Chapter 13. Hydrocarbons

1. Which one is the correct order of acidity?

(a) $CH{\equiv}CH > CH_3{-}C{\equiv}CH > CH_2{=}CH_2 > CH_3{-}CH_3$

(b) $CH{\equiv}CH > CH_2{=}CH_2 > CH_3{-}C{\equiv}CH > CH_3{-}CH_3$

(c) $CH_3{-}CH_3 > CH_2{=}CH_2 > CH_3{-}C{\equiv}CH > CH{\equiv}CH$

(d) $CH_2{=}CH_2 > CH_3{-}CH{=}CH_2 > CH_3{-}C{\equiv}CH > CH{\equiv}CH$

(NEET 2017)

2. Predict the correct intermediate and product in the following reaction :

$$H_3C{-}C{\equiv}CH \xrightarrow[HgSO_4]{H_2O,\ H_2SO_4} \underset{(A)}{\text{Intermediate}} \rightarrow \underset{(B)}{\text{Product}}$$

(a) $A: H_3C{-}\underset{\underset{OH}{|}}{C}{=}CH_2$ $B: H_3C{-}\underset{\underset{SO_4}{|}}{C}{=}CH_2$

(b) $A: H_3C{-}\underset{\underset{O}{\|}}{C}{-}CH_3$ $B: H_3C{-}C{\equiv}CH$

(c) $A: H_3C{-}\underset{\underset{OH}{|}}{C}{=}CH_2$ $B: H_3C{-}\underset{\underset{O}{\|}}{C}{-}CH_3$

(d) $A: H_3C{-}\underset{\underset{SO_4}{|}}{C}{=}CH_2$ $B: H_3C{-}\underset{\underset{O}{\|}}{C}{-}CH_3$

(NEET 2017)

3. With respect to the conformers of ethane, which of the following statements is true?

(a) Bond angle changes but bond length remains same.

(b) Both bond angle and bond length change.

(c) Both bond angle and bond length remain same.

(d) Bond angle remains same but bond length changes. *(NEET 2017)*

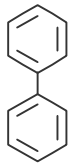
4. Which of the following can be used as the halide component for Friedel–Crafts reaction?

(a) Chlorobenzene (b) Bromobenzene

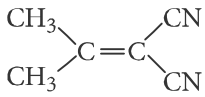
(c) Chloroethene

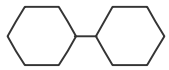
(d) Isopropyl chloride *(NEET-II 2016)*

5. In which of the following molecules, all atoms are coplanar?

(a) 

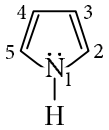
(b) 

(c) 

(d) 

(NEET-II 2016)

6. In pyrrole the electron density is maximum on

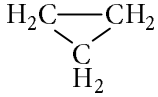


(a) 2 and 3 (b) 3 and 4

(c) 2 and 4 (d) 2 and 5

(NEET-II 2016)

7. Which of the following compounds shall not produce propene by reaction with HBr followed by elimination or direct only elimination reaction?

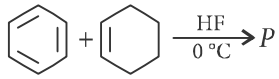
(a) 

(b) $H_3C{-}\overset{\overset{H_2}{|}}{C}{-}CH_2OH$

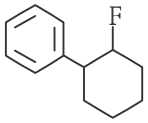
(c) $H_2C{=}C{=}O$

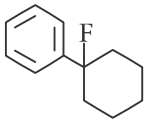
(d) $H_3C{-}\overset{\overset{H_2}{|}}{C}{-}CH_2Br$ *(NEET-II 2016)*

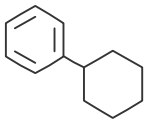
8. In the given reaction,

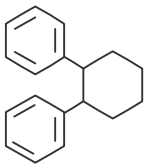


the product P is

(a) 

(b) 

(c) 

(d) 

(NEET-II 2016)

9. The compound that will react most readily with gaseous bromine has the formula

(a) C_3H_6 (b) C_2H_2
(c) C_4H_{10} (d) C_2H_4

(NEET-II 2016)

10. The correct statement regarding the comparison of staggered and eclipsed conformations of ethane, is

(a) the eclipsed conformation of ethane is more stable than staggered conformation even though the eclipsed conformation has torsional strain
(b) the staggered conformation of ethane is more stable than eclipsed conformation, because staggered conformation has no torsional strain
(c) the staggered conformation of ethane is less stable than eclipsed conformation, because staggered conformation has torsional strain
(d) the eclipsed conformation of ethane is more stable than staggered conformation, because eclipsed conformation has no torsional strain. *(NEET-I 2016)*

11. Consider the nitration of benzene using mixed conc. H_2SO_4 and HNO_3. If a large amount of $KHSO_4$ is added to the mixture, the rate of nitration will be

(a) unchanged (b) doubled
(c) faster (d) slower.

(NEET-I 2016)

12. The pair of electrons in the given carbanion, $CH_3C{\equiv}C^-$, is present in which of the following orbitals?

(a) sp^2 (b) sp
(c) $2p$ (d) sp^3

(NEET-I 2016)

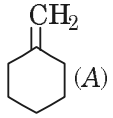
13. In the reaction

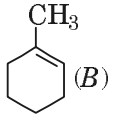
$$H{-}C{\equiv}CH \xrightarrow[(ii)\ CH_3CH_2Br]{(i)\ NaNH_2/liq.\ NH_3} X \xrightarrow[(ii)\ CH_3CH_2Br]{(i)\ NaNH_2/liq.\ NH_3} Y,$$

X and Y are

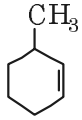
(a) X = 2-Butyne, Y = 2-Hexyne
(b) X = 1-Butyne, Y = 2-Hexyne
(c) X = 1-Butyne, Y = 3-Hexyne
(d) X = 2-Butyne, Y = 3-Hexyne. *(NEET-I 2016)*

14. In the reaction with HCl, an alkene reacts in accordance with the Markovnikov's rule to give a product 1-chloro-1 methylcyclohexane. The possible alkene is

(a)  (A)

(b)  (B)

(c) (A) and (B)

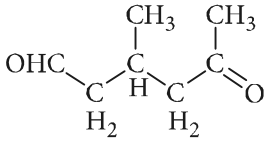
(d) 

(2015)

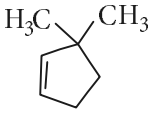
15. 2,3-Dimethyl-2-butene can be prepared by heating which of the following compounds with a strong acid?

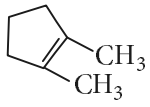
(a) $(CH_3)_3CCH{=}CH_2$
(b) $(CH_3)_2C{=}CHCH_2CH_3$
(c) $(CH_3)_2CHCH_2CH{=}CH_2$
(d) $(CH_3)_2CH{-}\underset{\displaystyle CH_3}{\underset{|}{CH}}{-}CH{=}CH_2$ *(2015)*

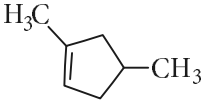
16. A single compound of the structure,

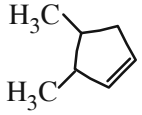


is obtainable from ozonolysis of which of the following cyclic compounds?

(a) 

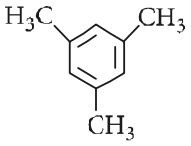
(b) 

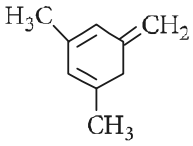
(c) 

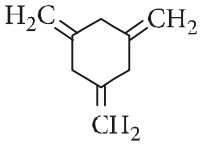
(d) 

(2015, Cancelled)

17. Given :

I. 

II. 

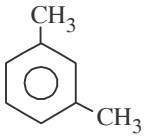
III. 

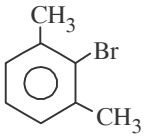
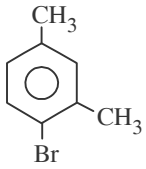
The enthalpy of hydrogenation of these compounds will be in the order as

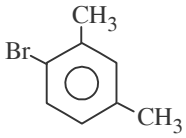
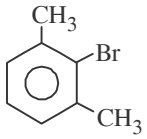
(a) II > III > I (b) II > I > III
(c) I > II > III (d) III > II > I

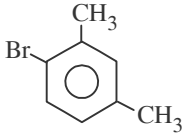
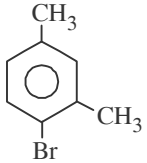
(2015, Cancelled)

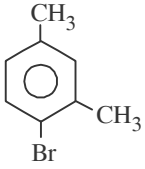
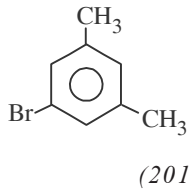
18. What products are formed when the following compound is treated with Br_2 in the presence of $FeBr_3$?



(a)  and 

(b)  and 

(c)  and 

(d)  and 

(2014)

19. Identify Z in the sequence of reactions :

$$CH_3CH_2CH=CH_2 \xrightarrow{HBr/H_2O_2} Y \xrightarrow{C_2H_5ONa} Z$$

(a) $CH_3-(CH_2)_3-O-CH_2CH_3$
(b) $(CH_3)_2CH-O-CH_2CH_3$
(c) $CH_3(CH_2)_4-O-CH_3$
(d) $CH_3CH_2-CH(CH_3)-O-CH_2CH_3$ *(2014)*

20. Which of the following organic compounds has same hybridization as its combustion product (CO_2)?

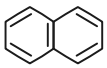
(a) Ethane (b) Ethyne
(c) Ethene (d) Ethanol *(2014)*

21. Which of the following compounds will not undergo Friedal-Craft's reaction easily?

(a) Nitrobenzene (b) Toluene
(c) Cumene (d) Xylene

(NEET 2013)

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

(a)  (b) 

(c)  (d) 

(Karnataka NEET 2013)

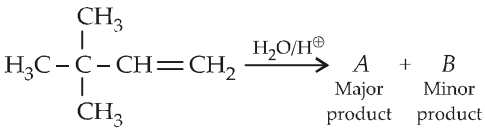
23. In the following reaction:

$$HC\equiv CH \xrightarrow[Hg^{2+}]{H_2SO_4} 'P'$$

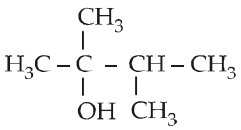
Product '*P*' will not give

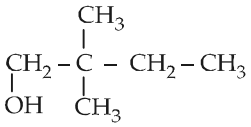
(a) Tollen's reagent test
(b) Brady's reagent test
(c) Victor Meyer test
(d) Iodoform test *(Karnataka NEET 2013)*

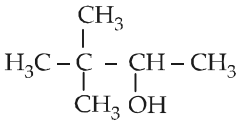
24. In the following reaction

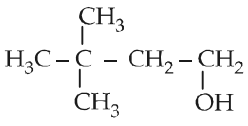


The major product is

(a) 

(b) 

(c) 

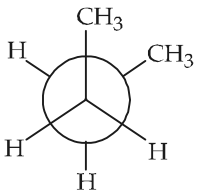
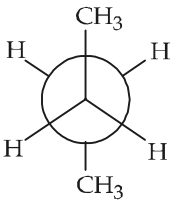
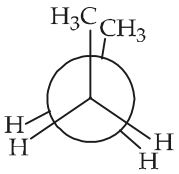
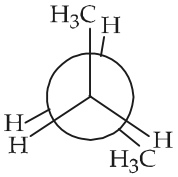
(d) 

(2012)

25. Which of the following acids does not exhibit optical isomerism?
(a) Maleic acid (b) α-amino acids
(c) Lactic acid (d) Tartaric acid
(2012)

26. Which of the following reagents will be able to distinguish between 1-butyne and 2-butyne?
(a) $NaNH_2$ (b) HCl
(c) O_2 (d) Br_2
(Mains 2012)

27. In the following the most stable conformation of *n*-butane is

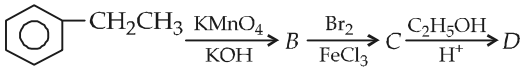
(a) 
(b) 
(c) 
(d) 

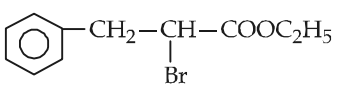
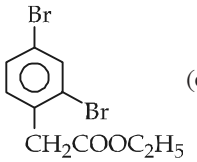
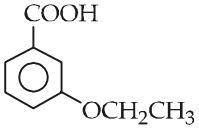
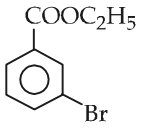
(2010)

28. Liquid hydrocarbons can be converted to a mixture of gaseous hydrocarbons by
(a) oxidation (b) cracking
(c) distillation under reduced pressure
(d) hydrolysis. *(2010)*

29. The reaction of toluene with Cl_2 in presence of $FeCl_3$ gives *X* and reaction in presence of light gives *Y*. Thus, *X* and *Y* are
(a) *X* = Benzal chloride, *Y* = *o*-chlorotoluene
(b) *X* = *m*-chlorotoluene, *Y* = *p*-chlorotoluene
(c) *X* = *o*- and *p*-chlorotoluene,
Y = Trichloromethyl benzene
(d) *X* = Benzyl chloride, *Y* = *m*-chlorotoluene
(2010)

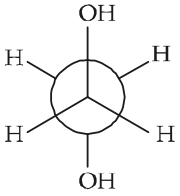
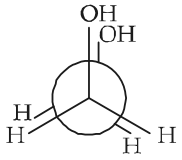
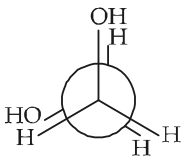
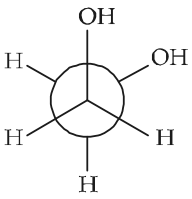
30. In a set of reactions, ethylbenzene yielded a product *D*.



D would be
(a) 
(b) 
(c) 
(d) 

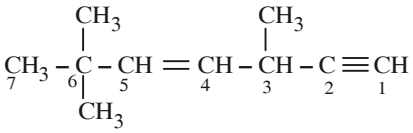
(2010)

31. Which of the following conformers for ethylene glycol is most stable?

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

(Mains 2010)

32. The state of hybridisation of C_2, C_3, C_5 and C_6 of the hydrocarbon,



is in the following sequence
(a) sp^3, sp^2, sp^2 and sp
(b) sp, sp^2, sp^2 and sp^3
(c) sp, sp^2, sp^3 and sp^2
(d) sp, sp^3, sp^2 and sp^3 *(2009)*

33. Which of the following compounds will exhibit *cis-trans (geometrical)* isomerism?
(a) Butanol (b) 2-Butyne
(c) 2-Butenol (d) 2-Butene
(2009)

34. Benzene reacts with CH_3Cl in the presence of anhydrous $AlCl_3$ to form
(a) chlorobenzene (b) benzyl chloride
(c) xylene (d) toluene.
(2009)

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

A (predominantly) is

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

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

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

(d) $CH_3-\underset{\displaystyle CH_3}{\overset{\displaystyle Br}{\overset{|}{\underset{|}{C}}}}-CH_2CH_3$ *(2008)*

36. In the hydrocarbon,

$\overset{6}{C}H_3-\overset{5}{C}H=\overset{4}{C}H-\overset{3}{C}H_2-\overset{2}{C}\equiv\overset{1}{C}H$

The state of hybridization of carbons 1, 3 and 5 are in the following sequence

(a) sp, sp^2, sp^3 (b) sp^3, sp^2, sp

(c) sp^2, sp, sp^3 (d) sp, sp^3, sp^2

(2008)

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

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

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

(b) $CH_3-CH_2-\underset{\displaystyle I}{\overset{|}{CH}}-CH_2Cl$

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

(d) $CH_3-\underset{\displaystyle Cl}{\underset{|}{CH}}-CH_2CH_2I$ *(2007)*

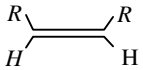
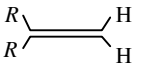
38. Which of the compound with molecular formula C_5H_{10} yields acetone on ozonolysis?

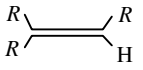
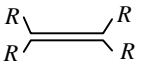
(a) 3-Methyl-1-butene (b) Cyclopentane

(c) 2-Methyl-1-butene (d) 2-Methyl-2-butene

(2007)

39. Which one of the following alkenes will react faster with H_2 under catalytic hydrogenation conditions?

(a)  (b) 

(c)  (d) 

(R = alkyl substituent)

(2005)

40. Products of the following reaction :

$CH_3C\equiv CCH_2CH_3 \xrightarrow[\text{(ii) hydrolysis}]{\text{(i) } O_3}$ are

(a) $CH_3COOH + CO_2$

(b) $CH_3COOH + HOOC.CH_2CH_3$

(c) $CH_3CHO + CH_3CH_2CHO$

(d) $CH_3COOH + CH_3COCH_3$ *(2005)*

41. Using anhydrous $AlCl_3$ as catalyst, which one of the following reactions produces ethylbenzene (PhEt)?

(a) $H_3C-CH_2OH + C_6H_6$

(b) $CH_3-CH=CH_2 + C_6H_6$

(c) $H_2C=CH_2 + C_6H_6$

(d) $H_3C-CH_3 + C_6H_6$ *(2004)*

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

(a) isopropyl bromide

(b) 3-bromopropane

(c) allyl bromide

(d) *n*-propyl bromide. *(2004)*

43. The compound $CH_3-\overset{\displaystyle CH_3}{\overset{|}{C}}=CH-CH_3$ on reaction with $NaIO_4$ in the presence of $KMnO_4$ gives

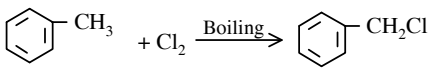
(a) CH_3COCH_3

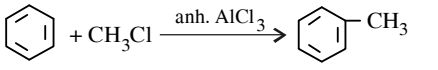
(b) $CH_3COCH_3 + CH_3COOH$

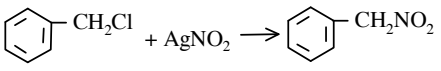
(c) $CH_3COCH_3 + CH_3CHO$

(d) $CH_3CHO + CO_2$ *(2003)*

44. Which one of the following is a free-radical substitution reaction?

(a) 

(b) 

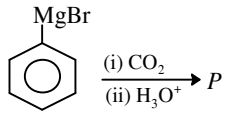
(c) 

(d) $CH_3CHO + HCN \rightarrow CH_3CH(OH)CN$

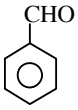
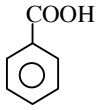
(2003)

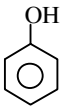
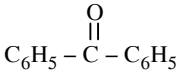
45. The correct order of reactivity towards the electrophilic substitution of the compounds aniline (I), benzene (II) and nitrobenzene (III) is

(a) III > II > I (b) II > III > I
(c) I < II > III (d) I > II > III
(2003)

46. 

In the above reaction product *P* is

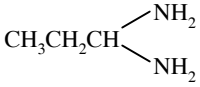
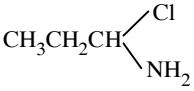
(a)  (b) 

(c)  (d) 

(2002)

47. When $CH_3CH_2CHCl_2$ is treated with $NaNH_2$, the product formed is

(a) $CH_3 - CH = CH_2$ (b) $CH_3 - C \equiv CH$

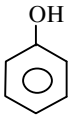
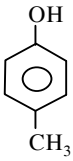
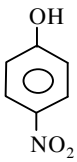
(c)  (d) 

(2002)

48. In preparation of alkene from alcohol using Al_2O_3 which is the effective factor?

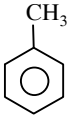
(a) Porosity of Al_2O_3
(b) Temperature
(c) Concentration
(d) Surface area of Al_2O_3. *(2001)*

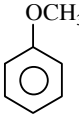
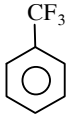
49. The correct acidic order of the following is

I.  II.  III. 

(a) I > II > III (b) III > I > II
(c) II > III > I (d) I > III > II
(2001)

50. Increasing order of electrophilic substitution for following compounds

(I)  (II) 

(III)  (IV) 

(a) IV < I < II < III (b) III < II < I < IV
(c) I < IV < III < II (d) II < III < I < IV
(2000)

51. In Friedel-Crafts reaction, toluene can be prepared by

(a) $C_6H_6 + CH_3Cl$ (b) $C_6H_5Cl + CH_4$
(c) $C_6H_6 + CH_2Cl_2$ (d) $C_6H_6 + CH_3COCl$
(2000)

52. Which reagent converts propene to 1-propanol?

(a) H_2O, H_2SO_4
(b) B_2H_6, H_2O_2, OH^-
(c) $Hg(OAc)_2$, $NaBH_4/H_2O$
(d) Aq. KOH *(2000)*

53. Which is maximum stable?

(a) 1-Butene (b) *cis*-2-Butene
(c) *trans*-2-Butene
(d) All have same stability. *(2000)*

54. 2-Butene shows geometrical isomerism due to

(a) restricted rotation about double bond
(b) free rotation about double bond
(c) free rotation about single bond
(d) chiral carbon. *(2000)*

55. Dihedral angle in staggered form of ethane is

(a) 0° (b) 120°
(c) 60° (d) 180° *(2000)*

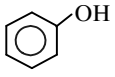
56. When acetylene is passed through dil. H_2SO_4 in the presence of $HgSO_4$, the compound formed is

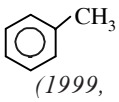
(a) acetic acid (b) ketone
(c) ether (d) acetaldehyde
(1999)

57. In Friedel-Craft's alkylation, besides $AlCl_3$ the other reactants are

(a) $C_6H_6 + CH_3Cl$ (b) $C_6H_6 + CH_4$
(c) $C_6H_6 + NH_3$ (d) $C_6H_6 + CH_3COCl$
(1999)

58. Which of the following compounds will be most easily attacked by an electrophile?

(a)  (b) 

(c)  (d) 

(1999, 1998)

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

(a) Electrophilic additions
(b) Delocalisation of π-electrons
(c) Greater stability
(d) Resonance *(1998)*

60. 2-Bromopentane is heated with potassium ethoxide in ethanol. The major product obtained is
(a) *trans*-2-pentene (b) 1-pentene
(c) 2-ethoxy pentane (d) 2-*cis*-pentene
(1998)

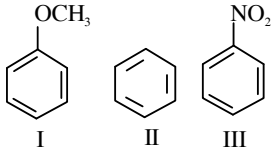
61. Which of the following reaction is expected to readily give a hydrocarbon product in good yields?
(a) $CH_3CH_3 \xrightarrow[h\upsilon]{Cl_2}$
(b) $(CH_3)_2CHCl \xrightarrow{C_2H_5OH}$
(c) $RCOOK \xrightarrow[\text{Oxidation}]{\text{Electrolysis}}$
(d) $RCOOAg \xrightarrow{I_2}$ *(1997)*

62. In a reaction $CH_2 = CH_2 \xrightarrow[\text{acid}]{\text{Hypochlorous}} M \xrightarrow{R} \begin{matrix}CH_2OH\\|\\CH_2OH\end{matrix}$
where M = Molecule and R = Reagent. M and R are
(a) CH_3CH_2OH and HCl
(b) $CH_2 = CH_2$ and heat
(c) CH_3CH_2Cl and NaOH
(d) $CH_2Cl - CH_2OH$ and aq. $NaHCO_3$.
(1997)

63. The cylindrical shape of an alkyne is due to
(a) two sigma C – C and one π C – C bonds
(b) one sigma C – C and two π C – C bonds
(c) three sigma C – C bonds
(d) three π C – C bonds. *(1997)*

64. In the commercial gasolines, the type of hydrocarbons which are more desirable is
(a) linear unsaturated hydrocarbon
(b) toluene
(c) branched hydrocarbon
(d) straight-chain hydrocarbon. *(1997)*

65. Among the following compounds (I-III) the correct reaction with electrophile is



(a) I > II > III (b) I = II > III
(c) II > III > I (d) III < I < II
(1997)

66. The most stable conformation of *n*-butane is
(a) gauche (b) staggered
(c) skew boat (d) eclipsed.
(1997)

67. Electrophile in the case of chlorination of benzene in the presence of $FeCl_3$ is
(a) Cl (b) $FeCl_3$
(c) Cl^+ (d) Cl^- *(1996)*

68. The reaction,
$CH_2 = CH - CH_3 + HBr \rightarrow CH_3CHBr - CH_3$ is
(a) electrophilic substitution
(b) free radical addition
(c) nucleophilic addition
(d) electrophilic addition. *(1996)*

69. Which of the following has zero dipole moment?
(a) 1-Butene (b) 2-Methyl-1-propene
(c) *cis*-2-Butene (d) *trans*-2-Butene
(1996)

70. The alkene $R - CH = CH_2$ reacts readily with B_2H_6 and the product on oxidation with alkaline hydrogen peroxides produces
(a) $R-\underset{\underset{CH_3}{|}}{C}=O$ (b) $R-\underset{\underset{OH}{|}}{CH}-\underset{\underset{OH}{|}}{CH_2}$
(c) $R - CH_2 - CHO$
(d) $R - CH_2 - CH_2-OH$ *(1995)*

71. One of the following which does not observe the anti-Markownikoff's addition of HBr, is
(a) pent-2-ene (b) propene
(c) but-2-ene (d) but-1-ene
(1994)

72. The reactive species in the nitration of benzene is
(a) NO_3 (b) HNO_3
(c) NO_2^+ (d) NO_2^- *(1994)*

73. $R - CH_2 - CCl_2 - R \xrightarrow{\text{Reagent}} R - C \equiv C - R$
The reagent is
(a) Na (b) HCl in H_2O
(c) KOH in C_2H_5OH (d) Zn in alcohol.
(1993)

74. Reduction of 2-butyne with sodium in liquid ammonia gives predominantly
(a) *cis*-2-butene (b) no reaction
(c) *trans*-2-butene (d) *n*-butane.
(1993)

75. A compound is treated with $NaNH_2$ to give sodium salt. Identify the compound.
(a) C_2H_2 (b) C_6H_6
(c) C_2H_6 (d) C_2H_4 *(1993)*

76. Reactivity of hydrogen atoms attached to different carbon atoms in alkanes has the order
(a) tertiary > primary > secondary
(b) primary > secondary > tertiary
(c) both (a) and (b)
(d) tertiary > secondary > primary. *(1993)*

77. Which is the correct symbol relating the two Kekule structures of benzene?
(a) ⇌ (b) →
(c) ≡ (d) ↔
(1993)

78. 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 π-electrons in benzene
(d) monosubstitution of benzene gives three isomeric products. *(1992)*

79. 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}. *(1989)*

80. 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) Ammoniacal silver nitrate. *(1989)*

Answer Key

1.	(a)	**2.**	(c)	**3.**	(c)	**4.**	(d)	**5.**	(a)	**6.**	(d)	**7.**	(c)	**8.**	(c)	**9.**	(a)	**10.**	(b)
11.	(d)	**12.**	(b)	**13.**	(c)	**14.**	(c)	**15.**	(a)	**16.**	(c)	**17.**	(d)	**18.**	(c)	**19.**	(a)	**20.**	(b)
21.	(a)	**22.**	(d)	**23.**	(c)	**24.**	(a)	**25.**	(a)	**26.**	(a)	**27.**	(b)	**28.**	(b)	**29.**	(c)	**30.**	(d)
31.	(d)	**32.**	(d)	**33.**	(d)	**34.**	(d)	**35.**	(d)	**36.**	(d)	**37.**	(c)	**38.**	(d)	**39.**	(a)	**40.**	(b)
41.	(c)	**42.**	(d)	**43.**	(b)	**44.**	(a)	**45.**	(d)	**46.**	(b)	**47.**	(b)	**48.**	(b)	**49.**	(b)	**50.**	(a)
51.	(a)	**52.**	(b)	**53.**	(c)	**54.**	(a)	**55.**	(c)	**56.**	(d)	**57.**	(a)	**58.**	(a)	**59.**	(a)	**60.**	(a)
61.	(c)	**62.**	(d)	**63.**	(b)	**64.**	(c)	**65.**	(a)	**66.**	(b)	**67.**	(c)	**68.**	(d)	**69.**	(d)	**70.**	(d)
71.	(c)	**72.**	(c)	**73.**	(c)	**74.**	(c)	**75.**	(a)	**76.**	(d)	**77.**	(d)	**78.**	(c)	**79.**	(a)	**80.**	(d)

EXPLANATIONS

1. (a) : Alkanes, alkenes and alkynes follow the following trend in their acidic behaviour :

$$\underset{sp}{HC\equiv CH} > \underset{sp^2\ sp^2}{H_2C=CH_2} > \underset{sp^3\ sp^3}{CH_3-CH_3}$$

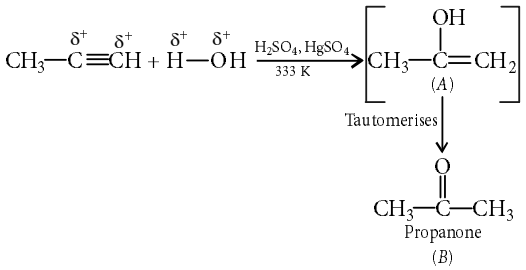
This is because *sp*-hybridised carbon is more electronegative than sp^2-hybridised carbon which is further more electronegative than sp^3-hybridised carbon. Hence, in ethyne proton can be released more easily than ethene and ethane.

Among alkynes the order of acidity is :

$$HC\equiv CH > CH_3-C\equiv CH >> CH_3-C\equiv C-CH_3$$

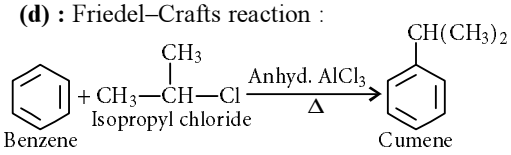
This is due to $+I$ effect of $-CH_3$ group.

2. (c) : In case of unsymmetrical alkynes addition of H_2O occurs in accordance with Markownikoff's rule.



3. (c) : Conformers of ethane have different dihedral angles.

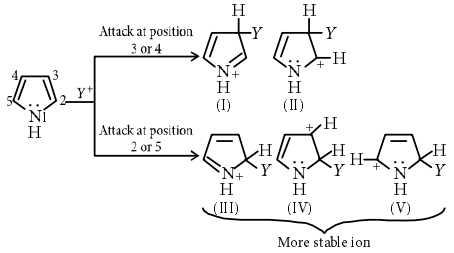
4. (d) : Friedel–Crafts reaction :



Chlorobenzene, bromobenzene and chloroethene are not suitable halide components as C–*X* bond acquires some double bond character due to resonance of lone pair of electrons with π bond.

5. (a) : Biphenyl is coplanar as all C-atoms are sp^2 hybridised.

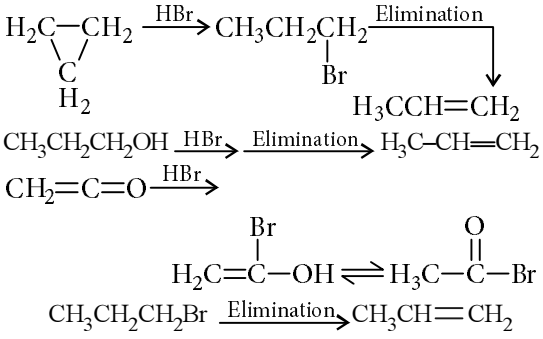
6. (d) : Pyrrole has maximum electron density on 2 and 5. It generally reacts with electrophiles at the C-2 or C-5 due to the highest degree of stability of the protonated intermediate.



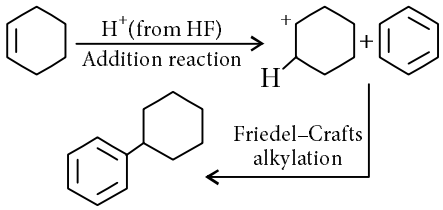
Attack at position 3 or 4 yields a carbocation that is a hybrid of structures (I) and (II). Attack at position 2 or 5 yields a carbocation that is a hybrid not only of structures (III) and (IV) (analogous to I and II) but also of structure (V). The extra stabilization conferred by (V) makes this ion the more stable one.

Also, attack at position 2 or 5 is faster because the developing positive charge is accommodated by three atoms of the ring instead of by only two.

7. (c) :

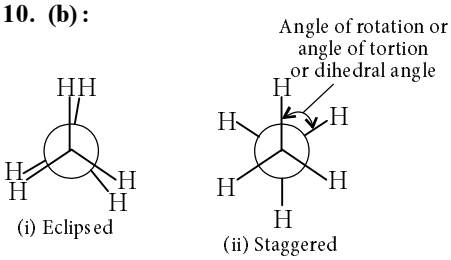


8. (c) :



9. (a)

10. (b) :



Newman's projections of ethane

Magnitude of torsional strain depends upon the angle of rotation about C—C bond. Staggered form has the least torsional strain and the eclipsed form has the maximum torsional strain. So, the staggered conformation of ethane is more stable than the eclipsed conformation.

11. (d) : Mechanism of nitration is :

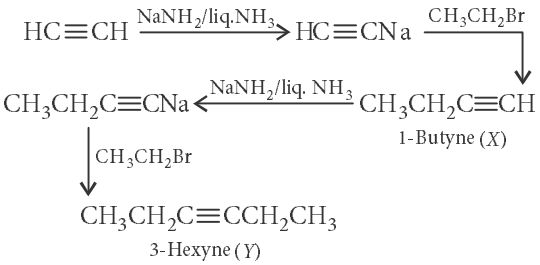
$$HNO_3 + 2H_2SO_4 \longrightarrow NO_2^+ + 2HSO_4^- + H_3O^+$$

If a large amount of $KHSO_4$ is added then conc. of HSO_4^- ions increases and the reaction will be shifted in backward direction hence, the rate of nitration will be slower.

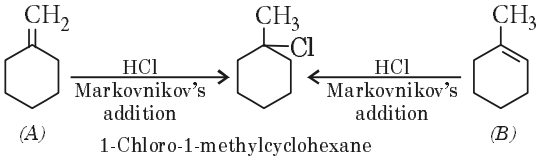
12. (b) : $\overset{sp}{CH_3}-\overset{sp}{C}\equiv C^-$

Thus, pair of electrons is present in *sp*-hybridised orbital.

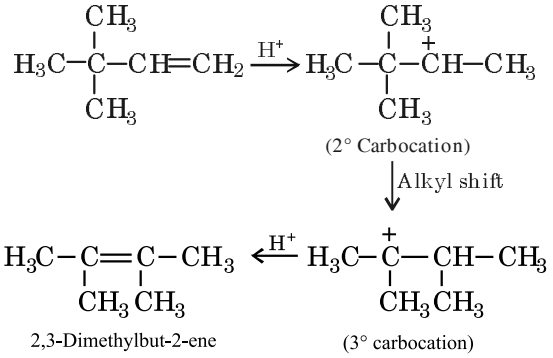
13. (c) :



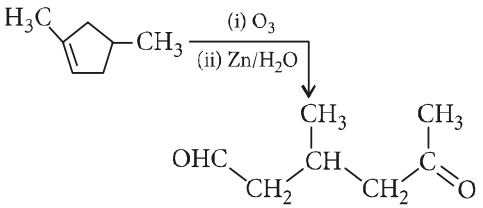
14. (c) :



15. (a) :



16. (c) :

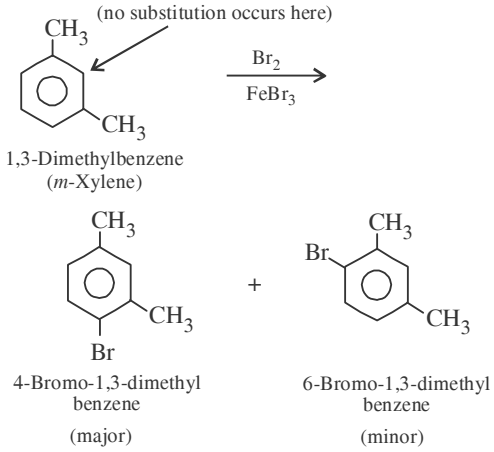


17. (d) : Enthalpy of hydrogenation is inversely proportional to the stability of alkenes.

Stability of alkenes : I > II > III

Enthalpy of hydrogenation : I < II < III

18. (c) : $-CH_3$ group is *o,p*-directing. Because of crowding, no substitution occurs at the carbon atom between the two $-CH_3$ groups in *m*-Xylene, even though two $-CH_3$ groups activate that position.



19. (a) : $CH_3CH_2CH=CH_2 \xrightarrow[\text{(peroxide or anti-markovnikov's effect)}]{HBr/H_2O_2} CH_3CH_2\underset{\underset{H}{|}}{\overset{\overset{Br}{|}}{CH}}-CH_2$ (1-Bromobutane, *Y*)

$\xrightarrow[\Delta]{C_2H_5ONa}$ $CH_3(CH_2)_3-O-CH_2CH_3$ (*Z*)

20. (b) : $C_2H_2 + \frac{5}{2}O_2 \longrightarrow 2CO_2 + H_2O$

Both ethyne and CO_2 have *sp*-hybridisation.

$\overset{sp}{O}=\overset{sp}{C}=O \qquad \overset{sp}{HC}\equiv\overset{sp}{CH}$

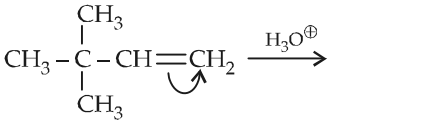
21. (a) : Nitrobenzene is strongly deactivated, hence will not undergo Friedel-Craft's reaction.

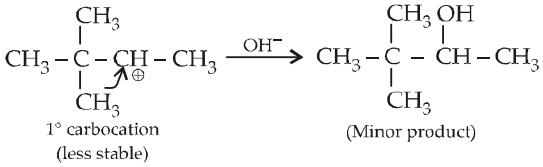
22. (d) : The molecules which do not satisfy Huckel rule or $(4n + 2)\pi$-electron rule are said to be non-aromatic. The compound (d) has total $4\pi e^-$. It does not follow $(4n + 2)$ rule. So it is non-aromatic compound. All other compounds (a, b, c) are planar and have $6\pi e^-$, so they are aromatic.

23. (c) : $HC\equiv CH \xrightarrow[Hg^{2+}]{H_2SO_4}$ $[CH_2=CHOH]$ (Vinyl alcohol) $\xrightarrow{\text{Tautomerises}}$ CH_3CHO (*P*, Acetaldehyde)

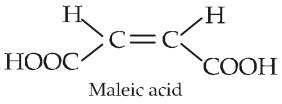
Acetaldehyde does not give Victor Meyer test.

24. (a) :





25. (a) : Maleic acid shows geometrical isomerism and not optical isomerism.

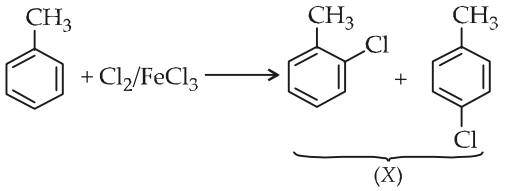


26. (a) : Terminal alkynes (1-butyne) react with $NaNH_2$ to form sodium acetylide and evolve hydrogen but 2-butyne do not.

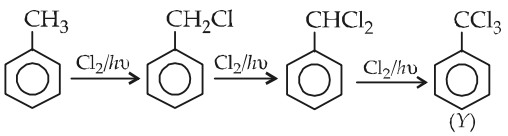
27. (b) : The anti-conformation is the most stable conformation of *n*-butane. In this, the bulky methyl groups are as far apart as possible thereby keeping steric repulsion at a minimum.

28. (b) : Cracking : The process of cracking converts higher alkanes into smaller alkanes and alkenes. This process can be used for production of natural gas.

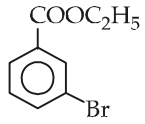
29. (c) : The reaction of Cl_2, in presence of $FeCl_3$, with benzene yields a ring substitution product.



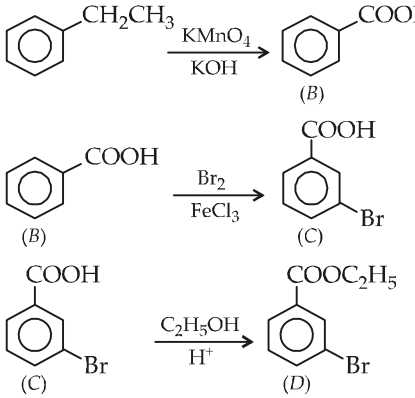
In presence of sunlight, free radical reaction takes place.



30. (d) :

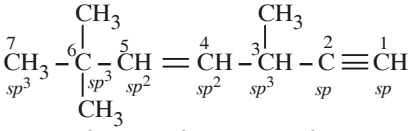


The given reaction sequence can be delineated as:



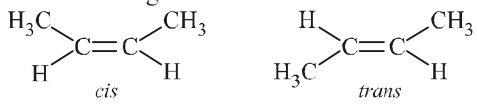
31. (d) : The conformation (d) is most stable because of intermolecular H-bonding.

32. (d) :

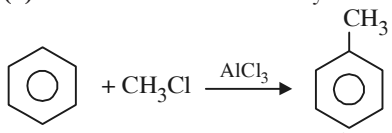


$\therefore$ C_2 - *sp*, C_3 - sp^3, C_5 - sp^2 and C_6 - sp^3

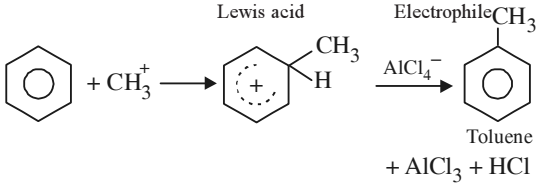
33. (d) : *Cis-trans* isomerism is exhibited by compounds having C=C, C=N and N=N groups, due to restricted rotation around the double bond. Among the given options only 2-butene qualifies to exhibit geometrical isomerism.



34. (d) : This is Friedel-Crafts alkylation.

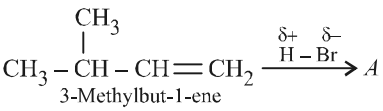


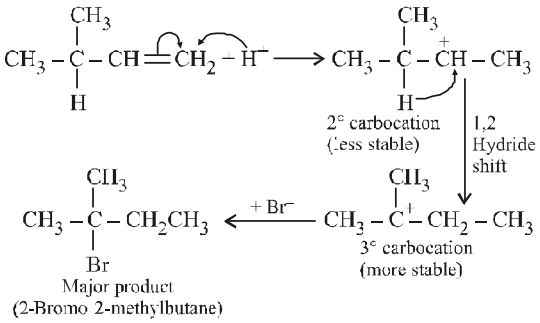
Mechanism: $CH_3Cl + AlCl_3 \rightarrow AlCl_4^- + CH_3^+$



$+ AlCl_3 + HCl$

35. (d) :





36. (d) : $\overset{sp^3}{CH_3}-\overset{sp^2}{CH}=\overset{sp^2}{CH}-\overset{sp^3}{CH_2}-\overset{sp}{C}\equiv\overset{sp}{CH}$

6 5 4 3 2 1

The state of hybridisation of carbon in 1, 3 and 5 position are *sp*, sp^3 sp^2.

37. (c) : $CH_3-CH_2-C\equiv CH + HCl \longrightarrow$

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

According to Markownikoff's rule, during hydrohalogenation to unsymmetrical alkene, the negative part of the addendum adds to less hydrogenated (*i.e.* more substituted) carbon atom.

38. (d) : (a)

$H_3C-\underset{CH_3}{\underset{|}{CH}}-CH=CH_2 \xrightarrow[(ii)\ Zn/H_2O_2]{(i)\ O_3}$

3-Methyl-1-butene

$H_3C-\underset{CH_3}{\underset{|}{CH}}-CH=O$ + CH_2O

2-Methylpropanal Formaldehyde

(b)  $\xrightarrow[(ii)\ Zn/H_2O_2]{(i)\ O_3}$ no reaction

(c) $H_3C-CH_2-\underset{CH_3}{\underset{|}{C}}=CH_2 \xrightarrow[(ii)\ Zn/H_2O_2]{(i)\ O_3}$

2-Methyl-1-butene

$H_3C-CH_2-\underset{CH_3}{\underset{|}{C}}=O$ + CH_2O

Ethylmethylketone Formaldehyde

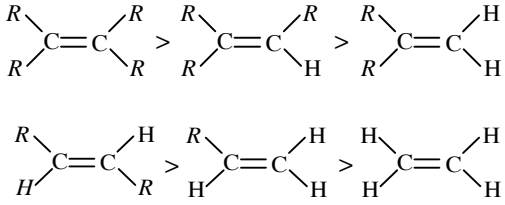
(d) $H_3C-\underset{CH_3}{\underset{|}{C}}=CH-CH_3 \xrightarrow[(ii)\ Zn/H_2O_2]{(i)\ O_3}$

2-Methyl-2-butene

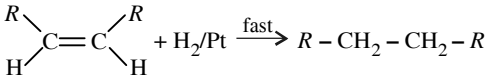
$H_3C-\underset{CH_3}{\underset{|}{\overset{O}{\overset{||}{C}}}}-CH_3$ + CH_3CHO

Acetone Acetaldehyde

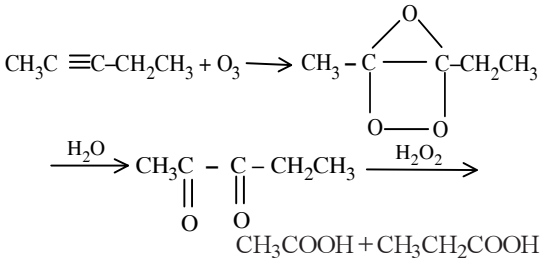
39. (a) : The relative rates of hydrogenation decrease with the increase of steric hindrance. In order of stability of alkene, most stable the alkene slowly it gives the product.



Hence alkene which will react faster with H_2 is that which is most unstable.



40. (b) : On ozonolysis, higher alkynes form diketones which are further oxidised to dicarboxylic acid.



41. (c) : $C_6H_5H + H_2C=CH_2 \xrightarrow[95°,\ pressure]{AlCl_3,\ HCl} C_6H_5CH_2CH_3$

42. (d) : The formation of *n*-propyl bromide in presence of peroxide can be explained as follows:

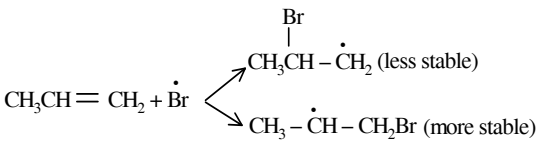
Step 1 : Peroxide undergoes fission to give free radicals.

$R-O-O-R \longrightarrow 2R-\dot{O}$

Step 2 : HBr combines with free radical to form bromine free radical.

$R-\dot{O} + HBr \longrightarrow R-OH + \dot{B}r$

Step 3 : $\dot{B}r$ attacks the double bond of the alkene to form a more stable free radical.



Step 4 : More stable free radical attacks on HBr.

$$CH_3\dot{C}HCH_2Br + HBr \longrightarrow CH_3CH_2CH_2Br + \dot{B}r$$

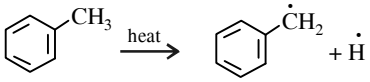
n-propyl bromide

Step 5 : $\dot{B}r + \dot{B}r \longrightarrow Br_2$

43. (b) :

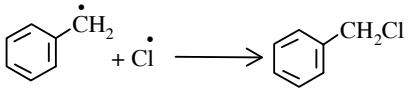
$$CH_3C(CH_3)=CH-CH_3 \xrightarrow[KMnO_4]{NaIO_4} CH_3-C(CH_3)=O + CH_3COOH$$

44. (a) :

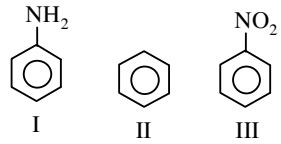


Benzyl free radical

$$Cl_2 \xrightarrow[\text{sunlight}]{\text{Energy}} 2\dot{C}l$$



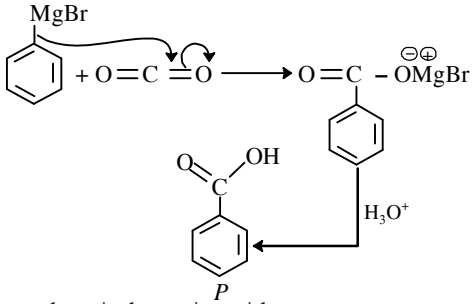
45. (d) :



I II III

$-NH_2$ group is electron donating hence increases electron density on ring. Benzene is also electron rich due to delocalisation of electrons. $-NO_2$ group is electron withdrawing hence, decreases electron density on ring. Thus, correct order for electrophilic substitution is I > II > III.

46. (b) :



P

The product is benzoic acid.

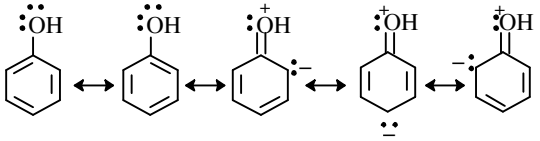
47. (b) : $CH_3CH_2CHCl_2 \xrightarrow{NaNH_2} CH_3C\equiv CH$

48. (b) : Alcohols may be dehydrated to the corresponding olefins. The order of ease of dehydration is

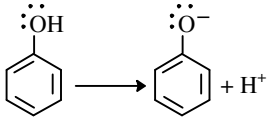
3° alcohol > 2° alcohol > 1° alcohol.

$$CH_3CH_2OH \xrightarrow[-H_2O]{Al_2O_3,\ 620\ K} CH_2=CH_2$$

49. (b) : Phenol exists as a resonance hybrid of the following structures.

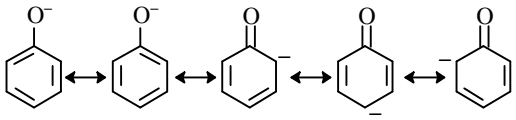


Thus, due to resonance the oxygen atom of the – OH group acquires a positive charge and hence attracts electron pair of the O – H bond leading to the release of hydrogen atom as proton.



Phenoxide ion

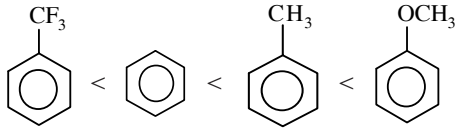
Once the phenoxide ion is formed it stabilises itself by resonance which is more stable than the parent phenol as there is no charge separation.



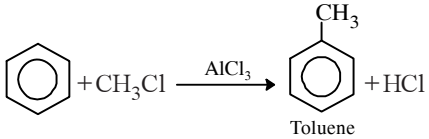
Effect of substituent → Presence of electron withdrawing groups (– NO_2, –*X*, – CN) increase the acidity of phenols while the presence of electron releasing groups (– NH_2, – CH_3) decrease the acidity of phenols. This explains the following order of acidity.

p-nitrophenol > phenol > *p*-cresol.

50. (a) : Due to –*I* effect of F atom, CF_3 in benzene ring deactivates the ring and does not favour electrophilic substitution. While – CH_3 and – OCH_3 are '+*I* group' which favours electrophilic substitution in the benzene ring at '*ortho*' and '*para*' positions. The +*I* effect of – OCH_3 is more than $-CH_3$, therefore the correct order for electrophilic substitution is



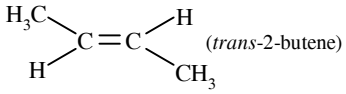
51. (a) : In Friedel-Crafts reaction toluene is obtained by the action of CH_3Cl on benzene in presence of $AlCl_3$.



Toluene

52. (b) : Propene adds to diborane (B_2H_6) giving an addition product. The addition compound on oxidation gives 1-propanol. Here addition of water takes place according to anti-Markownikoff's rule.

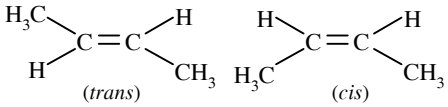
53. (c) :



(*trans*-2-butene)

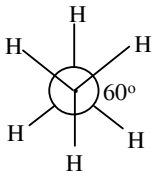
This is most stable as the repulsion between two methyl groups is least.

54. (a) : Due to restricted rotation about double bond, 2-butene shows geometrical isomerism.



(*trans*) (*cis*)

55. (c) : The staggered form of ethane has the following structure and the dihedral angle is 60°, which means 'H' atoms are at an angle of 60° to each other.



56. (d) :

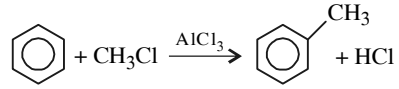
$$CH{\equiv}CH + H_2O \xrightarrow[HgSO_4]{\text{dil. } H_2SO_4} CH_2{=}CH{-}OH$$

Acetylene (unstable)

$CH_2{=}CH{-}OH \rightarrow CH_3{-}\underset{\underset{O}{\|}}{C}{-}H$

Acetaldehyde

57. (a) : In Friedel-Crafts reaction, an alkyl group is introduced into the benzene ring in presence of a Lewis acid ($AlCl_3$) catalyst. The reaction is



Benzene Toluene

58. (a) : – OH, – Cl and – CH_3 groups in benzene are *ortho-para* directing groups and activate the ring towards electrophilic substitution reaction. But among these –OH group is strongly activating while –CH_3 is weakly activating and –Cl is deactivating. Thus, phenol will be most easily attacked by an electrophile.

59. (a) : Arenes undergo nucleophilic substitution reaction and are resistant to addition reactions, due to delocalisation of π-electrons. These are also stabilized by resonance.

60. (a) :

$$CH_3 - \underset{\underset{Br}{|}}{CH} - CH_2 - CH_2 - CH_3 + C_2H_5 - {}^{-}OK^{+}$$

2-Bromopentane

$$\rightarrow CH_3 - \underset{\text{trans-(2-Pentene)}}{CH{=}CH} - CH_2 - CH_3 + KBr + C_2H_5 - OH$$

61. (c) : When an aqueous solution of sodium or potassium salt of carboxylic acid is electrolysed, hydrocarbon is evolved at anode.

62. (d) :

$$CH_2{=}CH_2 + HOCl \rightarrow \underset{\underset{CH_2Cl}{|}}{\overset{CH_2OH}{|}} \xrightarrow{\text{aq. } NaHCO_3} \underset{\underset{CH_2OH}{|}}{\overset{CH_2OH}{|}}$$

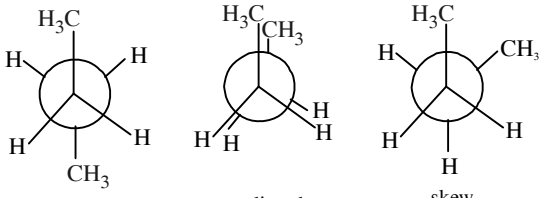
Therefore, $M = CH_2Cl{-}CH_2OH$ and R = aq.$NaHCO_3$

63. (b) : In alkyne, two carbon atoms constituting the triple bond are *sp*-hybridised. Carbon undergoes *sp*-hybridisation to form two *sp*-hybrid orbitals. The two 2*p*-orbitals remain unhybridised. Hybrid orbitals form one sigma bond while two π-bonds are formed by unhybridised orbitals.

64. (c) : The branching of chain increases the octane number of a fuel. High octane number means better fuel.

65. (a) : In structure III, withdrawal of electrons by – NO_2 causes decrease in reaction rate while in structure I, there is electron releasing effect by – OCH_3 group which accelerates the reaction.

66. (b) : $CH_3CH_2CH_2CH_3$ - *n*-butane
Newman projection for *n*-butane is



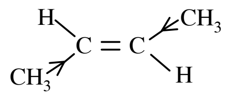
The staggered conformation has minimum repulsion between the hydrogen atoms attached tetrahedrally to the two carbon atoms. Thus, it is the most stable conformation.

67. (c) : $Cl_2 + FeCl_3 \rightarrow FeCl_4^{-} + Cl^{+}$

68. (d) : In this reaction, HBr undergoes heterolytic fission as $HBr \rightarrow H^{+} + Br^{-}$

$$CH_2 = CH - CH_3 + HBr \longrightarrow CH_3 - \overset{\oplus}{C}H - CH_3$$

$$\xrightarrow{Br^{-}} CH_3 - CHBr - CH_3$$

69. (d) : 

trans-2-butene

Both methyl group cancel each other. So net zero dipole moment exists.

70. (d) : $6(R-CH{=}CH_2)$ (Alkene) $\xrightarrow[\text{Ether, 0°C}]{B_2H_6} 2R(CH_2CH_2)_3B$

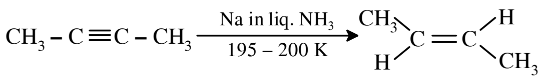
$\xrightarrow[\text{NaOH}]{H_2O_2} RCH_2CH_2OH + 2H_3BO_3$

71. (c) : In the case of but-2-ene ($CH_3{-}CH{=}CH{-}CH_3$) both double bonded carbons are identical. Therefore, it does not observe the anti-Markownikoff's addition of HBr.

72. (c) : Nitronium ion (NO_2^+) is an electrophile that actually attacks the benzene ring.

73. (c) : KOH in C_2H_5OH, when reacts with 1,1-dihaloalkanes form alkynes.

74. (c) : Reduction of non-terminal alkynes with Na in liq. NH_3 at 195 - 200 K gives *trans* alkene.



trans-But-2-ene

(Birch reduction)

75. (a) : Alkynes react with strong bases like $NaNH_2$ to form sodium acetylide derivative known as acetylides.

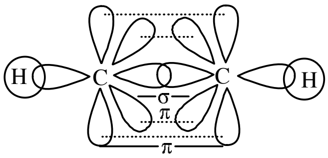
$H-C{\equiv}C-H + NaNH_2 \longrightarrow H-C{\equiv}\bar{C}-\overset{+}{Na} + 1/2H_2$

76. (d) : 3° > 2° > 1°. The reactivity of H-atom depends upon the stability of free radicals, therefore reactivity of H-atom follows the order.

3° > 2° > 1°

77. (d) : Benzene shows kekule structures which are resonating structures and these structures are separated by a double headed arrow (↔).

78. (c) : Due to resonance all the C – C bonds in the benzene possess same nature and the resonating structures are obtained because of the delocalisation of π-electrons.

79. (a) : 

The formation of C – H bond in acetylene involves *sp*-hybridised carbon atom. Since *s*-electrons are closer to the nucleus than *p* electrons, the electrons present in a bond having more *s*-character will be more closer to the nucleus. In alkynes *s* character is 50%, the electrons constituting this bond are more strongly bonded by the carbon nucleus. Thus, acetylenic C-atom becomes more electronegative in comparison to sp^2, sp^3 and hence the hydrogen atom present on carbon atom ($\equiv$ C – H) can be easily removed.

80. (d) : All the three reagents except ammoniacal $AgNO_3$ reacts with 1, 2 and 4 compounds. The compound 3 possessing the terminal alkyne only reacts with ammoniacal $AgNO_3$ and thus can be distinguished from 1, 2 and 4 compounds.