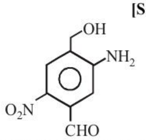
12

Organic Chemistry- Some Basic Principles & Techniques

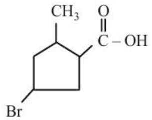
TOPIC 1 Classification and Nomenclature of Organic Compounds

1. The IUPAC name of the following compound is: **[Sep. 06, 2020 (II)]**



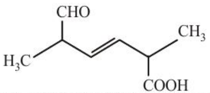
(a) 2-nitro-4-hydroxymethyl-5-amino benzaldehyde
(b) 3-amino-4-hydroxymethyl-5-nitrobenzaldehyde
(c) 5-amino-4-hydroxymethyl-2-nitrobenzaldehyde
(d) 4-amino-2-formyl-5-hydroxymethyl nitrobenzene

2. The IUPAC name of the following compound is : **[Sep. 04, 2020 (I)]**



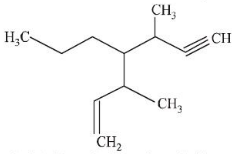
(a) 5-Bromo-3-methylcyclopentanoic acid
(b) 4-Bromo-2-methylcyclopentane carboxylic acid
(c) 3-Bromo-5-methylcyclopentanoic acid
(d) 3-Bromo-5-methylcyclopentane carboxylic acid

3. The IUPAC name for the following compound is : **[Sep. 02, 2020 (I)]**



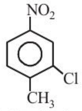
(a) 2, 5-dimethyl-5-carboxy-hex-3-enal
(b) 2, 5-dimethyl-6-carboxy-hex-3-enal
(c) 2, 5-dimethyl-6-oxo-hex-3-enoic acid
(d) 6-formyl-2-methyl-hex-3-enoic acid

4. The IUPAC name for the following compound is : **[April 12, 2019 (II)]**



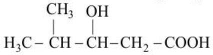
(a) 3-methyl-4-(3-methylprop-l-enyl)-l-heptyne
(b) 3,5-dimethyl-4-propylhept-6-en-l-yne
(c) 3-methyl-4-(1-methylprop-2-ynyl)-l-heptene
(d) 3,5-dimethyl-4-propylhept-1-en-6-yne

5. The correct IUPAC name of the following compound is: **[April 9, 2019 (I)]**



(a) 5-chloro-4-methyl-1-nitrobenzene
(b) 2-chloro-1-methyl-4-nitrobenzene
(c) 3-chloro-4-methyl-1-nitrobenzene
(d) 2-methyl-5-nitro-1-chlorobenzene

6. The IUPAC name of the following compound is :

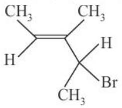


$$H_3C-\underset{\displaystyle CH_3}{CH}-\underset{\displaystyle OH}{CH}-CH_2-COOH$$

[April 8, 2019 (I)]

(a) 4, 4-Dimethyl-3-hydroxybutanoic acid
(b) 2-Methyl-3-hydroxypentan-5-oic acid
(c) 3-Hydroxy-4-methylpentanoic acid
(d) 4-Methyl-3-hydroxypentanoic acid

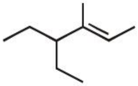
7. What is the IUPAC name of the following compound?



[Jan. 10, 2019 (II)]

(a) 3-Bromo-1, 2-dimethylbut-1-ene
(b) 3-Bromo-3-methyl-1, 2-dimethylprop-1-ene
(c) 2-Bromo-3-methylpent-3-ene
(d) 4-Bromo-3-methylpent-2-ene

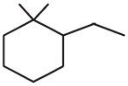
8. The IUPAC name of the following compound is :



[Online April 15, 2018(I)]

(a) 3-ethyl-4-methylhex-4-ene
(b) 4, 4-diethyl-3-methylbut-2-ene
(c) 4-methyl-3-ethylhex-4-ene
(d) 4-ethyl-3-methylhex-2-ene

9. The IUPAC name of the following compound is : **[Online April 8, 2017]**



(a) 1, 1–dimethyl–2–ethylcyclohexane
(b) 2–ethyl–1,1–dimethylcyclohexane
(c) 1–ethyl–2,2–dimethylcyclohexane
(d) 2, 2–dimethyl–1–ethylcyclohexane

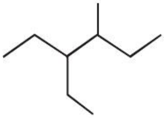
10. The hydrocarbon with seven carbon atoms containing a neopentyl and a vinyl group is : **[Online April 9, 2016]**

(a) 2, 2–dimethyl–4– pentene
(b) 4, 4– dimethyl pentene
(c) isopropyl–2–butene
(d) 2, 2–dimethyl–3–pentene

11. In allene (C_3H_4), the type(s) of hybridization of the carbon atoms is (are): **[Online April 11, 2014]**

(a) sp and sp^3 (b) sp^2 and sp
(c) only sp^2 (d) sp^2 and sp^3

12. The correct IUPAC name of the following compound is: **[Online April 19, 2014]**

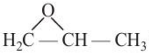


(a) 4 - methyl - 3 - ethylhexane
(b) 3 - ethyl - 4 - methylhexane
(c) 3, 4 - ethylmethylhexane
(d) 4 - ethyl - 3 - methylhexane

13. Which of the following cannot be represented by resonance structures? **[Online May 7, 2012]**

(a) Dimethyl ether (b) Nitrate anion
(c) Carboxylate anion (d) Toluene

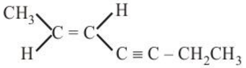
14. The IUPAC name of the compound



$H_2C\overset{O}{—}CH—CH_3$ is **[Online May 7, 2012]**

(a) 1, 2-propoxide (b) propylene oxide
(c) 1, 2-oxo propane (d) 1, 2-epoxy propane

15. The IUPAC name of the following compound is



[Online May 19, 2012]

(a) (E)-2-hepten-4-yne (b) (Z)-5-hepten-3-yne
(c) (E)-5-hepten-3-yne (d) (Z)-2-hepten-4-yne

16. Dipole moment is shown by **[Online May 26, 2012]**

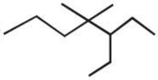
(a) 1, 2-dichlorobenzene
(b) *trans*-2, 3-dichloro-2-butene
(c) 1, 4-chlorobenzene
(d) *trans*-1, 2-dinitroethene

17. The IUPAC name of neopentane is **[2009]**

(a) 2, 2-dimethylpropane (b) 2-methylpropane
(c) 2, 2-dimethylbutane (d) 2- methylbutane

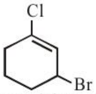
18. The correct decreasing order of priority for the functional groups of organic compounds in the IUPAC system of nomenclature is **[2008]**

(a) $-COOH, -SO_3H, -CONH_2, -CHO$
(b) $-SO_3H, -COOH, -CONH_2, -CHO$
(c) $-CHO, -COOH, -SO_3H, -CONH_2$
(d) $-CONH_2, -CHO, -SO_3H, -COOH$

19. The IUPAC name of  is

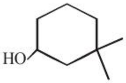
(a) 3-ethyl-4,4-dimethylheptane **[2007]**
(b) 1, 1-diethyl-2,2-dimethylpentane
(c) 4, 4-dimethyl-5,5-diethylpentane
(d) 5, 5-diethyl-4,4-dimethylpentane.

20. The IUPAC name of the compound shown below is :



(a) 3-bromo-1-chlorocyclohexene **[2006]**
(b) 1-bromo-3-chlorocyclohexene
(c) 2-bromo-6-chlorocyclohex-1-ene
(d) 6-bromo-2-chlorocyclohexene

21. The IUPAC name of the compound is **[2004]**

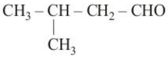
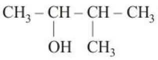
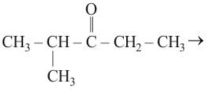


(a) 3, 3-dimethyl - 1- cyclohexanol
(b) 1, 1-dimethyl-3-hydroxy cyclohexane
(c) 3, 3-dimethyl-1-hydroxy cyclohexane
(d) 1, 1-dimethyl-3-cyclohexanol

22. Which one of the following does not have sp^2 hybridised carbon ? **[2004]**
(a) Acetonitrile (b) Acetic acid
(c) Acetone (d) Acetamide

23. The general formula $C_nH_{2n}O_2$ could be for open chain **[2003]**
(a) carboxylic acids (b) diols
(c) dialdehydes (d) diketones

24. The IUPAC name of $CH_3COCH(CH_3)_2$ is **[2003]**
(a) 2-methyl-3-butanone
(b) 4-methylisopropyl ketone
(c) 3-methyl-2-butanone
(d) Isopropylmethyl ketone

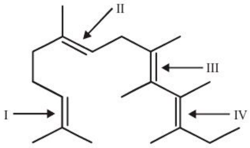
25. Which of the following compounds has wrong IUPAC name? **[2002]**
(a) $CH_3-CH_2-CH_2-COO-CH_2CH_3$ → ethyl butanoate
(b) 
$CH_3-\underset{\underset{CH_3}{|}}{CH}-CH_2-CHO$ → 3-methyl-butanal
(c) 
$CH_3-\underset{\underset{OH}{|}}{CH}-\underset{\underset{CH_3}{|}}{CH}-CH_3$ → 2-methyl-3-butanol
(d) 
$CH_3-\underset{\underset{CH_3}{|}}{CH}-\overset{\overset{O}{\|}}{C}-CH_2-CH_3$ → 2-methyl-3-pentanone

26. In which of the following species is the underlined carbon having sp^3 hybridisation? **[2002]**
(a) $CH_3\underline{C}OOH$ (b) $CH_3\underline{C}H_2OH$
(c) $CH_3\underline{C}OCH_3$ (d) $CH_2=\underline{C}H-CH_3$

TOPIC 2 Isomerism in Organic Compounds

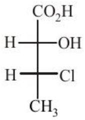
27. Which of the following compounds will show the maximum 'enol' content? **[April 8, 2019 (II)]**
(a) $CH_3COCH_2COOC_2H_5$ (b) $CH_3COCH_2COCH_3$
(c) CH_3COCH_3 (d) $CH_3COCH_2CONH_2$

28. In the following structure, the double bonds are marked as I, II, III and IV **[Online April 9, 2017]**



Geometrical isomerism is **not** possible at site (s) :
(a) III (b) I
(c) I and III (d) III and IV

29. The absolute configuration of

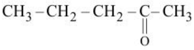
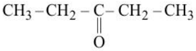
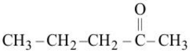
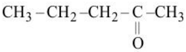
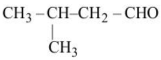
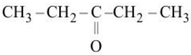


is : **[2016]**
(a) (2S, 3S) (b) (2R, 3R) (c) (2R, 3S) (d) (2S, 3R)

30. Which of the following compounds will exhibit geometrical isomerism ? **[2015]**
(a) 2 - Phenyl -1 - butene
(b) 1, 1 - Diphenyl - 1 - propene
(c) 1 - Phenyl - 2 - butene
(d) 3 - Phenyl -1 - butene

31. The optically inactive compound from the following is : **[Online April 10, 2015]**
(a) 2 - chloropropanal
(b) 2 - chlorobutane
(c) 2 - chloropentane
(d) 2 - chloro - 2- methylbutane

32. The number of structural isomers for C_6H_{14} is : **[Online April 11, 2015]**
(a) 4 (b) 3 (c) 6 (d) 5

33. Which of the following pairs of compounds are positional isomers ? **[Online April 11, 2015]**
(a) 
$CH_3-CH_2-CH_2-\underset{\underset{O}{\|}}{C}-CH_3$
and 
$CH_3-CH_2-\underset{\underset{O}{\|}}{C}-CH_2-CH_3$
(b) $CH_3-CH_2-CH_2-CH_2-CHO$
and 
$CH_3-CH_2-CH_2-\overset{\overset{O}{\|}}{C}-CH_3$
(c) 
$CH_3-CH_2-CH_2-\underset{\underset{O}{\|}}{C}-CH_3$
and 
$CH_3-\underset{\underset{CH_3}{|}}{CH}-CH_2-CHO$
(d) 
$CH_3-CH_2-\underset{\underset{O}{\|}}{C}-CH_2-CH_3$
and 
$\begin{matrix}CH_3\\CH_3\end{matrix}\rangle CH-CH_2-CHO$

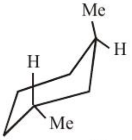
34. Which one of the following acids does not exhibit optical isomerism? **[Online April 12, 2014]**

(a) Lactic acid (b) Tartaric acid

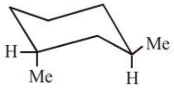
(c) Maleic acid (d) α-amino acids

35. Arrange in the correct order of stability (decreasing order) for the following molecules : **[Online April 22, 2013]**

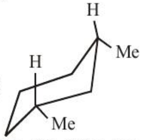
(I)



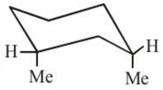
(II)



(III)



(IV)



(a) (I) > (II) > (III) > (IV) (b) (IV) > (III) > (II) $\approx$ (I)

(c) (I) > (II) $\approx$ (III) > (IV) (d) (III) > (I) $\approx$ (II) > (IV)

36. How many cyclic structures are possible for C_4H_6? **[Online May 7, 2012]**

(a) 3 (b) 5 (c) 6 (d) 4

37. Maleic acid and fumaric acids are **[Online May 26, 2012]**

(a) chain isomers (b) functional isomers

(c) tautomers (d) geometrical isomers

38. The change in the optical rotation of freshly prepared solution of glucose is known as: **[2011RS]**

(a) racemisation (b) specific rotation

(c) mutarotation (d) tautomerism

39. Out of the following, the alkene that exhibits optical isomerism is **[2010]**

(a) 3-methyl-2-pentene (b) 4-methyl-1-pentene

(c) 3-methyl-1-pentene (d) 2-methyl-2-pentene

40. The alkene that exhibits geometrical isomerism is: **[2009]**

(a) 2- methyl propene (b) 2-butene

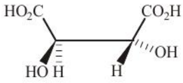
(c) 2- methyl -2- butene (d) propene

41. The number of stereoisomers possible for a compound of the molecular formula

$CH_3-CH=CH-CH(OH)-Me$ is: **[2009]**

(a) 2 (b) 4 (c) 6 (d) 3

42. The absolute configuration of **[2008]**



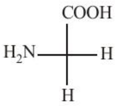
(a) S, S (b) R, R (c) R, S (d) S, R

43. Which one of the following conformations of cyclohexane is chiral? **[2007]**

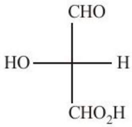
(a) Boat (b) Twist boat (c) Rigid (d) Chair

44. Which of the following molecules is expected to rotate the plane of plane-polarised light? **[2007]**

(a)



(b)



(c)

(d)

45. Increasing order of stability among the three main conformations (i.e. Eclipse, Anti, Gauche) of 2-fluoroethanol is **[2006]**

(a) Eclipse, Anti, Gauche (b) Anti, Gauche, Eclipse

(c) Eclipse, Gauche, Anti (d) Gauche, Eclipse, Anti

46. Which types of isomerism is shown by 2, 3-dichlorobutane? **[2005]**

(a) Structural (b) Geometric

(c) Optical (d) Diastereo

47. Which of the following will have a mesoisomer also? **[2004]**

(a) 2, 3- Dichloropentane

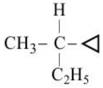
(b) 2, 3-Dichlorobutane

(c) 2-Chlorobutane

(d) 2-Hydroxypropanoic acid

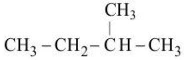
48. Amongst the following compounds, the optically active alkane having lowest molecular mass is **[2004]**

(a)



$CH_3-\underset{C_2H_5}{\overset{H}{C}}-\triangleleft$

(b)



$CH_3-CH_2-\overset{CH_3}{C}H-CH_3$

(c) $CH_3-CH_2-CH_2-CH_3$

(d) $CH_3-CH_2-C\equiv CH$

49. Which of the following compounds is not chiral? **[2004]**

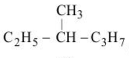
(a) 1-chloro-2-methyl pentane

(b) 2-chloropentane

(c) 1-chloropentane

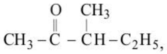
(d) 3-chloro-2-methyl pentane

50. Among the following four structures I to IV, **[2003]**



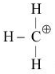
$C_2H_5-\overset{CH_3}{\overset{|}{C}H}-C_3H_7$

(I)



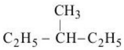
$CH_3-\overset{O}{\overset{\|}{C}}-\overset{CH_3}{\overset{|}{C}H}-C_2H_5$,

(II)



$H-\underset{H}{\underset{|}{\overset{H}{\overset{|}{C}}}}^{\oplus}$,

(III)



$C_2H_5-\overset{CH_3}{\overset{|}{C}H}-C_2H_5$

(IV)

it is true that

(a) only I and II are chiral compounds
(b) only III is a chiral compound
(c) only II and IV are chiral compounds
(d) all four are chiral compounds

51. A similarity between optical and geometrical isomerism is that **[2002]**

(a) each forms equal number of isomers for a given compound
(b) if in a compound one is present then so is the other
(c) both are included in stereoisomerism
(d) they have no similarity

52. Which of the following does not show geometrical isomerism? **[2002]**

(a) 1,2-dichloro-1-pentene (b) 1,3-dichloro-2-pentene
(c) 1,1-dichloro-1-pentene (d) 1,4-dichloro-2-pentene

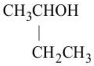
53. Racemic mixture is formed by mixing two **[2002]**

(a) isomeric compounds
(b) chiral compounds
(c) meso compounds
(d) enantiomers with chiral carbon

54. Following types of compounds (as I, II) **[2002]**

$CH_3CH=CHCH_3$

(I)



$\underset{CH_2CH_3}{\underset{|}{CH_3CHOH}}$

(II)

are studied in terms of isomerism in:

(a) chain isomerism (b) position isomerism
(c) conformers (d) stereoisomerism

TOPIC 3 Concept of Reaction Mechanism in Organic Compounds and Purification

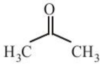
55. In an estimation of bromine by Carius method, 1.6 g of an organic compound gave 1.88 g of AgBr. The mass percentage of bromine in the compound is ______.
(Atomic mass, Ag = 108, Br = 80 g mol^{-1})
[NV, Sep. 06, 2020 (I)]

56. Which one of the following compounds possesses the most acidic hydrogen? **[Sep. 03, 2020 (I)]**

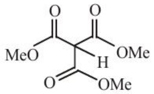
(a)

(b) $H_3C-C\equiv C-H$

(c)



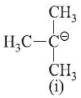
(d)



57. Glycerol is separated in soap industries by : **[Sep. 03, 2020 (I)]**

(a) Fractional distillation
(b) Differential extraction
(c) Steam distillation
(d) Distillation under reduced pressure

58. The increasing order of basicity for the following intermediates is (from weak to strong) **[Jan. 09, 2020 (I)]**



(i)

$H_2C=CH-\overset{\ominus}{C}H_2$

(ii)

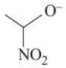
$HC\equiv\overset{\ominus}{C}$ (iii) $\overset{\ominus}{C}H_3$ (iv) $\overset{\ominus}{C}N$ (v)

(a) (iii) < (i) < (ii) < (iv) < (v)
(b) (v) < (i) < (iv) < (ii) < (iii)
(c) (v) < (iii) < (ii) < (iv) < (i)
(d) (iii) < (iv) < (ii) < (i) < (v)

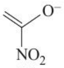
59. A flask contains a mixture of isohexane and 3-methylpentane. One of the liquids boils at 63 °C while the other boils at 60 °C. What is the best way to separate the two liquids and which one will be distilled out first? **[Jan. 08, 2020 (I)]**

(a) fractional distillation, isohexane
(b) simple distillation, 3-methylpentane
(c) simple distillation, isohexane
(d) fractional distillation, 3-methylpentane

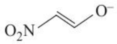
60. The correct order of stability for the following alkoxides is:



(A)



(B)



(C)

[Jan. 07, 2020 (II)]

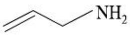
(a) (B) > (A) > (C) (b) (C) > (B) > (A)
(c) (C) > (A) > (B) (d) (B) > (C) > (A)

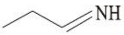
61. The increasing order of nucleophilicity of the following nucleophiles is : **[April 10, 2019 (II)]**

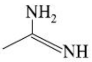
(i) $CH_3CO_2^-$ (ii) H_2O
(iii) $CH_3SO_3^-$ (iv) OH^-

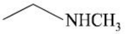
(a) (i) < (iv) < (iii) < (ii) (b) (ii) < (iii) < (iv) < (i)
(c) (iv) < (i) < (iii) < (ii) (d) (ii) < (iii) < (i) < (iv)

62. The increasing order of basicity of the following compounds is **[2018]**

(i) 

(ii) 

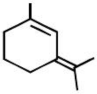
(iii) 

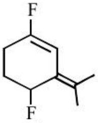
(iv) 

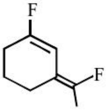
(a) (i) < (ii) < (iii) < (iv) (b) (ii) < (i) < (iii) < (iv)

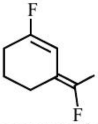
(c) (ii) < (i) < (iv) < (iii) (d) (iv) < (ii) < (i) < (iii)

63. The most polar compound among the following is : **[Online April 16, 2018]**

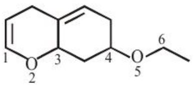
(a) 

(b) 

(c) 

(d) 

64. On the treatment of the following compound with a strong acid, the most susceptible site for bond cleavage is:



[Online April 15, 2018(II)]

(a) O2 – C3 (b) O5 – C6

(c) C4 – O5 (d) C1 – O2

65. Two compounds I and II are eluted by column chromatography(adsorption of I > II). Which one of the following is a correct statement? **[Online April 15, 2018 (II)]**

(a) II moves slower and has higher R_f value than I

(b) II moves faster and has higher R_f value than I

(c) I moves faster and has higher R_f value than II

(d) I moves slower and has higher R_f value than II

66. Which of the following statements is not true about partition chromatography ? **[Online April 8, 2017]**

(a) Mobile phase can be a gas

(b) Stationary phase is a finely divided solid adsorbent

(c) Separation depends upon equilibration of solute between a mobile and a stationary phase

(d) Paper chromatography is an example of partition chromatography

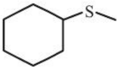
67. The increasing order of the boiling points for the following compounds is : **[Online April 9, 2017]**

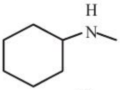
C_2H_5OH (I) C_2H_5Cl (II) $C_2H_5CH_3$ (III) $C_2H_5OCH_3$ (IV)

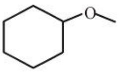
(a) (III) < (IV) < (II) < (I) (b) (IV) < (III) < (I) < (II)

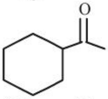
(c) (II) < (III) < (IV) < (I) (d) (III) < (II) < (I) < (IV)

68. A mixture containing the following four compounds is extracted with 1M HCl. The compound that goes to aqueous layer is : **[Online April 8, 2017]**

(I) 

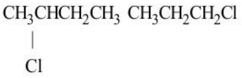
(II) 

(III) 

(IV) 

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

69. The increasing order of the reactivity of the following halides for the S_N1 reaction is **[2017]**



$CH_3\underset{\underset{Cl}{|}}{C}HCH_2CH_3$ $CH_3CH_2CH_2Cl$

(I) (II)

$p\text{-}H_3CO\text{–}C_6H_4\text{–}CH_2Cl$

(III)

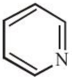
(a) (III) < (II) < (I) (b) (II) < (I) < (III)

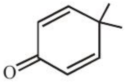
(c) (I) < (III) < (II) (d) (II) < (III) < (I)

70. Which of the following molecules is least resonance stabilized? **[2017]**

(a) 

(b) 

(c) 

(d) 

71. The distillation technique most suited for separating glycerol from pent-l-ye in the soap industry is : **[2016]**

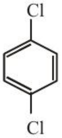
(a) Steam distillation.

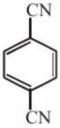
(b) Distillation under reduced pressure.

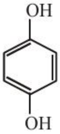
(c) Simple distillation

(d) Fractional distillation

72. For which of the following molecule significant $\mu \neq 0$? **[2014]**

(i) 

(ii) 

(iii) 

(iv) 

(a) Only (i) (b) (i) and (ii)

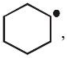
(c) Only (iii) (d) (iii) and (iv)

73. In which of the following pairs A is more stable than B? **[Online April 9, 2014]**

A B

(a)

,


(b)

,


(c)

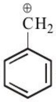
,


(d) $Ph_3C^{\bullet}$, $(CH_3)_3C^{\bullet}$

74. A solution of (–)–1–chloro–1–phenylethane in toluene racemises slowly in the presence of a small amount of $SbCl_5$, due to the formation of : **[2013]**

(a) carbanion (b) carbene
(c) carbocation (d) free radical

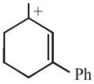
75. The order of stability of the following carbocations : **[2013]**

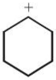
$CH_2=CH-\overset{\oplus}{C}H_2$; $CH_3-CH_2-\overset{\oplus}{C}H_2$;

is :

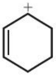
I II III

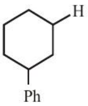
(a) III > II > I (b) II > III > I
(c) I > II > III (d) III > I > II

76. Which one of the following is most stable ? **[Online April 9, 2013]**

(a)


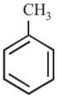
(b)


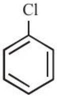
(c)


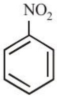
(d)


77. Given **[Online April 25, 2013]**


(A)


(B)


(C)


(D)

In the above compounds correct order of reactivity in electrophilic substitution reactions will be :

(a) B > A > C > D (b) D > C > B > A
(c) A > B > C > D (d) B > C > A > D

78. In nucleophilic substitution reaction, order of halogens as incoming (attacking) nucleophile is:

$I^- > Br^- > Cl^-$

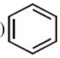
The order of halogens as departing nucleophile should be : **[Online April 25, 2013]**

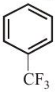
(a) $Br^- > I^- > Cl^-$ (b) $I^- > Br^- > Cl^-$
(c) $Cl^- > Br^- > I^-$ (d) $Cl^- > I^- > Br^-$

79. In the below mentioned compounds the decreasing order of reactivity towards electrophilic substitution is **[Online May 12, 2012]**

(i)


(ii)


(iii)


(iv)


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

80. The correct order of increasing basicity of the given conjugate bases ($R = CH_3$) is **[2010]**

(a) $RCO\bar{O} < HC\equiv\bar{C} < \bar{R} < \bar{N}H_2$

(b) $\bar{R} < HC\equiv\bar{C} < RCO\bar{O} < \bar{N}H_2$

(c) $RCO\bar{O} < \bar{N}H_2 < HC\equiv\bar{C} < \bar{R}$

(d) $RCO\bar{O} < HC\equiv\bar{C} < \bar{N}H_2 < \bar{R}$

81. Arrange the carbanions, **[2009]**

$(CH_3)_3\bar{C}, \bar{C}Cl_3, (CH_3)_2\bar{C}H, C_6H_5\bar{C}H_2$

order of their decreasing stability is

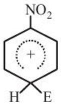
(a) $(CH_3)_2\bar{C}H > \bar{C}Cl_3 > C_6H_5\bar{C}H_2 > (CH_3)_3\bar{C}$

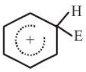
(b) $\bar{C}Cl_3 > C_6H_5\bar{C}H_2 > (CH_3)_2\bar{C}H > (CH_3)_3\bar{C}$

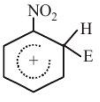
(c) $(CH_3)_3\bar{C} > (CH_3)_2\bar{C}H > C_6H_5\bar{C}H_2 > \bar{C}Cl_3$

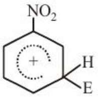
(d) $C_6H_5\bar{C}H_2 > \bar{C}Cl_3 > (CH_3)_3\bar{C} > (CH_3)_2\bar{C}H$

82. The electrophile, $E^{\oplus}$ attacks the benzene ring to generate the intermediate σ–complex. Of the following, which σ–complex is lowest energy? **[2008]**

(a)


(b)


(c) 

(d) 

83. Presence of a nitro group in a benzene ring **[2007]**

(a) deactivates the ring towards electrophilic substitution

(b) activates the ring towards electrophilic substitution

(c) renders the ring basic

(d) deactivates the ring towards nucleophilic substitution.

84. The increasing order of stability of the following free radicals is **[2006]**

(a) $(C_6H_5)_2\dot{C}H < (C_6H_5)_3\dot{C} < (CH_3)_3\dot{C} < (CH_3)_2\dot{C}H$

(b) $(CH_3)_2\dot{C}H < (CH_3)_3\dot{C} < (C_6H_5)_2\dot{C}H < (C_6H_5)_3\dot{C}$

(c) $(CH_3)_3\dot{C} < (CH_3)_2\dot{C}H < (C_6H_5)_2\dot{C}H < (C_6H_5)_3\dot{C}$

(d) $(C_6H_5)_3\dot{C} < (C_6H_5)_2\dot{C}H < (CH_3)_3\dot{C} < (CH_3)_2\dot{C}H$

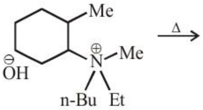
85. $CH_3Br + Nu^- \longrightarrow CH_3 - Nu + Br^-$

The decreasing order of the rate of the above reaction with nucleophiles (Nu$^-$) A to D is **[2006]**

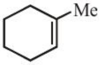
[Nu$^-$ = (A) PhO$^-$, (B) AcO$^-$, (C) HO$^-$, (D) CH$_3$O$^-$]

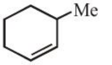
(a) A > B > C > D (b) B > D > C > A

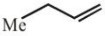
(c) D > C > A > B (d) D > C > B > A

86. 

The alkene formed as a major product in the above elimination reaction is **[2006]**

(a) 

(b) 

(c) 

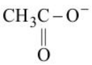
(d) $CH_2 = CH_2$

87. Due to the presence of an unpaired electron, free radicals are: **[2005]**

(a) cations (b) anions

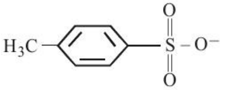
(c) chemically inactive (d) chemically reactive

88. The decreasing order of nucleophilicity among the nucleophiles is **[2005]**

(A) 
$CH_3C(=O)-O^-$

(B) CH_3O^-

(C) CN^-

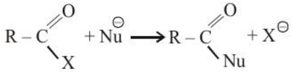
(D) 

is

(a) (C) > (B) > (A) > (D) (b) (B) > (C) > (A) > (D)

(c) (D) > (C) > (B) > (A) (d) (A) > (B) > (C) > (D)

89. The reaction **[2005, 2004]**


$$R-C(=O)X + \overset{\ominus}{Nu} \longrightarrow R-C(=O)Nu + X^{\ominus}$$

is fastest when X is

(a) OCOR (b) OC_2H_5 (c) NH_2 (d) Cl

90. Consider the acidity of the carboxylic acids :

(1) PhCOOH

(2) *o*-$NO_2C_6H_4COOH$

(3) *p*-$NO_2C_6H_4COOH$

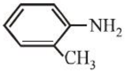
(4) *m*-$NO_2C_6H_4COOH$

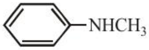
Which of the following order is correct ? **[2004]**

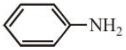
(a) 2 > 4 > 1 > 3 (b) 2 > 4 > 3 > 1

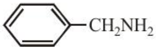
(c) 1 > 2 > 3 > 4 (d) 2 > 3 > 4 > 1

91. Which of the following is the strongest base ? **[2004]**

(a) 

(b) 

(c) 

(d) 

92. In the anion HCOO$^-$ the two carbon-oxygen bonds are found to be of equal length. What is the reason for it ? **[2003]**

(a) The C = O bond is weaker than the C — O bond

(b) The anion HCOO$^-$ has two resonating structures

(c) The anion is obtained by removal of a proton from the acid molecule

(d) Electronic orbitals of carbon atom are hybridised

93. Arrangement of $(CH_3)_3C-$, $(CH_3)_2CH-$, CH_3-CH_2- when attached to benzyl or an unsaturated group in increasing order of inductive effect is **[2002]**

(a) $(CH_3)_3C- < (CH_3)_2CH- < CH_3-CH_2-$

(b) $CH_3-CH_2- < (CH_3)_2CH- < (CH_3)_3C-$

(c) $(CH_3)_2CH- < (CH_3)_3C- < CH_3-CH_2-$

(d) $(CH_3)_3C- < CH_3CH_2- < (CH_3)_2CH-$

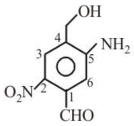
94. The functional group, which is found in amino acid is

(a) – COOH group (b) – NH$_2$ group **[2002]**

(c) – CH$_3$ group (d) both (a) and (b).

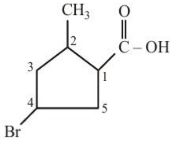
Hints & Solutions

1. **(c)**



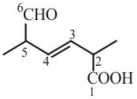
5-Amino-4-hydroxymethyl-2-nitrobenzaldehyde

2. **(b)**



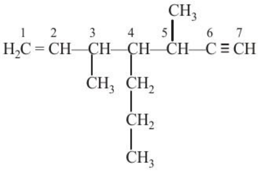
4-Bromo-2-methylcyclopentane carboxylic acid

3. **(c)**



(2, 5-dimethyl 1-6-oxo-hex-3-enoic acid)

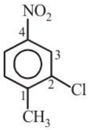
4. **(d)**



$$\overset{1}{H_2C}=\overset{2}{CH}-\underset{CH_3}{\overset{3}{CH}}-\underset{\substack{|\\CH_2\\|\\CH_2\\|\\CH_3}}{\overset{4}{CH}}-\overset{CH_3}{\overset{5}{CH}}-\overset{6}{C}\equiv\overset{7}{CH}$$

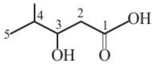
3, 5-dimethyl-4-propylhept-1-en-6-yne

5. **(b)**



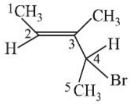
2-Chloro-1-methyl-4-nitrobenzene

6. **(c)**

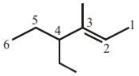


3-Hydroxy-4-methyl pentanoic acid

7. **(d)** IUPAC name: 4-Bromo-3-methylpent-2-ene

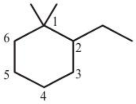


8. **(d)**



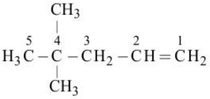
4-Ethyl-3-methylhex-2-ene

9. **(b)**



2-Ethyl-1,1-dimethylcyclohexane

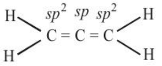
10. **(b)**



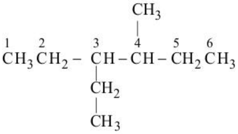
$$\overset{5}{H_3C}-\underset{CH_3}{\overset{\overset{CH_3}{|}}{\overset{4}{C}}}-\overset{3}{CH_2}-\overset{2}{CH}=\overset{1}{CH_2}$$

4, 4 - Dimethylpentene

11. **(b)**



12. **(b)**



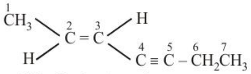
$$\overset{1}{CH_3}\overset{2}{CH_2}-\underset{\substack{|\\CH_2\\|\\CH_3}}{\overset{3}{CH}}-\overset{CH_3}{\overset{4}{CH}}-\overset{5}{CH_2}\overset{6}{CH_3}$$

3-Ethyl-4-methylhexane

13. **(a)** Ethers, due to absence of delocalized pair of electrons do not show resonance.

14. **(d)** 1, 2-Epoxy propane is the correct IUPAC name of given compound.

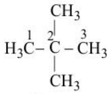
15. **(a)**



(E) – 2 – hepten – 4 – yne

16. **(a)** In 1, 2-dichlorobenzene the two dipoles are at 60° (i.e. unsymmetric). Thus possesses dipole moment.

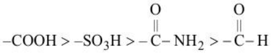
17. **(a)**



$$\mathrm{H_3\overset{1}{C}-\underset{CH_3}{\overset{CH_3}{\overset{2}{C}}}-\overset{3}{C}H_3}$$

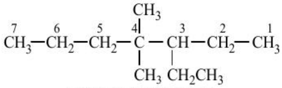
Neopentane
or 2,2- Dimethylpropane

18. **(a)** The correct order of priority for the given functional group is



$$\mathrm{-COOH > -SO_3H > -\overset{O}{\overset{\|}{C}}-NH_2 > -\overset{O}{\overset{\|}{C}}-H}$$

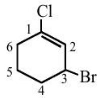
19. **(a)**



$$\mathrm{\overset{7}{C}H_3-\overset{6}{C}H_2-\overset{5}{C}H_2-\underset{CH_3}{\overset{CH_3}{\overset{4}{C}}}-\underset{CH_2CH_3}{\overset{3}{C}H}-\overset{2}{C}H_2-\overset{1}{C}H_3}$$

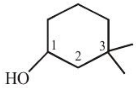
3-Ethyl-4,4-dimethylheptane

20. **(a)**



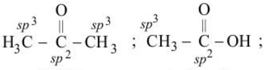
3-Bromo-1-chlorocyclohexene

21. **(a)**



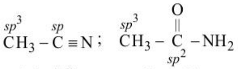
3, 3-Dimethyl -1 cyclohexanol

22. **(a)**



$$\mathrm{\overset{sp^3}{H_3C}-\underset{sp^2}{\overset{O}{\overset{\|}{C}}}-\overset{sp^3}{CH_3}\ ;\ \overset{sp^3}{CH_3}-\underset{sp^2}{\overset{O}{\overset{\|}{C}}}-OH\ ;}$$

Acetone Acetic acid

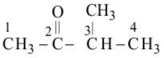


$$\mathrm{\overset{sp^3}{CH_3}-\overset{sp}{C}\equiv N\ ;\ \overset{sp^3}{CH_3}-\underset{sp^2}{\overset{O}{\overset{\|}{C}}}-NH_2}$$

Acetonitrile Acetamide

23. **(a)** $C_nH_{2n}O_2$ is general formula for carboxylic acid

24. **(c)**



$$\mathrm{\overset{1}{C}H_3-\overset{O}{\overset{\|}{\overset{2}{C}}}-\overset{CH_3}{\overset{|}{\overset{3}{C}}}H-\overset{4}{C}H_3}$$

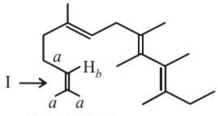
3-Methyl-2-butanone

25. **(c)** The correct name is 3 - methylbutan - 2 - ol

26. **(b)** In molecules (a), (c) and (d), the carbon atom has a multiple bond, only (b) has sp^3 hybridisation.

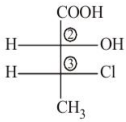
27. **(b)** Enolic form of acetylacetone (b) is quite stable due to H-bonding which leads to stable 6-membered ring.

28. **(b)**

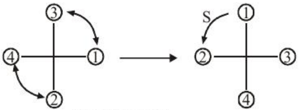


Both substituents are same
(Isomer not possible)

29. **(d)**

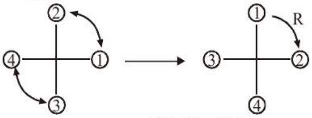


At (2),



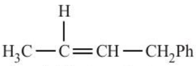
'S' configuration

At (3),



'R' configuration

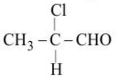
30. **(c)**



$$\mathrm{H_3C-\overset{H}{\overset{|}{C}}=CH-CH_2Ph}$$

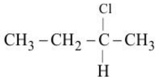
In 1-phenyl-2-butene, the two groups around the doubly bonded carbons are different. This compound can show *cis*-and *trans*-isomerism.

31. **(d)** The optically inactive compound must contains achiral carbon atom(s). Option (d) contains achiral carbon atom



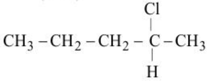
$$\mathrm{CH_3-\underset{H}{\overset{Cl}{C}}-CHO}$$

2- Chloropropanol
(chiral)



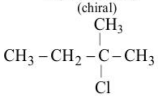
$$\mathrm{CH_3-CH_2-\underset{H}{\overset{Cl}{C}}-CH_3}$$

2-Chlorobutane
(chiral)



$$\mathrm{CH_3-CH_2-CH_2-\underset{H}{\overset{Cl}{C}}-CH_3}$$

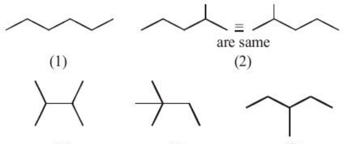
2-Chloropentane
(chiral)



$$\mathrm{CH_3-CH_2-\underset{Cl}{\overset{CH_3}{C}}-CH_3}$$

2-Chloro-2-methylbutane
(achiral)

32. **(d)**



The possible structural isomers = 5

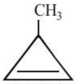
33. **(a)** Pentan-2-one and pentan-3-one are position isomers. (b), (c), (d) contain different compounds aldehyde and ketones. These exhibit functional group is omerism.

34. **(c)** Optically active compounds contain an asymmetric (chiral) carbon atom (a carbon atom attached to four different atoms or groups). Therefore, all acids except maleic acid exhibit optical isomerism.

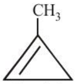
35. **(d)**

36. **(b)** Five cyclic structures are possible for C_4H_6. These are as following:

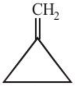
Cyclobutene



2-methyl cyclopropene



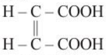
1-methyl cyclopropene



methylene cyclopropane

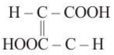
bicyclo [1, 1.0] butane

37. **(d)** Maleic acid and fumaric acids are geometrical isomers.



$$\begin{array}{c} H-C-COOH \\ \| \\ H-C-COOH \end{array}$$

Maleic acid



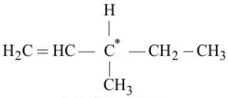
$$\begin{array}{c} H-C-COOH \\ \| \\ HOOC-C-H \end{array}$$

Fumaric acid

38. **(c)** When either of the two forms of glucose is dissolved in water, there is change in rotation till the equilibrium value of + 52.5°. This is known as mutarotation

$$\underset{+111.5^\circ}{\alpha\text{–D(+) Glucose}} \rightleftharpoons \underset{+52.5^\circ}{\text{Equilibrium mixture}} \rightleftharpoons \underset{+19.5^\circ}{\beta\text{–D–(+)Glucose}}$$

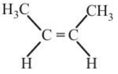
39. **(c)**



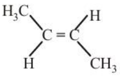
$$H_2C=HC-\overset{\overset{H}{|}}{\underset{\underset{CH_3}{|}}{C^*}}-CH_2-CH_3$$

3- Methyl-1-pentene

40. **(b)**

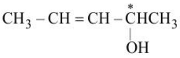


cis-2-Butene



trans-2-Butene

41. **(b)**



$$CH_3-CH=CH-\underset{\underset{OH}{|}}{\overset{*}{C}}HCH_3$$

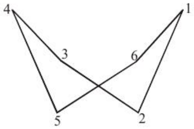
It exhibits both geometrical as well as optical isomerism.

cis - R	*cis* - S
trans - R	*trans* - S

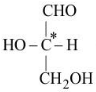
42. **(b)** The absolute configuration is (R, R)

(use priority rules to get the absolute configuration)

43. **(b)** Chiral conformation will not have plane of symmetry. Since twist boat does not have plane of symmetry, it is chiral.



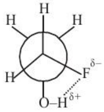
44. **(b)** The organic compounds which have chiral carbon atom (a carbon atom attached to four different groups or atoms) and do not have plane of symmetry rotate plane polarised light.



$$\begin{array}{c} CHO \\ | \\ HO-\overset{*}{C}-H \\ | \\ CH_2OH \end{array}$$

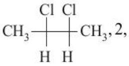
(* is asymmetric carbon)

45. **(a)**



Due to hydrogen bonding between H & F gauche conformation is most stable, hence the correct order is Eclipse, Anti, Gauche

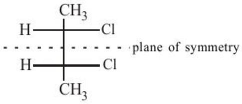
46. **(c)**



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

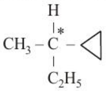
, 2, 3-Dichlorobutane exhibits optical isomerism due to the presence of two asymmetric carbon atoms.

47. **(b)** **Note:** Compounds containing two similar chiral C-atoms have plane of symmetry and can exist in *meso* form too.

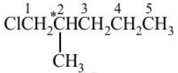


meso-2, 3-Dichlorobutane

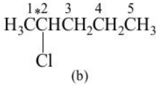
48. **(a)** Only 2-cylcopropylbutane has a chiral centre.



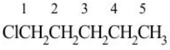
49. **(c)** 1-chloropentane is not chiral while others are chiral in nature


$Cl\overset{1}{C}H_2\underset{CH_3}{\overset{*2}{C}}H\overset{3}{C}H_2\overset{4}{C}H_2\overset{5}{C}H_3$

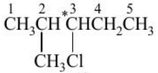
(a)


$H_3\overset{1}{C}\underset{Cl}{\overset{*2}{C}}H\overset{3}{C}H_2\overset{4}{C}H_2\overset{5}{C}H_3$

(b)

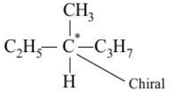

$Cl\overset{1}{C}H_2\overset{2}{C}H_2\overset{3}{C}H_2\overset{4}{C}H_2\overset{5}{C}H_3$

(c)

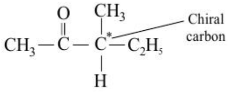

$\overset{1}{C}H_3\underset{CH_3}{\overset{2}{C}}H\underset{Cl}{\overset{*3}{C}}H\overset{4}{C}H_2\overset{5}{C}H_3$

(d)

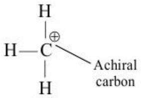
50. **(a)**


$C_2H_5-\overset{CH_3}{\underset{H}{C^*}}-C_3H_7$

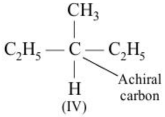
(I)


$CH_3-\overset{O}{\overset{\|}{C}}-\overset{CH_3}{\underset{H}{C^*}}-C_2H_5$

(II)


$H-\overset{H}{\underset{H}{C^{\oplus}}}$

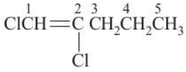
(III)


$C_2H_5-\overset{CH_3}{\underset{H}{C}}-C_2H_5$

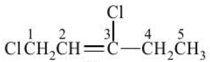
(IV)

51. **(c)** Both differ in the arrangement of group in space, therefore grouped under sterio-isomerism.

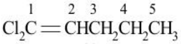
52. **(c)**


$Cl\overset{1}{C}H{=}\underset{Cl}{\overset{2}{C}}\,\overset{3}{C}H_2\overset{4}{C}H_2\overset{5}{C}H_3$

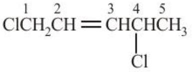
(a)


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

(b)


$Cl_2\overset{1}{C}{=}\overset{2}{C}H\overset{3}{C}H_2\overset{4}{C}H_2\overset{5}{C}H_3$

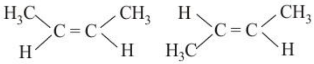
(c)


$Cl\overset{1}{C}H_2\overset{2}{C}H{=}\overset{3}{C}H\underset{Cl}{\overset{4}{C}}H\overset{5}{C}H_3$

(d)

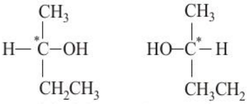
53. **(d)** A mixture of equal amount of two enantiomers is called a racemic mixture.

54. **(d)** Stereoisomerism, isomers differ in the arrangement of groups in space. The two structures show sterioisomerism. Structure I shows geometrical isomerism as it contains two different atoms or groups H and CH_3 attached to each carbon containing double bond.



cis-butene *trans*-butene

Structure II shows optical isomerism as it contains a chiral carbon (attached to four different groups) atom.


$H-\overset{CH_3}{\underset{CH_2CH_3}{C^*}}-OH \qquad HO-\overset{CH_3}{\underset{CH_3CH_2}{C^*}}-H$

Butyl alcohol (two enantiomers)

55. **(50)**

Mass of organic compound = 1.6 g

Mass of AgBr = 1.88 g

$$\text{Moles of Br} = \text{Moles of AgBr} = \frac{1.88}{188} = 0.01$$

$$\text{Mass of Br} = 0.01 \times 80 = 0.80\text{ g}$$

$$\%\text{ of Br} = \frac{0.80 \times 100}{1.60} = 50\%$$

Alternate Method :

$$\%\text{ of Br} = \frac{\text{Wt. of AgBr}}{\text{Wt. of O.C.}} \times \frac{\text{Molar mass of Br}}{\text{AgBr}} \times 100$$

$$= \frac{1.88}{1.6} \times \frac{80}{188} \times 100 = 50\%$$

56. **(d)** Acidic strength ∝ –I, –M effect. Due to strong – I, and –M effect of three – $COOCH_3$ groups, it has most acidic Hydrogen.

57. **(d)** Glycerol can be separated from spent-lye in soap industry by using reduce pressure distillation technique.

58. **(c)** Basicity order can be determined by the cummulative effect of the factors on the electron density of concerned atom.

59. **(a)** Liquid having lower boiling point comes out first in fractional distillation. Simple distillation can't be used as boiling point difference is very small.
3-Methylpantane will show greater boiling point (63°C) comparative to isohexane due to symmetrical structure. Therefore isohexane distilled out first.

60. **(b)** Electron withdrawing group like (NO_2) increase stability of alkoxide ion by dispersal of negative charge.

In (B) and (C) structures negative charge is in conjugation with double bond and also stabilised by electron withdrawing effect of nitro group.

61. **(d)** Higher the basicity of a base, stronger will be its nucleophilic character. Further a stronger base has a weaker conjugate acid. The acidic order of the conjugate acid of the given bases is

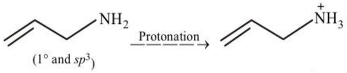
$$H_3O^+ > CH_3SO_3H > CH_3COOH > H_2O$$

Thus the increasing order of the basic nature or nucleophilicity of the given species is

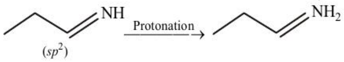
$$\underset{(ii)}{H_2O} < \underset{(iii)}{CH_3SO_3^-} < \underset{(i)}{CH_3COO^-} < \underset{(iv)}{OH^-}$$

62. **(c)**

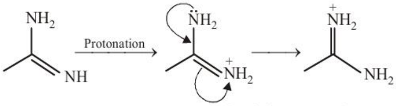
(i)



(ii)

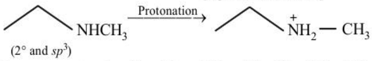


(iii)



[Equivalent resonance]

(iv)

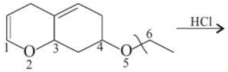


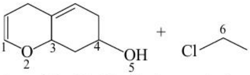
Hence, correct order of basicity will be : (ii) < (i) < (iv) < (iii).

63. **(c)** Among the substituents attached to the given compounds, fluorine has maximum electronegativity. so it will push electron pair towards itself. In option (b), the two F groups are attached opposite to each other, thus net dipole moment will cancel out and reduce its polarity. In option (d), the F groups are attached in slightly opposite direction, thus this also decreases its polarity. But in option (c), the compound has the two F groups along same direction, thus net dipole moment will increase in this direction and therefore it will exhibit maximum polarity. Hence the compound in option (c) has maximum polarity.

64. **(b)** The lone pair of electrons on O_2 is involved in resonance with C = C. Hence O_2 will not be protonated.

The lone pair of electrons on O5 is not involved in resonance with C = C. Hence, O5 will be protonated. Chloride ion will then attack least substituted C atom (C6)





65. **(b)** Since, adsorption of I > II, I is firmly attached to column (stationary phase). Hence, it moves slowly and will cover little distance, while II is loosely attached to column (stationary phase). Hence, it moves faster and will cover large distance.

66. **(b)** Partition chromatography is the process of separation whereby the component of the mixture get distributed into two phases that may be liquid-liquid, liquid gas but not to solid-gas. Thus, it is not possible that the stationory phase is a finally devided solid adsorbent in partition chromatography.

67. **(a)**

(I) C_2H_5OH	Hydrogen bonding Hydrogen bonding > dipole-dipole
(II) C_2H_5Cl	Dipole-dipole C_2H_5Cl is more polar than $C_2H_5OCH_3$ so, dipole-dipole C_2H_5Cl > dipole-dipole $C_2H_5OCH_3$
(III) $C_2H_5CH_3$	Weak vander Waals yarces
(IV) $C_2H_5OCH_3$	Dipole-dipole

Thus, boiling points order is -

(III) < (IV) < (II) < (I).

68. **(b)** When the given mixture is shaken with 1 M HCl, amine get protonated and becomes cation $(R_2\overset{\oplus}{N}H_2)$, which does not dissolve in organic solvent but usually dissolve in H_2O due to its charge. So, shaking with aqueous HCl will pull amines into the aqueous phase and leave all other compounds in organic layer.

69. **(b)** Since S_N1 reactions involve the formation of carbocation as intermediate in the rate determining step, more the stability of carbocation higher will be the reactivity of alkyl halides towards S_N1 route.

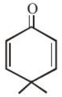
Since stability of carbocations follows order.

$$\underset{1^\circ\text{ carbocation}}{CH_3-CH_2-\overset{\oplus}{C}H_2} < \underset{2^\circ\text{ carbocation}}{CH_3-\overset{\oplus}{C}H-CH_2-CH_3}$$

$$< p-H_3CO-C_6H_4-\overset{\oplus}{C}H_2$$

Max. stable due to +M effect of $-OCH_3$ group.

70. **(d)**

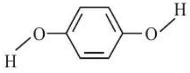


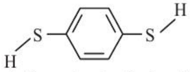
is nonaromatic and hence least reasonance stabilized, whereas other three are aromatic.

71. **(b)** Pent-l-ye and glycerol are separated by distillation under reduced pressure.

Under the reduced pressure, the liquid boil at low temperature and the temperature of decomposition will not reach. e.g. glycerol boils at 290 °C with decomposition but at reduced pressure it boils at 180° C without decomposition.

72. **(d)**



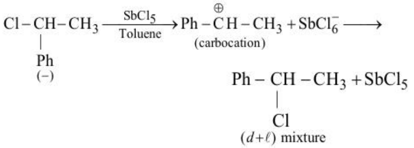


In both the molecules the bond moments are not cancelling with each other and hence the molecules has a resultant dipole.

73. **(d)** $Ph_3\overset{\bullet}{C}$ is more stable than $(CH_3)_3\overset{\bullet}{C}$ because resonance stabilisation effect in $Ph_3\overset{\bullet}{C}$ is more pronounced as compared to hyperconjugation stabilisation effect in $(CH_3)_3\overset{\bullet}{C}$, overall stability order among free radical is :

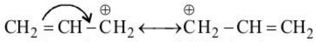
Triphenylmethyl > benzyl > allyl > tertiary alkyl > secondary > primary > methyl > vinyl

74. **(c)** Carbocations are planar, hence can be attacked on either side to form racemic mixture.



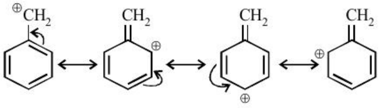
$$\underset{\substack{|\\ Ph\\ (-)}}{Cl-CH-CH_3} \xrightarrow[\text{Toluene}]{SbCl_5} \underset{\text{(carbocation)}}{Ph-\overset{\oplus}{C}H-CH_3} + SbCl_6^- \longrightarrow \underset{(d+\ell)\text{ mixture}}{\underset{\substack{|\\ Cl}}{Ph-CH-CH_3}} + SbCl_5$$

75. **(d)** Higher stability of allyl and benzyl carbocations is due to dispersal of positive charge by resonance



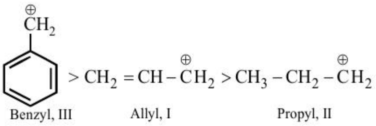
$$CH_2=CH-\overset{\oplus}{C}H_2 \longleftrightarrow \overset{\oplus}{C}H_2-CH=CH_2$$

Resonating structures of allyl carbocation



Resonating structures of benzyl carbocation

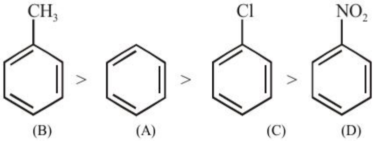
whereas in alkyl carbocations dispersal of positive charge on different hydrogen atoms is due to inductive effect. Hence the correct order of stability will be



$$C_6H_5\overset{\oplus}{C}H_2 > CH_2=CH-\overset{\oplus}{C}H_2 > CH_3-CH_2-\overset{\oplus}{C}H_2$$

76. **(a)** 3° carbocations are most stable.

77. **(a)** – Cl and – CH_3 groups are *o* and *p* directing. They are electron releasing due to + M and hyperconjugation effects. Further since such groups increase electron density in the nucleus, they facilitate further electrophilic substitution and hence known as activating group. The activating effect of these groups is in order of $-CH_3 > -X$ but chlorine exceptionally deactive the ring due to strong – I effect. Hence, it is difficult to carry out substitution in chlorobenzene than in benzene. Further – NO_2 is a deactivating group, hence deactivates the benzene nucleus, i.e. hinder the further substitution. Thus nitrobenzene undergo electrophilic substitution with a great difficulty, hence the correct order will be



78. **(b)** Since the leaving group breaks away as a base, it is easier to displace weaker bases as compared to stronger bases. Thus less basic the substituent, the more easily it is displaced.

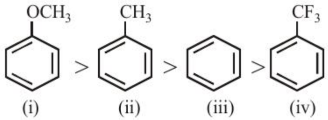
Since the basic strength of the given groups is in order.

$I^- < Br^- < Cl^-$

Thus the order of halogen leaving groups is

$I^- > Br^- > Cl^-$

79. **(d)** – OCH_3 and – CH_3 groups are activating group while – CF_3 is a deactivating group. Thus order is



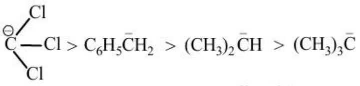
80. **(d)** The corresponding conjugate acid are

$$\underset{\text{Most acidic}}{CH_3COOH} > CH\equiv CH > NH_3 > \underset{\text{Least acidic}}{RH}$$

∴ the correct order of basicity is

$$RCOO^- < CH\equiv C^- < NH_2- < R^-$$

81. **(b)**



–ve charge highly dispersed due to – I effect

–M effect delocalises –ve charge

+I effect of CH_3 group intensifies the –ve charge

82. **(b)** In option (b) the complex formed is with benzene whereas in other cases it is formed with nitrobenzene with $-NO_2$ group in different positions (*o*-, *m*-, *p*-). The complex formed with nitrobenzene in any position of $-NO_2$ group is less stable than the complex formed with benzene, so the most stable complex has lowest energy.

83. **(a)** Nitro group is electron withdrawing group, so it deactivates the ring towards electrophilic substitution.

84. **(b)** The order of stability of free radicals

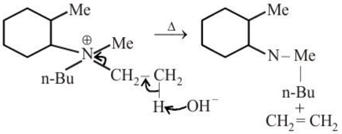
$$(C_6H_5)_3\dot{C} > (C_6H_5)_2\dot{C}H > (CH_3)_3\dot{C} > (CH_3)_2\dot{C}H$$

The stabilisation of first two is due to resonance and last two is due to hyper conjugation.

85. **(c)**

$$\underset{e^-s\text{ are delocalised}}{CH_3COO^-} < C_6H_5O^- < OH^- < \underset{\text{Max. }e^-\text{ density on O}}{{}^-OCH_3}$$

86. **(d)** **Hofmann's rule :** When theoretically more than one type of alkenes are possible in eliminations reaction, the alkene containing least alkylated (least substituted) double bond is formed as major product. Hence



Note: Therefore less sterically hundred β-hydrogen is removed.

87. **(d)** Free radicals are electrically neutral, unstable and very reactive on account of the presence of odd electrons.

88. **(a)** In moving down a group, the basicity and nucleophilicity are inversely related, *i.e.* nucleophilicity increases while basicity decreases. In going from left to right across a period, the basicity and nucleophilicity are directly related. Both of the characteristics decrease as the electronegativity of the atom bearing lone pair of electrons increases. If the nucleophilic centre of two or more species is same, nucleophilicity parallels basicity, *i.e.* more basic the species, stronger is its nucleophilicity.

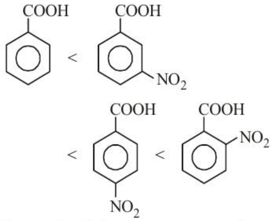
Hence based on the above facts, the correct order of nucleophilicity will be

$$\underset{(C)}{CN^-} > \underset{(B)}{CH_3O^-} > \underset{(A)}{CH_3COO^-} > \underset{(D)}{H_3CC_6H_4SO_3^-}$$

89. **(d)** —Cl is the best leaving group among the given options.

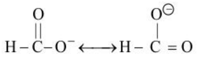
90. **(d)** In carboxylic acids, presence of electron withdrawing substituent e.g. $-NO_2$ disperses the negative charge of the anion and stabilises it and hence increases the acidity of the parent acid.

Further *o*-isomer will have higher acidity than corresponding *m*-and *p*-isomers due to ortho and high inductive effect of $-NO_2$ group. Since nitro group at *p*-position has more pronounced electron withdrawing than $-NO_2$ group at *m*-position, hence the correct order is:



91. **(d)** Lone pair of electrons present on the nitrogen of benzyl amine is not involved in resonance.

92. **(b)** $HCOO^-$ exists in following resonating structures



$$H-\overset{\overset{\displaystyle O}{\|}}{C}-O^- \longleftrightarrow H-\overset{\overset{\displaystyle O^{\ominus}}{|}}{C}=O$$

Hence in it both the carbon oxygen bonds are found equal.

93. **(b)** $-CH_3$ group has +I effect, as number of $-CH_3$ group increases, the inductive effect increases.

Therefore the correct order is

$$CH_3-CH_2- < (CH_3)_2CH- < (CH_3)_3C-$$

94. **(d)** Amino acids contain $-NH_2$ and $-COOH$ groups, e.g glycine H_2NCH_2COOH.