - \text{C}(\text{CH}_3)_3$ is
 (A) 3, 3, 4, 4-tetra methyl Hex-3-yne (B) 2, 2, 5, 5-tetra methyl Hex-3-yne
 (C) 2, 2, 5, 5-tetra methyl Hex-4-yne (D) di(trimethyl)-2-yne
71. How many alkyne isomers are possible for compound having molecular formula C_5H_8 ?
 (A) 2 (B) 4 (C) 3 (D) 5
72. Which of the following is isomer of propyne ?
 (A) Cyclo propyne (B) Cyclo propene (C) Propene (D) Propane

Answers : 66. (C), 67. (C), 68. (A), 69. (A), 70. (B), 71. (C), 72. (B)

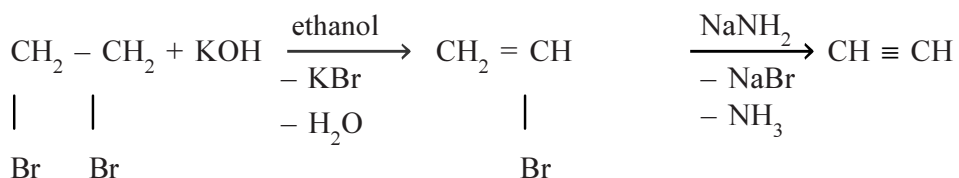
● Preparation and properties of alkyne

- **Preparation :**

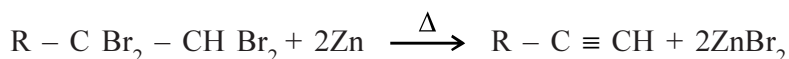
Hydrolysis of Calcium Carbide :



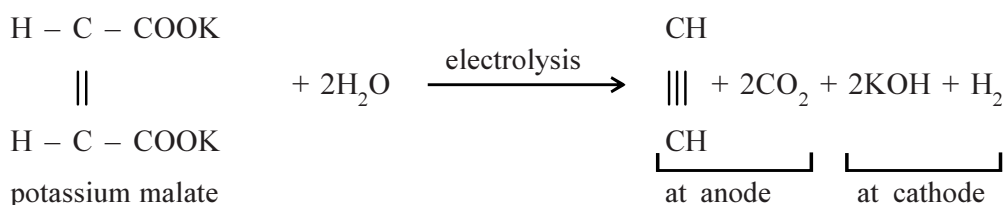
Dehydrohalogenation of vicinal dihalide :



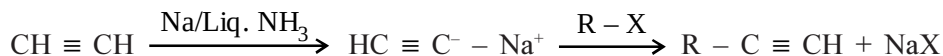
Dehalogenation of tetrahalide :



Kolbe's electrolysis method :



Higher alkyne from acetylene :



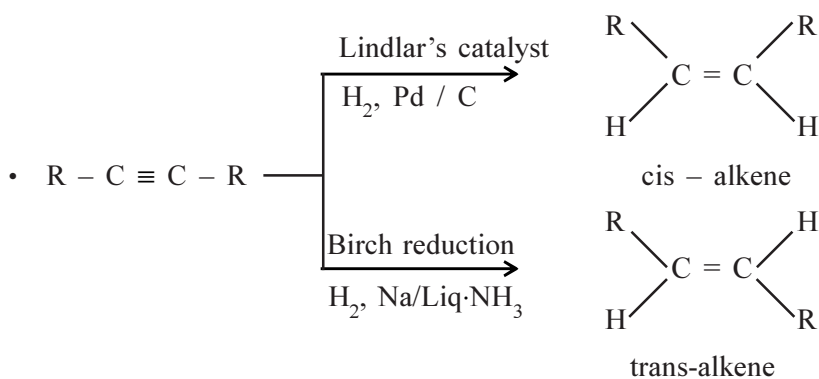
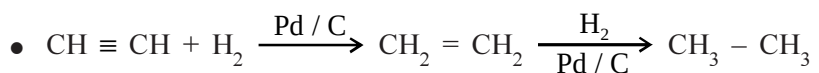
- **Physical properties**

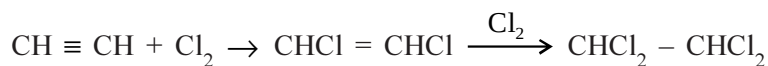
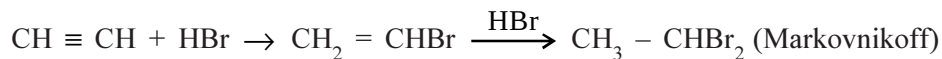
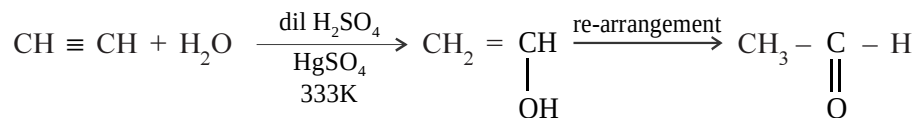
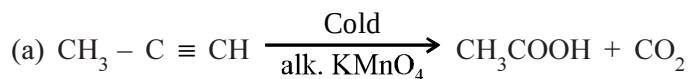
- Alkyne is weakly polar.
- Insoluble in water but soluble in non polar solvent.
- Compared to corresponding alkane and alkene, alkynes have higher boiling point and melting point.
- Ethyne and terminal alkyne shows acidic character. They are weak acids.

- **Chemical properties**

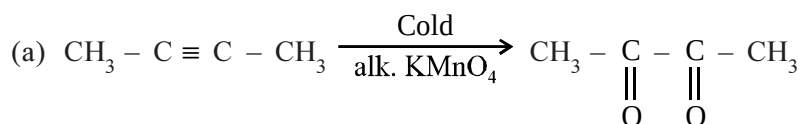
Like alkene alkyne also gives addition reactions. :

- **Hydrogenation :**

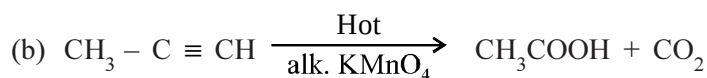


Halogenation :**Hydrohalogenation :****Hydration :****Polymerization :****Oxidation :**

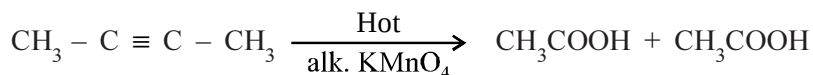
terminal alkyne



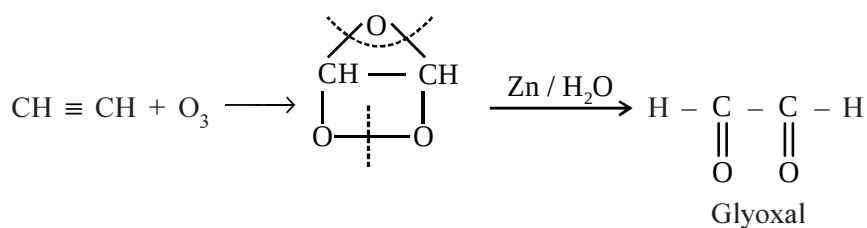
non terminal alkyne



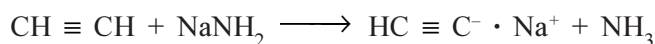
terminal alkyne



non-terminal alkyne

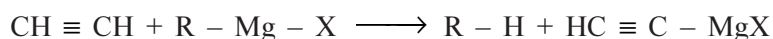
Ozonolysis :**Acidic nature :**

(i) Acetylene and terminal alkynes reacts with strong base like sodamide due to acidic nature.



Sodium acetylide

(ii) By decomposing Grignard reagent gives alkane



73. Colourless gas obtained by reaction between metal carbide and water is
 (A) Methane (B) ethane (C) acetylene (D) ethylene
74. Identify X and Y in the following reaction :

$$\text{CaC}_{2(s)} + \text{H}_2\text{O}_{(l)} \rightarrow \text{X} \xrightarrow[\text{HgSO}_4]{\text{dil H}_2\text{SO}_4} \text{Y}$$

 (A) X-ethylene Y-acetaldehyde (B) X-acetylene Y-ethanol
 (C) X-ethane Y-ethanol (D) X-acetylene Y-ethenol
75. 1, 2-di bromo ethane on reaction with alcoholic KOH gives
 (A) ethane (B) acetylene (C) ethylene (D) methane
76. Product obtain by reaction between haloalkene and sodamide is
 (A) alkane (B) alkene (C) alkyne (D) halo alkane
77. Which of the following compound has acidic hydrogen ?
 (A) ethene (B) ethyne (C) propyne (D) both (B) and (C)
78. By which of the following reaction propyne is formed ?
 (A) CH_3Br with acetylene (B) CH_3Br with sodium acetylide
 (C) CH_3I with sodium acetate (D) Methane with ethene
79. Oxidation of but-1-yne by hot alkaline KMnO_4 gives
 (A) $\text{CH}_3\text{CH}_2\text{CH}_2\text{COOH}$ (B) $\text{CH}_3\text{CH}_2\text{COOH}$
 (C) $\text{CH}_3\text{CH}_2\text{COOH} + \text{CO}_2 + \text{H}_2\text{O}$ (D) $\text{CH}_3\text{CH}_2\text{COOH} + \text{HCOOH}$
80. is obtained by reaction between acetylene and ethyl magnesium bromide.
 (A) Butane (B) Ethane (C) but-1-ene (D) but-2-ene
81. Final product of reductive ozonolysis of but-2-yne is
 (A) glyoxal (B) $2\text{CH}_3\text{COOH}$ (C) but 2, 3 - dione (D) butanal
82. Final product of C_2H_2 with HCl is
 (A) $\text{CH} = \text{CH} - \text{Cl}$ (B) $\text{CH}_3 - \text{CHCl}_2$ (C) $\begin{array}{c} \text{CH} - \text{Cl} \\ || \\ \text{CH} - \text{Cl} \end{array}$ (D) None
83. $\text{CH} \equiv \text{CH} + \text{HCl} \xrightarrow{\text{HgCl}_2}$ product.
 (A) Methyl chloride (B) Dichloro ethane (C) Vinyl chloride (D) Ethyl chloride
84. Which final product is obtained by reaction of propyne with dilute H_2SO_4 in presence of HgSO_4 .
 (A) propanal (B) propyl hydrogen sulphate
 (C) propanal (D) acetone
85. type of reactions are given by alkyne compounds.
 (A) substitution (B) addition (C) polymerization (D) all

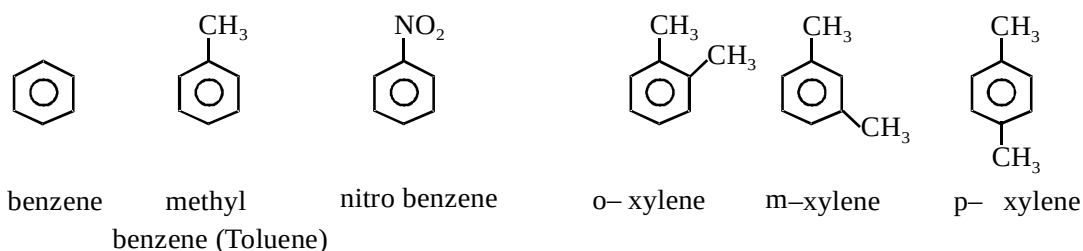
Answers : 73. (C), 74. (D), 75. (B), 76. (C), 77. (D), 78. (B), 79. (C), 80. (B), 81. (C), 82. (B), 83. (C), 84. (D), 85. (D)

● **Arene (aromatic hydro carbon) General information, Nomenclature and structure of benzene**

- Compounds having benzene ring are called aromatic compounds.
- Aromatic compounds having only carbon and hydrogen are called aromatic hydrocarbon or arene. Their first member is benzene.
- General formula of arene is C_nH_{2n-6m} where m = number of rings
- Aromatic compounds having benzene ring are called benzanoids. eg. biphenyl, naphthalene, anthracene, phenanthrene, naphacene
- Aromatic compounds which do not have benzene ring are called non-benzanoids. eg. pyrrole, furan, thiophene, pyridine.

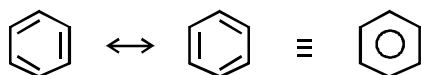
● **Nomenclature**

- By displacing hydrogen of benzene with other group substituted benzene can be obtained.



● **Structure of Benzene**

- Molecular formula of benzene is C_6H_6 . It has hexagonal cyclic structure with alternate $C - C$ and $C = C$.
- Resonating structure of benzene as per Kekulé is as follows :



- Mono substituted benzene has only one isomer while disubstituted has three isomers (or the meta and para)
- Benzene has less chemical reactivity and greater stability is called aromatic character.
- Benzene follows $(4n + 2) \pi e^-$ rule of Huckel hence it is aromatic.

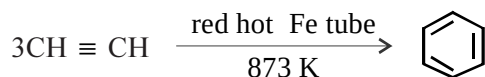
86. Which of the following is aromatic hydrocarbon ?
 (A) cyclohexane (B) toluene (C) phenol (D) aniline
87. Molecular formula of anthracene is
 (A) C_6H_6 (B) C_6H_{12} (C) $C_{10}H_8$ (D) $C_{14}H_{10}$
88. Which of the following is non benzanoid ?
 (A) Naphthalene (B) Aniline (C) Pyridine (D) Naphthacene
89. Reaction of benzene with 3 moles Cl_2 in presence of sunlight gives product.
 (A) $C_6H_3Cl_3$ (B) C_6Cl_6 (C) $C_6H_6Cl_6$ (D) C_6H_5Cl
90. Chemical name of pesticide gamaxene is
 (A) DDT (B) BHC (C) chloral (D) hexa chlorethane

91. Carbon-carbon bond length in benzene is pm.
 (A) 154 and 134 (B) only 134 (C) only 154 (D) 139
92. Which product is obtained by ozonolysis of benzene followed by hydrolysis of product ?
 (A) Benzenetriozone (B) acetaldehyde (C) glyoxal (D) benzene
93. According to Huckel's rule how many π e⁻s are present in phenanthrene ?
 (A) 6 (B) 10 (C) 12 (D) 14
94. Benzene shows type of reaction.
 (A) substitution (B) addition (C) oxidation (D) all the given
95. How many σ and π bonds are present in biphenyl respectively ?
 (A) 22 and 6 (B) 23 and 6 (C) 13 and 5 (D) 12 and 6
96. Which of the following sentence is correct for benzene ?
 (A) Due to unsaturation benzene gives addition reaction easily.
 (B) In benzene 3 types of C-H bond.
 (C) In benzene cyclic delocalized π bonds are present.
 (D) In benzene 6π electrons are localized.
97. Number of σ and π bonds in phenol are respectively.
 (A) 13, 2 (B) 12, 3 (C) 13, 3 (D) 13, 4
98. What is the hybridization of all six carbon in benzene ?
 (A) sp (B) sp^2 (C) sp^3 (D) sp^2 and sp^3
99. Why benzene has higher stability and less reactivity ?
 (A) sp^3 hybridization of six carbon atom (B) cyclic structure of six carbon atom
 (C) high resonance energy (D) unsaturated nature of benzene ring
100. Which compound do not follow Huckel's rule ?
 (A) Benzene (B) Cyclohexane (C) Naphthalene (D) Pyrrole

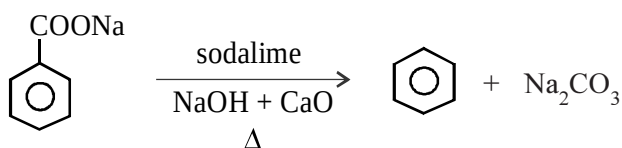
Answers : 86. (B), 87. (D), 88. (C), 89. (C), 90. (B), 91. (D), 92. (C), 93. (D), 94. (D), 95. (B), 96. (C), 97. (C), 98. (B), 99. (C), 100. (B)

● Preparation of Benzene

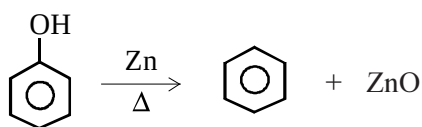
- By cyclic polymerization of ethyne



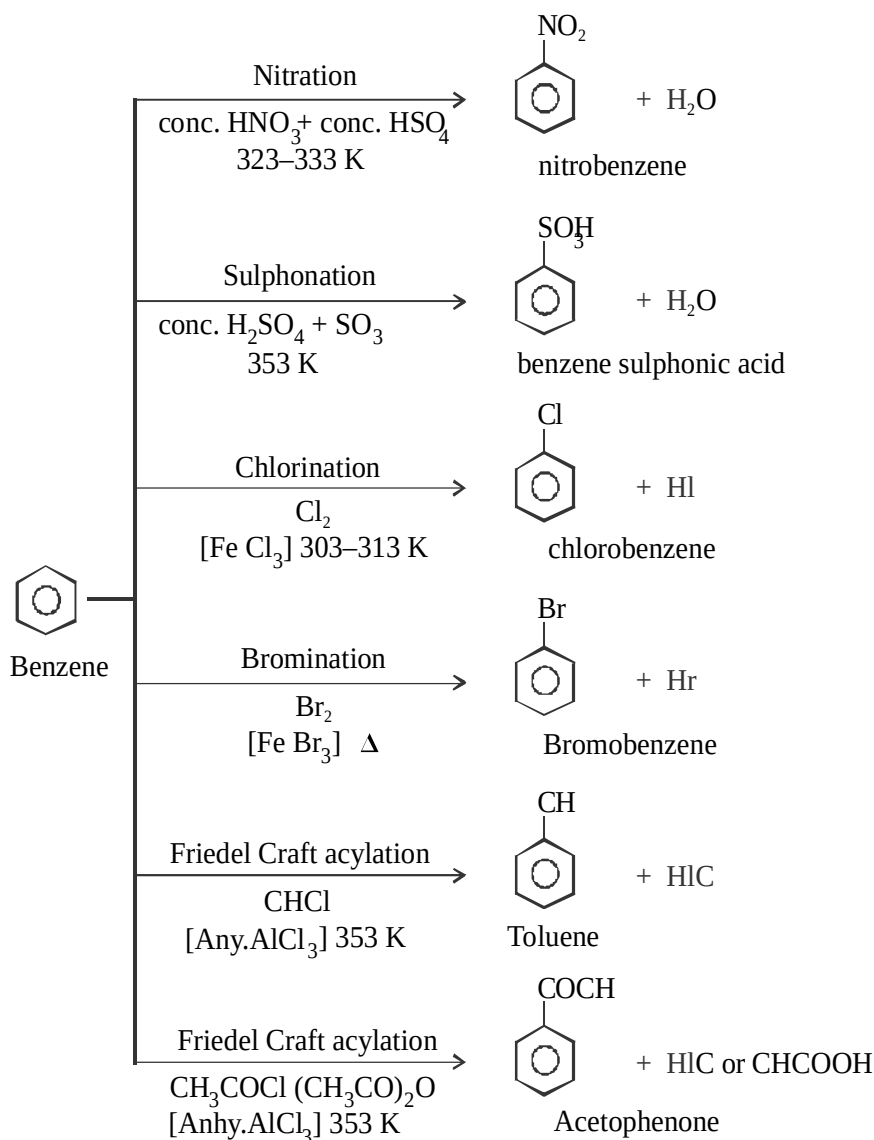
- By decarboxylation of sodium benzoate



- By reduction of phenol



● **Electrophillic substitution reaction of benzene**

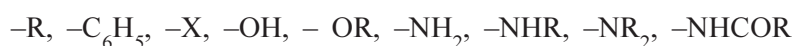


● **Directive effect of inductive group**

● Due to effect of first group connected with benzene, at which position second group is connected is determined. Hence 1st group present in mono substituted benzene is called inductive group and this effect is called directive effect.

● Directive effect are at two types :

(a) o and p directive group (e^- donor group)



(b) meta directive group (e^- attracting group)



101. By which reaction of phenol, benzene can be obtained ?
 (A) oxidation (B) reduction (C) decarboxylation (D) cyclization
102. Which of the following is strongest o/p directive group ?
 (A) $-\text{OH}$ (B) $-\text{Cl}$ (C) $-\text{C}_6\text{H}_5$ (D) $-\text{Br}$
103. due to inductive effect of which group in benzene substitution takes place at meta position ?
 (A) $-\text{NH}_2$ (B) $-\text{Cl}$ (C) $-\text{CH}_3$ (D) $-\text{COCH}_3$
104. Which of the following compound produces meta product during chlorination?
 (A) ethoxy benzene (B) chloro benzene (C) ethyl benzoate (D) toluene
105. Electrophilic ion substituted during acylation of benzene is
 (A) $^+\text{CH}_3$ (B) CH_3^- (C) $^+\text{SO}_3\text{H}$ (D) CH_3^+CO
106. Product obtained by nitration of benzene is (Temperature 323 K)
 (A) nitro benzene (B) nitroso benzene
 (C) O-dinitro benzene (D) m-dinitrobenzene
107. Product obtained by reaction of benzene with concentrated HNO_3 and H_2SO_4 of 353 to 363 K temperature is
 (A) benzene sulphonic acid (B) nitro benzene
 (C) m-dinitro benzene (D) (o and p) dinitro benzene
108. Which of the following compound is most reactive towards electrophilic aromatic substitution reaction ?
 (A) benzene (B) toluene (C) benzoic acid (D) nitro benzene
109. In which of the following compound second substitution is difficult ?
 (A) toluene (B) chloro benzene (C) phenol (D) aceto phenone
110. At which position new group will enter during nitration of toluene ?
 (A) ortho (B) meta (C) para (D) ortho + para

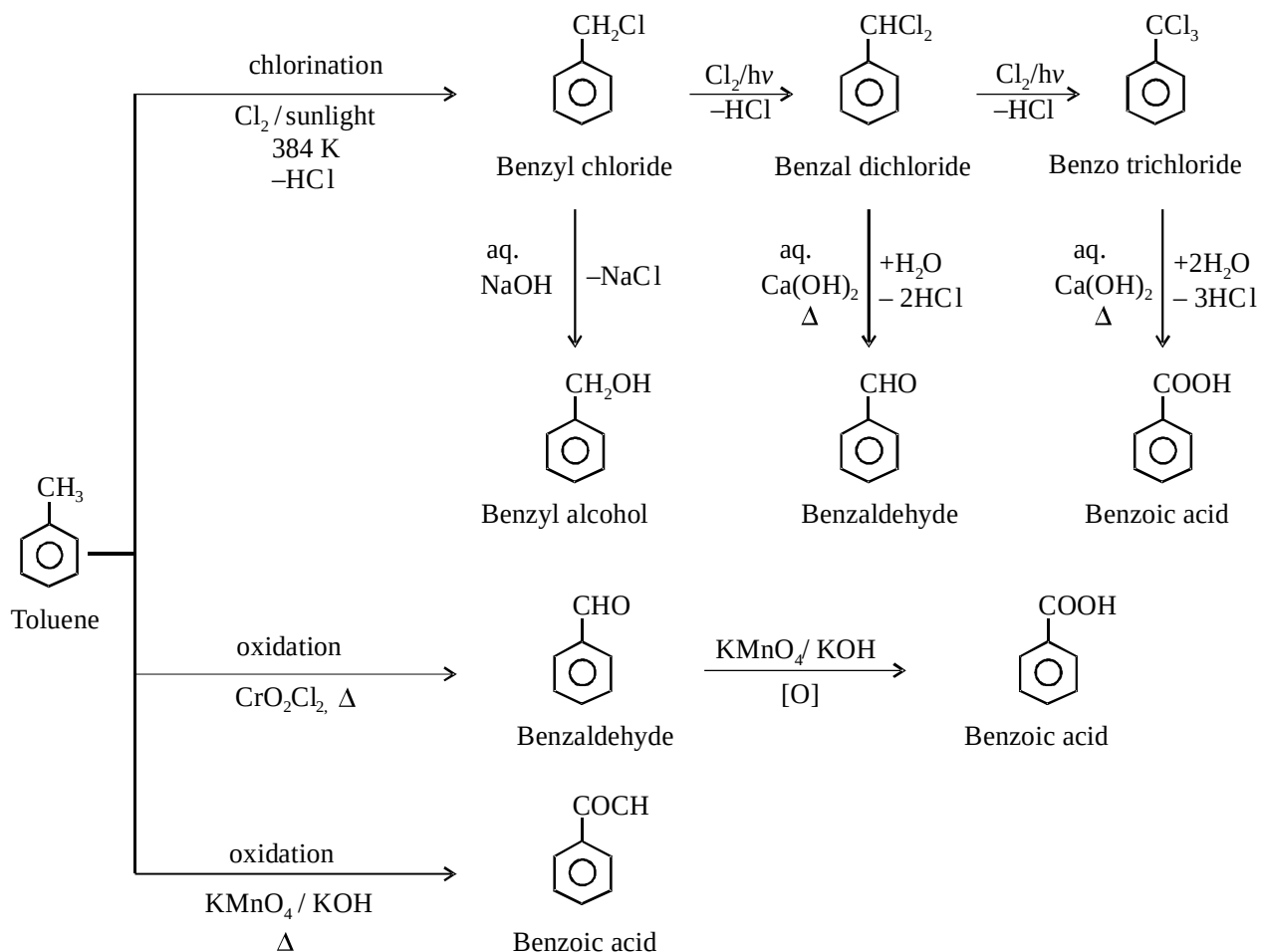
Answers : 101. (B), 102. (A), 103. (D), 104. (C), 105. (D), 106. (A), 107. (C), 108. (B), 109. (D), 110. (D)

● **Reaction and conversion of toluene**

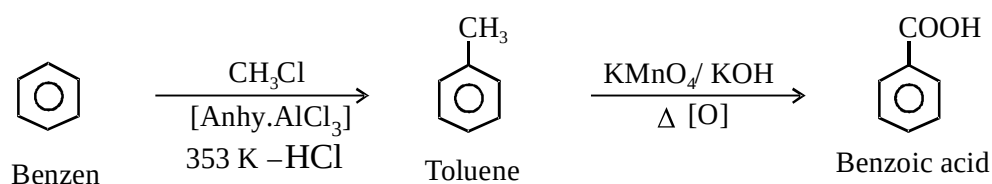
Reaction of phenyl group in toluene :

- Toluene also gives electrophilic substitution reaction like benzene for eg. nitration, sulphonation, chlorination, bromination, alkylation, acylation etc.
- $-\text{CH}_3$ group in toluene is ortho-para directive group hence second substitution takes place at ortho and para position. (Study the reactions from Textbook.)

● Reaction of methyl group in toluene :

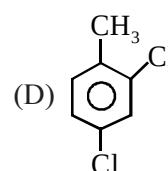
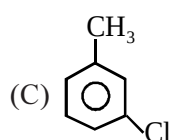
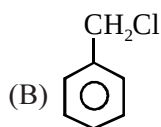
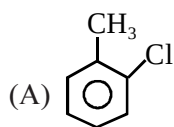


Conversion : Process to convert one organic compound into another is called organic conversion.
eg, Benzene to benzoic acid.

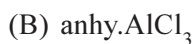
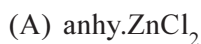


111. Product obtained by complete nitration of toluene is
- (A) o-nitro toluene (B) p-nitro toluene
- (C) 2, 4-dinitro toluene (D) 2, 4, 6-trinitro toluene
112. is obtained by reaction of toluene with Cl_2 in presence of FeCl_3 .
- (A) m-chloro benzene (B) benzyl chloride
- (C) o and p chloro toluene (D) chloro benzene

113. is obtained by chlorination of toluene in presence of sunlight .



114. In Friedel Craft reaction catalyst is used.



115. What is the function of anhy AlCl_3 in Friedel Craft reaction ?

(A) To absorb water.

(B) To produce free radical.

(C) To produce electrophilic ion.

(D) To produce nucleophilic ion.

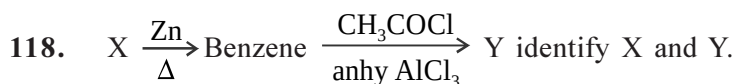
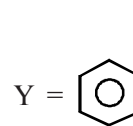
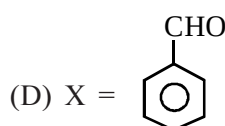
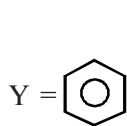
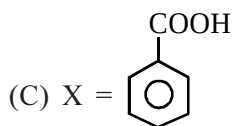
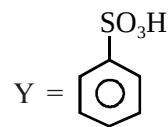
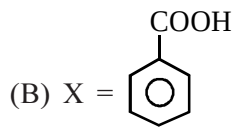
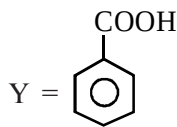
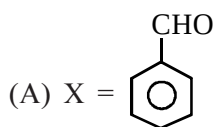
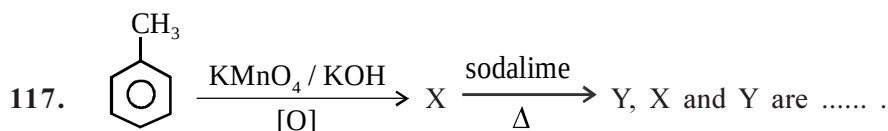
116. Methylation of toluene in presence of HF/BF_3 gives

(A) o-xylene

(B) p-xylene

(C) o and p xylene

(D) m-xylene

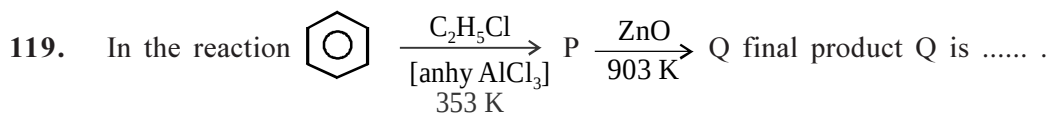


(A) X-benzoic acid, Y-toluene

(B) X-phenol, Y-toluene

(C) X-phenol, Y-aceto phenone

(D) X-toluene, Y-aceto phenone



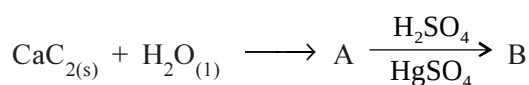
(A) Benzene

(B) m-Xylene

(C) ethyl benzene

(D) styrene

120. Identify A and B in the following reaction :



(A) A-ethylene B-acetaldehyde

(B) A-acetylene B-propanol

(C) A-ethane B-ethanol

(D) A-acetylene B-acetaldehyde

Instruction : For question no. 121 to 125 for correct sentence T and for incorrect sence F then select correct option :

121. (i) Each 'carbon in benzene is sp^2 hybridized.
 (ii) In benzene C–C bondlength is 154 and 134 para alternatively.
 (iii) In benzene 6π electrons are loalized.
 (iv) In benzene 6 carbon and 6 hydrogen are identical.
 (A) TFFT (B) FTFT (C) TTFF (D) TTTF
122. (i) At normal temperature benzene gives addition reaction with H_2 , Cl_2 and O_3 .
 (ii) Benzene gives nucleophilic substitution reaction easily.
 (iii) Reactivity of benzene is more than alkene.
 (A) TFT (B) TTT (C) TTF (D) FFF
123. (i) Benzene is plannar.
 (ii) In benzene cyclic shaped molecular orbital of 6π electron.
 (iii) Due to resonance reactivity of benzene increases.
 (iv) Benzene is insoluble in water.
 (A) TTFT (B) TTFF (C) FTTF (D) TTFF
124. (i) $-NHCH_3$ is meta directing group.
 (ii) Chlorination of benzoic acid gives O–chloro benzoic acid.
 (iii) TNT is used as explosive.
 (iv) Ozonolysis of benzene gives addition reaction.
 (A) TFFT (B) TTFT (C) FFTT (D) FFTF
125. (i) Chlorobenzene gives Friedel Craft reaction.
 (ii) $-OH$ group is electron donor group.
 (iii) Nitration of benzene done by nucleophile $^+NO_2$.
 (iv) Benzene burns with sooty flame.
 (A) TTFT (B) TFFF (C) FTTF (D) TTFT

Instruction : Read the paragraph carefully and answer the questions below it.

Paragraph : The compound or ions which follows Huckel's rule are called aromatic compounds. Main important point of this law are as follows :

- (i) Compound or ion must be plannar.
 (ii) It has delocalized π electron coloured.
 (iii) π electron cloud should cover all the carbon atom of cyclic system.
 (iv) Total number of πe^- should be $4n + 2$ where $n = 0, 1, 2, \dots$

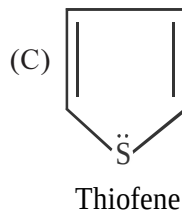
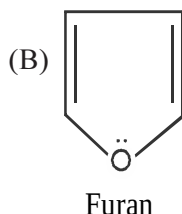
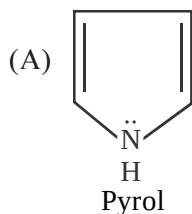
126. Which of the following compound is not aromatic ?



127. Which of the following system is aromatic ?



128. Which of the following compound is aromatic ?



(D) all

● In question 129 to 131 column-I and column-II are given match them and select correct option :

129.

Column-I	Column-II
(1) alkane	(p) $C_n H_{2n-2}$
(2) alkene	(q) $C_n H_{2n}$
(3) alkyne	(r) $C_n H_{2n+2}$
(4) arene	(s) $C_n H_{2n-6m}$

(A) (1)–(r), (2)–(q), (3)–(p), (4)–(s)
 (B) (1)–(p), (2)–(q), (3)–(r), (4)–(s)
 (C) (1)–(s), (2)–(r), (3)–(q), (4)–(r)
 (D) (1)–(r), (2)–(s), (3)–(p), (4)–(q)

130.

Column-I (Reaction)	Column-II (Hydro carbon product)
(a) decarboxylation of sodium acetate	(p) ethyne
(b) Wurtz reaction	(q) 2-methyl propane
(c) Corey-House reaction	(r) n-butane
(d) dehydro halogenation	(s) methane

(A) (a)–(r), (b)–(p), (c)–(q), (d)–(s)
 (B) (a)–(s), (b)–(r), (c)–(q), (d)–(p)
 (C) (a)–(q), (b)–(s), (c)–(r), (d)–(p)
 (D) (a)–(p), (b)–(q), (c)–(s), (d)–(r)

131.

Column-I (Reaction)	Column-II (Reagent)
(a) $CH_3COCH_3 \rightarrow CH_3CH_2CH_3$	(p) Sodalime
(b) $CH_3CH_2Br \rightarrow CH_2 = CH_2$	(q) Zn powder
(c) $C_6H_5COOH \rightarrow C_6H_6$	(r) alcoholic KOH
(d) $C_6H_5OH \rightarrow C_6H_6$	(s) HI / Red P

(A) (a)–(p), (b)–(s), (c)–(q), (d)–(r)
 (B) (a)–(q), (b)–(p), (c)–(s), (d)–(r)
 (C) (a)–(s), (b)–(r), (c)–(p), (d)–(q)
 (D) (a)–(s), (b)–(q), (c)–(r), (d)–(p)

● In the following questions two sentences are given out of which one is assertion (A) and other is reason (R). Study the sentences given below properly and select the open given below :

- (A) Assertion (A) and reason (R) both are correct and reason (R) is correct explanation of assertion (A).
 (B) Assertion (A) and reason (R) both are correct but reason (R) is not correct explanation of assertion (A).
 (C) Assertion (A) is correct while reason (R) is incorrect.
 (D) Assertion (A) is incorrect while reason (R) is correct.

132. **Assertion (A)** : Stability of benzene is less than alkene
Reason (R) : Resonance energy of benzene indicates it's greater stability and less chemical reactivity.
133. **Assertion (A)** : cis but-2-ene is polar while trans but-2-ene is non polar.
Reason (R) : In trans isomer both methyl groups are on opposite sides hence net dipole moment is zero.
134. **Assertion (A)** : Though benzene has double bond it does not undergo polymerization.
Reason (R) : In normal condition benzene does not behave as alkane.
135. **Assertion (A)** : Compared to n-pentane boiling point of neo pentane is more.
Reason (R) : neo-pentane has quaternary carbon.
136. **Assertion (A)** : Dehydration of butan-2-ol mainly gives but-2-ene.
Reason (R) : Dehydration takes place mainly through carbocation intermediate.
137. **Assertion (A)** : Benzene easily gives electrophilic substitution reaction.
Reason (R) : Benzene is unsaturated hydro carbon.
138. **Assertion (A)** : By addition reaction of propene with HCl in presence of peroxide mainly gives 2-chloro propane.
Reason (R) : This reaction takes place by free radical intermediate.
139. **Assertion (A)** : Cyclopenta dienyl anion is more stable than allyl anion.
Reason (R) : Cyclopenta dienyl anion is aromatic.
140. **Assertion (A)** : Reaction of acetylene with sodamide gives sodium acetylide and ammonia.
Reason (R) : sp hybridized carbon of atoms acetylene are highly electro negative.

Answers : 111. (D), 112. (C), 113. (B), 114. (B), 115. (C), 116. (D), 117. (C), 118. (C), 119. (D), 120. (D), 121. (A), 122. (D), 123. (A), 124. (C), 125. (A), 126. (B), 127. (B), 128. (D), 129. (A), 130. (B), 131. (C), 132. (D), 133. (D), 134. (C), 135. (B), 136. (D), 137. (B), 138. (D), 139. (A), 140. (A).

