HYDROCARBONS

FACT/DEFINITION TYPE QUESTIONS

1. Which of the following fuel cause the least pollution ?
(a) Petrol (b) CNG
(c) Kerosene (d) LPG

2. LPG mainly contains :
(a) ethyne (b) butane
(c) methane (d) ethane

3. Natural gas is a mixture of :
(a) $CH_4 + C_2H_6 + C_3H_8$ (b) $CO + H_2 + CH_4$
(c) $CO + H_2$ (d) $H_2O + CO_2$

4. Which of the following gas is find in coal mines and marshy places?
(a) Methane (b) Ethane
(c) Benzene (d) Propane

5. Which of the following represents the correct general formula of alkanes ?
(a) C_nH_{2n} (b) C_nH_{2n+2}
(c) C_nH_{2n-2} (d) C_nH_n

6. Two adjacent members of a homologous series have
(a) a difference of CH_2 in their structure
(b) a different of 14 amu in molecular mass
(c) same general method of preparation
(d) All the above

7. Methane, ethane and propane are said to form a homologous series because all are
(a) hydrocarbons
(b) saturated compounds
(c) aliphatic compounds
(d) differ from each other by a CH_2 group

8. Which of the following does not belong to the same homologous series?
(a) CH_4 (b) C_2H_6
(c) C_3H_8 (d) C_4H_8

9. In which of the following compounds only primary carbon atoms are present?
(a) $CH_3-\underset{\displaystyle CH_3}{\underset{|}{CH}}-CH_2-CH_3$ (b) $CH_3-\underset{\displaystyle CH_3}{\underset{|}{CH}}-CH_3$

(c) $CH_3-\underset{\displaystyle CH_3}{\overset{\displaystyle CH_3}{\overset{|}{\underset{|}{C}}}}-CH_3$ (d) CH_3-CH_3

10. The IUPAC name of the following compound

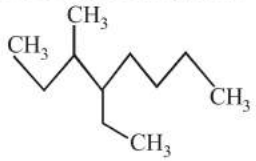
$H_3C-CH_2-\underset{\displaystyle CH_2CH_3}{\underset{|}{CH}}-CH_2-\underset{\displaystyle CH_3}{\underset{|}{CH}}-CH_2CH_3$

is
(a) 3-ethyl-5-methylheptane
(b) 5-ethyl-3-methylheptane
(c) 3,5-diethylhexane
(d) 1,1-diethyl-3-methylpentane

11. The number of chain isomers possible for the hydrocarbon C_5H_{12} is
(a) 1 (b) 2
(c) 3 (d) 4

12. The number of primary, secondary and tertiary carbons in 3, 4-dimethylheptane are respectively
(a) 4, 3 and 2 (b) 2, 3 and 4
(c) 4, 2 and 3 (d) 3, 4 and 2

13. Name of the given compound -



(a) 2, 3-diethyl heptane (b) 5-ethyl-6-methyl octane
(c) 4-ethyl-3-methyl octane (d) 3-methyl-4-ethyl octane

14. Which of the following statements is false for isopentane–
(a) It has three CH_3 groups
(b) It has one CH_2 group
(c) It has one CH group
(d) It has a carbon which is not bonded to hydrogen

15. Molecular formula of which of the following alkane can exist in more than one structure ?
(a) CH_4 (b) C_2H_6
(c) C_3H_8 (d) C_4H_{10}

16. How many isomers are possible for the C_5H_{12} ?
(a) 2 (b) 3
(c) 4 (d) 5

17. The number of 4° carbon atoms in 2,2,4,4-tetramethyl pentane is –
(a) 1 (b) 2
(c) 3 (d) 4

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18. Which one of the following cannot be prepared by Wurtz reaction ?
(a) CH_4 (b) C_2H_6
(c) C_3H_8 (d) C_4H_{10}

19. The reaction,
$CH_3 - Br + 2Na + Br - CH_3 \rightarrow$ the product, is called
(a) Wurtz reaction (b) Perkin's reaction
(c) Aldol condensation (d) Levit reaction

20. Pure methane can be produced by
(a) Wurtz reaction
(b) Kolbe's electrolytic method
(c) Soda-lime decarboxylation
(d) Reduction with H_2

21. Sodium salts of carboxylic acids on heating with soda lime give alkanes containing _____ than the carboxylic acid.
(a) one carbon more (b) one carbon less
(c) two carbon less (d) Either (a) or (b)

22. Which one of the following has the least boiling point?
(a) 2, 2– dimethylpropane (b) n-butane
(c) 2-methylpropane (d) n-pentane

23. Which one of the following has highest boiling point?
(a) n-Octane (b) 2,2 dimethyl pentane
(c) Iso-octan (d) All have equal values

24. Which of the following reactions of methane is incomplete combustion ?
(a) $2CH_4 + O_2 \xrightarrow{Cu/523\,K/100\,atm} 2CH_3OH$
(b) $CH_4 + O_2 \xrightarrow{Mo_2O_3} HCHO + H_2O$
(c) $CH_4 + O_2 \rightarrow C(s) + 2H_2O(l)$
(d) $CH_4 + 2O_2 \rightarrow CO_2(g) + 2H_2O(l)$

25. In the free radical chlorination of methane, the chain initiating step involves the formation of
(a) chlorine free radical
(b) hydrogen chloride
(c) methyl radical
(d) chloromethyl radical.

26. Which one of the following gives only one monochloro derivative?
(a) n-hexane (b) 2-methylpentane
(c) 2, 3-dimethylpentane (d) neo-pentane

27. Photochemical halogenation of alkane is an example of
(a) electrophilic substitution
(b) electrophilic addition
(c) nucleophilic substitution
(d) free radical substitution

28. 2-Methylbutane on reacting with bromine in the presence of sunlight gives mainly
(a) 1-bromo-3-methylbutane
(b) 2-bromo-3-methylbutane
(c) 2-bromo-2-methylbutane
(d) 1-bromo-2-methylbutane

29. Complete combustion of CH_4 gives :
(a) $CO_2 + H_2O$ (b) $CO_2 + H_2$
(c) $COCl_2$ (d) $CO + CO_2 + H_2O$

30. Aromatisation of *n*-hexane gives :
(a) cyclohexane (b) benzene
(c) cycloheptane (d) toluene

31. Liquid hydrocarbons can be converted to a mixture of gaseous hydrocarbons by :
(a) oxidation
(b) cracking
(c) distillation under reduced pressure
(d) hydrolysis

32. n-Hexane isomerises in presence of anhydrous aluminium chloride and hydrogen chloride gas to give
(a) 2-Methyl pentane (b) 3-Methyl pentane
(c) Both (a) and (b) (d) Neither (a) nor (b)

33. Which of the following represents the correct reaction ?
(a) $CH_4 + 2H_2O \xrightarrow{Ni} CO_2 + 4H_2$
(b) $CH_4 + H_2O \xrightarrow{Ni} CO + 3H_2$
(c) $CH_4 + H_2O \xrightarrow{Ni} CH_3OH + H_2$
(d) $CH_4 + H_2O \xrightarrow{Ni} HCHO + 2H_2$

34. How many conformations are possible for ethane ?
(a) 2 (b) 3
(c) infinite (d) one

35. Spatial arrangements of atoms which can be converted into one another by rotation around a C–C single bond are called
(a) Stereoisomers (b) Tautomers
(c) Optical isomers (d) Conformers

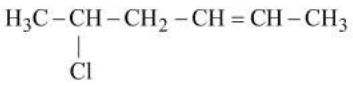
36. General formula of alkenes and alkyl radicals are respectively:
(a) C_nH_{2n} and C_nH_{2n+1} (b) C_nH_{2n} and C_nH_{2n+2}
(c) C_nH_{2n-1} and C_nH_{2n} (d) C_nH_{2n+1} and C_nH_{2n+2}

37. The restricted rotation about carbon-carbon double bond in 2- butene is due to
(a) overlap of one s- and one sp^2-hybridized orbitals
(b) overlap of two sp^2-hybridized orbitals
(c) overlap of one p-and one sp^2-hybridized orbitals
(d) sideways overlap of two p-orbitals

38. Bond angle in alkenes is equal to
(a) 120° (b) 109°28'
(c) 180° (d) 60°

39. The molecular formula of a compound in which double bond is present between C & C :
(a) C_nH_{2n+2} (b) C_nH_n
(c) C_nH_{2n} (d) C_nH_{2n-2}

40. IUPAC name of the following compound is



(a) 5-chloroheptene (b) 4-chloropent-1-ene
(c) 5-chloropent-3-ene (d) 5-chlorohex-2-ene

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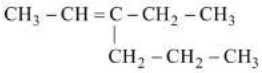
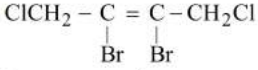
41. IUPAC name of the following compound will be

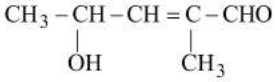


(a) 3–Ethyl–2–hexene (b) 3–Propyl–2–hexene
(c) 3–Propyl–3–hexene (d) 4–Ethyl–4–hexene

42. Which of the following represents the correct IUPAC name of the compound
$CH_2=CH-CH_2Cl$?
(a) Allyl chloride (b) 1- chloro -3- propene
(c) 3- chloro-1- propene (d) Vinyl chloride

43. The name of  according to IUPAC nomenclature system is
(a) 2, 3- dibromo -1, 4- dichlorobutene-2
(b) 1, 4- dichloro-2, 3- dibromobutene-2
(c) Dichlorodibromobutene
(d) Dichlorodibromobutane

44. The IUPAC name of



(a) 4-Hydroxy-1-methylpentanal
(b) 4-Hydroxy-2-methylpent-2-en-1-al
(c) 2-Hydroxy-4-methylpent-3-en-5-al
(d) 2-Hydroxy-3-methylpent-2-en-5-al

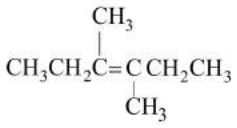
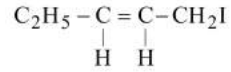
45. The alkene that exhibits geometrical isomerism is
(a) 2- methyl propene (b) 2-butene
(c) 2- methyl -2- butene (d) propene

46. Which one of the following exhibits geometrical isomerism?
(a) 1, 2-dibromopropene (b) 2, 3-dimethylbut-2-ene
(c) 2, 3-dibromobut-2-ene (d) Both (a) and (c)

47. The compounds $CH_3CH=CHCH_3$ and $CH_3CH_2CH=CH_2$
(a) are tautomers
(b) are position isomers
(c) contain same number of $sp^3 - sp^3$, $sp^3 - sp^2$ and $sp^2 - sp^2$ carbon-carbon bonds
(d) exist together in dynamic equilibrium

48. The total number of isomers for C_4H_8 is
(a) 5 (b) 6
(c) 7 (d) 8

49. Consider the following statements : A hydrocarbon of molecular formula C_5H_{10} is a
I. monosubstituted alkene
II. disubstituted alkene
III. trisubstituted alkene
Which of the following statement(s) is(are) correct?
(a) I, II and III (b) I and II
(c) II and III (d) I and III

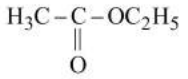
50. Geometrical isomerism is not shown by
(a) 
(b) 
(c) $CH_2=C(Cl)CH_3$
(d) $CH_3-CH=CH-CH=CH_2$

51. Hex-2-ene and 2-methylpent-2-ene exhibit
(a) chain isomerism (b) position isomerism
(c) geometrical isomerism (d) optical isomerism

52. Ethyl bromide gives ethylene when reacted with –
(a) ethyl alcohol (b) dilute H_2SO_4
(c) aqueous KOH (d) alcoholic KOH

53. By which reaction ethene is obtained from ethyne -
(a) oxidation (b) polymerisation
(c) hydrogenation (d) dehydrogenation

54. The major product formed when 2-bromobutane is treated with alcoholic KOH is
(a) 2-Butanol (b) 1-Butene
(c) 1-Butanol (d) Trans-2-butene

55. Ethyl alcohol is heated with conc. H_2SO_4. The product formed is :
(a)  (b) C_2H_6
(c) C_2H_4 (d) C_2H_2

56. Alcoholic solution of KOH is used for
(a) Dehydrogenation (b) Dehalogenation
(c) Dehydration (d) Dehydrohalogenation

57. Paraffins are soluble in
(a) Distilled water (b) Benzene
(c) Methanol (d) Sea water

58. When hydrochloric acid gas is treated with propene in presence of benzoyl peroxide, it gives
(a) 2-Chloropropane (b) Allyl chloride
(c) No reaction (d) n-Propyl chloride.

59. "The addition of unsymmetrical reagents to unsymmetrical alkenes occurs in such a way that the negative part of the addendum goes to that carbon atom of the double bond which carries lesser number of hydrogen atoms" is called by :
(a) Saytzeff rule (b) Markownikoff's rule
(c) Kharasch effect (d) Anti-Saytzeff rule

60. When one mole of an alkene on ozonolysis produces 2 moles of propanone, the alkene is
(a) 3-methyl-1-butene
(b) 2, 3-dimethyl-1-butene
(c) 2, 3-dimethyl-2-pentene
(d) 2, 3-dimethyl-2-butene

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61. Which alkene on ozonolysis gives CH_3CH_2CHO and

$CH_3\overset{\overset{O}{\|}}{C}CH_3$

(a) $CH_3CH_2CH=C(CH_3)_2$

(b) $CH_3CH_2CH=CHCH_2CH_3$

(c) $CH_3CH_2CH=CHCH_3$

(d) $CH_3-C(CH_3)=CHCH_3$

62. Reaction of HBr with propene in the presence of peroxide gives

(a) isopropyl bromide (b) 3-bromo propane

(c) allyl bromide (d) n-propyl bromide

63. $H_3C-\underset{\displaystyle CH_3}{\underset{|}{CH}}-CH=CH_2+HBr\rightarrow A$

A(predominantly) is :

(a) $CH_3-\underset{\displaystyle CH_3}{\underset{|}{CH}}-CH_2-CH_2Br$

(b) $CH_3-\underset{\displaystyle CH_3}{\overset{\displaystyle Br}{\overset{|}{\underset{|}{C}}}}-CH_2-CH_3$

(c) $CH_3-\underset{\displaystyle Br}{\underset{|}{CH}}-\underset{\displaystyle CH_3}{\underset{|}{CH}}-CH_3$

(d) $CH_3-\underset{\displaystyle CH_3}{\underset{|}{CH}}-\underset{\displaystyle Br}{\underset{|}{CH}}-CH_3$

64. Butene-1 may be converted to butane by reaction with

(a) Sn – HCl (b) Zn – Hg

(c) Pd/H_2 (d) Zn – HCl

65. Alkenes usually show which type of reaction –

(a) addition (b) substitution

(c) elimination (d) superposition

66. A reagent used to test unsaturation in alkene is -

(a) ammonical Cu_2Cl_2 (b) ammonical $AgNO_3$

(c) solution of Br_2 in CCl_4 (d) conc. H_2SO_4

67. In the given reaction

$$CH_3CH_2CH=CHCH_3\xrightarrow{X}CH_3CH_2COOH+CH_3COOH$$

The X is

(a) C_2H_5ONa (b) Conc. HCl +Anhy.$ZnCl_2$

(c) Anh. $AlCl_3$ (d) $KMnO_4/OH^-$

68. Polythene is a resin obtained by polymerisation of

(a) Butadiene (b) Ethylene

(c) Methane (d) Ethyne

69. Ethyl hydrogen sulphate is obtained by reaction of H_2SO_4 on

(a) Ethylene (b) Ethane

(c) Ethyl chloride (d) Ethanol

70. The negative part of an addendum adds on to the carbon atom joined to the least number of hydrogen atoms. This statement is called

(a) Thiele's theory (b) Peroxide effect

(c) Markownikoff's rule (d) Baeyer's strain theory

71. Which of the following compounds does not follow Markownikoff's law ?

(a) $CH_3CH=CH_2$ (b) CH_2CHCl

(c) $CH_3CH=CHCH_3$ (d) None of these

72. In the following sequence of reactions, the alkene affords the compound 'B'

$$CH_3-CH=CH-CH_3\xrightarrow{O_3}A\xrightarrow[Zn]{H_2O}B.$$

The compound B is

(a) CH_3CH_2CHO (b) CH_3COCH_3

(c) $CH_3CH_2COCH_3$ (d) CH_3CHO

73. One mole of a symmetrical alkene on ozonolysis gives two moles of an aldehyde having a molecular mass of 44 u. The alkene is

(a) propene (b) 1-butene

(c) 2-butene (d) ethene

74. The alkene that will give the same product with HBr in the absence as well as in the presence of peroxide is

(a) 2-butene (b) 1-butene

(c) propene (d) 1-hexene

75. Ethylene reacts with alkaline $KMnO_4$ to form

(a) Oxalic acid (b) HCHO

(c) Ethyl alcohol (d) Glycol

76. The reaction of HI with $CH_3-CH=CH_2$ at 400°C yields :

(a) $CH_2I-CH=CH_2$ (b) $CH_3-CHI-CH_3$

(c) $CH_3-CH_2-CH_2I$ (d) $CH_2I-CH_2-CH_2I$

77. Ethene when treated with Br_2 in the presence of CCl_4 which compound is formed

(a) 1, 2-dibromoethane (b) 1-bromo-2-chloroethane

(c) Both (a) and (b) (d) 1, 1, 1-tribromoethane

78. In a reaction

$$CH_2=CH_2\xrightarrow[\text{acid}]{\text{Hypochlorous}}M\xrightarrow{R}\underset{\displaystyle CH_2-OH}{\overset{\displaystyle CH_2-OH}{\overset{|}{\underset{|}{}}}}$$

Where M = molecule; R = reagent; M and R are

(a) CH_3CH_2Cl and NaOH

(b) CH_3Cl-CH_2OH and aq. $NaHCO_3$

(c) CH_3CH_2OH and HCl

(d) $CH_2=CH_2$ and heat

79. The test for unsaturation is confirmed by the decolourisation of which of the following

(a) Iodine water (b) $CuSO_4$ solution

(c) Bromine water (d) All of these

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80. Isopropyl alcohol is obtained by reacting which of the following alkenes with conc. H_2SO_4 and H_2O

(a) Ethylene (b) Propylene
(c) 2-methyl propene (d) Isoprene

81. Which one of the following is the strongest bond?

(a) $>C=C<$ (b) $-C\equiv C-$

(c) $-\overset{|}{C}-\overset{|}{C}=$ (d) $-\overset{|}{C}-\overset{|}{C}-$

82. An alkyne has general formula :

(a) C_nH_{2n} (b) C_nH_{2n+1}
(c) C_nH_{2n+2} (d) C_nH_{2n-2}

83. The IUPAC name of the compound $CH_3CH=CHC\equiv CH$ is

(a) Pent-1-yn-3-ene (b) Pent-4-yn-2-ene
(c) Pent-3-en-1-yne (d) Pent-2-en-4-yne

84. Number of alkynes for formula C_5H_8 is –

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

85. The IUPAC name of the compound having the formula $CH\equiv C-CH=CH_2$ is :

(a) 1-butyn-3-ene (b) but-1-yne-3-ene
(c) 1-butene-3-yne (d) 3-butene-1-yne

86. The homologue of ethyne is

(a) C_2H_4 (b) C_2H_6
(c) C_3H_8 (d) C_3H_6

87. The C - H bond length is minimum in the bond formed by

(a) *sp* - *s* overlapping (as in alkynes)
(b) sp^2 – *s* overlapping (as in alkenes)
(c) sp^3 – *s* overlapping (as in alkanes)
(d) None of these

88. Triple bond of ethyne is made of

(a) Three σ – bonds
(b) Three π – bonds
(c) Two σ and one π – bond
(d) Two π and one σ – bond

89. Maximum carbon-carbon bond distance is found in –

(a) ethyne (b) ethene
(c) ethane (d) benzene

90. The acetylene molecule contains :

(a) 5 sigma bonds (b) 4 sigma and 1 pi bonds
(c) 3 sigma and 2 pi bonds (d) 2 sigma and 3 pi bonds

91. Butyne-2 contains :

(a) *sp* hybridised carbon atoms only
(b) sp^3 hybridised carbon atoms only
(c) both *sp* and sp^2 hybridised carbon atoms
(d) both *sp* and sp^3 hybridised carbon atoms

92. The correct order towards bond length is

(a) $C-C<C=C<C\equiv C$ (b) $C\equiv C<C=C<C-C$
(c) $C=C<C\equiv C<C-C$ (d) $C=C<C-C<C\equiv C$

93. Which C-atom is the most electronegative in this structure?

$$\overset{III}{CH_3}-\overset{II}{CH_2}-\overset{I}{C}\equiv CH$$

(a) I
(b) II
(c) III
(d) all are equal electronegative

94. $R-CH_2-CCl_2-R \xrightarrow{\text{Reagent}} R-C\equiv C-R$

The reagent is

(a) Na (b) HCl in H_2O
(c) KOH in C_2H_5OH (d) Zn in alcohol.

95. Calcium carbide when treated with water gives :

(a) ethylene (b) methane
(c) acetylene (d) ethane

96. Which one of the following has the minimum boiling point ?

(a) 1-Butene (b) 1-Butyne
(c) *n*- Butane (d) Isobutane

97. Ammonical silver nitrate forms a white precipitate easily with

(a) $CH_3C\equiv CH$ (b) $CH_3C\equiv CCH_3$
(c) $CH_3CH=CH_2$ (d) $CH_2=CH_2$

98. When acetylene is passed through dil. H_2SO_4 in presence of $HgSO_4$, the compound formed is

(a) ether (b) acetaldehyde
(c) acetic acid (d) ketone

99. Which of the following will be the final product when C_2H_2 reacts with HCl

(a) $\begin{matrix}CH\\\|\\CHCl\end{matrix}$ (b) $\begin{matrix}CH_3\\|\\CHCl_2\end{matrix}$

(c) $\begin{matrix}CHCl\\\|\\CHCl\end{matrix}$ (d) None of these

100. The hydrocarbon which can react with sodium in liquid ammonia is

(a) $CH_3CH_2CH_2C\equiv CCH_2CH_2CH_3$
(b) $CH_3CH_2C\equiv CH$
(c) $CH_3CH=CHCH_3$
(d) $CH_3CH_2C\equiv CCH_2CH_3$

101. Which of these will not react with acetylene?

(a) NaOH (b) Ammonical $AgNO_3$
(c) Na (d) HCl.

102. When acetylene is passed over heated iron tube, the product obtained is –

(a) C_2H_2 (b) C_4H_4
(c) C_6H_6 (d) C_8H_8

103. But–2–yne on chlorination gives

(a) 1 –chlorobutane
(b) 1, 2 –dichlorobutane
(c) 1, 1, 2, 2 –tetrachlorobutane
(d) 2, 2, 3, 3 –tetrachlorobutane

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104. When propyne reacts with aqueous H_2SO_4 in the presence of $HgSO_4$, the major product is
(a) Propanal
(b) Propyl hydrogen sulphate
(c) Acetone
(d) Propanol

105. Propyne on polymerisation gives
(a) Mesitylene (b) Benzene
(c) Ethyl benzene (d) Propyl benzene

106. What happens when a mixture of acetylene and hydrogen is passed over heated Lindlar's catalyst ?
(a) Ethane and water are formed
(b) Ethylene is formed
(c) Acetylene and ethane are formed
(d) None of these

107. Which of the following reaction is shown by alkynes ?
(a) Addition (b) Substitution
(c) Polymerization (d) All of these

108. Which of the following reactions will yield 2, 2-dibromopropane ?
(a) $HC \equiv CH + 2HBr \rightarrow$
(b) $CH_3C \equiv CH + 2HBr \rightarrow$
(c) $CH_3CH = CH_2 + HBr \rightarrow$
(d) $CH_3CH = CHBr + HBr \rightarrow$

109. In the given reactions

$$CH_3C \equiv CH \xrightarrow{A} CH_3CBr_2CHBr_2$$

$$CH_3C \equiv CH \xrightarrow{B} CH_3CBr_2CH_3$$

$$CH_3C \equiv CH \xrightarrow[333\ K]{Hg^{2+}/H^+} C$$

$$HC \equiv CH \xrightarrow[333\ K]{Hg^{2+}/H^+} D$$

A, B, C and D are respectively
(a) HBr, Br_2, CH_3COCH_3, CH_3CHO
(b) Br_2, HBr, CH_3COCH_3, CH_3CHO
(c) HBr, HBr, CH_3COCH_3, CH_3CHO
(d) Br_2, HBr, CH_3CH_2CHO, CH_3CHO

110. Which of the following polymer can be used as electrodes in batteries ?
(a) Polypropene (b) Polyacetylene
(c) Polyethene (d) Polyisoprene

111. Which of the following catalyst is used for the following conversion ?

$$3CH \equiv CH \xrightarrow[873\ K]{} \text{C}_6\text{H}_6$$

(a) Platinized Asbestos (b) Red hot iron tube
(c) Platinized Nickel (d) Iron-molybdenum

112. Which one of the following is a non-benzenoid aromatic compound?
(a) Aniline (b) Benzoic acid
(c) Naphthalene (d) Tropolone

113. Benzene was discovered by
(a) Ramsay (b) Dalton
(c) Faraday (d) Priestley

114. The ring structure of benzene was proposed by
(a) Faraday (b) Davy
(c) Kekule (d) Wohler

115. Six carbon atoms f benzene are of
(a) one type (b) two types
(c) three types (d) six types

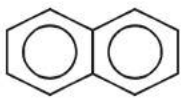
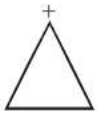
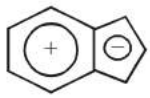
116. Select the true statement about benzene amongst the following
(a) Because of unsaturation benzene easily undergoes addition
(b) There are two types of C – C bonds in benzene molecule
(c) There is cyclic delocalisation of pi-electrons in benzene
(d) Monosubstitution of benzene gives three isomeric products.

117. The benzene molecule contains
(a) 6 sp^2 hybrid carbons (b) 3 sp^2 hybrid carbons
(c) 6 sp^3 hybrid carbons (d) 3 sp^3 hybrid carbons

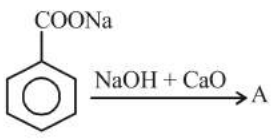
118. Aromatic compounds burn with sooty flame because
(a) they have a ring structure of carbon atoms
(b) they have a relatively high percentage of hydrogen
(c) they have a relatively high percentage of carbon
(d) they resist reaction with oxygen of air

119. Carbon atom in benzene molecule is inclined at an angle of
(a) 120° (b) 180°
(c) 109° 28' (d) 60°

120. The conditions for aromaticity is :
(a) molecule must have cyclic clouds of delocalised π electrons
(b) molecule must contain $(4n + 2)\ \pi$ electrons
(c) Both (a) and (b)
(d) None of the above

121. The chemical system that is non-aromatic is
(a) 
(b) 
(c) 
(d) 

122. Benzene can be directly obtained from
(a) Acetylene (b) Phenol
(c) Chlorobenzene (d) All the above

123. 

The product A is
(a) Benzene (b) Benzaldehyde
(c) Toluene (d) Benzoic acid

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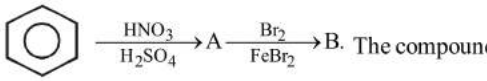
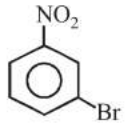
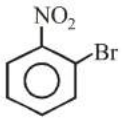
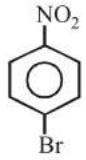
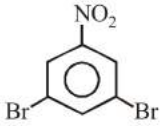
124. In a reaction of C_6H_5Y, the major product (> 60%) is m-isomer, so the group Y is
(a) $-COOH$ (b) $-NH_2$
(c) $-OH$ (d) $-Cl$

125.  The compound B is

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

126. Chlorobenzene is *o*, *p*-directing in electrophilic substitution reaction. The directing influence is explained by
(a) +M of Ph (b) +I of Cl
(c) +M of Cl (d) +I of Ph

127. Catalytic hydrogenation of benzene gives
(a) xylene (b) cyclohexane
(c) benzoic acid (d) toluene

128. The strongest ortho - para and strongest meta - directing groups respectively are
(a) $-NO_2$ and $-NH_2$ (b) $-CONH_2$ and $-NH_2$
(c) $-NH_2$ and $-CONH_2$ (d) $-NH_2$ and $-NO_2$

129. For the formation of toluene by Friedal Craft reaction, reactants used in presence of anhydrous $AlCl_3$ are
(a) C_2H_2 and CCl_4 (b) CH_4 and $CaCN_2$
(c) C_6H_6 and CH_3Cl (d) C_2H_5OH and Zn

130. Benzene can be obtained in the reaction
(a) Ethene + 1, 3-butadiene
(b) Trimerisation of ethyne
(c) Reduction of PhCHO
(d) All of these

131. Nitration of benzene by nitric acid and sulphuric acid is
(a) Electrophilic substitution
(b) Electrophilic addition
(c) Nucleophilic substitution
(d) Free radical substitution

132. $C_6H_6 + CH_3Cl \xrightarrow[AlCl_3]{BHC,\ anhydrous} C_6H_5CH_3 + HCl$
is an example of
(a) Friedel - Craft's reaction
(b) Kolbe's synthesis
(c) Wurtz reaction
(d) Grignard reaction

133. Benzene reacts with $CH_3COCl + AlCl_3$ to give
(a) chlorobenzene (b) toluene
(c) benzyl chloride (d) acetophenone

134. Benzene on reaction with ozone forms _____.
(a) 2 molecules of aldehyde and 1 molecule of ketone
(b) 2 molecules of ketone and 1 molecule of aldehyde
(c) triozonide
(d) hexaozonide

135. $AlCl_3$ acts as _____ in Friedel-Crafts reaction
(a) nucleophile (b) electrophile
(c) free radical (d) intermediate

STATEMENT TYPE QUESTIONS

136. The electrophilic substitutions reactions of benzene takes place via
(i) generation of electrophile
(ii) generation of nucleophile
(iii) formation of carbocation intermediate
(iv) removal of proton from the carbocation intermediate
(a) (i), (iii) and (iv) (b) (ii), (iii) and (iv)
(c) (i) and (iv) (d) (ii) and (iv)

137. During the nitration of benzene. In the process of generation of nitronium ion sulphuric acid behaves as a/an _____ and nitric acid behave as a/an _____.
(a) base, acid (b) acid, base
(c) strong acid, weak acid (d) weak acid, strong acid

138. Benzene is highly unsaturated but it does not undergo addition reaction because
(a) π-electrons of benzene are delocalised.
(b) cyclic structures do not show addition reaction
(c) benzene is a non-reactive compound
(d) All of the above

139. Which of the following statements are correct ?
(i) LNG is obtained by liquefaction of natural gas.
(ii) Petrol is obtained by fractional distillation of petroleum.
(iii) Coal gas is obtained by destructive distillation of coal.
(iv) CNG is found in upper strata during drilling of oil wells.
(a) (i), (ii) and (iv) (b) (i), (ii) and (iii)
(c) (i) and (iii) (d) (ii) and (iv)

140. Which of the following statements are correct ?
(i) Saturated hydrocarbons contain only carbon-carbon single bonds.
(ii) Saturated hydrocarbons contain both carbon-carbon and carbon-hydrogen single bond.
(iii) Unsaturated hydrocarbons contain carbon-carbon double bonds.
(iv) Unsaturated hydrocarbons contain carbon-carbon double and triple bonds both.
(a) (i) and (iii) (b) (ii) and (iv)
(c) (i) and (ii) (d) (i) and (iv)

141. Which of the following statements are correct regarding structure of methane ?
(i) Methane has tetrahedral structure.
(ii) The bond angle between all H – C – H bonds is 109.5°.
(iii) The carbon atom is sp^2 hybridized.
(iv) C – C and C – H bond lengths are 154 pm and 112 pm respectively.
(a) (i), (ii) and (iii) (b) (i), (iii) and (iv)
(c) (i), (ii) and (iv) (d) (i), (ii), (iii) and (iv)

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142. In the preparation of alkanes from hydrogenation of alkenes and alkynes. Finely divided catalysts are used which of the following statement(s) is/are correct regarding these catalysts

(i) Platinum and palladium catalyse the reaction at room temperature.

(ii) Nickel catalyse the reaction at relatively higher temperature and pressure.

(iii) Platinum and palladium catalyse the reaction at higher temperature.

(a) (i) and (iii) (b) (i) and (ii)

(c) (ii) and (iii) (d) (i) only

143. Which of the following statements are correct ?

(i) The rate of reactivity of alkanes with halogens is $F_2 > Cl_2 > Br_2 > I_2$.

(ii) Rate of replacement of hydrogens of alkanes is $3° > 2° > 1°$

(iii) Fluorination of alkanes is a very slow process.

(iv) Iodination of alkanes is too violent to be controlled.

(a) (i), (ii) and (iii) (b) (i) and (ii)

(c) (ii) and (iii) (d) (i) and (iv)

144. Which of the following statements are correct ?

(i) Decomposition reaction of higher alkanes into smaller fragments by the application of heat is called pyrolysis.

(ii) Pyrolysis and cracking are different processes.

(iii) Dodecane on pyrolysis gives a mixture of heptane and pentene.

(iv) Pyrolysis follow free radical mechanism.

(a) (i), (ii) and (iii) (b) (i), (ii) and (iv)

(c) (i), (iii) and (iv) (d) (ii) and (iv)

145. Which of the following statement(s) is/are correct ?

(i) Alkanes can have infinite number of conformations by rotation around a C – C single bonds.

(ii) Rotation around C – C single bond is completely free.

(iii) Rotation is hindered by a small energy barrier of 1-20 kJ mol^{-1} due to torsional strain.

(a) (i) and (ii) (b) (i) and (iii)

(c) (ii) and (iii) (d) Only (iii)

146. Which of the following statements are correct ?

(i) Stability of conformation is affected due to torsional strain.

(ii) Magnitude of torsional strain depends upon the angle of rotation about C – C bond.

(iii) Eclipsed form has least torsional strain.

(iv) Staggered form has maximum torsional strain.

(a) (i) and (iii) (b) (i) and (ii)

(c) (iii) and (iv) (d) (i) and (iv)

147. Which of the following statements are correct ?

(i) The general formula of alkenes is C_nH_{2n}.

(ii) Alkenes are also known as paraffins.

(iii) Bond length of C–C double bond in alkene is shorter than C–C single bond in alkane.

(iv) Carbon–Carbon double bond in alkene consists of two sigma bonds.

(v) Alkenes are easily attacked by electrophilic reagent.

(a) (i) and (iv) (b) (i), (iii) and (v)

(c) (i) and (iii) (d) (i), (ii), (iv) and (v)

148. Which of the following statements are correct ?

(i) Cis form of alkene is polar whereas trans form is non-polar

(ii) Cis form of alkene is non-polar whereas trans form is polar.

(iii) In case of solid alkenes the trans isomer has higher melting point than the cis isomer.

(iv) Cis and trans both form have same properties.

(a) (i) and (iii) (b) (ii) and (iii)

(c) (i), (iii) and (iv) (d) (i) and (iv)

149. Which of the following statements are correct ?

(i) Alkynes on reduction with palladised charcoal form cis alkenes.

(ii) Alkynes on reduction with palladised charcoal form trans alkenes.

(iii) Alkynes on reduction with sodium in liquid ammonia form trans alkenes.

(iv) Propyne on reduction with palladised charcoal form a mixture of cis and trans propene.

(a) (i) and (iv) (b) (i) and (iii)

(c) (ii) and (iv) (d) (i), (iii) and (iv)

150. Which of the following statements are correct ?

(i) Polynuclear hydrocarbons contain two or more benzene rings fused together.

(ii) Polynuclear hydrocarbons have carcinogenic property.

(iii) Polynuclear hydrocarbons are formed on incomplete combustion of organic materials like tobacco, coal and petroleum.

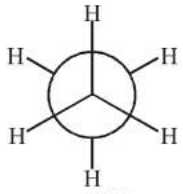
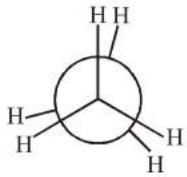
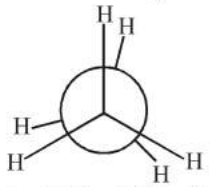
(iv) They are also produced in human body due to various biochemical reactions.

(a) (i), (ii) and (iv) (b) (i), (iii) and (iv)

(c) (ii), (iii) and (iv) (d) (i), (ii) and (iii)

MATCHING TYPE QUESTIONS

151. Match the columns

Column-I		Column-II
(A) Eclipsed	(p)	
(B) Staggered	(q)	
(C) Skew	(r)	

(a) A – (r), B – (p), C – (q) (b) A – (r), B – (q), C – (p)

(c) A – (p), B – (q), C – (r) (d) A – (q), B – (p), C – (r)

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152. Match the columns

Column-I		Column-II	
(A)	$CH_2=CH_2 \rightarrow CH_3-CH_3$	(p)	H_2, Zn, H^+
(B)	$CH_3Cl \rightarrow CH_4$	(q)	NaOH, CaO
(C)	$CH_3Br \rightarrow CH_3CH_3$	(r)	H_2, Pt/Pd
(D)	$CH_3COONa \rightarrow CH_4$	(s)	Na, dry ether

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

153. Match the columns

Column-I		Column-II	
(A)	$CH_4 + O_2 \xrightarrow{Cu/523K/100\ atm}$	(p)	HCHO
(B)	$CH_4 + O_2 \xrightarrow[\Delta]{Mo_2O_3}$	(q)	$(CH_3)_3COH$
(C)	$C_2H_6 + O_2 \xrightarrow[\Delta]{(CH_3COO)_2Mn}$	(r)	CH_3OH
(D)	$(CH_3)_3CH \xrightarrow[oxidation]{KMnO_4}$	(s)	CH_3COOH

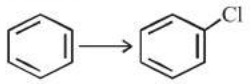
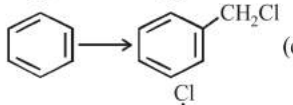
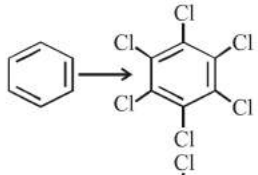
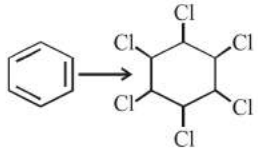
(a) A – (s), B – (p), C – (r), D – (s)
(b) A – (q), B – (p), C – (s), D – (r)
(c) A – (r), B – (p), C – (s), D – (q)
(d) A – (p), B – (q), C – (r), D – (s)

154. Match the columns

Column-I		Column-II	
(A)	$CH \equiv CH + H_2 \longrightarrow CH_2=CH_2$	(p)	Zn
(B)	$CH_3CH_2Br \longrightarrow CH_2=CH_2$	(q)	Conc. H_2SO_4
(C)	$CH_2BrCH_2Br \longrightarrow CH_2=CH_2$	(r)	Pd/C
(D)	$CH_3CH_2OH \longrightarrow CH_2=CH_2$	(s)	Alc. KOH

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

155. Match the columns

Column-I		Column-II	
(A)		(p)	Cl_2, uv, 500 K
(B)		(q)	anhy. $AlCl_3$
(C)		(r)	CH_2Cl_2, anhy. $AlCl_3$
(D)		(s)	Cl_2, anhy. $AlCl_3$,

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

156. Match the following reactants in Column I with the corresponding reaction products in Column II and choose the correct option from the codes given below.

Column - I		Column - II	
(A)	Benzene + $Cl_2 \xrightarrow{AlCl_3}$	(p)	Benzoic acid
(B)	Benzene + $CH_3Cl \xrightarrow{AlCl_3}$	(q)	Methyl phenyl ketone
(C)	Benzene + $CH_3COCl \xrightarrow{AlCl_3}$	(r)	Toluene
(D)	Toluene $\xrightarrow{KMnO_4/NaOH}$	(s)	Chlorobenzene

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

157. Match the columns

Column - I		Column - II	
(A)	Alkyl + Acid halide in presence of dry ether	(p)	Sulphonation
(B)	Arene + Acid halide in presence of $AlCl_3$	(q)	Wurtz reaction
(C)	Arene + Fuming sulphuric in presence of $AlCl_3$	(r)	Catalytic hydrogenation
(D)	Arene + Hydrogen in presence of Ni	(s)	Friedel-Crafts reaction

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

158. Match the columns

Column - I		Column - II	
(A)	Aromatic	(p)	Planar
(B)	Antiaromatic	(q)	Non-planar
(C)	Huckel rule	(r)	$4n\pi$ localised electrons
(D)	Cyclo-octatetraene	(s)	$(4n+2)\pi$ delocalised electrons

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

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159. Match the columns

Column - I (Reactants)		Column - II (No. of chlorinated products)
(A) Benzene $\xrightarrow{Cl_2,\ light}$	p.	Three compounds
(B) Toluene $\xrightarrow{Cl_2,\ light}$	q.	Four compounds
(C) Methane $\xrightarrow{Cl_2,\ light}$	r.	Single monochloro derivative
(D) Benzene $\xrightarrow{Cl_2,\ AlCl_3}$	s.	Six isomeric compounds

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

ASSERTION-REASON TYPE QUESTIONS

Directions : Each of these questions contain two statements, Assertion and Reason. Each of these questions also has four alternative choices, only one of which is the correct answer. You have to select one of the codes (a), (b), (c) and (d) given below.

(a) Assertion is correct, reason is correct; reason is a correct explanation for assertion.
(b) Assertion is correct, reason is correct; reason is not a correct explanation for assertion
(c) Assertion is correct, reason is incorrect
(d) Assertion is incorrect, reason is correct.

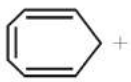
160. **Statement-1 :** 1-Butene on reaction with HBr in the presence of a peroxide produces 1-bromobutane.
Statement-2 : It involves the free radical mechanism.

161. **Statement-1 :** CH_4 does not react with Cl_2 in dark.
Statement-2 : Chlorination of CH_4 takes place in sunlight.

162. **Statement-1 :** Iodination of alkanes is reversible.
Statement-2 : Iodination is carried out in presence of iodic acid.

163. **Statement-1 :** All the hydrogen atoms in $CH_2=C=CH_2$ lie in one plane.
Statement-2 : Carbon atoms are sp^2 and sp hybridized.

164. **Statement-1 :** Tropylium cation is aromatic in nature



Statement-2 : The only property that determines its aromatic behaviour is its planar structure.

CRITICAL THINKING TYPE QUESTIONS

165. In cyclopropane, cyclobutane and cyclohexane, the common group is

(a) $-\overset{|}{\underset{|}{C}}-$ (b) $-\overset{|}{\underset{|}{C}}H$
(c) $-CH_3$ (d) $\overset{|}{\underset{|}{C}}H_2$

166. The number of primary, secondary, tertiary and quaternary carbons in neopentane are respectively
(a) 4, 3, 2 and 1 (b) 5, 0, 0 and 1
(c) 4, 0, 0 and 1 (d) 4, 0, 1 and 1

167. The IUPAC name of $CH_3-CH_2-\overset{\overset{H}{|}}{\underset{\underset{CH_3}{|}}{C}}-\overset{\overset{C_4H_9}{|}}{\underset{\underset{CH_3}{|}}{C}}-CH_3$: –

(a) 3, 4, 4–Trimethyl octane
(b) 3, 4, 4–Trimethyl heptane
(c) 2–Ethyl, 3,3–dimethyl heptane
(d) 2–Butyl, 2 methyl,3–ethyl butane

168. Which one of the following has the lowest boiling point?
(a) 2-methylbutane (b) 2-methyl propane
(c) 2, 2-dimethyl propane (d) n-pentane

169. Arrange the following in decreasing order of their boiling points.
(A) n–butane (B) 2-methylbutane
(C) n-pentane (D) 2, 2–dimethylpropane
(a) A > B > C > D (b) B > C > D > A
(c) D > C > B > A (d) C > B > D > A

170. When neo-pentyl bromide is subjected to Wurtz reaction, the product formed is
(a) 2,2,4,4-tetramethylhexane
(b) 2,2,4,4-tetramethylpentane
(c) 2,2,5,5-tetramethylhexane
(d) 2,2,3,3-tetramethylhexane

171. Which one of the following reactions is expected to readily give a hydrocarbon product in good yields ?

(a) $RCOOK \xrightarrow[\text{oxidation}]{\text{Electrolytic}}$
(b) $RCOO^-Ag^+ \xrightarrow{Br_2}$
(c) $CH_3CH_3 \xrightarrow[h\upsilon]{Cl_2}$
(d) $(CH_3)_3CCl \xrightarrow{C_2H_5OH}$

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172. A hydrocarbon A on chlorination gives B which on heating with alcoholic potassium hydroxide changes into another hydrocarbon C. The latter decolourises Baeyer's reagent and on ozonolysis forms formaldehyde only. A is
(a) Ethane (b) Butane
(c) Methane (d) Ethene

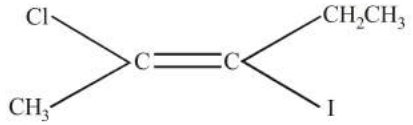
173. Which of the following compounds can yield only one monochlorinated product upon free radical chlorination?
(a) Propane (b) 2, 2-Dimethylpropane
(c) 2-Methylpropane (d) n-Butane

174. In the eclipsed conformation of ethane, the dihedral angle between the hydrogen atoms of adjacent methyl groups is
(a) 60° (b) 120°
(c) 0° (d) 180°

175. The nodal plane in the π-bond of ethene is located in
(a) the molecular plane
(b) a plane parallel to the molecular plane
(c) a plane perpendicular to the molecular plane which bisects the carbon - carbon σ -bond at right angle
(d) a plane perpendicular to the molecular plane which contains the carbon - carbon σ -bond.

176. The IUPAC name of the compound having the formula $(CH_3)_3CCH=CH_2$ is –
(a) 3, 3, 3-trimethyl-1-propane
(b) 1, 1, 1-trimethyl-1-butene
(c) 3, 3-dimethyl-1-butene
(d) 1, 1-dimethyl-1, 3-butene

177. The IUPAC name of the following compound is

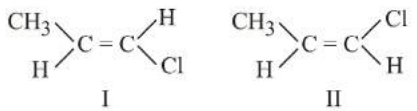


(a) trans-2-chloro-3-iodo-2-pentene
(b) cis-3-iodo-4-chloro-3-pentene
(c) trans-3-iodo-4-chloro-3-pentene
(d) cis-2-chloro-3-iodo-2-pentene

178. The number of possible open chain (acyclic) isomeric compounds for molecular formula C_5H_{10} would be
(a) 8 (b) 7
(c) 6 (d) 5

179. Correct order of stability is :
(a) cis -2- butene > 1-butene > trans -2-butene
(b) trans-2-butene > cis-2-butene > 1-butene
(c) 1-butene > cis-2-butene > trans-2- butene
(d) cis-2-butene > trans-2-butene > 1-butene

180. Which of the following is correct set of physical properties of the geometrical isomers –



I II

	Dipole moment	B.P.	M.P.	Stability
(a)	I > II	I > II	II > I	I > II
(b)	II > I	II > I	II > I	II > I
(c)	I > II	I > II	I > II	I > II
(d)	II > I	II > I	I > II	I > II

181. But-2-ene exhibits cis-trans-isomerism due to
(a) rotation around $C_3 - C_4$ sigma bond
(b) restricted rotation around C = C bond
(c) rotation around $C_1 - C_2$ bond
(d) rotation around $C_2 - C_3$ double bond

182. In the following reactions,

(i) $CH_3-\underset{\displaystyle OH}{\underset{|}{CH}}-CH-CH_3 \xrightarrow{H^+/Heat} \underset{(\text{Major products})}{A} + \underset{(\text{Minor products})}{B}$

(ii) $A \xrightarrow[\text{in absence of peroxide}]{HBr,\text{dark}} \underset{(\text{Major product})}{C} + \underset{(\text{Minor product})}{D}$

the major products (A) and (C) are respectively :

(a) $CH_2=\underset{\displaystyle CH_3}{\underset{|}{C}}-CH_2-CH_3$ and $\underset{\displaystyle Br}{\underset{|}{CH_2}}-\underset{\displaystyle CH_3}{\underset{|}{CH}}-CH_2-CH_3$

(b) $CH_3-\underset{\displaystyle CH_3}{\underset{|}{C}}=CH-CH_3$ and $CH_3-\underset{\displaystyle Br}{\underset{|}{\underset{\displaystyle CH_3}{\underset{|}{C}}}}-CH_2-CH_3$

(c) $CH_3-\underset{\displaystyle CH_3}{\underset{|}{C}}=CH-CH_3$ and $CH_3-\underset{\displaystyle Br}{\underset{|}{\underset{\displaystyle CH_3}{\underset{|}{CH}}}}-CH-CH_3$

(d) $CH_2=\underset{\displaystyle CH_3}{\underset{|}{C}}-CH_2-CH_3$ and $CH_3-\underset{\displaystyle Br}{\underset{|}{\underset{\displaystyle CH_3}{\underset{|}{C}}}}-CH_2-CH_3$

183. When 3, 3-dimethyl 2-butanol is heated with H_2SO_4, the major product obtained is
(a) 2,3-dimethyl 2-butene
(b) 3, 3-dimethyl 1- butene
(c) 2, 3-dimethyl 1- butene
(d) *cis* & *trans* isomers of 2, 3-dimethyl 2-butene

184. An alkene having molecular formula C_7H_{14} was subjected to ozonolysis in the presence of zinc dust. An equimolar amount of the following two compounds was obtained

$\begin{matrix}CH_3\\CH_3\end{matrix}\!\!>\!C=O$ and $\begin{matrix}CH_3\\CH_3CH_2\end{matrix}\!\!>\!C=O$

The IUPAC name of the alkene is
(a) 3, 4-dimethyl-3-pentene (b) 3, 4-dimethyl-2-pentene
(c) 2, 3-dimethyl-3-pentene (d) 2, 3-dimethyl-2-pentene

185. Reaction of hydrogen bromide with propene in the absence of peroxide is a/an
(a) free radical addition
(b) nucleophilic addition
(c) electrophilic substitution
(d) electrophilic addition

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186. Which of the following types of reaction occur when a reactant has got a double bond ?

(i) Addition
(ii) Photolysis
(iii) Nucleophilic substitution
(iv) Polymerization

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

187. The disappearance of the characteristic purple colour of $KMnO_4$ in its reaction with an alkene is the test for unsaturation. It is known as

(a) Markownikoff test (b) Baeyer test
(c) Wurtz test (d) Grignard test

188. $CH_2 = CHCl$ reacts with HCl to form

(a) $CH_2Cl - CH_2Cl$ (b) $CH_3 - CHCl_2$
(c) $CH_2 = CHCl.HCl$ (d) None of these

189. The only alcohol that can be prepared by the indirect hydration of alkene is

(a) Ethyl alcohol (b) Propyl alcohol
(c) Isobutyl alcohol (d) Methyl alcohol

190. Which reactions are most common in alkenes

(a) Electrophilic substitution reactions
(b) Nucleophillic substitution reactions
(c) Electrophilic addition reactions
(d) Nucleophilic addition reactions

191. In the presence of peroxide, hydrogen chloride and hydrogen iodide do not give anti-Markownikov's addition to alkenes because

(a) Both are highly ionic
(b) One is oxidising and the other is reducing
(c) One of the steps is endothermic in both the cases
(d) All the steps are exothermic in both the cases

192. Which of the following statements is incorrect regarding dehydrohalogenation of alkenes ?

(a) During the reaction hydrogen atom is eliminated from the β - carbon atom.
(b) Rate of reaction for same alkyl group; Iodine > Bromine > Chlorine
(c) Rate of reaction; $(CH_3)_3C- > (CH_3)_2CH- > CH_3CH_2-$
(d) Only nature of halogen atom determine rate of the reaction.

193. How many structural isomers are possible for the alkyne C_6H_{10} ?

(a) 7 (b) 6
(c) 8 (d) 5

194. Which of the following will have least hindered rotation around carbon - carbon bond ?

(a) Ethane (b) Ethylene
(c) Acetylene (d) Hexachloroethane

195. Acetylenic hydrogens are acidic because

(a) Sigma electron density of C – H bond in acetylene is nearer to carbon, which has 50% *s*-character
(b) Acetylene has only open hydrogen in each carbon
(c) Acetylene contains least number of hydrogens among the possible hydrocarbons having two carbons
(d) Acetylene belongs to the class of alkynes with molecular formula, C_nH_{2n-2}.

196. Propyne can be prepared by dehydrohalogenation of

(a) 1–chloropropane
(b) 1, 2–dichloropropane
(c) 1, 2–dichloroethane
(d) 1, 1, 2, 2–tetrachloroethane

197. Which is the most suitable reagent among the following to distinguish compound (3) from rest of the compounds ?

1. $CH_3 - C \equiv C - CH_3$
2. $CH_3 - CH_2 - CH_2 - CH_3$
3. $CH_3 - CH_2C \equiv CH$
4. $CH_3 - CH = CH_2$.

(a) Bromine in carbon tetrachloride
(b) Bromine in acetic acid
(c) Alk $KMnO_4$
(d) Ammonical silver nitrate.

198. Predict the product C obtained in the following reaction of butyne-1.

$$CH_3CH_2 - C \equiv CH + HCl \longrightarrow B \xrightarrow{HI} C$$

(a) $CH_3 - CH_2 - CH_2 - \underset{\displaystyle Cl}{\overset{\displaystyle I}{\underset{|}{\overset{|}{C}}}} - H$

(b) $CH_3 - CH_2 - \overset{\displaystyle I}{\overset{|}{C}}H - CH_2Cl$

(c) $CH_3CH_2 - \underset{\displaystyle Cl}{\overset{\displaystyle I}{\underset{|}{\overset{|}{C}}}} - CH_3$

(d) $CH_3 - \underset{\displaystyle Cl}{\underset{|}{C}}H - CH_2CH_2I$

199. The correct increasing order of acidity of the following alkynes

(1) $CH_3 - C \equiv C - CH_3$
(2) $CH_3 - C \equiv CH$
(3) $CH \equiv CH$

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

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200. Identify the alkyne in the following sequence of reactions.

$$\text{Alkyne} \xrightarrow[\text{Lindlar's catalyst}]{H_2} A \xrightarrow{\text{Ozonolysis}} \underset{\text{only}}{B} \xleftarrow{\text{Wacker Process}}$$

$CH_2 = CH_2$

(a) $H_3C - C \equiv C - CH_3$

(b) $H_3C - CH_2 - C \equiv CH$

(c) $H_2C = CH - C \equiv CH$

(d) $HC \equiv C - CH_2 - C \equiv CH$

201. Which of the following represent the correct order of acidic strength ?

(i) $HC \equiv CH > H_2C = CH_2 > CH_3 - CH_3$

(ii) $HC \equiv CH > CH_3 - CH_3 > H_2C = CH_2$

(iii) $CH_3C \equiv CH > HC \equiv CH > CH_3 - C \equiv C - CH_3$

(iv) $HC \equiv CH > CH_3 - C \equiv CH > CH_3 - C \equiv C - CH_3$

(a) (i) and (iii) (b) (ii) and (iv)

(c) (i) and (iv) (d) (i) and (iv)

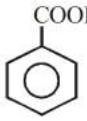
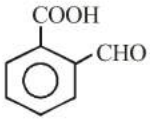
202. Which one of these is not compatible with arenes?

(a) Greater stability

(b) Delocalisation of π-electrons

(c) Electrophilic additions

(d) Resonance

203.  and  are

(a) Position isomer (b) Chain isomer

(c) Functional isomer (d) Stereoisomer

204. The carbon-carbon bond length in benzene is

(a) Same as in C_2H_4

(b) In between C_2H_6 and C_2H_2

(c) In between C_2H_4 and C_2H_2

(d) In between C_2H_6 and C_2H_4

205. Point out the wrong statement in relation to the structure of benzene

(a) It forms only one monosubstitution product

(b) The C - C bond distance in benzene is uniformly 1.397Å

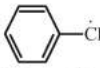
(c) It is a resonance hybrid of a number of canonical forms

(d) It has three delocalised π-molecular orbitals

206. The ratio of σ to π bonds in benzene is :

(a) 2 (b) 3

(c) 4 (d) 8

207. The radical,  is aromatic because it has :

(a) 7 p-orbitals and 6 unpaired electrons

(b) 7 p-orbitals and 7 unpaired electrons

(c) 6 p-orbitals and 7 unpaired electrons

(d) 6 p-orbitals and 6 unpaired electrons

208. (i) Chlorobenzene and (ii) benzene hexachloride are obtained from benzene by the reaction of chlorine, in the pesence of

(a) (i) Direct sunlight and (ii) anhydrous $AlCl_3$

(b) (i) Sodium hydroxide and (ii) sulphuric acid

(c) (i) Ultraviolet light and (ii) anhydrous $FeCl_3$

(d) (i) Anhydrous $AlCl_3$ and (ii) direct sunlight

209. A group which deactivates the benzene ring towards electrophilic substitution but which directs the incoming group principally to the o- and p-positions is

(a) $-NH_2$ (b) $-Cl$

(c) $-NO_2$ (d) $-C_2H_5$

210. Benzene can be obtained by heating either benzoic acid with X or phenol with Y. X and Y are respectively.

(a) Zinc dust and soda lime

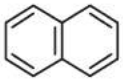
(b) Soda lime and zinc dust

(c) Zinc dust and sodium hydroxide

(d) Soda lime and copper

211. Which of the following chemical system is non aromatic?

(a)  (b) 

(c)  (d) 

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HINTS AND SOLUTIONS

FACT/DEFINITION TYPE QUESTIONS

1. **(d)** LPG is used as a domestic fuel with the least pollution.

2. **(b)** LPG mainly contains butane.

3. **(a)** Natural gas is a mixture of CH_4, C_2H_6 and C_3H_8.

4. **(a)** **5.** **(b)** **6.** **(d)** **7.** **(d)** **8.** **(d)**

9. **(d)** $\overset{1^\circ}{CH_3} - \overset{1^\circ}{CH_3}$

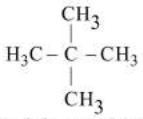
Both carbon atoms in ethane are primary.

10. **(a)**

11. **(c)** Pentane (C_5H_{12}) exists as three chain isomers

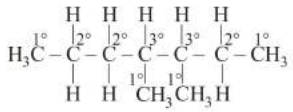
$CH_3CH_2CH_2CH_2CH_3$ (n-pentane)

$CH_3-CH(CH_3)-CH_2-CH_3$ (2–methylbutane (iso pentane))



2,3-dimethylpropane (neo pentane)

12. **(a)**

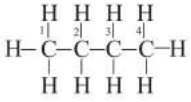


3, 4-dimethylheptane

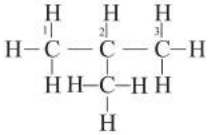
There are four 1° C-atoms, three 2° C-atoms and two 3° C-atoms

13. **(c)** **14.** **(d)**

15. **(d)** CH_4, C_2H_6 and C_3H_8 can have only one structure but C_4H_{10} can have more than one structure. Possible structures of C_4H_{10} are following



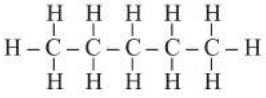
Butane (n- butane), (b.p. 273 K)

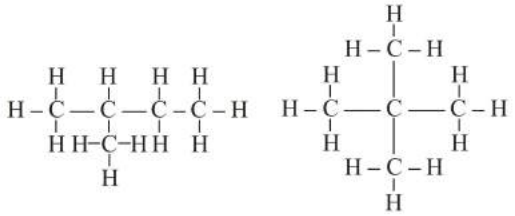


2-Methylpropane (isobutane)

(b.p.261 K)

16. **(b)** Possible isomers of C_5H_{12} are





17. **(b)**

18. **(a)** CH_4 has only one carbon atom, hence it can't be prepared by Wurtz reaction, which involves two molecules of alkyl halide.

19. **(a)** When alkyl halide is treated with sodium metal in presence of ether, alkane is obtained, this reaction is called as Wurtz reaction.

$$R-\mathbf{X}+\mathbf{2Na}+\mathbf{X}-R' \xrightarrow{\text{dry ether}} R-R'+2NaBr$$

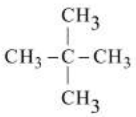
$$CH_3-Br+2Na+Br-CH_3 \xrightarrow{\text{dry ether}} CH_3-CH_3+2NaBr$$

20. **(c)** Other three methods can be used for the preparation of alkane having at least two carbon atoms.

21. **(b)** Sodium salts of carboxylic acids on heating with soda lime (mixture of sodium hydroxide and calcium oxide) give alkanes containing one carbon atom less than the carboxylic acid. This process of elimination of carbon dioxide from a carboxylic acid is known as decarboxylation

$$\underset{\text{Sodium ethanoate}}{CH_3COO^-Na^+} + NaOH \xrightarrow[\Delta]{CaO} \underset{\text{Methane}}{CH_4} + Na_2CO_3$$

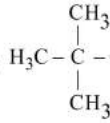
22. **(a)** Higher is the branching lesser will be the boiling point further increase in molecular weight increases boiling point in alkane. Hence 2, 2–dimethyl propane will have least boiling point.



23. **(a)** n-octane has highest boiling point due to unbranched chain and maximum carbon atoms. It has max. Van der Waal forces.

24. **(c)**

25. **(a)** $Cl_2 \xrightarrow[\text{Chain initiation}]{h\nu} 2Cl^{\bullet}$

26. **(d)** Neo-pentane,  , has only 1° hydrogen and hence gives only one monochloro derivative.

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27. **(d)**

28. **(c)** $CH_3-\underset{\displaystyle CH_3}{\underset{|}{CH}}-CH_2-CH_3 \xrightarrow[\text{sunlight}]{Br_2} CH_3-\underset{\displaystyle Br}{\underset{|}{\overset{\displaystyle CH_3}{\overset{|}{C}}}}-CH_2CH_3$

2–bromo–2–methyl butane

Ease of replacement of H-atom 3° > 2° > 1°.

29. **(a)** Complete combustion of all organic compounds leads to formation of $CO_2 + H_2O$.

30. **(b)** $CH_3-CH_2-CH_2-CH_2-CH_2-CH_3$

$\xrightarrow{\text{Aromatisation}}$ 

Benzene

Aromatisation is a process in which aromatic compounds are formed from open chain compounds.

31. **(b)** During cracking higher hydrocarbons (liquid) are converted to lower gaseous hydrocarbons.

32. **(c)** n-Alkanes on heating with anhydrous aluminium chloride and hydrogen chloride gas isomerise to branched chain alkanes.

33. **(b)** Methane reacts with steam at 1273 K in the presence of nickel catalyst to form carbon monoxide and dihydrogen. This method is used for industrial preparation of dihydrogen gas.

34. **(c)** A conformation is defined as the relative arrangement of atoms or groups around a central atom, obtained by the free rotation of one part of the molecule with respect to rest of the molecule. For a complete rotation of 360°, one part may rotate through any degree say 0.1°, 0.5°, 1° etc. giving rise to infinite number of relative arrangements of group (atom) around a central atom, keeping other part fixed.

35. **(d)** Spatial arrangements of atoms which can be converted around a C – C single bond are called conformations or conformers or rotamers.

36. **(a)**

37. **(d)**

38. **(a)** As predicted by the VSEPR model of electron pair repulsion, the molecular geometry of alkenes includes bond angles about each carbon in a double bond of about 120°.

39. **(c)** Double bond in between carbon-carbon is present in alkenes whose general formula is C_nH_{2n}.

40. **(d)** $H_3\overset{6}{C}-\underset{\displaystyle Cl}{\underset{|}{\overset{5}{C}H}}-\overset{4}{C}H_2-\overset{3}{C}H=\overset{2}{C}H-\overset{1}{C}H_3$

IUPAC name : 5- chlorohex-2-ene

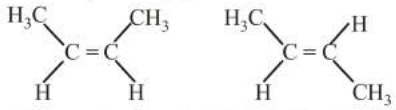
41. **(a)**

42. **(c)** $\overset{1}{C}H_2=\overset{2}{C}H-\overset{3}{C}H_2Cl$

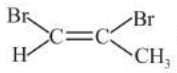
43. **(a)** Since **b** (from bromo) comes earlier in alphabetical order than **c** (from chloro), the correct name should be 2, 3-dibromo-1, 4-dichlorobutene-2 and not 1,4-dichloro-2, 3-dibromobutene-2.

44. **(b)** $\overset{5}{C}H_3-\underset{\displaystyle OH}{\underset{|}{\overset{4}{C}H}}-\overset{3}{C}H=\overset{2}{C}-\overset{1}{C}HO$ (with CH_3 on C-2)

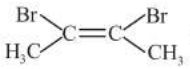
4-Hydroxy-2-methylpent-2-en-1-al

45. **(b)** 

46. **(d)** Alkenes having double bonds with two different groups on each end of the double bond show geometrical isomerism. $A_2b_2c_2$, A_2b_2cd, A_2bcde.



1,2-dibromopropene



2,3-dibromobut-2-ene

47. **(b)** The two isomers differ in the position of the double bond so they are called position isomers.

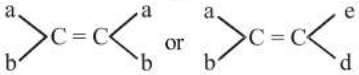
48. **(b)** $CH_3CH_2CH=CH_2$ (1-butene (*i*)); $CH_3CH=CHCH_3$ (2- butene (*ii*), (*iii*) (*cis,- trans*)); $(CH_3)_2C=CH_2$ (2-methylpropene (*iv*))

cyclobutane (*v*)

methylcyclopropane (*vi*)

49. **(a)** As sketched in the above question , C_5H_{10} may be monosubstituted (i) and (iv), disubstituted as in (ii), (iii) and (v) and trisubstituted as in (vi)

50. **(c)** The condition for geometrical isomerism is



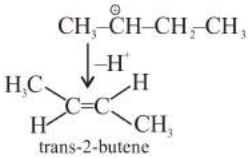
51. **(a)**

52. **(d)** $CH_3-CH_2-Br + KOH \xrightarrow[\text{(alc)}]{} CH_2=CH_2 + KBr + H_2O$

53. **(c)**

54. **(d)** $CH_3-\underset{\displaystyle Br}{\underset{|}{CH}}-CH_2-CH_3 \xrightarrow{\text{alc. KOH}}$

2-Bromobutane



trans-2-butene

55. **(c)** $C_2H_5OH \xrightarrow[KMnO_4]{\text{conc. } H_2SO_4} C_2H_4 + H_2O$

Note : If ethyl alcohol is taken in excess and the reaction is carried out at a temperature of 433-443 K diethyl ether is formed.

$\underset{\text{(excess)}}{2C_2H_5OH} \xrightarrow[433-443\ K]{\text{conc. } H_2SO_4} C_2H_5OC_2H_5 + H_2O$

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56. (d) Alcoholic KOH is used for dehydrohalogenation e.g.

$$CH_3-CH_2-CH_2-CH_2Cl \xrightarrow[KOH]{alc.} CH_3-CH_2-CH=CH_2$$

57. (b) Paraffins or alkanes are non-polar compounds. Hence soluble in benzene.

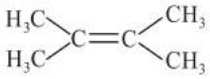
58. (a) Peroxide effect is observed only in case of HBr. Therefore, addition of HCl to propene even in the presence of benzyoyl peroxide occurs according to Markovnikov's rule :

$$CH_3-CH=CH_2 \xrightarrow[(C_6H_5CO)_2O_2]{HCl} CH_3-CHCl-CH_3$$

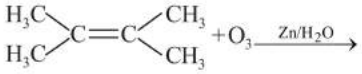
59. (b) Markonikov's way of addition :

$$CH_3-CH=CH_2 \xrightarrow{A^+B^-} CH_3-\underset{B}{CH}-\underset{A}{CH_2}$$

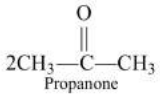
60. (d) Since given alkene on ozonolysis gives 2 moles of propanone hence alkene should have a double bond between two equivalent C atoms i.e. the formula should be



i.e.

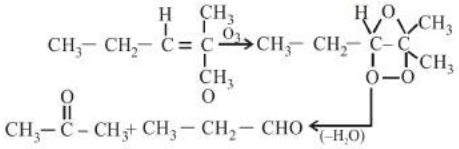


2, 3-dimethyl but-2-ene



Propanone

61. (a)

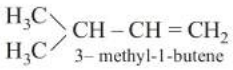


62. (d) In presence of peroxide, HBr adds on alkenes in anti–markovnikov's way, thus

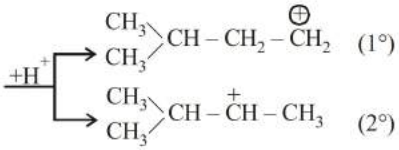
$$\underset{\text{Propene}}{H_3CCH=CH_2} + HBr \xrightarrow{\text{Peroxide}} \underset{n\text{–propyl bromide}}{H_3CCH_2CH_2Br}$$

Kharasch observed that the addition of HBr to unsymmetrical alkene in the presence of organic peroxides follows an opposite course to that suggested by Markownikoff . This is termed anti-Markownikoff or peroxide effect.

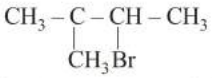
63. (b) We know that in case of an unsymmetrical alkene there is the possibility of forming two products. In such cases the formation of major product is decided on the basis of *Markownikoffs rule* which is rationalized in terms of *stability of the intermediate* carbocation. Also remember that 3° carbocation is more stable than 2° carbocation and 2° carbocation is more stable than 1° carbocation.



3– methyl-1-butene



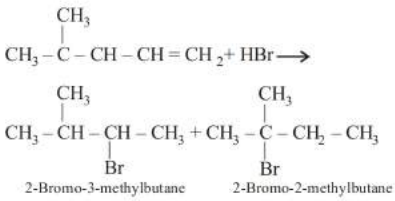
of the two possibilities 2° carbocation is more stable so the product of the reaction expected was predominantly one formed by 2° carbocation i.e.



i.e. 2– Bromo-3-Methylbutane

However *some electrophilic addition reaction form products that are clearly not the result of the addition of electrophile to the sp^2 carbon bonded to the most hydrogens and the addition of a nucleophile to the other sp^2 carbon.*

In the above cases the addition of HBr to 3-methyl-1-butene the two products formed are shown below.



2-Bromo-3-methylbutane 2-Bromo-2-methylbutane

In this case the major product formed is 2- Bromo-2-methylbutane i.e. option (b) is correct answer.

(**Note**: The unexpected product results from a rearrangement of carbocation intermediate. Please note that all carbocation do not rearrange.

64. (c) Alkenes combine with hydrogen under pressure and in presence of a catalyst (Ni, Pt or Pd) and form alkanes.

$$\text{Butene - 1} \xrightarrow{H_2/Pd} \text{Butane}$$

65. (a) Alkenes are unsaturated hydrocarbon having double bond so generally gives addition reaction.

66. (c)

67. (d) A doubly bonded carbon atom having an alkyl group is oxidised to aldehyde which is further oxidised to carboxylic acid.

$$CH_3CH_2CH=CHCH_3 \xrightarrow[(ii)H^+]{(i)KMnO_4,OH^-} \underset{\downarrow}{CH_3CHO} + \underset{\downarrow}{CH_3CH_2CHO}$$

$$\underset{\downarrow}{CH_3COOH} \quad \underset{\downarrow}{CH_3CH_2COOH}$$

68. (b) Polythene is manufactured by heating ethylene to 473K under a pressure of 1500 atmosphere and in the presence of a trace of oxygen.

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$$n(CH_2=CH_2)\xrightarrow[\text{Trace of oxygen}]{473K,1500atm}(-CH_2-CH_2-)_n$$

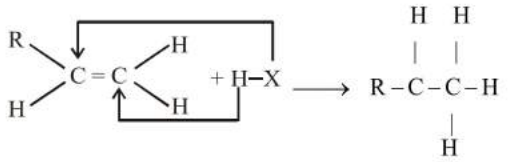
The polythene manufactured in this way is called low density of polythene.

69. (a) $CH_2=\overset{\curvearrowleft}{CH_2}+H\overset{\curvearrowleft}{-O}-SO_2OH \longrightarrow$ (H_2SO_4)

$$CH_3\overset{\oplus}{C}H_2+OSO_2OH \longrightarrow \underset{\text{Ethyl hydrogen sulphate}}{CH_3CH_2OSO_2OH}$$

Addition of sulphuric acid takes place according to Markownikoff's rule. Alkanes do not absorb cold conc. H_2SO_4.

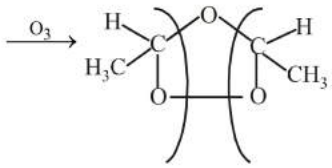
70. (c) According to Markownikoff's rule, "in case of addition of an unsymmetrical reagent (H– X), the positive part get attached to the C which is least substituted or which bears larger number of hydrogen atoms."



Markownikoff's rule is based on the stability of carbocations (3° > 2° > 1° > methyl).

71. (c) As per Markovnikoff's law, the positive part (e.g. H of HX) or the less negative part of the reagent adds to that carbon atom of alkene which has more number of hydrogen atoms (the rich gets richer). So (c) is the correct option as the two carbons containing the double bond have one H atom each i.e. symmetric.

$$\underset{\text{2–butene}}{CH_3CH=CHCH_3}$$



$$\xrightarrow{Zn/H_2O} 2CH_3CHO$$

74. (a) The addition of HBr takes place according to anti-Markovnikoff's rule in presence of peroxide for unsymmetrical alkenes.

The addition of HBr to symmetrical alkenes is not affected by the presence or absence of peroxide.

75. (d) $CH_2=CH_2+KMnO_4 \xrightarrow{OH^{\ominus}}$

$$\underset{\text{Glycol}}{\underset{OH\quad OH}{CH_2-CH_2}}+MnO_2+KOH$$

76. (b) When unsymmetrical unsaturated hydrocarbon reacts with unsymmetrical reagent, then negative part of reagents attacks that carbon which has less H-atom. [Markownikoff's rule]

$$\underset{\text{Propene-2}}{CH_3-CH=CH_2}+HI \xrightarrow{400°C} \underset{\text{2-Iodopropane}}{CH_3-\underset{I}{CH}-CH_3}$$

77. (a) $CH_2=CH_2+Br_2 \xrightarrow{CCl_4} \underset{\text{1, 2-dibromo ethane}}{\underset{Br\quad Br}{CH_2-CH_2}}$

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81. **(b)** Greater the *s*-character of C, higher is its electronegativity, shorter and stronger will be the bond formed by it. Thus $-C \equiv C-$ is the strongest bond.

82. **(b)** General formula for alkynes is C_nH_{2n-2}

83. **(c)** When both double and triple bonds are present, then triple bond is considered as the principal group.

$$\overset{5}{CH_3}-\overset{4}{CH}=\overset{3}{CH}-\overset{2}{C}\equiv\overset{1}{CH}$$

84. **(b)** Three alkynes are possible for the formula C_5H_8.

$CH_3CH_2CH_2C\equiv CH$

$$\begin{matrix} CH_3 \\ \diagdown \\ \quad CH-C\equiv CH \\ \diagup \\ CH_3 \end{matrix}$$

$CH_3CH_2C\equiv CCH_3$

85. **(c)** If both the double and triple bonds are present, the compound is regarded as derivative of alkyne. Further if double and triple bonds are at equidistance from either side, the preference is given to double bond.

86. **(d)** C_2H_2 and C_3H_4 are homologue because they differ by $-CH_2$ group. Both have triple bond in their molecule.

87. **(a)**

88. **(d)** In $CH \equiv CH$ triple bond consists of one σ and two π bonds.

89. **(c)** In C_2H_6, C – C bond length is 1.54 Å.

90. **(c)** Acetylene molecule can be represented as,

$$H-\underset{\sigma}{C}\overset{\pi}{\underset{\pi}{\equiv\sigma}}C-\underset{\sigma}{H}$$

So, it contains 3 σ and 2 π bonds.

91. **(d)** We know that carbon having

(i) 4 σ bonds correspond to sp^3

(ii) 3 σ and 1 π bond correspond to sp^2

(iii) 2 σ and 2 π bonds correspond to sp

$$\overset{(1)}{H_3C}-\overset{(2)}{C}\equiv\overset{(3)}{C}-\overset{(4)}{CH_3}$$

	(1)	(2)	(3)	(4)
No. of bonds :	4σ	2σ	2σ	4σ
	–	2π	2π	–
Hybridisation :	sp^3	sp	sp	sp^3

Thus, butyne-2 has sp and sp^3 hybridised carbon atoms.

92. **(b)** $\underset{1.20A^\circ}{C\equiv C} < \underset{1.34A^\circ}{C=C} < \underset{1.54A^\circ}{C-C}$

93. **(a)** As the number of bonds between carbon atoms increases, electronegativity of that carbon also increases due to increasing active power of electrons. Also *sp* hybrid is more electronegative than sp^2 which is more electronegative than sp^3($\because$ *s* character decreases) Hence, option (a) is correct.

94. **(c)** On heating ethylene chloride (1, 1 dichloro ethane) with alcoholic potash followed by sodamide alkyne is obtained

$$R-CH_2-CCl_2-R \xrightarrow{alc.KOH} R-CH=CCl-R$$

$$\xrightarrow{NaNH_2} R-C\equiv C-R$$

95. **(c)** $\underset{\text{Calcium carbide}}{CaC_2} + 2H_2O \longrightarrow \underset{\text{Acetylene}}{HC\equiv CH} + Ca(OH)_2$

96. **(d)** Among isomeric alkanes, the straight chain isomer has higher boiling point than the branched chain isomer. The greater the branching of the chain, the lower is the boiling point. Further due to the presence of π electrons, these molecules are slightly polar and hence have higher boiling points than the corrosponding alkanes.

97. **(a)** Terminal alkyenes give a white precipitate easily on reaction with ammonical silver nitrate solution.

98. **(b)** $CH \equiv CH + H_2O \xrightarrow[HgSO_4.60^\circ C]{\text{dil } H_2SO_4}$

$$\underset{\text{unstable}}{[CH_2=CHOH]} \longrightarrow CH_3CHO$$

99. **(b)** $CH \equiv CH + HCl \rightarrow CH_2=CH-Cl \xrightarrow{HCl}$

$$CH_3-CH\begin{matrix}Cl\\Cl\end{matrix}$$

1, 1-dichloroethane

100. **(b)** Alkynes having terminal $-C \equiv H$ react with Na in liquid ammonia to yield H_2 gas. $CH_3CH_2C \equiv CH$ can react with Na in liquid NH_3 so the correct answer is (b).

$$CH_3CH_2C\equiv CH \xrightarrow[\text{liquid } NH_3]{\text{Na in}}$$

$$CH_3CH_2C\equiv C^-Na^+ + \frac{1}{2}H_2(g)$$

101. **(a)** Acetylene reacts with the other three as:

$$CH\equiv CNa \xleftarrow[\text{liq. } NH_3]{Na} CH\equiv CH \xrightarrow{+HCl} \underset{CHCl}{\overset{CH_2}{\|}}$$

$$\xrightarrow{+HCl} \underset{CHCl_2}{\overset{CH_3}{|}}$$

$$CH\equiv CH \xrightarrow{[AgNO_3+NH_4OH]} \underset{\text{white ppt.}}{AgC\equiv CAg} + NH_4NO_3$$

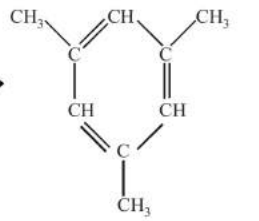
102. **(c)** **103.** **(d)**

104. **(c)** $CH_3-C\equiv CH + H_2O \xrightarrow[1\%\ HgSO_4]{40\%\ H_2SO_4}$

$$CH_3-\underset{OH}{\overset{|}{C}}=CH_2 \xrightarrow{\text{Rearrangement}} CH_3-\underset{O}{\overset{\|}{C}}-CH_3$$

Acetone

105. **(a)** $3CH_3-C\equiv CH \longrightarrow$



Mesitylene or 1, 3, 5-trimethyl benzene

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106. (b) $\underset{\text{Acetyle}}{CH \equiv CH} + H_2 \xrightarrow[\text{Catalyst Pd. } BaSO_4]{\text{Lindlar's}} \underset{\text{Ethylene}}{CH_2 = CH_2}$

107. (d) Addition – $CH \equiv CH + 3H_2 \xrightarrow{Ni} CH_3 - CH_3$

Substitution –

$$CH \equiv CH + Na \longrightarrow CH \equiv C^-Na^+ + \frac{1}{2}H_2$$

Polymerization –

$$3CH \equiv CH \xrightarrow[\text{Polymerization}]{\text{hot Cu tube}} \underset{\text{Benzene}}{C_6H_6}$$

108. (b) $CH_3C \equiv CH + 2HBr \longrightarrow CH_3 - \underset{\displaystyle Br}{\overset{\displaystyle Br}{\overset{|}{\underset{|}{C}}}} - CH_3$

109. (b)

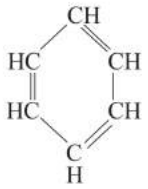
110. (b) Thin film of polyacetylene can be used as electrodes in batteries. These films are good conductors, lighter and cheaper than the metal conductors.

111. (b)

112. (d) Amongst all tropolone is a non-benzenoid aromatic compound.

113. (c)

114. (c) Kekule in 1865 suggested a ring structure of benzene in which the ring was composed of six carbon atoms, each of which carries one atom of hydrogen. To satisfy the fourth valency of the carbon atom, he suggested three alternate double bonds.



115. (a)

116. (c) Benzene do not show addition reactions like other unsaturated hydrocarbons. However it show substitution reactions. Due to resonance all the C – C bonds have the same nature, which is possible because of the cyclic delocalisation of π-electrons in benzene. Monosubstitution will give only a single product.

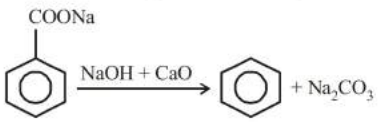
117. (a) In the benzene molecule all the six carbons are sp^2 hybridised as each C has one double bond.

118. (c) They have a relatively high percentage of carbon.

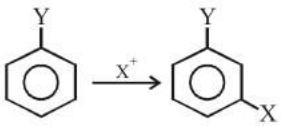
119. (a) **120. (c)** **121. (c)**

122. (d) Benzene can be obtained by all the compounds given.

123. (a) This is an example of decarboxylation reaction.



124. (a)



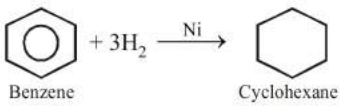
m-isomer
(> 60%)

Y = –COOH because it is meta directing group while $-NH_2$, –OH and –Cl are *o* and *p* directing groups.

125. (a) $-NO_2$ is a meta-directing group. As it is also a deactivating group so no chance of introduction of second – Br atom.

126. (c) Cl exhibits –I effect and +M effect.

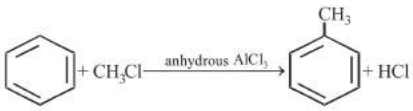
127. (b)



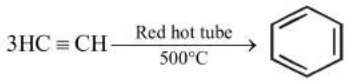
Benzene Cyclohexane

128. (d)

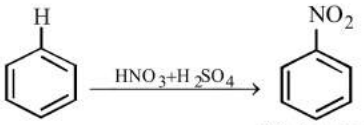
129. (c)



130. (b) Benzene can be obtained by polymerisation of acetylene.



131. (a) In electrophilic substitution reaction an electrophile (in this case NO_2^+) replaces another atom (in this case H) from the substrate (benzene).

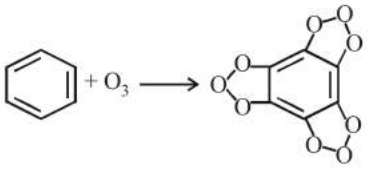


Nitrobenzene

132. (a) This is an example of Friedel - Craft alkylation.

133. (d)

134. (c)



Benzene triozonide

135. (b) Friedel- Craft reaction occurs in presence of an attacking reagent which is an electrophile ($AlCl_3$).

STATEMENT TYPE QUESTIONS

136. (a) According to experimental evidences, electrophilic substitution reactions are supposed to proceed via the following three steps:

(1) Generation of the electrophile

(2) Formation of carbocation intermediate

(3) Removal of proton from the carbocation intermediate

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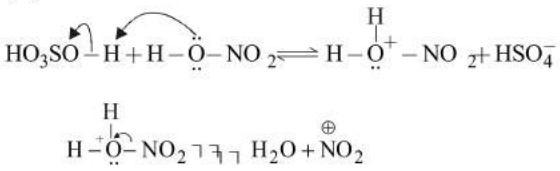
137. (b)



Protonated nitric acid — Nitronium ion

In the process of generation of nitronium ion, sulphuric acid serves as an acid and nitric acid as a base.

138. (a) π-electrons of benzene rings are delocalised throughout the molecule. This makes the molecule very stable. The stability resists breaking of double bonds for addition.

139. (b) Natural gas is found in upper strata during drilling of oil wells. The gas after compression is known as Compressed Natural Gas (CNG).

140. (b)

141. (c) In methane carbon atom is sp^3 hybridized.

142. (b) Dihydrogen gas adds to alkenes and alkynes in the presence of finely divided catalysts like platinum, palladium or nickel to form alkanes. These metals adsorb dihydrogen gas on their surfaces and activate the hydrogen-hydrogen bond. Platinum and palladium catalyse the reaction at room temperature but relatively higher temperature and pressure are required with nickel catalyst.

143. (b) For statement (iii), Fluorination is too violent to be controlled. For statement (iv), Iodination is very slow and a irreversible reaction. It can be carried out in the presence of oxidizing agents like HIO_3 or HNO_3

$$CH_4 + I_2 \Rightarrow CH_3I + HI$$

$$5HI + HIO_3 \rightarrow 3I_2 + 3H_2O$$

144. (c) Pyrolysis and cracking are same process.

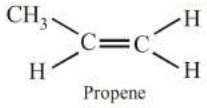
145. (b) Rotation around a C-C single bond is not completely free. It is hindered by a small energy barrier of 1-20 kJ mol^{-1} due to weak repulsive interaction between the adjacent bonds. Such a type of repulsive interaction is called **torsional strain**.

146. (b) Eclipsed form has maximum torsional strain while staggered form has the least.

147. (b) For statement (ii), Alkenes are also known as olefins. For statement (iv), Carbon–Carbon double bond in alkene consists of one sigma and one pi bond.

148. (a) For statement (i), cis form of alkenes have significant dipole moment whereas dipole moment of trans form is almost zero. For statement (iv), due to different arrangements of atoms or groups in space cis and trans isomers differ in their properties like melting point, boiling point, dipole moment, solubility etc.

149. (b) For statement (ii), alkynes on reduction with Pd/C form cis-alkenes. For statement (iv), Propyne on reduction with Pd/C form propene. Propene does not show geometrical isomerism. Only those compounds show geometrical isomerism which have two different atoms or groups attached to each carbon atom.



Propene

150. (d) Polynuclear hydrocarbons are not produced in human body by any biochemical reaction as when they enter into human body they undergo various biochemical reactions which finally damage DNA and cause cancer.

MATCHING TYPE QUESTIONS

151. (a) Among the infinite number of conformations in the staggered conformation hydrogen atoms are as far as apart as possible. While in eclipse conformation hydrogen atoms are perfectly eclipsed.
In skew conformation, hydrogen atoms are closer than in staggered but away than in eclipsed conformation.

152. (a)

$$\underset{\text{Ethene}}{CH_2=CH_2} + H_2 \xrightarrow{Pt/Pd/Ni} \underset{\text{Ethane}}{CH_3-CH_3}$$

$$\underset{\text{Chloromethane}}{CH_3-Cl} + H_2 \xrightarrow{Zn,H^+} \underset{\text{Methane}}{CH_4} + HCl$$

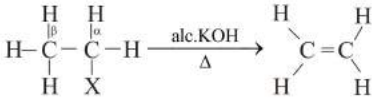
$$\underset{\text{Bromomethane}}{CH_3Br} + 2Na + BrCH_3 \xrightarrow{\text{dry ether}} \underset{\text{Ethane}}{CH_3-CH_3} + 2NaBr$$

$$CH_3COO^-Na^+ + NaOH \xrightarrow[\Delta]{CaO} CH_4 + Na_2CO_3$$

153. (c)

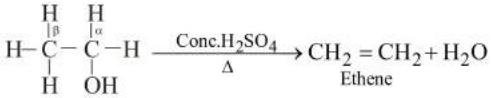
154. (a)

$$\underset{\text{Ethyne}}{CH \equiv CH} + H_2 \xrightarrow{Pd/C} \underset{\text{Ethene}}{CH_2=CH_2}$$



(X = Cl, Br, I)

$$CH_2Br-CH_2Br + Zn \longrightarrow CH_2=CH_2 + ZnBr_2$$



Ethanol — Ethene

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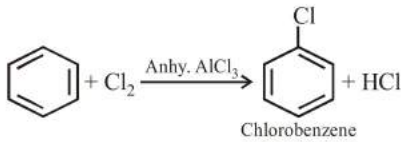
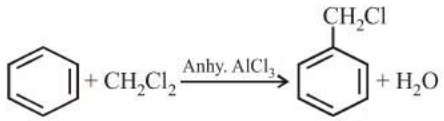
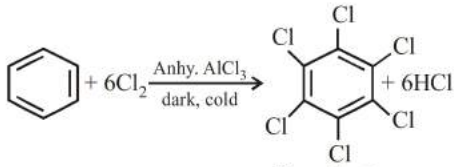
155. (b)



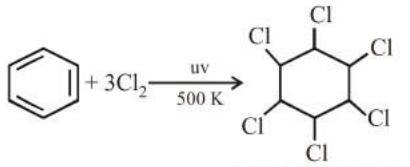
Chlorobenzene



Benzyl chloride



Hexachlorobenzene (C_6Cl_6)



Benzene hexachloride. (BHC)

156. (a) (A) $C_6H_6 + Cl_2 \xrightarrow{AlCl_3} C_6H_5Cl$
(Benzene) (Chlorobenzene)

(B) $C_6H_6 + CH_3Cl \xrightarrow{AlCl_3} C_6H_5CH_3 + HCl$
(Toluene)

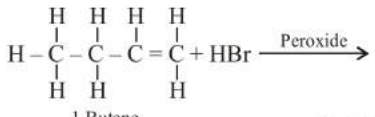
(C) $C_6H_6 + CH_3COCl \longrightarrow C_6H_5COCH_3 + HCl$
methyl phenyl ketone

(D) $C_6H_5 - CH_3 \xrightarrow[NaOH]{KMnO_4} C_6H_5COOH$
(Toulene)

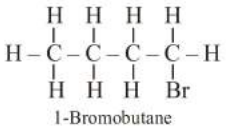
157. (d) **158. (a)** **159. (b)**

ASSERTION-REASON TYPE QUESTIONS

160. (a) This reaction is followed by anti Markownikoff rule



1 Butene



1-Bromobutane

In this reaction anti Markownikoff's addition is explained on the basis of the fact that in the presence peroxides, addition takes place via free radical mechanism rather than the ionic mechanism.

161. (b) The assertion that chlorination of CH_4 does not take place in dark is correct because it is a free radical reaction and free radicals are obtained in presence of sun light.

162. (b) Iodination is reversible since formed HI is a strong reducing agent and reduces the alkyl iodide back to alkane. $CH_4 + I_2 \rightleftharpoons CH_3I + HI$
Iodination can be done only in presence of strong oxidising agents like iodic acid which destroys the hydriodic acid.

163. (d) The two hydrogen atoms on first carbon and the two H-atoms on the third carbon atom lie in perpendicular planes. The central carbon atom is *sp*-hybridized while terminal carbon atoms are sp^2-hybridized

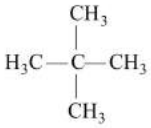
164. (c) $(4n + 2)\pi$ electrons and planar structure are the essential conditions for aromaticity.

CRITICAL THINKING TYPE QUESTIONS

165. (d)  ;

In all these we find $\overset{|}{CH_2}$ group i.e. correct answer is (d).

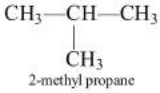
166. (c) The structure of neopentane is



It has 1 quaternary and 4 primary carbons.

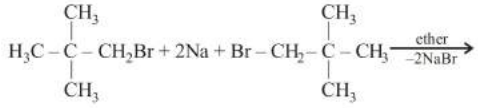
167. (a)

168. (b) For the compounds with same molecular mass, boiling point decreases with increase in branching. The boiling point also increases steadily with increase in molecular mass. Hence 2-methyl propane will have lowest boiling point

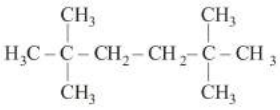


2-methyl propane

169. (d)

170. (c) 

neo-pentyl bromide



2,2,5,5-tetramethylhexane

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171. (a) Electrolysis of a concentrated aqueous solution of either sodium or potassium salts of saturated mon-carboxylic acids yields higher alkane at anode.

$$2RCOOK \xrightarrow[\text{Oxidation}]{\text{Electrolytic}} 2RCOO^- + 2K^+ \quad (\text{Anode}, \text{Cathode})$$

At anode $2RCOO^- \rightarrow 2RCOO + 2e^- \longrightarrow$

$$R-R + 2CO_2$$

At Cathode $2K^+ + 2e^- \rightarrow 2K$

$2K + H_2O \rightarrow 2KOH + H_2\uparrow$

(Kolbe's Method)

172. (a) Given

$$A \xrightarrow{Cl_2} B \xrightarrow{\text{alc./KOH}} C \xrightarrow{O_3/H_2O} CH_2O$$

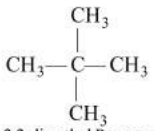
Hydrocarbon

Since hydrocarbon C give only CH_2O, on ozonolysis, C should be $CH_2 = CH_2$ hence going backward A should be ethane. Thus the reactions are

$$\underset{(A)}{CH_3CH_3} \xrightarrow{Cl_2/hv} \underset{(B)}{CH_3CH_2Cl} \xrightarrow[KOH]{\text{alc.}} \ldots$$

$$\underset{(C)}{CH_2=CH_2} \xrightarrow[\Delta]{O_3/H_2O} \underset{(D)}{HCHO}$$

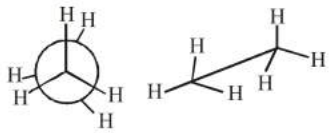
173. (b)



2,2-dimethyl Propane

All hydrogen atoms are equivalent in 2, 2-dimethylpropane. So it forms only one monochlorinated product.

174. (c) In the eclipsed conformation of ethane, the dihedral angle between hydrogen atoms of adjacent methyl groups is 0°.

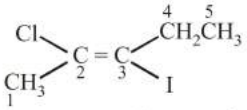


175. (a) The π bond is formed by the sideways overlapping of two *p*-orbitals of the two carbon atoms.

The molecular plane does not have any π electron density as the *p*-orbitals are perpendicular to the plane containing the ethene molecule. The nodal plane in the π-bond of ethene is located in the molecular plane.

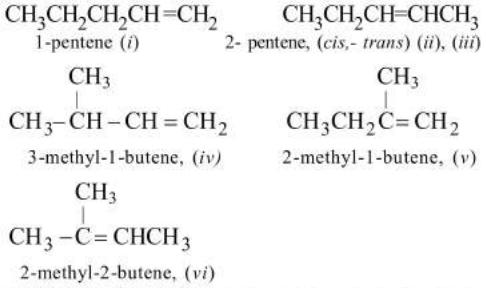
176. (c)

177. (a)



Correct IUPAC name of above compound is trans-2-chloro-3-iodo-2-pentene

178. (c) C_5H_{10} has 1° degree of unsaturation since the isomers are acyclic, all of these are alkenes. For writing the isomers, first introduce the double bond at different possible positions, and then consider the possibility of branching in the alkyl group.



1-pentene (*i*) — 2- pentene, (*cis*,- *trans*) (*ii*), (*iii*)

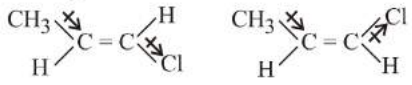
3-methyl-1-butene, (*iv*) — 2-methyl-1-butene, (*v*)

2-methyl-2-butene, (*vi*)

179. (b) Stability of an alkene depends upon the heat of hydrogenation of an alkene. The heat of hydration is the standard enthalpy change in hydrogenation of on alkene. The lower the heat of hydrogenation of an alkene higher will be stability.

Order of stability	Heat of hydrogenation (kJ/mol)
trans-2-butene	– 115.5
cis-2-butene	– 119.6 and
1-butene	– 126.8 respectively.

180. (c) In compounds



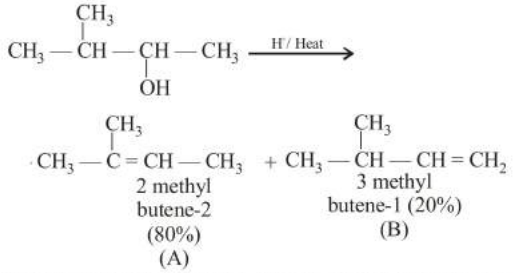
I II

first has more dipole moment than second.

Therefore its boiling point will be higher. Melting point depends on symmetry therefore I has higher melting point than II. Steric crowding in I is more than II therefore I is more stable than II.

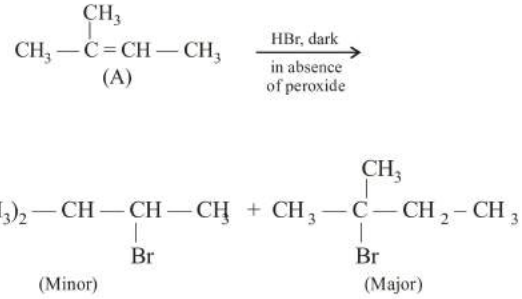
181. (b)

182. (b)



2 methyl butene-2 (80%) (A) + 3 methyl butene-1 (20%) (B)

In this case dehydration is governed by Saytzeff's rule according to which hydrogen is preferentially eliminated from the carbon atom with fewer number of hydrogen atoms i.e., poor becomes poorer. Thus, 2-methyl butene-2 is the major product.



(Minor) (Major)

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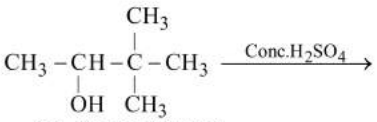
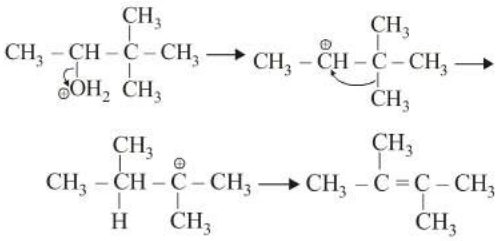
This reaction is governed by Markownikoff's rule according to which when an unsymmetrical reagent e.g. HBr adds to an unsymmetrical alkene, then the negative part of the reagent is added to that carbon atom of the double bond which bears the least number of hydrogen atom. Thus, in above case. 2-methyl 2-bromo butane will be the major product.

183. (a) When 3, 3 dimethyl 2-butanol is heated with H_2SO_4 the major product obtained is 2, 3 dimethyl 2-butene.

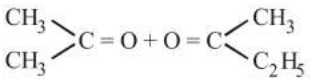


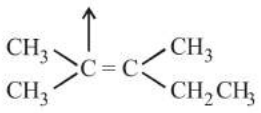
3,3–dimethyl 2-butanol



2, 3 dimethyl -2-butene

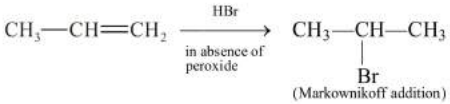
184. (d)





2,3-Dimethyl-2-pentene

185. (d) Addition of hydrogen halide to alkene is an example of electrophilic addition involving carbocations as intermediates.



(Markownikoff addition)

186. (a) Addition reaction occurs on a double bond.
The compound containing double bonds are also undergo polymerisation. So, the correct option are both (a) and (d) e.g.

$$CH_2=CH_2+HOCl \longrightarrow CH_2OH-CH_2Cl$$
(addition reaction)

$$nCH_2=CH_2 \xrightarrow{\text{Polymerisation}} \underset{\text{Polyethene}}{\left[CH_2-CH_2\right]_n}$$

187. (b) Alkenes react with cold alkaline $KMnO_4$ solution to form glycols. During this reaction $KMnO_4$ (violet) gets converted to MnO_2 (brown ppt.) and therefore the colour of $KMnO_4$ is disappeared.

$$>C=C<+KMnO_4 \xrightarrow{OH^{\ominus}} \underset{\text{1,2–diols}}{-\overset{|}{\underset{OH}{C}}-\overset{|}{\underset{OH}{C}}-} + MnO_2 + KOH$$

This test is known as Baeyer test.

188. (b) $CH_2=CH_2-Cl+HCl \longrightarrow CH_3CHCl_2$
Addition of HCl takes place according to Markownikoff's rule. (H goes to C which is least substituted)

189. (a) $\underset{\|}{\overset{CH_2}{CH_2}}+H_2SO_4 \rightarrow \underset{CH_2H_2SO_4}{\overset{CH_3}{|}} \xrightarrow{H_2O}$

$$\underset{CH_2OH}{\overset{CH_3}{|}}+H_2SO_4$$

Except ethyl alcohol, no other primary alcohol can be prepared by this method as the addition of H_2SO_4 follows Markownikoff's rule. Generally secondary and tertiary alcohols are obtained.

190. (c) Electrophilic addition reactions are shown by alkenes or alkynes, in these reactions attacking species is electrophile

$$CH_3-CH=CH_2+H^+ \xrightarrow{\text{Slow}} \underset{2^\circ \text{ carbonium ion}}{CH_3-CH-CH_3}$$

$$CH_3-\overset{+}{C}H-CH_3+Br^- \xrightarrow{\text{Fast}} \underset{\text{2-Bromopropane}}{CH_3-\underset{Br}{\underset{|}{CH}}-CH_3}$$

191. (c)

192. (d) Nature of halogen atom and the alkyl group both determine rate of reaction.

193. (a) (i) $HC\equiv C-CH_2-CH_2-CH_2-CH_3$
Hex–1–yne

(ii) $CH_3-C\equiv C-CH_2-CH_2-CH_3$
Hex–2–yne

(iii) $CH_3-CH_2-C\equiv C-CH_2-CH_3$
Hex–3–yne

(iv) $HC\equiv C-\underset{CH_3}{\underset{|}{CH}}-CH_2-CH_3$
3- Methylpent -1-yne

(v) $HC\equiv C-CH_2-\underset{CH_3}{\underset{|}{CH}}-CH_3$
4- Methylpent -1-yne

(vi) $CH_3-C\equiv C-\underset{CH_3}{\underset{|}{CH}}-CH_3$
4- Methylpent -2-yne

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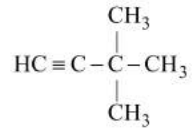
(vii) 

3,3- Dimethylbut-1-yne

194. (a) Ethylene has restricted rotation, acetylene has no rotation, hexachloroethane has more rotation than ethylene but less than ethane because of greater size of the substituent (chlorine) in hexachloroethane than in ethane (substituent is hydrogen).

195. (a) The acidity of acetylene or 1–alkyne can be explained on the basis of molecular orbital concept according to which formation of C—H bond in acetylene involves *sp*-hybridised carbon atom. Now since s electrons are closer to the nucleus than *p* electrons, the electrons present in a bond having more *s* character will be correspondingly more closer to the nucleus.
Thus owing to high *s* character of the C—H bond in alkynes (*s* = 50%), the electrons constituting this bond are more strongly held by the carbon nucleus i.e., the acetylenic carbon atom or the *sp* orbital acts as more electronegative species than the sp^2 and sp^3 with the result the hydrogen present on such a carbon atom (≡C—H) can be easily removed as a proton.

196. (b)

197. (d) Br_2 in CCl_4 (a), Br_2 in CH_3COOH (b) and alk. $KMnO_4$ (c) will react with all unsaturated compounds, i.e., 1, 3 and 4 while ammonical $AgNO_3$ (d) reacts only with terminal alkynes, i.e., 3 and hence 3 can be distinguished from 1, 2 and 4 by. ammonical $AgNO_3$ (d).

198. (c) This reaction occurs according to Markownikoff's rule which states that when an unsymmetrical alkene undergo hydrohalogenation, the negative part goes to that C-atom which contain lesser no. of H-atom.

$$CH_3-CH_2-C\equiv CH + HCl \longrightarrow CH_3-CH_2-\underset{Cl}{\underset{|}{C}}=CH_2$$

$$\xrightarrow{HI} CH_3-CH_2-\underset{Cl}{\underset{|}{\overset{I}{\overset{|}{C}}}}-CH_3$$

199. (a) Only terminal alkynes show acidic nature. Ethyne is more acidic than propyne. But-2-yne is not acidic as it does not contain any hydrogen attached to sp hybridised carbon.

200. (a)

201. (c) Due to the maximum percentage of *s* character (50%), the *sp* hybridised orbitals of carbon atoms in ethyne molecules have highest electronegativity; hence, these attract the shared electron pair of the C-H bond of ethyne to a greater extent than that of the sp^2 hybridised orbitals of carbon in ethene and the sp^3 hybridised orbital of carbon in ethane. Thus in ethyne, hydrogen atoms can be liberated as protons more easily as compared to ethene and ethane.

202. (c) In arenes, π electrons are delocalised, hence arenes do not undergo addition reactions easily. Aromatic compounds (Arenes) are highly stable and show resonance. eg. Benzene is the simplest example.

203. (c) Compounds having same molecular formula but different functional groups in their molecules are called functional isomers.

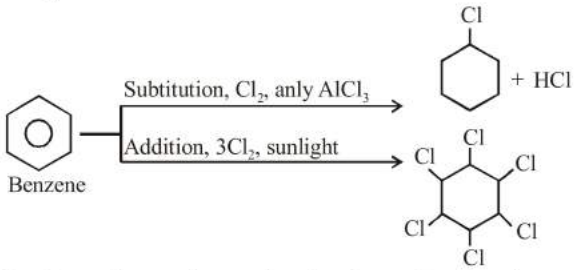
204. (d) In benzene due to delocalisation of π - electrons, all the C – C bond lengths are equal as each C – C bond has some double bond character and thus the bond length is between single and double bond, i.e., between C_2H_6 and C_2H_4.

205. (a)

206. (c) Benzene has 12 σ and 3 π bonds.
∴ Ratio of σ bonds to π bonds = 12/3 = 4

207. (d) Presence of 6*p* orbitals, each containing one unpaired electron, in a six membered cyclic structure is in accordance with Huckel rule of aromaticity.

208. (a)



209. (b) –Cl group is o-, p-directing due to +R effect ; however it is deactivating due to strong –I effect of Cl (difference from other o-, p-directing groups which are activating). The net result is that chlorobenzene undergoes o, p-substitution, but with difficulty

210. (b) $C_6H_5COOH + \underset{(X)}{NaOH} \rightarrow C_6H_5COONa + H_2O$

$$C_6H_5OH + \underset{(Y)}{Zn} \xrightarrow{\text{distill}} C_6H_6 + ZnO$$

211. (a) Huckel rule is not obeyed. It has only four electrons. Further it does not have continous conjugation.

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