CHAPTER
12

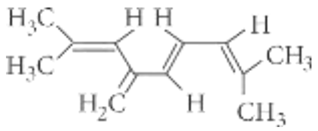
Organic Chemistry - Some Basic Principles and Techniques

12.2 Tetravalence of Carbon : Shapes of Organic Compounds

1. The number of sigma (σ) and pi (π) bonds in pent-2-en-4-yne is
   (a) 13 σ bonds and no π bond
   (b) 10 σ bonds and 3 π bonds
   (c) 8 σ bonds and 5 π bonds
   (d) 11 σ bonds and 2 π bonds. *(NEET 2019)*

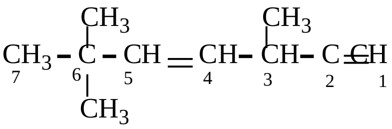
2. Which of the following molecules represents the order of hybridisation *sp*^{2}, *sp*^{2}, *sp*, *sp* from left to right atoms?
   (a) $HC\equiv C - C\ CH \equiv$
   (b) $CH_2\ CH - C\ CH \equiv$
   (c) $CH_2 = CH - CH\ \ CH_2$
   (d) $CH_3 - CH = CH - CH_3$ *(NEET 2018)*

3. The total number of π-bond electrons in the following structure is



   (a) 12 (b) 16 (c) 4 (d) 8
   (2015, Cancelled)

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



$$\underset{7}{CH_3}-\underset{6}{\overset{\overset{\displaystyle CH_3}{|}}{\underset{\underset{\displaystyle CH_3}{|}}{C}}}-\underset{5}{CH}=\underset{4}{CH}-\underset{3}{\overset{\overset{\displaystyle CH_3}{|}}{CH}}-\underset{2}{C}\equiv\underset{1}{CH}$$

   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)

5. In the hydrocarbon,

$$\underset{6}{CH_3}-\underset{5}{CH}=\underset{4}{CH}-\underset{3}{CH_2}-\underset{2}{C}\equiv\underset{1}{CH}$$

   the state of hybridisation 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)*

6. In which of the following compounds there is more than one kind of hybridisation (*sp*, *sp*^{2}, *sp*^{3}) for carbon?
   (a) $CH_2 = CH - CH = CH_2$
   (b) $H - C\equiv C - H$
   (c) $CH_3CH_2CH_2CH_3$
   (d) $CH_3 - CH = CH - CH_3$
   (1995)

7. A straight chain hydrocarbon has the molecular formula C_8H_{10}. The hybridisation of the carbon atoms from one end of the chain to the other are respectively *sp*^{3}, *sp*^{2}, *sp*^{2}, *sp*^{3}, *sp*^{2}, *sp*^{2}, *sp* and *sp*. The structural formula of the hydrocarbon would be
   (a) $CH_3C\ \ CCH_2 - CH\ \ -CHCH = CH_2$
   (b) $CH_3CH_2 - CH\ \ CHCH \equiv CHC - CH$
   (c) $CH_3CH - CHCH_2 - C\ \ -CCH = CH_2$
   (d) $CH_3CH\ CHCH_2 - CH\ CHC\ CH$ *(1991)*

8. Which of the following possesses a *sp*-carbon in its structure?
   (a) $CH_2 = CCl - CH\ \ CH_2$
   (b) $CCl_2 = CCl_2$ (c) $CH_2 = C = CH_2$
   (d) $CH_2\ \ CH - CH\ \ CH_2$
   (1989)

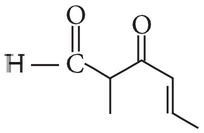
   (a) 120° and 109.5° (b) 90° and 109.5°
   (c) 109.5° and 90° (d) 109.5° and 120°
   (1988)

12.4 Classification of Organic Compounds

10. An organic compound *X*(molecular formula $C_6H_7{}_2O\ N$) has six carbon atoms in a ring system, two double bonds and a nitro group as substituent, *X* is
   (a) homocyclic but not aromatic
   (b) aromatic but not homocyclic
   (c) homocyclic and aromatic
   (d) heterocyclic and aromatic. *(1990)*

12.5 Nomenclature of Organic Compounds

11. The IUPAC name of the compound



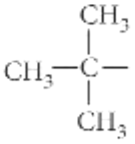
is ________.

(a) 5-formylhex-2-en-3-one
(b) 5-methyl-4-oxohex-2-en-5-al
(c) 3-keto-2-methylhex-5-enal
(d) 3-keto-2-methylhex-4-enal *(NEET 2017)*

12. The structure of isobutyl group in an organic compound is

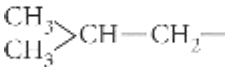
(a) $CH_3—CH_2—CH_2—CH_2—$

(b)



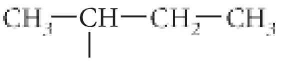
$CH_3-\overset{CH_3}{\underset{CH_3}{C}}-$

(c)



$\begin{matrix}CH_3\\CH_3\end{matrix}>CH-CH_2-$

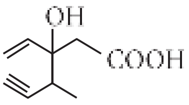
(d)



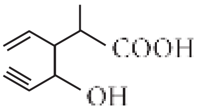
$CH_3-\underset{|}{CH}-CH_2-CH_3$ *(NEET 2013)*

13. Structure of the compound whose IUPAC name is 3-ethyl-2-hydroxy-4-methylhex-3-en-5-ynoic acid is

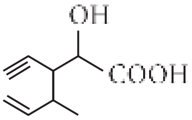
(a)



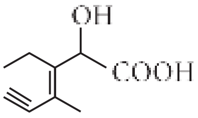
(b)



(c)



(d)

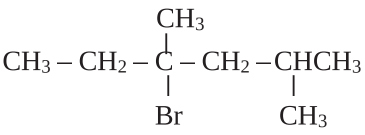


(NEET 2013)

14. Which nomenclature is not according to IUPAC system?

(a) $Br-CH_2-CH=CH_2$
1-Bromoprop-2-ene

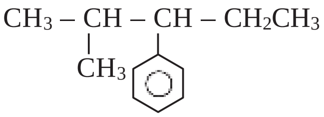
(b)



$CH_3-CH_2-\overset{CH_3}{\underset{Br}{C}}-CH_2-\underset{CH_3}{CH}CH_3$

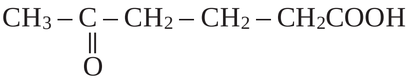
4-Bromo-2,4-dimethylhexane

(c)



2-Methyl-3-phenylpentane

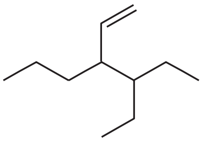
(d)



$CH_3-\underset{\underset{O}{\|}}{C}-CH_2-CH_2-CH_2COOH$

5-Oxohexanoic acid *(2012)*

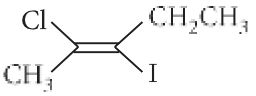
15. The correct IUPAC name for the compound



is

(a) 4-ethyl-3-propylhex-1-ene
(b) 3-ethyl-4-ethenylheptane
(c) 3-ethyl-4-propylhex-5-ene
(d) 3-(1-ethylpropyl)hex-1-ene. *(2011)*

16. The IUPAC name of the following compound is



(a) *trans*-2-chloro-3-iodo-2-pentene
(b) *cis*-3-iodo-4-chloro-3-pentane
(c) *trans*-3-iodo-4-chloro-3-pentene
(d) *cis*-2-chloro-3-iodo-2-pentene.
(Mains 2011, 1998)

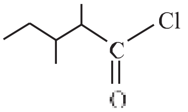
17. The IUPAC name of the compound $CH_3CH=CHC\equiv CH$ is

(a) pent-4-yn-2-ene (b) pent-3-en-1-yne
(c) pent-2-en-4-yne (d) pent-1-yn-3-ene.
(Mains 2010)

18. The IUPAC name of the compound having the formula $CH\equiv C—CH=CH_2$ is

(a) 1-butyne-3-ene (b) but-1-yne-3-ene
(c) 1-butene-3-yne (d) 3-butene-1-yne.
(2009)

19. The IUPAC name of

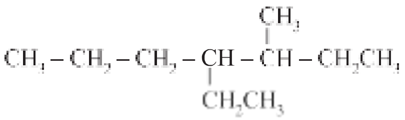


is

(a) 1-chloro-1-oxo-2,3-dimethylpentane
(b) 2-ethyl-3-methylbutanoyl chloride
(c) 2,3-dimethylpentanoyl chloride
(d) 3,4-dimethylpentanoyl chloride. *(2006)*

20. Names of some compounds are given. Which one is not in IUPAC system?

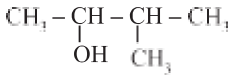
(a)



$CH_3-CH_2-CH_2-\underset{CH_2CH_3}{CH}-\overset{CH_3}{CH}-CH_2CH_3$

3-Methyl-4-ethylheptane

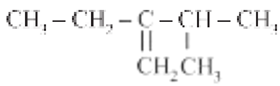
(b)



$CH_3-\underset{OH}{CH}-\underset{CH_3}{CH}-CH_3$

3-Methyl-2-butanol

(c)

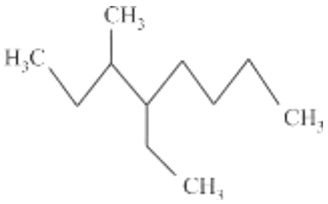


$CH_3-CH_2-\underset{\underset{CH_2}{\|}}{C}-\underset{CH_3}{CH}-CH_3$

2-Ethyl-3-methylbut-1-ene

(d) $CH_3-C\equiv C-CH(CH_3)_2$ *(2005)*
4-Methyl-2-pentyne

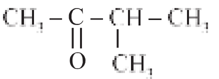
21. Name of the compound given below is

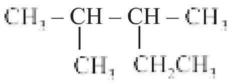


(a) 4-ethyl-3-methyloctane
(b) 3-methyl-4-ethyloctane
(c) 2,3-diethylheptane
(d) 5-ethyl-6-methyloctane. *(2003)*

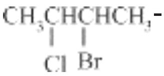
22. IUPAC name of the following is
$CH_2=CH-CH_2-CH_2-C\equiv CH$
(a) 1,5-hexenyne (b) 1-hexene-5-yne
(c) 1-hexyne-5-ene (d) 1,5-hexynene. *(2002)*

23. The incorrect IUPAC name is

(a)  $CH_3-\underset{\underset{O}{\|}}{C}-\underset{\underset{CH_3}{|}}{CH}-CH_3$ - 2-methyl-3-butanone

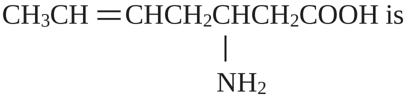
(b)  $CH_3-\underset{\underset{CH_3}{|}}{CH}-\underset{\underset{CH_2CH_3}{|}}{CH}-CH_3$ -2,3-dimethylpentane

(c) $CH_3-C\equiv CCH(CH_3)_2$ -4-methyl-2-pentyne

(d)  $CH_3\underset{\underset{Cl}{|}}{CH}\underset{\underset{Br}{|}}{CH}CH_3$-3-bromo-2-chlorobutane. *(2001)*

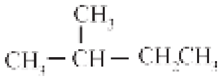
24. The IUPAC name of $(CH_3)_2CH-CH_2-CH_2Br$ is
(a) 1-bromo-3-methylbutane
(b) 2-methyl-3-bromopropane
(c) 1-bromopentane
(d) 2-methyl-4-bromobutane. *(1996)*

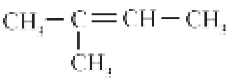
25. The IUPAC name for

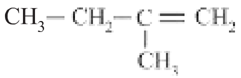
 $CH_3CH=CHCH_2\underset{\underset{NH_2}{|}}{CH}CH_2COOH$ is

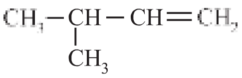
(a) 3-amino-5-heptenoic acid
(b) β-amino-δ-heptenoic acid
(c) 5-amino-2-heptenoic acid
(d) 5-amino-hex-2-enecarboxylic acid. *(1995)*

26. 2-Methyl-2-butene will be represented as

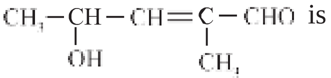
(a)  $CH_3-\overset{\overset{CH_3}{|}}{CH}-CH_2CH_3$

(b)  $CH_3-\underset{\underset{CH_3}{|}}{C}=CH-CH_3$

(c)  $CH_3-CH_2-\underset{\underset{CH_3}{|}}{C}=CH_2$

(d)  $CH_3-\underset{\underset{CH_3}{|}}{CH}-CH=CH_2$ *(1992)*

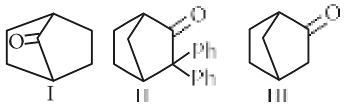
27. The IUPAC name of

 $CH_3-\underset{\underset{OH}{|}}{CH}-CH=\underset{\underset{CH_3}{|}}{C}-CHO$ is

(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. *(1992)*

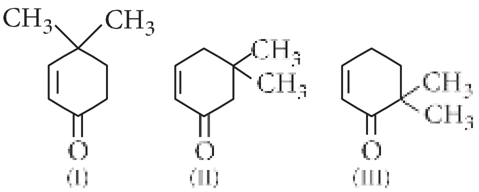
12.6 Isomerism

28. Which among the given molecules can exhibit tautomerism?



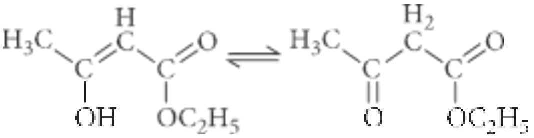
(a) III only (b) Both I and III
(c) Both I and II (d) Both II and III
(NEET-II 2016)

29. Given :



Which of the given compounds can exhibit tautomerism?
(a) II and III (b) I, II and III
(c) I and II (d) I and III
(2015, Cancelled)

30. The enolic form of ethyl acetoacetate as shown below has



(a) 9 sigma bonds and 2 pi-bonds
(b) 9 sigma bonds and 1 pi-bond
(c) 18 sigma bonds and 2 pi-bonds
(d) 16 sigma bonds and 1 pi-bond. *(2015, Cancelled)*

31. Which one of the following pairs represents stereoisomerism?
(a) Structural isomerism and geometrical isomerism
(b) Optical isomerism and geometrical isomerism
(c) Chain isomerism and rotational isomerism
(d) Linkage isomerism and geometrical isomerism
(2005)

32. The molecular formula of diphenylmethane,  is $C_{13}H_{12}$.

How many structural isomers are possible when one of the hydrogen is replaced by a chlorine atom?
(a) 6 (b) 4 (c) 8 (d) 7 *(2004)*

33. Tautomerism is exhibited by
(a) R_3CNO_2 (b) RCH_2NO_2
(c) $(CH_3)_3CNO$ (d) $(CH_3)_2NH$ *(1997)*

34. The number of isomers in $C_4H_{10}O$ will be
(a) 7 (b) 8 (c) 5 (d) 6 *(1996)*

35. Isomers of a substance must have the same
(a) structural formula (b) physical properties
(c) chemical properties (d) molecular formula.
(1991)

36. How many chain isomers could be obtained from the alkane C_6H_{14}?
(a) Four (b) Five
(c) Six (d) Seven *(1988)*

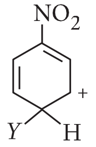
12.7 Fundamental Concepts in Organic Reaction Mechanism

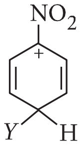
37. A tertiary butyl carbocation is more stable than a secondary butyl carbocation because of which of the following?
(a) $-I$ effect of $-CH_3$ groups
(b) $+R$ effect of $-CH_3$ groups
(c) $-R$ effect of $-CH_3$ groups
(d) Hyperconjugation *(NEET 2020)*

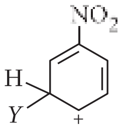
38. The most stable carbocation, among the following is
(a) $(CH_3)_3C-\overset{+}{C}H-CH_3$
(b) $CH_3-CH_2-\overset{+}{C}H-CH_2-CH_3$
(c) $CH_3-\overset{+}{C}H-CH_2-CH_2-CH_3$
(d) $CH_3-CH_2-\overset{+}{C}H_2$ *(Odisha NEET 2019)*

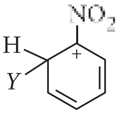
39. Which of the following is correct with respect to $-I$ effect of the substituents? (R = alkyl)
(a) $-NH_2 < -OR < -F$ (b) $-NR_2 < -OR < -F$
(c) $-NH_2 > -OR > -F$ (d) $-NR_2 > -OR > -F$
(NEET 2018, 1998)

40. Which of the following carbocations is expected to be most stable?

(a) 

(b) 

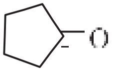
(c) 

(d) 

(NEET 2018)

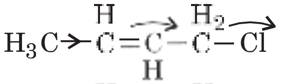
41. The correct statement regarding electrophile is
(a) electrophile is a negatively charged species and can form a bond by accepting a pair of electrons from another electrophile
(b) electrophiles are generally neutral species and can form a bond by accepting a pair of electrons from a nucleophile
(c) electrophile can be either neutral or positively charged species and can form a bond by accepting a pair of electrons from a nucleophile
(d) electrophile is a negatively charged species and can form a bond by accepting a pair of electrons from a nucleophile. *(NEET 2017)*

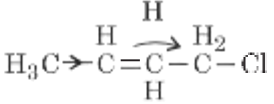
42. Which of the following statements is not correct for a nucleophile?
(a) Ammonia is a nucleophile.
(b) Nucleophiles attack low e^- density sites.
(c) Nucleophiles are not electron seeking.
(d) Nucleophile is a Lewis acid. *(2015)*

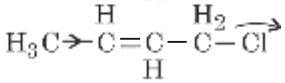
43. Treatment of cyclopentanone  with methyl lithium gives which of the following species?

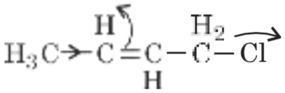
(a) Cyclopentanonyl radical
(b) Cyclopentanonyl biradical
(c) Cyclopentanonyl anion
(d) Cyclopentanonyl cation *(2015, Cancelled)*

44. Which of the following is the most correct electron displacement for a nucleophilic reaction to take place?

(a) 

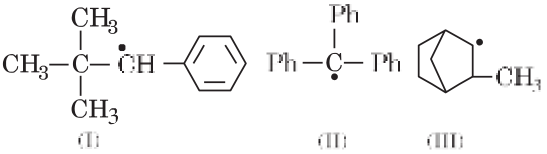
(b) 

(c) 

(d) 

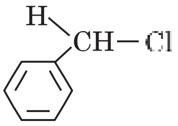
(2015, Cancelled)

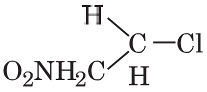
45. Consider the following compounds :

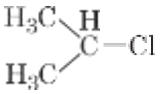


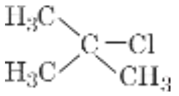
Hyperconjugation occurs in
(a) III only (b) I and III
(c) I only (d) II only.
(2015, Cancelled)

46. In which of the following compounds, the C—Cl bond ionisation shall give most stable carbonium ion?

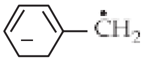
(a) 

(b) 

(c) 

(d) 

(2015, Cancelled)

47. The radical,  is aromatic because it has

(a) 7 *p*-orbitals and 7 unpaired electrons
(b) 6 *p*-orbitals and 7 unpaired electrons
(c) 6 *p*-orbitals and 6 unpaired electrons
(d) 7 *p*-orbitals and 6 unpaired electrons.

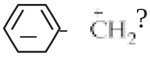
(NEET 2013)

48. Arrange the following in increasing order of stability.

1. $(CH_3)_2 — \overset{+}{C} — CH_2 — CH_3$
2. $(CH_3)_3 — \overset{+}{C}$
3. $(CH_3)_2 — \overset{+}{C}H$ 4. $CH_3 — \overset{+}{C}H_2$
5. $\overset{+}{C}H_3$

(a) 5 < 4 < 3 < 1 < 2 (b) 4 < 5 < 3 < 1 < 2
(c) 1 < 5 < 4 < 3 < 2 (d) 5 < 4 < 3 < 2 < 1

(Karnataka NEET 2013)

49. What is the hybridisation state of benzyl carbonium ion  ?

(a) sp^2 (b) spd^2 (c) sp^2d (d) sp^3

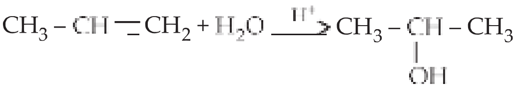
(Karnataka NEET 2013)

50. Homolytic fission of the following alkanes forms free radicals $CH_3 — CH_3$, $CH_3 — CH_2 — CH_3$, $(CH_3)_2CH — CH_3$, $CH_3 — CH_2 — CH(CH_3)_2$.
Increasing order of stability of the radicals is

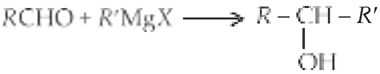
(a) $(CH_3)_2\dot{C} — CH_2 — CH_3 < CH_3 — \dot{C}H — CH_3 < CH_3 — \dot{C}H_2 < (CH_3)_3\dot{C}$
(b) $CH_3 — \dot{C}H_2 < CH_3 — \dot{C}H — CH_3 < (CH_3)_2\dot{C} — CH_2 — CH_3 < (CH_3)_3\dot{C}$
(c) $CH_3 — \dot{C}H_2 < CH_3 — \dot{C}H — CH_3 < (CH_3)_3\dot{C} < (CH_3)_2\dot{C} — CH_2 — CH_3$
(d) $(CH_3)_3\dot{C} < (CH_3)_2\dot{C} — CH_2 — CH_3 < CH_3 — \dot{C}H — CH_3 < CH_3 — \dot{C}H_2$

(Karnataka NEET 2013)

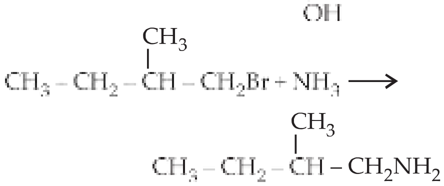
51. Which one is a nucleophilic substitution reaction among the following?

(a) 

$CH_3 - CH = CH_2 + H_2O \xrightarrow{H^+} CH_3 - \underset{\displaystyle OH}{\underset{|}{CH}} - CH_3$

(b) 

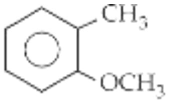
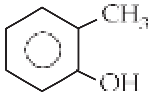
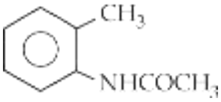
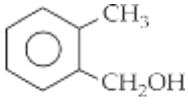
$RCHO + R'MgX \longrightarrow R - \underset{\displaystyle OH}{\underset{|}{CH}} - R'$

(c) 

$CH_3 - CH_2 - \overset{\displaystyle CH_3}{\overset{|}{CH}} - CH_2Br + NH_3 \longrightarrow CH_3 - CH_2 - \overset{\displaystyle CH_3}{\overset{|}{CH}} - CH_2NH_2$

(d) $CH_3CHO + HCN \longrightarrow CH_3CH(OH)CN$ *(2011)*

52. Which one of the following is most reactive towards electrophilic reagent?

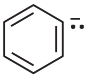
(a) 
(b) 
(c) 
(d) 

(2011, 2010)

53. Which of the following species is not electrophilic in nature?

(a) $\overset{+}{Cl}$ (b) BH_3
(c) H_3O^+ (d) $\overset{+}{N}O_2$ *(Mains 2010)*

54. The stability of carbanions in the following:

(i) $RC \equiv \bar{C}$ (ii) 
(iii) $R_2C = \bar{C}H$ (iv) $R_3C — \bar{C}H_2$

is in the order of

(a) (iv) > (ii) > (iii) > (i) (b) (i) > (iii) > (ii) > (iv)
(c) (i) > (ii) > (iii) > (iv) (d) (ii) > (iii) > (iv) > (i)

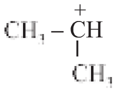
(2008)

55. For (i) I^-, (ii) Cl^-, (iii) Br^-, the increasing order of nucleophilicity would be

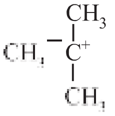
(a) $Cl^- < Br^- < I^-$ (b) $I^- < Cl^- < Br^-$
(c) $Br^- < Cl^- < I^-$ (d) $I^- < Br^- < Cl^-$ *(2007)*

56. Which amongst the following is the most stable carbocation?

(a) $\overset{+}{C}H_3$ (b) $CH_3\overset{+}{C}H_2$

(c) 

$CH_3 - \underset{\displaystyle CH_3}{\underset{|}{\overset{+}{C}H}}$

(d) 

$CH_3 - \overset{\displaystyle CH_3}{\overset{|}{\underset{\displaystyle CH_3}{\underset{|}{C^+}}}}$

(2005)

57. Which of the following is the most stable carbocation (carbonium ion)?

(a) $CH_3\overset{+}{C}H_2$ (b) $(CH_3)_2\overset{+}{C}H$
(c) $(CH_3)_3\overset{+}{C}$ (d) $C_6H_5\overset{+}{C}H_2$ *(1991)*

58. Cyclic hydrocarbon '*A*' has all the carbon and hydrogen atoms in a single plane. All the carbon–carbon bonds have the same length, less than 1.54 Å, but more than 1.34 Å. The bond angle will be

(a) 109°28′ (b) 100°
(c) 180° (d) 120° *(1989)*

12.8 Methods of Purification of Organic Compounds

59. Paper chromatography is an example of

(a) adsorption chromatography
(b) partition chromatography
(c) thin layer chromatography
(d) column chromatography. *(NEET 2020)*

60. The most suitable method of separation of 1 : 1 mixture of *ortho* and *para*-nitrophenols is
(a) chromatography (b) crystallisation
(c) steam distillation (d) sublimation.
(NEET 2017, 1999, 1993)

61. The best method for the separation of naphthalene and benzoic acid from their mixture is
(a) distillation (b) sublimation
(c) chromatography (d) crystallisation. *(2005)*

62. In steam distillation of toluene, the pressure of toluene in vapour is
(a) equal to pressure of barometer
(b) less than pressure of barometer
(c) equal to vapour pressure of toluene in simple distillation
(d) more than vapour pressure of toluene in simple distillation. *(2001)*

63. Which of the following technique is most suitable for purification of cyclohexanone from a mixture containing benzoic acid, isoamyl alcohol, cyclohexane and cyclohexanone?
(a) Sublimation (b) Evaporation
(c) Crystallisation (d) IR spectroscopy
(1997)

12.9 Qualitative Analysis of Organic Compounds

64. Nitrogen detection in an organic compound is carried out by Lassaigne's test. The blue colour formed corresponds to which of the following formulae?
(a) $Fe_3[Fe(CN)_6]_2$ (b) $Fe_4[Fe(CN)_6]_3$
(c) $Fe_4[Fe(CN)_6]_2$ (d) $Fe_3[Fe(CN)_6]_3$
(Karnataka NEET 2013)

65. The Lassaigne's extract is boiled with conc. HNO_3 while testing for halogens. By doing so it
(a) decomposes Na_2S and NaCN, formed
(b) helps in the precipitation of AgCl
(c) increases the solubility product of AgCl
(d) increases the concentration of NO_3^- ions.
(2011)

66. In sodium fusion test of organic compounds, the nitrogen of the organic compound is converted into
(a) sodamide (b) sodium cyanide
(c) sodium nitrite (d) sodium nitrate.
(1991)

67. Lassaigne's test is used in qualitative analysis to detect
(a) nitrogen (b) sulphur
(c) chlorine (d) all of these. *(1989)*

68. A blue colouration is not obtained when
(a) ammonium hydroxide dissolves in copper sulphate
(b) copper sulphate solution reacts with $K_4[Fe(CN)_6]$
(c) ferric chloride reacts with sod. ferrocyanide
(d) anhydrous $CuSO_4$ is dissolved in water. *(1989)*

12.10 Quantitative Analysis

69. In Duma's method for estimation of nitrogen, 0.25 g of an organic compound gave 40 mL of nitrogen collected at 300 K temperature and 725 mm pressure. If the aqueous tension at 300 K is 25 mm, the percentage of nitrogen in the compound is
(a) 16.76 (b) 15.76 (c) 17.36 (d) 18.20
(2015, Cancelled)

70. In the Kjeldahl's method for estimation of nitrogen present in a soil sample, ammonia evolved from 0.75 g of sample neutralized 10 mL of 1 M H_2SO_4. The percentage of nitrogen in the soil is
(a) 37.33 (b) 45.33
(c) 35.33 (d) 43.33 *(2014)*

71. In Dumas' method of estimation of nitrogen 0.35 g of an organic compound gave 55 mL of nitrogen collected at 300 K temperature and 715 mm pressure. The percentage composition of nitrogen in the compound would be (aqueous tension at 300 K = 15 mm)
(a) 15.45 (b) 16.45
(c) 17.45 (d) 14.45 *(2011)*

72. Kjeldahl's method is used in the estimation of
(a) nitrogen (b) halogens
(c) sulphur (d) oxygen. *(1990)*

ANSWER KEY

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

Hints & Explanations

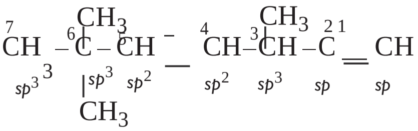
1. (b) : $\overset{5}{\text{HC}}\equiv\overset{4}{\text{C}}-\overset{3}{\text{CH}}=\overset{2}{\text{CH}}-\overset{1}{\text{CH}_3}$

Pent-2-en-4-yne

(10 σ-bonds and 3π-bonds)

2. (b) : $\overset{sp^2}{\text{CH}_2}=\overset{sp^2}{\text{CH}}-\overset{sp}{\text{C}}\equiv\overset{sp}{\text{CH}}$

3. (d) : There are four double bonds. Hence, no. of π-electrons = 2 × 4 = 8.

4. (d) : 
$$\underset{sp^3}{\overset{7}{\text{CH}_3}}-\underset{\underset{\text{CH}_3}{|}\ sp^3}{\overset{\text{CH}_3}{\overset{6|}{\text{C}}}}-\underset{sp^2}{\overset{5}{\text{CH}}}=\underset{sp^2}{\overset{4}{\text{CH}}}-\underset{sp^3}{\overset{\text{CH}_3}{\overset{3|}{\text{CH}}}}-\underset{sp}{\overset{2}{\text{C}}}\equiv\underset{sp}{\overset{1}{\text{CH}}}$$

∴ C_2 - sp, C_3 - sp^3, C_5 - sp^2 and C_6 - sp^3

5. (d) : $\underset{6}{\overset{sp^3}{\text{CH}_3}}-\underset{5}{\overset{sp^2}{\text{CH}}}=\underset{4}{\overset{sp^2}{\text{CH}}}-\underset{3}{\overset{sp^3}{\text{CH}_2}}-\underset{2}{\overset{sp}{\text{C}}}\equiv\underset{1}{\overset{sp}{\text{CH}}}$

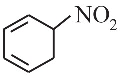
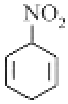
The state of hybridisation of carbon in 1, 3 and 5 position are sp, sp^3 and sp^2.

6. (d) : $\underset{\underset{sp^3}{\downarrow}}{\text{CH}_3}-\underset{\underset{sp^2}{\downarrow}}{\text{CH}}=\underset{\underset{sp^2}{\downarrow}}{\text{CH}}-\underset{\underset{sp^3}{\downarrow}}{\text{CH}_3}$

7. (d) : $\overset{sp^3}{\text{CH}_3}\overset{sp^2}{\text{CH}}=\overset{sp^2}{\text{CH}}-\overset{sp^3}{\text{CH}_2}-\overset{sp^2}{\text{CH}}=\overset{sp^2}{\text{CH}}-\overset{sp}{\text{C}}\equiv\overset{sp}{\text{CH}}$

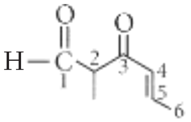
8. (c) : $\overset{sp^2}{\text{CH}_2}=\overset{sp}{\text{C}}=\overset{sp^2}{\text{CH}_2}$

9. (a) : Tetrachloroethene being an alkene has sp^2-hybridised C-atoms and hence the angle Cl – C – Cl is 120° while in tetrachloromethane, carbon is sp^3 hybridised, therefore the angle Cl – C – Cl is 109°28′.

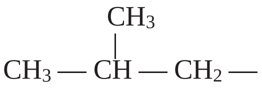
10. (a) :  or 

($C_6H_7O_2N$)

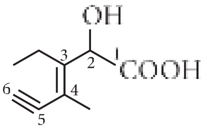
Hence, it is homocyclic (as the ring system is made of one type of atoms, *i.e.,* carbon) but not aromatic.

11. (d) : 

3-Keto-2-methylhex-4-enal

12. (c) : 
$\text{CH}_3 — \overset{\overset{\text{CH}_3}{|}}{\text{CH}} — \text{CH}_2 —$

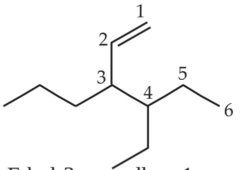
(*iso*-butyl group)

13. (d) : 

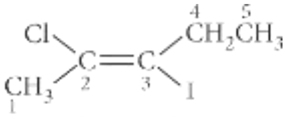
IUPAC name of the compound is 3-ethyl-2-hydroxy-4-methylhex-3-en-5-ynoic acid.

14. (a) : $\text{Br}-\overset{3}{\text{CH}_2}-\overset{2}{\text{CH}}=\overset{1}{\text{CH}_2}$

3-Bromopropene

15. (a) : 

4-Ethyl-3-propylhex-1-ene

16. (a) : 

trans-2-Chloro-3-iodo-2-pentene

17. (b) : $\overset{5}{\text{C}}\text{H}_3\overset{4}{\text{C}}\text{H}=\overset{3}{\text{C}}\text{H}\overset{2}{\text{C}}\equiv\overset{1}{\text{C}}\text{H}$

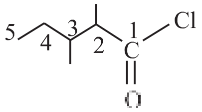
Pent-3-en-1-yne

If a molecule contains both carbon-carbon double or triple bonds, the two are treated as per in seeking the lowest number combination. However, if the sum of numbers turns out to be the same starting from either of the carbon chain, then lowest number is given to the C=C double bond.

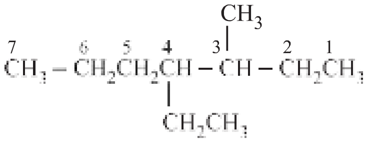
18. (c) : $\overset{4}{\text{CH}}\equiv\overset{3}{\text{C}}-\overset{2}{\text{CH}}=\overset{1}{\text{CH}_2}$

1-Butene-3-yne

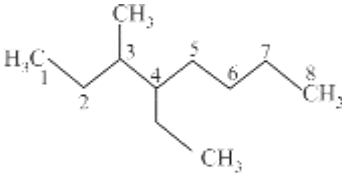
Since the sum of numbers starting from either side of the carbon chain turns out to be the same, so lowest number is given to the C=C end.

19. (c) : 

It is 2,3-dimethylpentanoyl chloride.

20. (a) : 
$\overset{7}{\text{CH}_3}-\overset{6}{\text{C}}\text{H}_2\overset{5}{\text{C}}\text{H}_2\underset{\underset{\text{CH}_2\text{CH}_3}{|}}{\overset{4}{\text{CH}}}-\overset{\overset{\text{CH}_3}{|}}{\overset{3}{\text{CH}}}-\overset{2}{\text{C}}\text{H}_2\overset{1}{\text{C}}\text{H}_3$

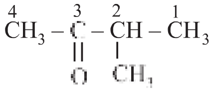
4-Ethyl-3-methylheptane

21. (a) : 

4-Ethyl-3-methyloctane

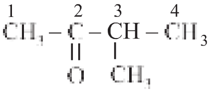
22. (b) : $\overset{1}{\text{CH}_2}=\overset{2}{\text{CH}}-\overset{3}{\text{CH}_2}-\overset{4}{\text{CH}_2}-\overset{5}{\text{C}}\equiv\overset{6}{\text{CH}}$

The double bond gets priority over triple bond. Therefore, correct IUPAC name is 1-hexene-5-yne.

23. (a) : 
$\overset{4}{\text{CH}_3}-\underset{\underset{\text{O}}{||}}{\overset{3}{\text{C}}}-\underset{\underset{\text{CH}_3}{|}}{\overset{2}{\text{CH}}}-\overset{1}{\text{CH}_3}$ (wrong numbering)

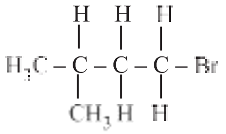
The $-\overset{\overset{O}{\|}}{C}-$ group should get priority over methyl group.

∴ Correct IUPAC name is



$\overset{1}{C}H_3-\overset{2}{\underset{\underset{O}{\|}}{C}}-\overset{3}{\underset{\underset{CH_3}{|}}{C}H}-\overset{4}{C}H_3$: 3-Methyl-2-butanone

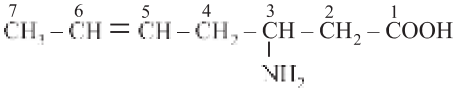
24. (a) :



$H_3C-\underset{\underset{CH_3}{|}}{\overset{\overset{H}{|}}{C}}-\underset{\underset{H}{|}}{\overset{\overset{H}{|}}{C}}-\underset{\underset{H}{|}}{\overset{\overset{H}{|}}{C}}-Br$

1-Bromo-3-methylbutane

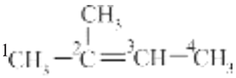
25. (a) :



$\overset{7}{C}H_3-\overset{6}{C}H=\overset{5}{C}H-\overset{4}{C}H_2-\overset{3}{\underset{\underset{NH_2}{|}}{C}H}-\overset{2}{C}H_2-\overset{1}{C}OOH$

As —COOH group is highest priority group, it is numbered one. So, the IUPAC name is 3-amino-5-heptenoic acid.

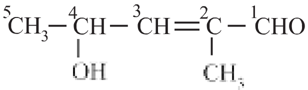
26. (b) :



${}^1CH_3-\overset{\overset{CH_3}{|}}{{}^2C}={}^3CH-{}^4CH_3$

2-Methyl-2-butene

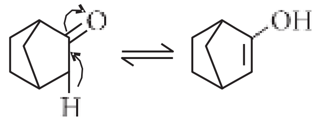
27. (b) :



${}^5CH_3-\underset{\underset{OH}{|}}{{}^4CH}-{}^3CH=\underset{\underset{CH_3}{|}}{{}^2C}-{}^1CHO$

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

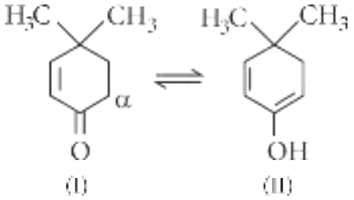
28. (a) : α-Hydrogen at bridge carbon never participate in tautomerism. Thus, only (III) exhibits tautomerism.



keto-form (III) enol-form

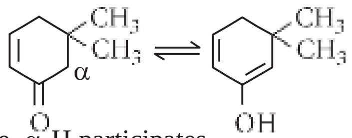
29. (b) : In keto-enol tautomerism,

(I)



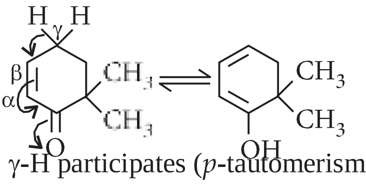
here, α-H participates.

(II)



here, α-H participates.

(III)

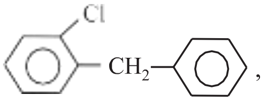


here, γ-H participates (*p*-tautomerism).

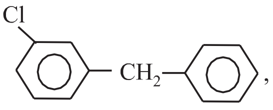
30. (c) : Enolic form of ethyl acetoacetate has 18 σ-bonds and 2 π-bonds.

31. (b)

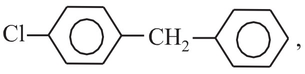
32. (b) : Only four structural isomers are possible for monochlorinated diphenylmethane.



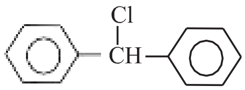
(i)



(ii)



(iii)



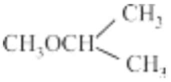
(iv)

33. (b) : It is a special type of functional isomerism, in which both the isomers are represented by one and the same substance and are always present in equilibrium. It is exhibited by nitroalkane (RCH_2NO_2) and isonitroalkane.

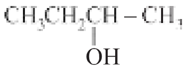
34. (a) : There are 7 isomers in $C_4H_{10}O$. Out of these, 4 are alcohols and 3 are ethers.

$CH_3CH_2-O-CH_2CH_3$,

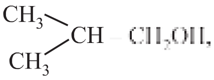
$CH_3OCH_2CH_2CH_3$,

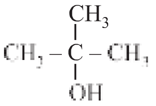


$CH_3CH_2CH_2CH_2OH$,



$CH_3CH_2\underset{\underset{OH}{|}}{C}H-CH_3$





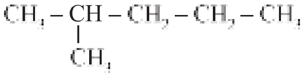
$CH_3-\overset{\overset{CH_3}{|}}{\underset{\underset{OH}{|}}{C}}-CH_3$

35. (d) : Isomers must have same molecular formula but different structural formula.

36. (b) : 5-chain isomers are obtained from alkane C_6H_{14}.

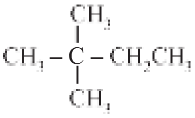
(i) $CH_3CH_2CH_2CH_2CH_2CH_3$

(ii)



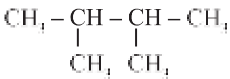
$CH_3-\underset{\underset{CH_3}{|}}{C}H-CH_2-CH_2-CH_3$

(iii)



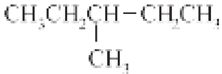
$CH_3-\overset{\overset{CH_3}{|}}{\underset{\underset{CH_3}{|}}{C}}-CH_2CH_3$

(iv)



$CH_3-\underset{\underset{CH_3}{|}}{C}H-\underset{\underset{CH_3}{|}}{C}H-CH_3$

(v)



$CH_3CH_2\underset{\underset{CH_3}{|}}{C}H-CH_2CH_3$

37. (d) : *tert*-Butyl carbocation, $(CH_3)_3\overset{+}{C}$ is more stable than *sec*-butyl carbocation $(CH_3)_2\overset{+}{C}H$ due to hyperconjugation.

$(CH_3)_3\overset{+}{C}$ has nine C — H bonds while $(CH_3)_2\overset{+}{C}H$ has six C — H bonds. Thus, there is more hyperconjugative structures in *tert*-butyl carbocation.

38. (c) : Among the given carbocations,

$CH_3-\overset{+}{C}H-CH_2-CH_2-CH_3$ is most stable carbocation. As is consists of maximum number of α-hydrogens and stablised by hyperconjugation.

39. (a, b) : –*I* effect increases on increasing the electronegativity of atom.

∴ $-NH_2 < -OR < -F$ (–*I* effect)

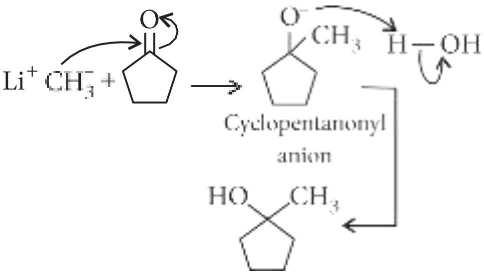
Also, $-NR_2 < -OR < -F$ (–*I* effect)

40. (c) : $-NO_2$ group is *meta*-directing, thus will stabilize a electrophile at *m*-position.

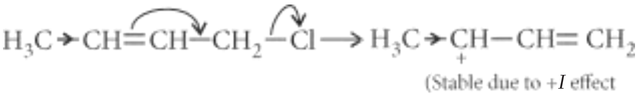
41. (c)

42. (d) : Nucleophiles are electron rich species hence, they are Lewis bases.

43. (c) :

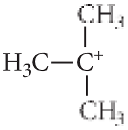


44. (a) : Nucleophile will attack a stable carbocation (S_N1 reaction).



(Stable due to +*I* effect of $-CH_3$ group)

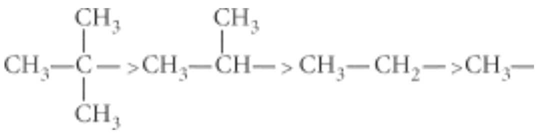
45. (a) : Hyperconjugation can occur only in compound III as it has α-hydrogen atom.

46. (d) :  is most stable due to hyperconjugation.

$H_3C-\overset{\displaystyle CH_3}{\underset{\displaystyle CH_3}{C^+}}$

47. (c)

48. (a) : Greater the number of electron donating alkyl groups (+*I* effect), greater is the stability of carbocations. +*I* effect is in the order :



$$CH_3-\overset{\displaystyle CH_3}{\underset{\displaystyle CH_3}{C}}- > CH_3-\overset{\displaystyle CH_3}{CH}- > CH_3-CH_2- > CH_3-$$

More the number of hyperconjugative structures of carbocations, more is the stability.

Hence, the order of stability of carbocations is

5 < 4 < 3 < 1 < 2.

49. (a)

50. (b) : More the number of hyperconjugative structures, the greater is the stability.

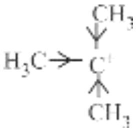
51. (c) : Nucleophilic substitution reaction involves the displacement of a nucleophile by another.

52. (b) : +*R* effect of —OH group is greater than that of $-OCH_3$ group.

53. (c)

54. (c) : Higher the no. of electron releasing groups lower will be stability of carbanion, and vice-versa. So, the order of stability of carbanions is

55. (a) : In case of different nucleophiles, but present in the same group in the periodic table, then larger is the atomic mass, higher is the nucleophilicity. Hence, the increasing order of nucleophilicity of the halide ions is $F^- < Cl^- < Br^- < I^-$.

56. (d) : 

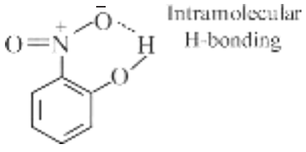
3° carbon is more stable due to the stabilization of the charge by three methyl groups (or $+I^-$ effect). It can also be explained on the basis of hyperconjugation. Greater the number of hyperconjugative α-H atoms, more will be the hyperconjugative structures and more will be the stability.

57. (c) : 3° > 2° > 1° more the delocalisation of positive charge, more is its stability.

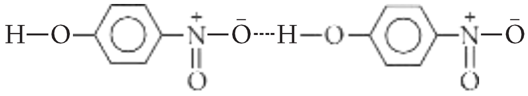
58. (d) : All the properties mentioned in the question suggest that it is a benzene molecule. Since in benzene all carbons are sp^2-hybridised, therefore, C – C – C angle is 120°.

59. (b) : Paper chromatography is a type of partition chromatography.

60. (c) : The *o*- and *p*-nitrophenols are separated by steam distillation since *o*-isomer is steam volatile due to intramolecular H-bonding while *p*-isomer is not steam volatile due to association of molecules by intermolecular H-bonding.



(*o*-Nitrophenol)



Intermolecular H-bonding (*p*-Nitrophenol)

61. (b) : Sublimation method is used for those organ substances which pass directly from solid to vapour state on heating and vice-versa on cooling *e.g.* benzoic acid, naphthalene, camphor, anthracene, etc. Naphthalene is volatile and benzoic acid is non-volatile due to the formation of the dimer.

62. (b) : In steam distillation of toluene, the pressure of toluene in vapour is less than pressure of barometer, because it is carried out when a solid or liquid is insoluble in water and is volatile with steam but the impurities are non-volatile.

63. (d) : In the IR spectroscopy, each functional group appears at a certain peak (in cm^{-1}). So, cyclohexanone can be identified by carbonyl peak.

64. (b) : $\underset{\text{Sodium ferrocyanide}}{3Na_4[Fe(CN)_6]} + 2Fe_2(SO_4)_3 \longrightarrow \underset{\substack{\text{Ferric ferrocyanide}\\\text{(Prussian blue)}}}{Fe_4[Fe(CN)_6]_3} + 6Na_2SO_4$

65. (a) : In case of Lassaigne's test of halogens, it is necessary to remove sodium cyanide and sodium sulphide from the sodium extract if nitrogen and sulphur are present. This is done by boiling the sodium extract with conc. HNO_3.

$$NaCN + HNO_3 \rightarrow NaNO_3 + HCN\uparrow$$
$$Na_2S + 2HNO_3 \rightarrow 2NaNO_3 + H_2S\uparrow$$

66. (b) : Sodium cyanide ($Na + C + N \rightarrow NaCN$).

67. (d)

68. (b) : $2CuSO_4 + K_4[Fe(CN)_6] \rightarrow \underset{\text{chocolate ppt.}}{Cu_2[Fe(CN)_6]} + 2K_2SO_4$

69. (a) : Mass of organic compound = 0.25 g

Experimental values, At STP

V_1 = 40 mL, V_2 = ?

T_1 = 300 K, T_2 = 273 K

P_1 = 725 – 25 = 700 mm, P_2 = 760 mm

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

$$V_2 = \frac{P_1V_1T_2}{T_1P_2} = \frac{700 \times 40 \times 273}{300 \times 760} = 33.52 \text{ mL}$$

22400 mL of N_2 at STP weighs = 28 g

$\therefore$ 33.52 mL of N_2 at STP weighs $= \frac{28 \times 33.52}{22400}$

= 0.0419 g

$$\% \text{ of N} = \frac{\text{Mass of nitrogen at STP}}{\text{Mass of organic compound taken}} \times 100$$

$$= \frac{0.0419}{0.25} \times 100 = 16.76\%$$

70. (a) : $H_2SO_4 + 2NH_3 \rightarrow (NH_4)_2SO_4$

10 mL of 1 M H_2SO_4 = 10 mmol

[∵ $M \times V_{(mL)}$ = mmol]

Acid used for the absorption of ammonia

= 10 mL of 2 N (or 1 M) H_2SO_4

$$\% \text{ of N} = \frac{1.4 \times N \times V}{W} = \frac{1.4 \times 2 \times 10}{0.75} = 37.33\%$$

71. (b) : Given : V_1 = 55 mL, V_2 = ?

P_1 = 715 – 15 = 700 mm, P_2 = 760 mm

T_1 = 300 K, T_2 = 273 K

General gas equation, $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$

Volume of nitrogen at STP,

$$V_2 = \frac{P_1V_1T_2}{P_2T_1} = \frac{700 \times 55 \times 273}{760 \times 300} = 46.099 \text{ mL}$$

% of nitrogen $= \frac{V_2}{8W}$, where W = the mass of organic compound.

$$\% \text{ of N} = \frac{46.099}{8 \times 0.35} = 16.46$$

72. (a)

* * *