CHAPTER 9

Organic Chemistry — Some Basic Principles and Techniques

Section-A JEE Advanced/ IIT-JEE

A Fill in the Blanks

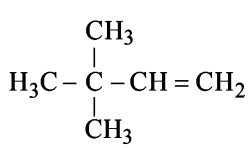
1. Among the given cations, ... is most stable. *(1981)*
(*sec*-butyl carbonium ion; *tert*-butyl carbonium ion; *n*-butyl carbonium ion)
2. The compound having both *sp* and sp^2 hybridized carbon atoms is ..... . *(1981)*
(propene, propane, propadiene)
3. ..... ring is most strained. *(1981)*
(Cyclopropane, Cyclobutane, Cyclopentane)
4. The terminal carbon atom in butane is ..... hybridised. *(1985)*
5. A ..... diol has two hydroxyl groups on ..... carbon atoms. *(1986)*
6. Isomers which are ..... mirror images are known as ..... . *(1988)*
(superimposable, non-superimposable, enantiomers, diastereomers, epimers)
7. The valence atomic orbitals on carbon in silver acetylide is ..... hybridized. *(1990)*
8. The kind of delocalization involving sigma bond orbitals is called ..... . *(1994)*
9. The IUPAC name of succinic acid is ..... . *(1994)*

B True / False

1. Iodide is a better nucleophile than bromide. *(1985 - ½ Mark)*
2. An electron donating substituent in benzene orients the incoming electrophilic group to the meta position. *(1987)*
3. 2, 3, 4-Trichloropentane has three asymmetric carbon atoms. *(1990)*
4. During S_N1 reaction, the leaving group leaves the molecule before the incoming group is attached to the molecule. *(1990)*

C MCQs with One Correct Answer

1. The bond order of individual carbon-carbon bonds in benzene is *(1981)*
(a) one (b) two
(c) between one and two (d) one and two, alternately
2. Molecule in which the distance between the two adjacent carbon atoms is largest is *(1981)*
(a) Ethane (b) Ethene
(c) Ethyne (d) Benzene
3. The compound which is not isomeric with diethyl ether is *(1981)*
(a) *n*-propyl methyl ether (b) butan-1-ol
(c) 2-methylpropan-2-ol (d) butanone
4. Among the following, the compound that can be most readily sulphonated is *(1982)*
(a) benzene (b) nitrobenzene
(c) toluene (d) chlorobenzene
5. The compound 1, 2-butadiene has *(1983)*
(a) only *sp* hybridized carbon atoms
(b) only sp^2 hybridized carbon atoms
(c) both *sp* and sp^2 hybridized carbon atoms
(d) *sp*, sp^2 and sp^3 hybridized carbon atoms
6. Which of the following compounds will exhibit *cis-trans* (geometrical) isomerism? *(1983)*
(a) 2-butene (b) 2-butyne
(c) 2-butanol (d) butanal
7. The IUPAC name of the compound having the formula



is : *(1984)*
(a) 3, 3, 3-Trimethyl-1-propene
(b) 1, 1, 1-Trimethyl-2-propene
(c) 3, 3-Dimethyl-1-butene
(d) 2, 2-Dimethyl-3-butene
8. An isomer of ethanol is : *(1986)*
(a) methanol (b) diethyl ether
(c) acetone (d) dimethyl ether
9. Out of the following compounds, which will have a zero dipole moment? *(1987)*
(a) 1, 1-dichloroethylene
(b) *cis*-1, 2-dichloroethylene
(c) *trans*-1, 2-dichloroethylene
(d) None of these compounds

10. The bond between carbon atom (1) and carbon atom (2) in compound $N \equiv \underset{1}{C} - \underset{2}{CH} = CH_2$ involves the hybrids as *(1987)*

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

11. The IUPAC name of the compound *(1987)*

$CH_2 = CH - CH(CH_3)_2$ is

(a) 1, 1-dimethyl –2-propene (b) 3-methyl 1-butene
(c) 2-vinylpropane (d) 1-isopropylethylene

12. The number of isomers of C_6H_{14} is *(1987,2007)*

(a) 4 (b) 5
(c) 6 (d) 7

13. The Cl—C—Cl angle in 1,1,2,2-tetrachloroethene and tetrachloromethane respectively will be about *(1988)*

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

14. In CH_3CH_2OH, the bond that undergoes heterolytic cleavage most readily is *(1988)*

(a) C—C (b) C—O
(c) C—H (d) O—H

15. The compound which has one isopropyl group is : *(1989)*

(a) 2, 2, 3, 3-tetramethylpentane
(b) 2, 2-dimethylpentane
(c) 2, 2, 3-trimethylpentane
(d) 2-methylpentane

16. The C–H bond distance is the longest in : *(1989)*

(a) C_2H_2 (b) C_2H_4
(c) C_2H_6 (d) $C_2H_2Br_2$

17. The number of sigma and pi-bonds in 1-butene-3-yne are : *(1989)*

(a) 5 sigma and 5 pi (b) 7 sigma and 3 pi
(c) 8 sigma and 2 pi (d) 5 sigma and 4 pi

18. The compound which gives the most stable carbonium ion on dehydration is : *(1989)*

(a) $CH_3 - \underset{\displaystyle CH_3}{\underset{|}{CH}} - CH_2OH$ (b) $CH_3 - \underset{\displaystyle CH_3}{\overset{\displaystyle CH_3}{\overset{|}{\underset{|}{C}}}} - OH$

(c) $CH_3 - CH_2 - CH_2 - CH_2OH$

(d) $CH_3 - \underset{\displaystyle OH}{\underset{|}{CH}} - CH_2 - CH_3$

19. The hybridization of carbon atoms in C–C single bond of $HC \equiv C - CH = CH_2$ is *(1991)*

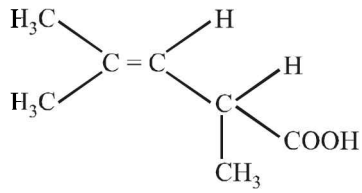
(a) $sp^3 - sp^3$ (b) $sp^2 - sp^3$
(c) $sp - sp^2$ (d) $sp^3 - sp$

20. The products of combustion of an aliphatic thiol (RSH) at 298 K are *(1992)*

(a) $CO_2(g)$, $H_2O(g)$ and $SO_2(g)$
(b) $CO_2(g)$, $H_2O(l)$ and $SO_2(g)$
(c) $CO_2(l)$, $H_2O(l)$ and $SO_2(g)$
(d) $CO_2(g)$, $H_2O(l)$ and $SO_2(l)$

21. Isomers which can be interconverted through rotation around a single bond are *(1992)*

(a) Conformers (b) Diastereomers
(c) Enantiomers (d) Positional isomers

22. The structure  shows :

(a) geometrical isomersism *(1995S)*
(b) optical isomerism
(c) geometrical & optical isomerism
(d) tautomerism.

23. Allyl isocyanide has : *(1995S)*

(a) 9σ and 4π bonds
(b) 8σ and 5π bonds
(c) 9σ, 3π and 2 non-bonded electrons
(d) 8σ, 3π and 4 non-bonded electrons

24. Arrange in order of decreasing trend towards S_E reactions : *(1995S)*

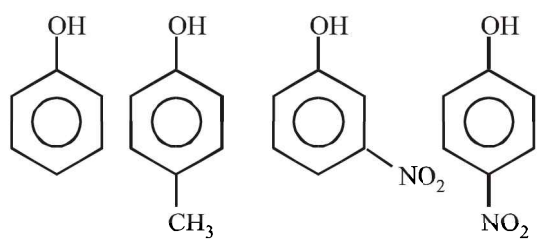
Chlorobenzene, benzene, anilinium chloride, toluene
I II III IV

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

25. Most stable carbonium ion is : *(1995S)*

(a) p—NO_2—C_6H_4—CH_2^+
(b) $C_6H_5CH_2^+$
(c) p—Cl—C_6H_4—CH_2^+
(d) p–CH_3O—C_6H_4—CH_2^+

26. In the following compounds, *(1996)*



(I) (II) (III) (IV)

The order of acidity is :

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

27. Arrange the following compounds in order of increasing dipole moment. *(1996)*

Toluene (I) *m*-dichlorobenzene (II)
o-dichlorobenzene (III) *p*-dichlorobenzene (IV)

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

28. How many optically active stereoisomers are possible for butane-2, 3-diol? *(1997)*

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

29. In the compound $CH_2=CH-CH_2-CH_2-C\equiv CH$, the C_2-C_3 bond is of the type, *(1999)*

(a) $sp-sp^2$ (b) sp^3-sp^3

(c) $sp-sp^3$ (d) sp^2-sp^3

30. The optically active tartaric acid is named as D–(+)–tartaric acid because it has a positive *(1999)*

(a) optical rotation and is derived from D-glucose

(b) pH in organic solvent

(c) optical rotation and is derived from D – (+) – glyceraldehyde

(d) optical rotation only when substituted by deuterium

31. Which of the following compounds will exhibit geometrical isomerism ? *(2000S)*

(a) 1-Phenyl-2-butene (b) 3-Phenyl-1-butene

(c) 2-Phenyl-1-butene (d) 1,1-Diphenyl-1-propene

32. Which of the following has the highest nucleophilicity? *(2000S)*

(a) F^- (b) OH^-

(c) CH_3^- (d) NH_2^-

33. The order of reactivities of the following alkyl halides for a S_N2 reaction is *(2000S)*

(a) RF > RCl > RBr > RI (b) RF > RBr > RCl > RI

(c) RCl > RBr > RF > RI (d) RI > RBr > RCl > RF

34. Which of the following has the most acidic hydrogen ? *(2000S)*

(a) 3-Hexanone (b) 2, 4-Hexanedione

(c) 2, 5-Hexanedione (d) 2, 3-Hexanedione

35. The number of isomers for the compound with molecular formula $C_2BrClFI$ is *(2001S)*

(a) 3 (b) 4

(c) 5 (d) 6

36. An S_N2 reaction at an asymmetric carbon of a compound always gives *(2001S)*

(a) an enantiomer of the substrate

(b) a product with opposite optical rotation

(c) a mixture of diastereomers

(d) a single stereoisomer

37. Which of the following compounds exhibits stereoisomerism? *(2002S)*

(a) 2-methylbutene-1 (b) 3-methylbutyne-1

(c) 3-methylbutanoic acid (d) 2-methylbutanoic acid

38. Which of the following acids has the smallest dissociation constant ? *(2002S)*

(a) $CH_3CHFCOOH$ (b) FCH_2CH_2COOH

(c) $BrCH_2CH_2COOH$ (d) $CH_3CHBrCOOH$

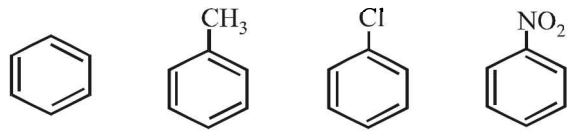
39. Identify the correct order of boiling points of the following compounds; *(2002S)*

$\underset{1}{CH_3CH_2CH_2CH_2OH}, \underset{2}{CH_3CH_2CH_2CHO}, \underset{3}{CH_3CH_2CH_2COOH}$

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

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

40. Identify the correct order of reactivity in electrophilic substitution reactions of the following compounds *(2002S)*

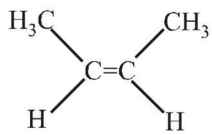


1 2 3 4

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

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

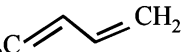
41. Which of the following hydrocarbons has the lowest dipole moment ? *(2002S)*

(a)  (b) $CH_3C\equiv CCH_3$

(c) $CH_3CH_2C\equiv CH$ (d) $CH_2=CH-C\equiv CH$

42. Which of the following represents the given mode of hybridisation $sp^2-sp^2-sp-sp$ from left to right? *(2003S)*

(a) $H_2C=CH-C\equiv N$ (b) $HC\equiv C-C\equiv CH$

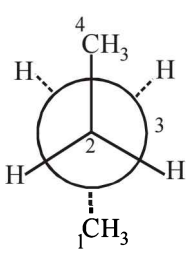
(c) $H_2C=C=C=CH_2$ (d) 

43. Among the following, the molecule with the highest dipole moment is: *(2003S)*

(a) CH_3Cl (b) CH_2Cl_2

(c) $CHCl_3$ (d) CCl_4

44. In the given conformation, if C_2 is rotated about C_2-C_3 bond anticlockwise by an angle of 120° then the conformation obtained is *(2004S)*



(a) fully eclipsed conformation

(b) partially eclipsed conformation

(c) gauche conformation

(d) staggered conformation

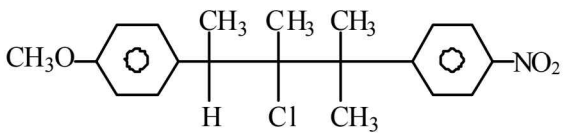
45. Which of the following resonating structures of 1–methoxy–1,3–butadiene is least stable? *(2005S)*

(a) $\overset{\ominus}{C}H_2-CH=CH-CH=\overset{\oplus}{O}-CH_3$

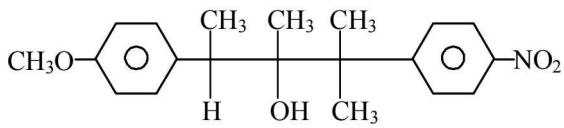
(b) $CH_2=CH-\overset{\ominus}{C}H-CH=\overset{\oplus}{O}-CH_3$

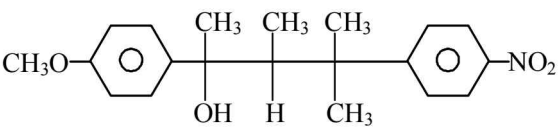
(c) $\overset{\ominus}{C}H_2-\overset{\oplus}{C}H-CH=CH-O-CH_3$

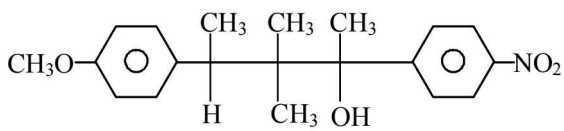
(d) $CH_2=CH-\overset{\ominus}{C}H-\overset{\oplus}{C}H-O-CH_3$

46. 

compound on hydrolysis in aqueous acetone will give *(2005S)*

(i) 

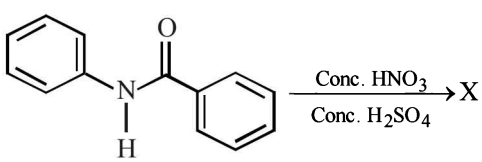
(ii) 

(iii) 

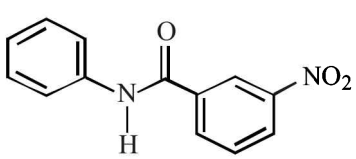
(a) Mixture of (i) and (ii) (b) Mixture of (i) and (iii)
(c) Only (iii) (d) Only (i)

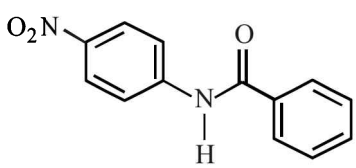
47. The IUPAC name of C_6H_5COCl is *(2006 - 3M, –1)*
(a) Benzene chloro ketone
(b) Benzoyl chloride
(c) Chloro phenyl ketone
(d) Benzene carbonyl chloride

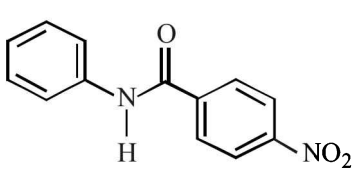
48. In the following reaction,

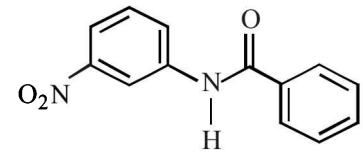


the structure of the major product 'X' is *(2007)*

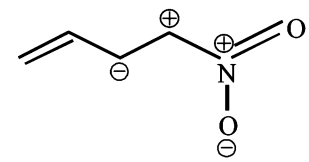
(a) 

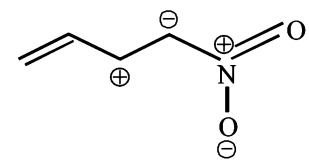
(b) 

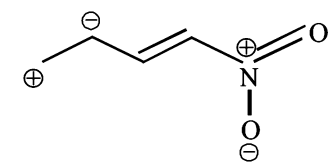
(c) 

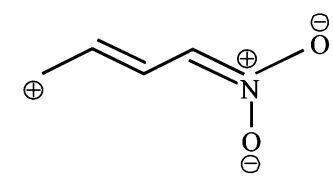
(d) 

49. Among the following, the least stable resonance structure is *(2007)*

(a) 

(b) 

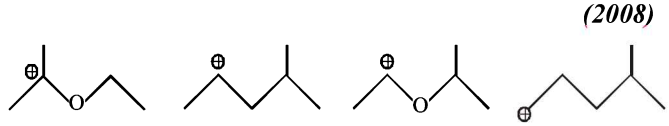
(c) 

(d) 

50. The number of stereoisomers obtained by bromination of *trans-2-butene* is *(2007)*
(a) 1 (b) 2
(c) 3 (d) 4

51. Hyperconjugation involves overlap of the following orbitals
(a) σ-σ (b) σ - π *(2008)*
(c) p- p (d) π-π

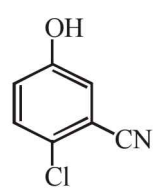
52. The correct stability order for the following species is *(2008)*



(I) (II) (III) (IV)

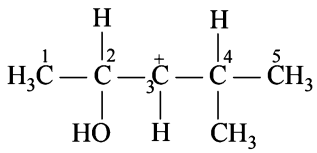
(a) (II) > (IV) > (I) > (III) (b) (I) > (II) > (III) > (IV)
(c) (II) > (I) > (IV) > (III) (d) (I) > (III) > (II) > (IV)

53. The IUPAC name of the following compound is *(2009)*



(a) 4-Bromo-3-cyanophenol
(b) 2-Bromo-5-hydroxybenzonitrile
(c) 2- Cyano-4-hydroxybromobenzene
(d) 6-Bromo-3-hydroxybenzonitrile

54. In the following carbocation, H/CH_3 that is most likely to migrate to the positively charged carbon is *(2009)*

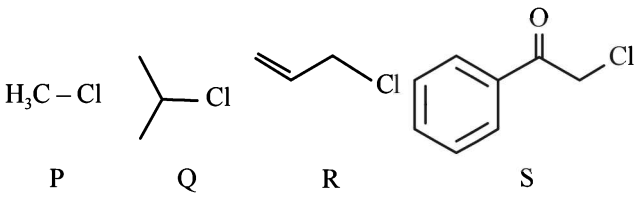


(a) CH_3 at C-4 (b) H at C-4
(c) CH_3 at C-2 (d) H at C-2

55. Among the following compounds, the most acidic is *(2011)*

(a) *p*-nitrophenol (b) *p*-hydroxybenzoic acid
(c) *o*-hydroxybenzoic acid (d) *p*-toluic acid

56. KI in acetone, undergoes S_N2 reaction with each of P, Q, R and S. The rates of the reaction vary as *(JEE Adv. 2013)*



P Q R S

(a) P > Q > R > S (b) S > P > R > Q
(c) P > R > Q > S (d) R > P > S > Q

D MCQs with One or More Than One Correct

1. Resonance structures of a molecule should have :

(a) identical arrangement of atoms *(1984)*
(b) nearly the same energy content
(c) the same number of paired electrons
(d) identical bonding

2. Phenol is less acidic than : *(1986)*

(a) acetic acid (b) *p*-methoxyphenol
(c) *p*-nitrophenol (d) ethanol

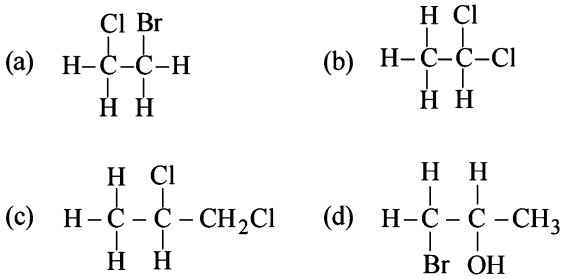
3. Dipole moment is shown by : *(1986)*

(a) 1, 4-dichlorobenzene
(b) *cis*- 1, 2-dichloroethane
(c) *trans* -1, 2-dichloroethene
(d) *trans*- 1, 2-dichloro-2-pentene

4. Only two isomeric monochloro derivatives are possible for: *(1986)*

(a) *n*-butane (b) 2, 4-dimethylpentane
(c) benzene (d) 2-methylpropane

5. Which of the following have asymmetric carbon atom? *(1989)*



6. What is the decreasing order of strength of the bases OH^-, NH_2^-, $HC \equiv C^-$ and $CH_3CH_2^-$? *(1993)*

(a) $CH_3 - CH_2^- > NH_2^- > H - C \equiv C^- > OH^-$
(b) $H - C \equiv C^- > CH_3 - CH_2^- > NH_2^- > OH^-$
(c) $OH^- > NH_2^- > H - C \equiv C^- > CH_3 - CH_2^-$
(d) $NH_2^- > H - C \equiv C^- > OH^- > CH_3 - CH_2^-$

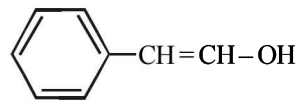
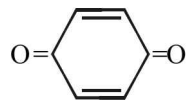
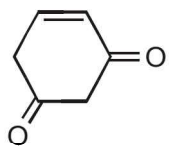
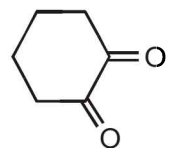
7. Which of the following compounds will show geometrical isomerism? *(1998)*

(a) 2–butene (b) propene
(c) 1–phenylpropene (d) 2–methyl–2–butene

8. Among the following compounds, the strongest acid is *(1998)*

(a) $HC \equiv CH$ (b) C_6H_6
(c) C_2H_6 (d) CH_3OH

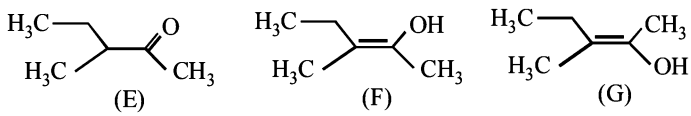
9. Tautomerism is exhibited by *(1998)*

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

10. An aromatic molecule will *(1999)*

(a) have 4n π electrons (b) have (4n + 2) π electrons
(c) be planar (d) be cyclic

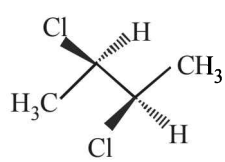
11. The correct statements(s) concerning the structures E,F and G is (are)– *(2008)*



(E) (F) (G)

(a) E,F, and G are resonance structures
(b) E,F and E, G are tautomers
(c) F and G are geometrical isomers
(d) F and G are diastereomers

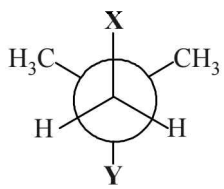
12. The correct statement(s) about the compound given below is (are) *(2008)*



(a) The compound is optically active
(b) The compound possesses centre of symmetry
(c) The compound possesses plane of symmetry
(d) The compound possesses axis of symmetry

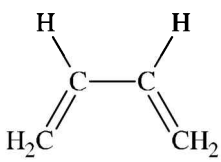
13. The correct statement(s) about the compound *(2009)*
$H_3C(HO)HC–CH=CH–CH(OH)CH_3$ **(X)** is(are)
(a) The total number of stereoisomers possible for **X** is 6
(b) The total number of diastereomers possible for **X** is 3
(c) If the stereochemistry about the double bond in **X** is *trans*, the number of enantiomers possible for **X** is 4
(d) If the stereochemistry about the double bond in **X** is *cis*, the number of enantiomers possible for **X** is 2

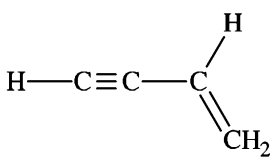
14. In the Newman projection for 2,2-dimethylbutane



X and **Y** can respectively be *(2010)*
(a) H and H (b) H and C_2H_5
(c) C_2H_5 and H (d) CH_3 and CH_3

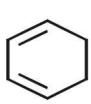
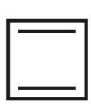
15. Amongst the given options, the compound(s) in which all the atoms are in one plane in all the possible conformations (if any), is (are) *(2011)*

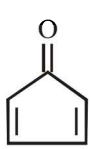
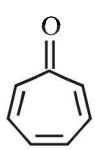
(a) 

(b) 

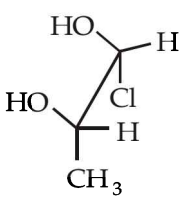
(c) $H_2C=C=O$
(d) $H_2C=C=CH_2$

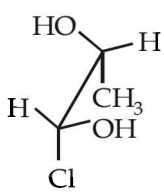
16. Which of the following molecules, in pure form, is (are) **unstable** at room temperature ? *(2012)*

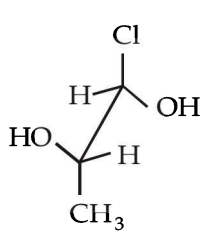
(a)  (b) 

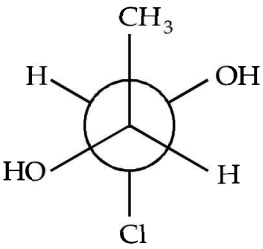
(c)  (d) 

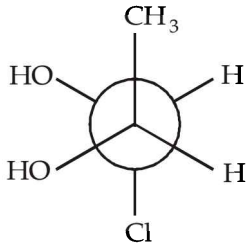
17. Which of the given statement(s) about **N, O, P** and **Q** with respect to **M** is (are) correct ? *(2012)*


M


N


O


P


Q

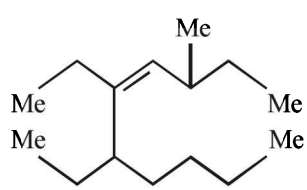
(a) **M** and **N** are non-mirror image stereoisomers
(b) **M** and **O** are identical
(c) **M** and **P** are enantiomers
(d) **M** and **Q** are identical

18. The hyperconjugative stabilities of tert-butyl cation and 2-butene, respectively, are due to *(JEE Adv. 2013)*
(a) $\sigma \rightarrow p$ (empty) and $\sigma \rightarrow \pi^*$ electron delocalisations
(b) $\sigma \rightarrow \sigma^*$ and $\sigma \rightarrow \pi$ electron delocalisations
(c) $\sigma \rightarrow p$ (filled) and $\sigma \rightarrow \pi$ electron delocalisations
(d) p (filled) $\rightarrow \sigma^*$ and $\sigma \rightarrow \pi^*$ electron delocalisations

E Subjective Problems

1. Arrange the following in :
(*i*) Increasing reactivity towards HCN *(1985)*
CH_3CHO, CH_3COCH_3, HCHO, $C_2H_5COCH_3$
(*ii*) *n*-butane, *n*-butanol, *n*-butyl chloride, isobutane in increasing order of boiling point. *(1988)*
(*iii*) benzene, toluene, methoxybenzene, chlorobenzene in increasing order of reactivity towards sulphonation with fuming sulphuric acid. *(1988)*
(*iv*) Increasing order of acid strength : *(1991)*
$ClCH_2COOH$(I), CH_3CH_2COOH(II), $ClCH_2CH_2COOH$(III), $(CH_3)_2CHCOOH$(IV), CH_3COOH(V)
(*v*) Increasing reactivity in nucleophilic substitution reactions *(1992)*
CH_3F, CH_3I, CH_3Br, CH_3Cl

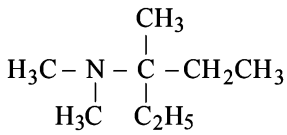
2. (*i*) Write the IUPAC name of: *(1986)*
$CH_3CH_2CH=CHCOOH$
(*ii*) Give the IUPAC name of the following compound : *(1990)*



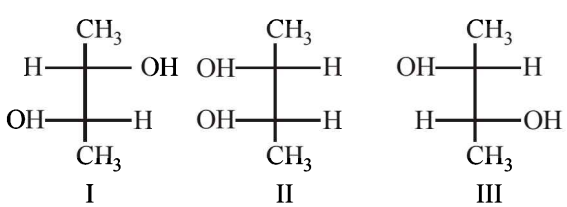
(Me = Methyl)

(*iii*) Write the IUPAC name for the following :

(1991)



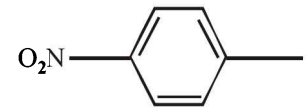
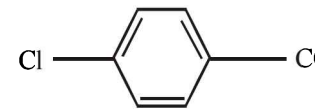
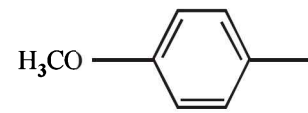
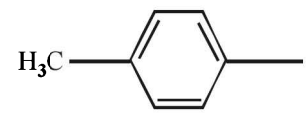
3. For nitromethane molecule, write structure(s).
   (*i*) showing significant resonance stabilisation. *(1986)*
   (*ii*) indicating tautomerism. *(1986)*
4. Give reasons for the following :
   (*i*) Carbon oxygen bond lengths in formic acid are 1.23Å and 1.36Å and both the carbon oxygen bonds in sodium formate have the same value i.e. 1.27Å. *(1988)*
   (*ii*) Phenyl group is known to exert negative inductive effect. But each phenyl ring in biphenyl ($C_6H_5-C_6H_5$) is more reactive than benzene towards electrophilic substitution. *(1992)*
   (*iii*) Aryl halides are less reactive than alkyl halides towards nucleophilic reagents *(1994)*
   (*iv*) $CH_2{=}CH^-$ is more basic than $HC \equiv C^-$.
   (*v*) Normally, benzene gives electrophilic substitution reaction rather than electrophilic addition reaction although it has double bonds.
5. Write the structural formula of 4-chloro-2-pentene. *(1988)*
6. Write tautomeric forms for phenol. *(1992)*
7. Write down the structures of the stereoisomers formed when *cis*-2-butene is reacted with bromine. *(1995)*
8. Discuss the hybridisation of carbon atoms in allene (C_3H_4) and show the π-orbital overlaps. *(1999)*
9. Identify the pairs of enantiomers and diastereomers from the following compounds I, II and III *(2000)*

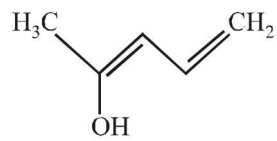


I II III

10. Which one is more soluble in diethyl ether - anhydrous $AlCl_3$ or hydrous $AlCl_3$? Explain in terms of bonding. *(2003)*

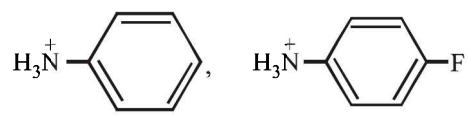
11. Match the K_a values *(2003)*

		K_a
(a)	Benzoic acid	6.4×10^{-5}
(b)		30.6×10^{-5}
(c)		10.2×10^{-5}
(d)		3.3×10^{-5}
(e)		4.2×10^{-5}

12.  *(2003)*

Write resonance structure of the given compound.

13. Which of the following is more acidic and why ? *(2004)*



14. (*i*) $\mu_{obs} = \sum_i \mu_i x_i$, where μ_i is the dipole moment of a stable conformer of the molecule, $Z-CH_2-CH_2-Z$ and x_i is the mole fraction of the stable conformer.

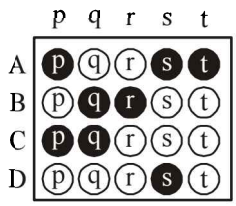
Given : $\mu_{obs} = 1.0$ D and $x_{(Anti)} = 0.82$

Draw all the stable conformers of $Z-CH_2-CH_2-Z$ and calculate the value of $\mu_{(Gauche)}$.

(*ii*) Draw the stable conformer of Y – CHD – CHD – Y (meso form), when Y = CH_3 (rotation about C_2-C_3) and Y = OH (rotation about C_1-C_2) in Newmann projection. *(2005)*

F Match the Following

Each question contains statements given in two columns, which have to be matched. The statements in Column-I are labelled A, B, C and D, while the statements in Column-II are labelled p, q, r, s and t. Any given statement in Column-I can have correct matching with ONE OR MORE statement(s) in Column-II. The appropriate bubbles corresponding to the answers to these questions have to be darkened as illustrated in the following example :
If the correct matches are A-p, s and t; B-q and r; C-p and q; and D-s then the correct darkening of bubbles will look like the given.



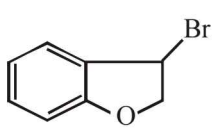
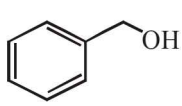
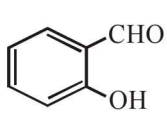
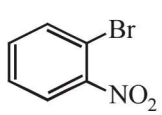
1. Given below are certain matching type questions, where two columns (each having 4 items) are given. Immediately after the columns the matching grid is given, where each item of Column I has to be matched with the items of Column II, by encircling the correct match(es). Note that an item of **Column I** can match with more than one item of **Column II**. All the items of **Column II** must be matched. Match the following : *(2006 - 6M)*

Column I	**Column II**
(A) $C_6H_5CH_2CD_2Br$ on reaction with $C_2H_5O^-$ gives $C_6H_5–CH=CD_2$	(p) E1 reaction
(B) $PhCHBrCH_3$ and $PhCHBrCD_3$, both react with the same rate	(q) E2 reaction
(C) $C_6H_5CH_2CH_2Br$ on treatment with $C_2H_5O^-$ and C_2H_5OD gives $C_6H_5CD=CH_2$	(r) E1cB reaction
(D) $C_6H_5CH_2CH_2Br$ reacts faster than $C_6H_5CD_2CH_2Br$ on reaction with $C_2H_5O^-$ in ethanol	(s) First order reaction

2. Match the compounds/ions in **Column I** with their properties/reactions in **Column II**. Indicate your answer by darkening the appropriate bubbles of the 4 × 4 matrix given in the ORS. *(2007)*

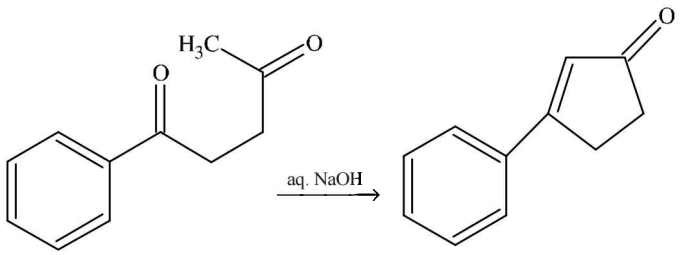
Column I	**Column II**
(A) C_6H_5CHO	(p) gives precipitate with 2, 4-dinitrophenylhydrazine
(B) $CH_3C\equiv CH$	(q) gives precipitate with $AgNO_3$
(C) CN^-	(r) is a nucleophile
(D) I^-	(s) is involved in cyanohydrin formation

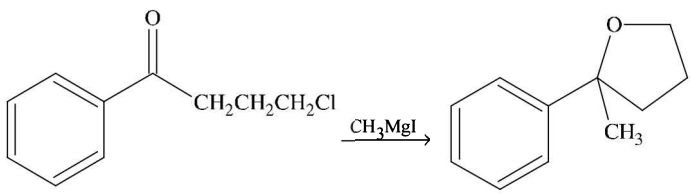
3. Match each of the compounds given in **Column-I** with the reaction(s), that they can undergo, given in **Column-II.** *(2009)*

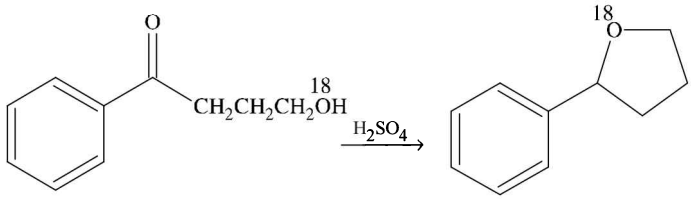
Column-I	**Column-II**
(A) 	(p) Nucleophilic substitution
(B) 	(q) Elimination
(C) 	(r) Nucleophilic addition
(D) 	(s) Esterification with acetic anhydride
	(t) Dehydrogenation

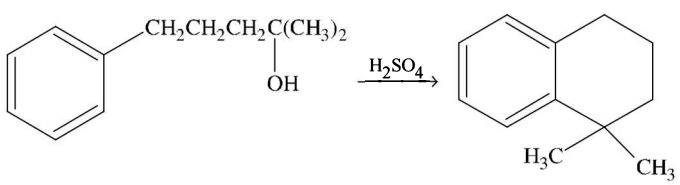
4. Match the reactions in **Column I** with appropriate types of steps/reactive intermediate involved in these reactions as given in **Column II.** *(2011)*

Column I

(A) 

(B) 

(C) 

(D) 

Column II

(p) Nucleophilic substitution

(q) Electrophilic substitution

(r) Dehydration

(s) Nucleophilic addition

(t) Carbanion

H Assertion & Reason Type Questions

Read the following Statement-1(Asseration) and Statement -2 (Reason) and answer as per the options given below :

(a) If both Statement -1 and Statement -2 are correct, and Statement -2 is the correct explanation of the Statement -2.

(b) If both Statement -1 and Statement -2 are correct, but Statement -2 is not the correct explanation of the Statement -1.

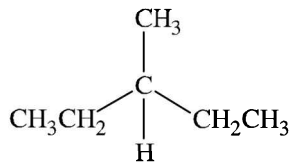
(c) If Statement -1 is correct but Statement -2 is incorrect.

(d) If Statement -1 is incorrect but Statement -2 is correct.

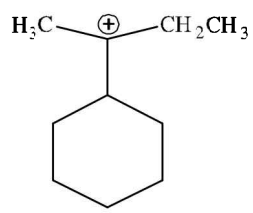
1. **Statement -1:** Aryl halides undergo nucleophilic substitution with ease.
   Statement -2: The carbon-halogen bond in aryl halides has partial double bond character. *(1991)*
2. **Statement -1:** Phenol is more reactive than benzene towards electrophilic substitution reactions.
   Statement-2: In the case of phenol, the intermediate carbocation is more resonance stabilized. *(2000S)*
3. **Statement -1:** Molecules that are not superimpossable on their mirror images are chiral.
   Statement -2: All chiral molecules have chiral centres. *(2007)*

I Integer Value Correct Type

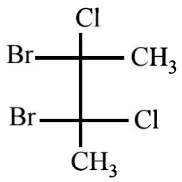
1. The total number of cyclic structural as well as stereo isomers possible for a compound with the molecular formula C_5H_{10} is *(2009)*
2. The total number of cyclic isomers possible for a hydrocarbon with the molecular formula C_4H_6 is 5. *(2010)*
3. The maximum number of isomers (including stereoisomers) that are possible on monochlorination of the following compound is *(2011)*



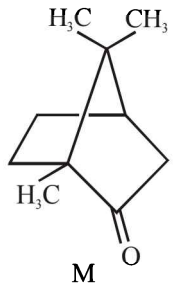
4. The total number of contributing structures showing hyperconjugation (involving C–H bonds) for the following carbocation is *(2011)*



5. The total number(s) of **stable** conformers with **non-zero** dipole moment for the following compound is (are) *(JEE Adv. 2014)*



6. The total number of stereoisomers that can exist for M is *(JEE Adv. 2015)*



M

Section-B JEE Main / AIEEE

1. 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) $(CH_3)_3C- < CH_3-CH_2-(CH_3)_2CH-$
2. 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.
3. 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
4. The functional group, which is found in amino acid is **[2002]**
   (a) $-COOH$ group (b) $-NH_2$ group
   (c) $-CH_3$ group (d) both (a) and (b).
5. Which of the following compounds has wrong IUPAC name? **[2002]**
   (a) $CH_3-CH_2-CH_2-COO-CH_2CH_3$ → ethyl butanoate
   (b) $CH_3-\underset{\underset{CH}{|}}{CH}-CH_2-CHO$ → 3-methyl-butanal
   (c) $CH_3-\underset{\underset{OH}{|}}{CH}-\underset{\underset{CH_3}{|}}{CH}-CH_3$ → 2-methyl-3-butanol
   (d) $CH_3-\underset{\underset{CH_3}{|}}{\overset{\overset{O}{\|}}{C}}-CH_2-CH_3$ → 2-methyl-3-pentanone
6. 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
7. 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) $CH_2=\underline{C}H-CH_3$
8. Racemic mixture is formed by mixing two **[2002]**
   (a) isomeric compounds
   (b) chiral compounds
   (c) meso compounds
   (d) enantiomers with chiral carbon.
9. Following types of compounds (as I, II) **[2002]**

   $CH_3CH=CHCH_3$ (I) $\quad CH_3\underset{\underset{CH_2CH_3}{|}}{CHOH}$ (II)

   are studied in terms of isomerism in:
   (a) chain isomerism (b) position isomerism
   (c) conformers (d) stereoisomerism
10. The reaction: **[2002]**

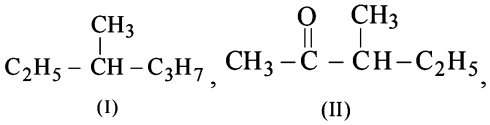
    $(CH_3)_3C-Br \xrightarrow{H_2O} (CH_3)_3C-OH$
    (a) elimination reaction
    (b) substitution reaction
    (c) free radical reaction
    (d) displacement reaction.

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

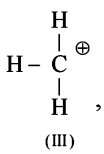
(a) The C = O bond is weaker than the C — O bond
(b) The anion $HCOO^-$ has two resonating structures
(c) The anion is obtained by removal of a proton from the acid molecule
(d) Electronic orbitals of carbon atom are hybridised

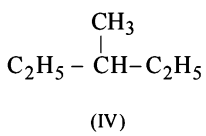
12. The general formula $C_nH_{2n}O_2$ could be for open chain
(a) carboxylic acids (b) diols **[2003]**
(c) dialdehydes (d) diketones

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


(I)

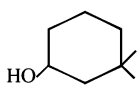
(II)


(III)


(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

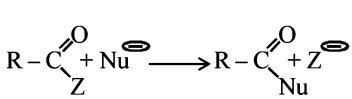
14. Which one of the following has the minimum boiling point ?
(a) 1 - Butene (b) 1 - Butyne **[2004]**
(c) n- Butane (d) isobutane

15. 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

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

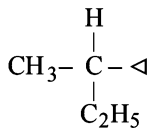
17. Which of the following will have a mesoisomer also?
(a) 2, 3- Dichloropentane **[2004]**
(b) 2, 3-Dichlorobutane
(c) 2-Chlorobutane
(d) 2-Hydroxypropanoic acid

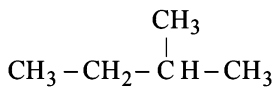
18. Rate of the reaction **[2004]**



is fastest when Z is
(a) OC_2H_5 (b) NH_2
(c) Cl (d) $OCOCH_3$

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

(a) 

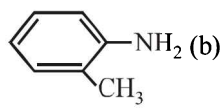
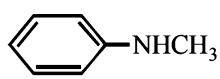
(b) 

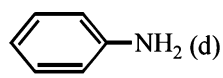
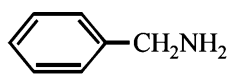
(c) $CH_3-CH_2-CH_2-CH_3$

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

20. Consider the acidity of the carboxylic acids :
(a) PhCOOH (b) o-$NO_2C_6H_4COOH$
(c) p-$NO_2C_6H_4COOH$ (d) 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

21. Which of the following is the strongest base ?

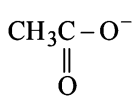
(a)  (b) 

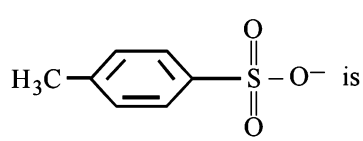
(c)  (d) 

22. Which of the following compounds is not chiral?
(a) 1-chloro-2-methyl pentane **[2004]**
(b) 2-chloropentane
(c) 1-chloropentane
(d) 3-chloro-2-methyl pentane

23. Due to the presence of an unpaired electron, free radicals are: **[2005]**
(a) cations (b) anions
(c) chemically inactive (d) chemically reactive

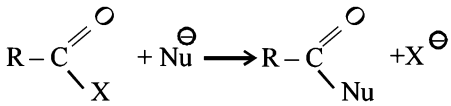
24. The decreasing order of nucleophilicity among the nucleophiles **[2005]**

(A)  (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)

25. The reaction [2005]

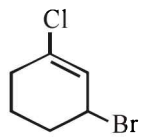


is fastest when X is

(a) OCOR (b) OC_2H_5

(c) NH_2 (d) Cl

26. 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

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

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

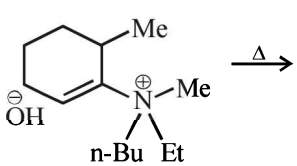
28. $CH_3Br + Nu^- \longrightarrow CH_3 - Nu + Br^-$ The decreasing order of the rate of the above reaction with nucleophiles (Nu^-) A to D is [2006]

[Nu^- = (A) PhO^-, (B) AcO^-, (C) HO^-, (D) CH_3O^-]

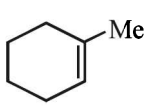
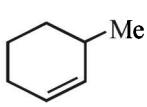
(a) A > B > C > D (b) B > D > C > A

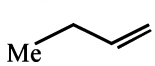
(c) D > C > A > B (d) D > C > B > A

29.



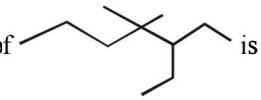
The alkene formed as a major product in the above elimination reaction is [2006]

(a)  (b) 

(c)  (d) $CH_2 = CH_2$

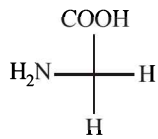
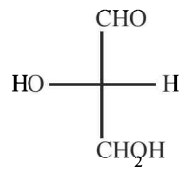
30. Increasing order of stability among the three main conformations (i.e. Eclipse, Anti, Gauche) of 2-fluoroethanol is [2006]

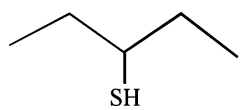
(a) Eclipse, Anti, Gauche
(b) Anti, Gauche, Eclipse
(c) Eclipse, Gauche, Anti
(d) Gauche, Eclipse, Anti

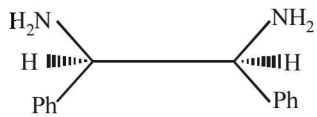
31. The IUPAC name of  is [2007]

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

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

(a)  (b) 

(c) 

(d) 

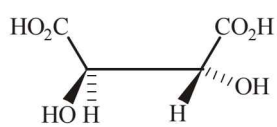
33. Presence of a nitro group in a benzene ring [2007]

(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.

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

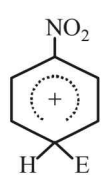
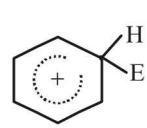
(a) Boat (b) Twist boat
(c) Rigid (d) Chair.

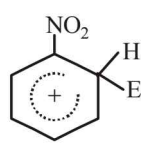
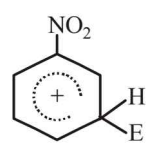
35. The absolute configuration of [2008]



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

36. 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) 

37. 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) $-CONH_2, -CHO, -SO_3H, -COOH$

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

(a) 2, 2 dimethylpropane

(b) 2 methylpropane

(c) 2, 2 dimethylbutane

(d) 2-methylbutane

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

$(CH_3)_3\bar{C}, \bar{C}Cl_3, (CH_3)_2\bar{C}H, C_6H_5\bar{C}H_2$ in order of their decreasing stability :

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

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]**

(b) 2 (c) 4

(d) 6 (d) 3

42. 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) $RCO\bar{O} < HC\equiv\bar{C} < \bar{N}H_2 < \bar{R}$

43. 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

44. Identify the compound that exhibits tautomerism : **[2011]**

(a) 2-Butene (b) Lactic acid

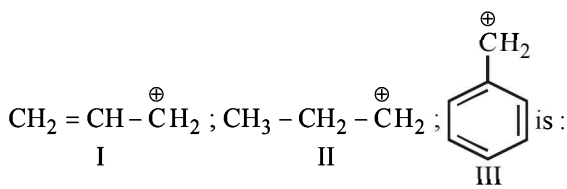
(c) 2-Pentanone (d) Phenol

45. 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 : **[JEE M 2013]**

(a) carbanion (b) carbene

(c) carbocation (d) free radical

46. The order of stability of the following carbocations :



[JEE M 2013]

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

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

47. For the estimation of nitrogen, 1.4 g of an organic compound was digested by Kjeldahl method and the evolved ammonia was absorbed in 60 mL of $\frac{M}{10}$ sulphuric acid. The unreacted acid required 20 mL of $\frac{M}{10}$ sodium hydroxide for complete neutralization. The percentage of nitrogen in the compound is: **[JEE M 2014]**

(a) 6% (b) 10%

(c) 3% (d) 5%

48. Which of the following compounds will exhibit geometrical isomerism ? **[JEE M 2015]**

(a) 2 - Phenyl -1 - butene

(b) 1, 1 - Diphenyl - 1 - propene

(c) 1 - Phenyl - 2 - butene

(d) 3 - Phenyl -1 - butene

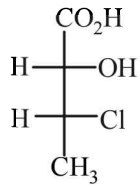
49. In Carius method of estimation of halogens, 250 mg of an organic compound gave 141 mg of AgBr. The percentage of bromine in the compound is : **[JEE M 2015]**

(at. mass Ag = 108; Br = 80)

(a) 48 (b) 60

(c) 24 (d) 36

50. The absolute configuration of **[JEE M 2016]**



is :

(a) (2S, 3S) (b) (2R, 3R)

(c) (2R, 3S) (d) (2S, 3R)

51. The distillation technique most suited for separating glycerol from spent-lye in the soap industry is : **[JEE M 2016]**

(a) Steam distillation.

(b) Distillation under reduced pressure.

(c) Simple distillation

(d) Fractional distillation