12
Chapter

ORGANIC CHEMISTRY
Some Basic Principles-1

A SINGLE CORRECT CHOICE TYPE

Each of these questions has 4 choices (a), (b), (c) and (d) for its answer, out of which ONLY ONE is correct.

1. Which of the following statement is true?
(a) The boiling point of NO is higher than that for N_2 because the former has higher molecular weight
(b) The boiling point of NO is higher because of greater vander Waals forces than in N_2
(c) The boiling point of NO is higher than that of N_2 because of dipole-dipole forces
(d) The boiling point of N_2 is higher because N_2 is inert

2. Solubility of sodium chloride in water is due to
(a) hydrogen bond
(b) ion-dipole force
(c) both
(d) dipole-dipole interaction

3. Sodium chloride dissolves in dimethy sulphoxide (DMSO, a polar aprotic solvent) because of
(a) hydrogen bond (b) cation -dipole force
(c) anion-dipole force (d) all the three

4. Water and hydrogen fluoride has much larger difference in their boiling points. This is due to
(a) high electronegativity of F
(b) more extensive hydrogen bonding in HF
(c) more extensive H-bonding in H_2O
(d) smaller size of HF than that of H_2O

5. Arrange the following compounds in order of their decreasing boiling points

ROH, RCN, RCOOH, $RCONH_2$, RCOOR

(a) $RCONH_2 > RCOOH > ROH \approx RCN >>> RCOOR$
(b) $RCOOH > ROH > RCOOR > RCONH_2 > RCN$
(c) $RCOOH > RCONH_2 > ROH > RCN > RCOOR$
(d) $RCOOH > RCONH_2 > ROH > RCOOR > RCN$

6. Which of the following is aprotic nonpolar solvent?
(a) liquified NH_3 (b) $(CH_3)_2S=O$
(c) CCl_4 (d) $HCON(CH_3)_2$

7. Which of the following is true?
(a) A *cis* isomer has lower b.p. than the *trans*
(b) A *cis* isomer has lower m.p. than the *tans*
(c) All isomers of nitrophenols are equal soluble in water
(d) All the three are correct

8. Which statement is true regarding hybrid orbital numbre rule (HON rule)?
(a) Every σ bond is formed by the use of a hybrid orbital
(b) Every unshared pair of electrons on an atom is present in an HO.
(c) An unpaired electron is not present is HO
(d) All are true

9. The central atom of which of the following does not use HO?
(a) H_2S (b) $:PH_3$
(c) both (d) $CH_2=NH$

10. In which of the following two carbon atoms are differently hybridised?

$CH_2=\overset{+}{C}H$ (i) $CH_3\overset{-}{C}HCH_3$ (ii) $CH_2=\overset{-}{C}H$ (iii)

$CH\equiv\overset{-}{C}$ (iv) $\overset{\bullet}{C}(CH_3)_3$ (v)

(a) (i) (b) (ii)
(c) (v) (d) (i) and (v)

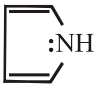
11. Which of the following has only one type of hybridised carbon?
(a) $CH_3-\overset{+}{C}H-CH_3$ (b) $CH_3-C\equiv CH$
(c) $CH_2=CH-\overset{+}{C}H_2$ (d) $CH_2=C=CH_2$

MARK YOUR RESPONSE	1. ⓐⓑⓒⓓ	2. ⓐⓑⓒⓓ	3. ⓐⓑⓒⓓ	4. ⓐⓑⓒⓓ	5. ⓐⓑⓒⓓ
	6. ⓐⓑⓒⓓ	7. ⓐⓑⓒⓓ	8. ⓐⓑⓒⓓ	9. ⓐⓑⓒⓓ	10. ⓐⓑⓒⓓ
	11. ⓐⓑⓒⓓ				

12. In XeF_2, Xe is .... hybridised
(a) *sp* (b) sp^2
(c) sp^3 (d) sp^3d

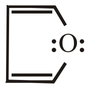
13. Hybridisation of phosphorus in $POCl_3$ should be
(a) sp^3 (b) sp^3d
(c) sp^3d^2 (d) sp^3d^3

14. The type of hybrid orbitals used by C and N in the formation of C–N bond in pyrrole



is
(a) sp^2 and sp^3 (b) sp^2 and *sp*
(c) sp^2 and sp^2 (d) sp^2 and *s*

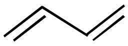
15. Which type of orbitals C and O use in the formation of C–O bond in furan,



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

16. Ketene, $CH_2 = C = O$, has
(a) only sp^2 hybridized carbon atom
(b) only *sp* hybridized carbon atom
(c) sp^2 and *sp* hybridized carbon atoms
(d) sp^2, *sp* and sp^3 hybridized carbon atoms

17. Which of the following represents the given mode of hybridization $sp^2–sp^2–sp–sp$ from left to right ?
(a) $CH_2 = CH - C \equiv N$ (b) $CH \equiv C - C \equiv CH$
(c) $CH_2 = C = C = CH_2$ (d)



18. Which of the following statement is false?
(a) Feeble acids and bases are weaker than H_2O
(b) Weak acids are weaker than H_3O^+ but stonger than H_2O
(c) Weak bases are weaker than OH^- but stronger than H_2O
(d) None

19. Which of the following statement is true?
(a) Acetic acid is more acidic in water than in methyl alcohol
(b) Acetic acid is less acidic in water than in methyl alcohol
(c) Acetic acid shows aqual acidic character in both solvents
(d) None of the three is true

20. Which of the following pair of acids has same conjugate base?
(a) sulphuric acid and bisulphate ion
(b) HCN and HNC
(c) Cyanic acid (HO–C≡N) and isocyanic acid (HN=C=O)
(d) Both b and c

21. The pK_a value is minimum for
(a) H_2SO_4 (b) HI
(c) CF_3COOH (d) $HSbF_6$

22. Ammonia is more basic than phosphine because
(a) In phosphine, the H–P–H bond angle is 90° while the H–N–H bond angle is 107°
(b) P is greater in size than N
(c) N has greater electronegativity than P
(d) of all the above factors

23. OH^- is more basic than SH^- because
(a) oxygen is more electronegative than sulphur
(b) oxygen is smaller than sulphur
(c) O and S are differently hybridised
(d) none of the three

24. Which of the following statement is true?
(a) $:\underset{\cdot\cdot}{\ddot{O}}H^-$ is more basic than $:\ddot{N}H_2^-$ because more electrons are available on OH^-
(b) OH^- is more basic than NH^-_2 because O is more electronegative than N
(c) OH^- is less basic than NH^-_2 because it has lesser number of non-bonding electron pairs
(d) OH^- is less basic than NH^-_2 because O is bigger in size than N.

25. Which is true regarding the relative basic character of the following two pairs?
(a) $NH_3 > NH_2OH$ (b) $^-CCl_3 > {}^-CF_3$
(c) Both are true (d) Nither is true

26. Pick up the ambident nucleophile
(a) CN^- (b) NO_2^-
(c) Both a and b (d) H_2O

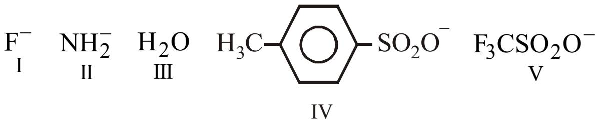
MARK YOUR RESPONSE	12. ⓐⓑⓒⓓ	13. ⓐⓑⓒⓓ	14. ⓐⓑⓒⓓ	15. ⓐⓑⓒⓓ	16. ⓐⓑⓒⓓ
	17. ⓐⓑⓒⓓ	18. ⓐⓑⓒⓓ	19. ⓐⓑⓒⓓ	20. ⓐⓑⓒⓓ	21. ⓐⓑⓒⓓ
	22. ⓐⓑⓒⓓ	23. ⓐⓑⓒⓓ	24. ⓐⓑⓒⓓ	25. ⓐⓑⓒⓓ	26. ⓐⓑⓒⓓ

27. Which of the following behaves as an ambiphilic reagent ?
(a) H_2O (b) CH_3CHO
(c) CH_3CN (d) All the three

28. Which of the following is not correct?

	Order of basicity	**Order of nucleophilicity**
(a)	$F^- > Cl^- > Br^-$	$Br^- > Cl^- > F^-$
(b)	$H-O-O^- > OH^-$	$H-O-O^- > OH^-$
(c)	$^-CH_3 > NH_2^- > OH^-$	$^-CH_3 > NH_2^- > OH^-$
(d)	$H_2O > H_2S$	$H_2O < H_2S$

29. The correct arrangement for leaving tendency among the following groups is



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

30. Which of the following is true ?
(a) *tert* - Butoxide is a stronger base as well as stronger nucleophile than ethoxide
(b) *tert* - Butoxide is a weaker base but stronger nucleophile than ethoxide
(c) *tert*- Butoxide is a stronger base, but weaker nucleophile than ethoxide
(d) *tert*- Butoxide and ethoxide are equally strong bases as well as strong nucleophiles

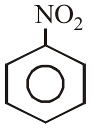
31. Arrange the following in decreasing order of their dipole moment
CH_3Cl $CHCl_3$ $CFCl_3$ CH_2Cl_2
(a) $CHCl_3 > CH_2Cl_2 > CH_3Cl > CFCl_3$
(b) $CFCl_3 > CHCl_3 > CH_2Cl_2 > CH_3Cl$
(c) $CH_3Cl > CH_2Cl_2 > CHCl_3 > CFCl_3$
(d) $CHCl_3 > CFCl_3 > CH_2Cl_2 > CH_3Cl$

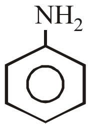
32. If the dipole moment of CH_3F is 1.847 D, the dipole moment of CD_3F will be
(a) 1.837D (b) 1.857D
(c) 1.847D (d) 1.723D

33. Which of the following is false regarding dipole moments of the following pairs?
(i) $CH_3Br > CH_3I$ (ii) $CH_3Cl > CH_3F$
(iii) $NH_3 > NF_3$ (iv) $HF > HCl$
(a) only (ii) (b) (ii) and (iii)
(c) (i), (ii) and (iii) (d) None

34. In which of the following electron pair does not play a significant role in dipole moment?
(a) $\ddot{N}H_3$ (b) $H_2\ddot{O}:$
(c) $\ddot{P}H_3$ (d) $H_3O\!:^{+}$

35. The correct order of dipole moments of the three compounds should be


I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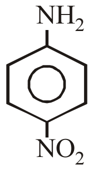
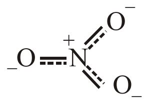

III

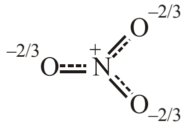
(a) I > III > II (b) III > I > II
(c) II > III > I (d) none of these

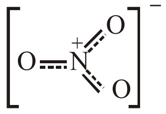
36. Which of the following is true regarding formal charges on the constituent atoms of NO^-_3 ion?
(a) Formal charge on N is zero
(b) Formal charge on all the three oxygen atoms is similar
(c) Formal charge on one of the oxygen atoms is different
(d) Formal charges on all the three oxygen atoms are different

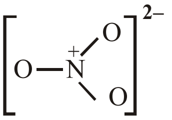
37. Which of the following is false regarding a good contributor of a resonance hybrid?
(a) It must have as many bonds as possible
(b) It must have as many octets as possible
(c) Negative charge, if any, should be on electronegative atom
(d) None of the three

38. Which of the following is more appropriate representation for the resonance hybrid of nitrate ion?

(a) 

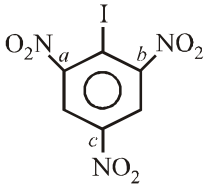
(b) 

(c) 

(d) 

MARK YOUR RESPONSE					
	27. ⓐⓑⓒⓓ	28. ⓐⓑⓒⓓ	29. ⓐⓑⓒⓓ	30. ⓐⓑⓒⓓ	31. ⓐⓑⓒⓓ
	32. ⓐⓑⓒⓓ	33. ⓐⓑⓒⓓ	34. ⓐⓑⓒⓓ	35. ⓐⓑⓒⓓ	36. ⓐⓑⓒⓓ
	37. ⓐⓑⓒⓓ	38. ⓐⓑⓒⓓ			

39. 2, 4, 6- Trinitroiodobenzene has three C–N bonds



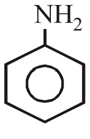
labelled as *a, b* and *c*. The correct bond length of the three bonds is

(a) $a = b = c$ (b) $a > b > c$

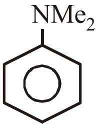
(c) $a = b > \underline{c}$ (d) $a = b < c$

40. Which of the following is the strongest base?

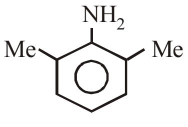
(a)



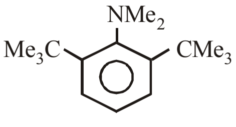
(b)



(c)



(d)



41. Pyridine has 6 bonding (π) and 2 nonbonding electrons, which statement is true regarding resonance in pyridine?

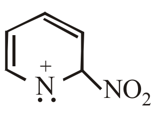
(a) All of these electrons are involved in resonance

(b) 4 π and 2 non-bonding electrons are involved in resonance

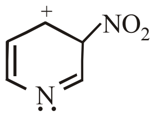
(c) Only 6π electrons are involved in resonance

(d) Any of the 6 electrons

42. Which of the following is more stable?



I



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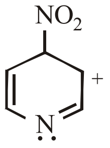
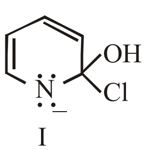


III

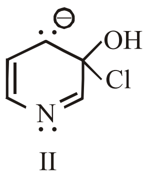
(a) I (b) II

(c) III (d) all are equally stable

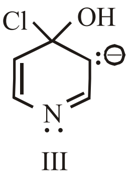
43. Which of the following is least stable?



I



II



III

(a) I (b) II (c) III (d) None

44. The revese of heterolytic cleavage is called

(a) ionic bonding

(b) covalent bonding

(c) coordinate covalent bonding

(d) none

45. Which of the following is not a reaction intermediate?

(a) $C_2H_5\overset{\bar{\cdot\cdot}}{C}H_2$ (b) $C_2H_5-\overset{\bullet}{\underset{\bullet}{C}}-H$

(c) $C_2H_5\overset{\cdot\cdot}{C}-H$ (d) None

46. Which of the typical intermediate is *sp* hybridised?

(a) Carbanion (b) Free radical

(c) Triplet carbene (d) Singlet carbene

47. Presence of electron-withdrawing substituents

(a) stabilizes carbocations, carbanions as well as free radicals

(b) stabilizes carbocations and carbanions

(c) stabilizes carbocations and free radicals

(d) stabilizes carbanions

48. The decreasing order of stability among following is

(i) $CH_3CH_2^-$ (ii) $CH_2 = \bar{C}H$

(iii) $CH \equiv \bar{C}$

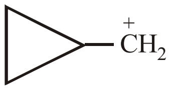
(a) (i) > (ii) > (iii) (b) (ii) > (iii) > (i)

(c) (iii) > (ii) > (i) (d) all equal

49. Arrange the following carbocations in decreasing order of stability

$\underset{I}{CH_2 = CH\overset{+}{C}H_2}$ $\underset{II}{CH_2 = \overset{+}{C}H}$ $\underset{III}{(CH_3)_3\overset{+}{C}}$

$\underset{IV}{Ph_3\overset{+}{C}}$



V

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

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

50. The correct order of increasing stability of the following carbanions is

$\underset{I}{CH_2 = CH\overset{\ominus}{C}H_2}$ $\underset{II}{CH_2 = \overset{\ominus}{C}H}$

$\underset{III}{(CH_3)_3\bar{C}}$ $\underset{IV}{Ph_3\bar{C}}$ $\underset{V}{\bar{C}H_3}$

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

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

MARK YOUR RESPONSE	39. ⓐⓑⓒⓓ	40. ⓐⓑⓒⓓ	41. ⓐⓑⓒⓓ	42. ⓐⓑⓒⓓ	43. ⓐⓑⓒⓓ
	44. ⓐⓑⓒⓓ	45. ⓐⓑⓒⓓ	46. ⓐⓑⓒⓓ	47. ⓐⓑⓒⓓ	48. ⓐⓑⓒⓓ
	49. ⓐⓑⓒⓓ	50. ⓐⓑⓒⓓ			

51. The correct order for decreasing stability of the following free radicals is

$(CH_3)_3\dot{C}$ I

$C_6H_5\dot{C}H_2$ II

$CH_2=CH\dot{C}HCH_3$ III

$CH_2=CH\dot{C}(CH_3)_2$ IV

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

52. Which of the following is a correct statement?

(a) Singlet dimethylcarbene, $(CH_3)_2C:$, is more satable than the triplet $(CH_3)_2\overset{\bullet}{\underset{\bullet}{C}}$

(b) Singlet difluorocarbene, $F_2C:$ is less stable than the corresponding triplet

(c) Both of the statements are true

(d) None is true

53. The correct order for decreasing stability for the following singlet carbenes is

(a) $:CF_2 > :CCl_2 > :CBr_2$
(b) $:CBr_2 > :CCl_2 > :CF_2$
(c) $:CF_2 \approx :CCl_2 > :CBr_2$
(d) $:CF_2 = :CCl_2 = :CBr_2$

54. Arrange the following compounds in decreasing order of C–Cl bond length.

CH_3-CH_2-Cl I

C_6H_5Cl II

$CH_2=CHCl$ III

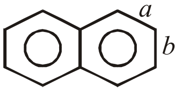
(a) I > II > II
(b) III > II > I
(c) I > III > II
(d) I = II = III

55. Which of the C–C single bond is strongest in

$H_3C\overset{a}{-}CH=CH\overset{b}{-}CH=CH\overset{c}{-}CH_3$

(a) *a*
(b) *b*
(c) *c*
(d) all equal

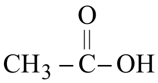
56. Predict the relative bond lengths *a* and *b*, in naphthalene



(a) $a > b$
(b) $a < b$
(c) $a = b$
(d) none of these

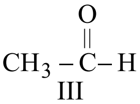
57. The C–O bond lengths in the following three compounds is

CH_3-OH I



$CH_3-\overset{\overset{\displaystyle O}{\|}}{C}-OH$

II

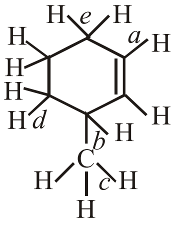


$CH_3-\overset{\overset{\displaystyle O}{\|}}{C}-H$

III

(a) I > II > III
(b) I > III > II
(c) I > II = III
(d) all equal

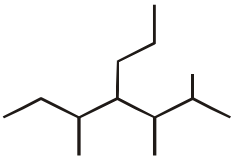
58. The following structure has five different types of C–H bonds, marked *a* to *e*



Arrange the five C–H bonds in decreasing order of their bond energy.

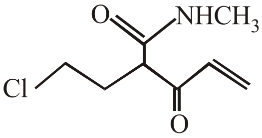
(a) $a > b > d > e > c$
(b) $a > c > b > d = e$
(c) $a > c > d > e > b$
(d) $a > b > c > d > e$

59. The correct IUPAC name for



(a) 5-methyl -4-(1'-2'-demethylpropyl) heptane
(b) 3-methyl-4-(1',2'-dimethylpropyl) heptane
(c) 2,3,5-trimethyl-4-propylheptane
(d) 4-propyl-2,3,5-trimethylpeptane

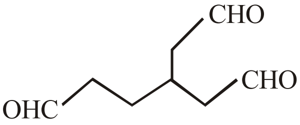
60. IUPAC name



is

(a) 4- Acetamido-6-chloropexen-3-one
(b) 4-Chloromethyl-1-methylamono-1-oxohent-4-en-3one
(c) N-Methyl-2-(2'-chloroethyl)-3-keto-4-pentenamide
(d) 4-Chloroethyl-3-keto-5-methylamidopentene

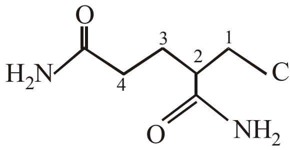
61. The correct IUPAC name for



is

(a) 3-(Formylmethyl) hexane -1, 6-dial
(b) 2-(Formylmethyl) butane-1, 4-dial
(c) 2-(Formylmethyl) butane-1, 4-dicarbaldehyde
(d) None of the three

MARK YOUR RESPONSE	51. ⓐⓑⓒⓓ	52. ⓐⓑⓒⓓ	53. ⓐⓑⓒⓓ	54. ⓐⓑⓒⓓ	55. ⓐⓑⓒⓓ
	56. ⓐⓑⓒⓓ	57. ⓐⓑⓒⓓ	58. ⓐⓑⓒⓓ	59. ⓐⓑⓒⓓ	60. ⓐⓑⓒⓓ
	61. ⓐⓑⓒⓓ				

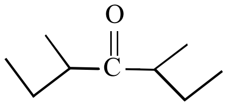
62. IUPAC name for  is

(a) 3-Carbamoylhexane-1, 6-dicarboxamide

(b) Butane - 1, 2, 4- tricarboxamide

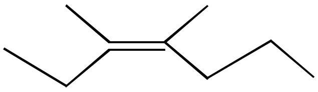
(c) 1, 2, 4-Tricarbamoylbutane

(d) None of the three

63.  is

(a) di-sec-butyl ketone	(b) di-ter-butyl ketone
(c) di -isopropyl ketone	(d) di-sec-butyl aldehyde

64. IUPAC name of the following compound is

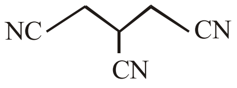


(a) *trans*-3, 4 dimethyl-2-heptene

(b) *cis*-4, 5-dimethyl-4-heptene

(c) *cis*-3, 4-dimethyl-3-heptene

(d) *trans*-4, 5-dimethyl-4-heptene

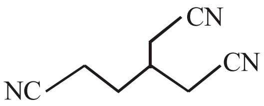
65. IUPAC name for  is

(a) 2-Cyanopropane- 1, 2-dinitrile

(b) Propane -1, 2, 3- tricarbonitrile

(c) Pentane-1, 3, 5- trinitrile

(d) 3-Cyanopenfane -1, 5-dinitrile

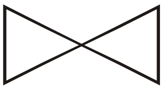
66. IUPAC neme for 

(a) 2-(Cyanomethyl) butane-1, 4-dicarbonirile

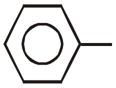
(b) 2-(Cyanomethyl) butane-1, 4-dinitrile

(c) 3-(Cyanomethyl) hexanedinitrile

(d) 4-(Cyanomethyl) hexanedinitrile

67. IUPAC name for  is

(a) Spiro [2.2] propane	(b) Spiro [2.2] pentane
(c) 1, 1-Dicyclopropane	(d) Spiro [2.0] propane

68. IUPAC name for  CH$_2$COOH is

(a) phenylacetic acid	(b) 2-phenylethanoic acid
(c) benzylformic acid	(d) benzoacetic acid

69. Which of the following is true regarding hyperconjugation, also known as no-bond resonance?

(i) Like inductive effect it involves donation of electrons through σ bonds

(ii) Hyperconjugation involves overlapping of filled orbitals with the empty *p* orbital of the carbocation

(iii) Like resonance, it involves displacement of π or lone pair of electrons to the carbon bearing positive charge

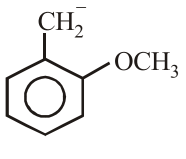
(iv) It involves delocalisation of σ and π- electrons

(a) (ii) and (iv)	(b) (ii)
(c) (iii)	(d) none

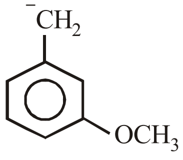
70. Hyperconjugation explains the stability of

(a) Carbocations	(b) Carbanions
(c) Free radicals	(d) Two of the three

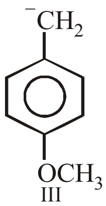
71. Arrange the following in decreasing order of stability.



I



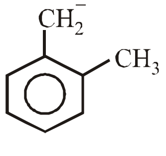
II



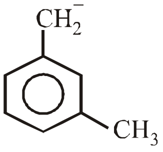
III

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

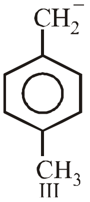
72. The correct order of stability of the three isomeric carbanions is



I



II

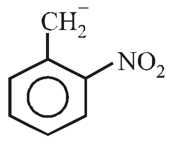


III

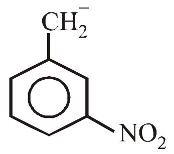
(a) I < II < III	(b) I > III > II
(c) II > I > III	(d) II > III > I

MARK YOUR RESPONSE					
	62. ⓐⓑⓒⓓ	63. ⓐⓑⓒⓓ	64. ⓐⓑⓒⓓ	65. ⓐⓑⓒⓓ	66. ⓐⓑⓒⓓ
	67. ⓐⓑⓒⓓ	68. ⓐⓑⓒⓓ	69. ⓐⓑⓒⓓ	70. ⓐⓑⓒⓓ	71. ⓐⓑⓒⓓ
	72. ⓐⓑⓒⓓ				

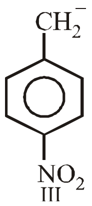
73. The three carbanions follows which order of stability



I



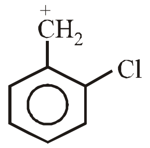
II



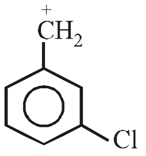
III

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

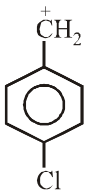
74. The correct arrangement for the relative stability of the three carbocations is



I



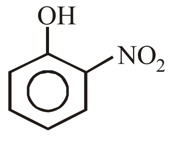
II



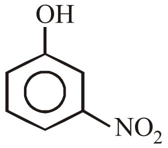
III

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

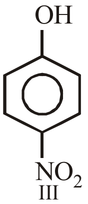
75. Arrange the following phenols in order of their increasing acidity.



I



II



III

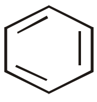
(a) I > III > II (b) I > II > III
(c) III > I > II (d) III > II > I

76. α-Hydrogen is most acidic in

(a) CH_3CHO (b) CH_3COCH_3
(c) CH_3COCH_2CHO (d) $CH_3COCH_2COOCH_3$

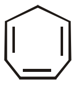
77. Which of the following has maximum resonance energy ?

(a)



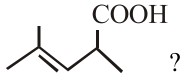
(b)

(c)



(d) All equal

78. Which type of isomerism is possible in the compound



?

(a) Geometrical (b) Optical
(c) Both (d) None

79. Which property is responsible for the racemisation of an optically active compound ?

(a) Enthalpy (b) Entropy
(c) Both (d) Presence of symmetry

80. Allyl isonitrile has

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

81. The maximum number of carbon atoms arranged linearly in the molecule, $CH_3C \equiv C - CH_2 - CH = C = CH_2$

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

82. Organic compound of the molecular formula $C_2H_2Br_2$ can exist in how many isomeric forms ?

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

83. Possible number of stereoisomers of glucose are

(a) 2 (b) 4
(c) 8 (d) 16

84. Keto-enol tautomerism is observed in

(a) $C_6H_5COC_6H_5$ (b) $C_6H_5COCH=CH_2$
(c) $C_6H_5COCH_2COCH_3$ (d) both (b) and (c)

85. The possible number of isomers of acyclic compounds for the molecular formula C_4H_6 is

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

86. The possible number of isomers of cyclic compounds for the molecular formula C_4H_6 can be

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

87. Which pair of isomerism is not possible together?

(a) Ring-chain and functional
(b) Geometrical and optical
(c) Metamerism and functional
(d) Metamerism and chain

MARK YOUR RESPONSE	73. ⓐⓑⓒⓓ	74. ⓐⓑⓒⓓ	75. ⓐⓑⓒⓓ	76. ⓐⓑⓒⓓ	77. ⓐⓑⓒⓓ
	78. ⓐⓑⓒⓓ	79. ⓐⓑⓒⓓ	80. ⓐⓑⓒⓓ	81. ⓐⓑⓒⓓ	82. ⓐⓑⓒⓓ
	83. ⓐⓑⓒⓓ	84. ⓐⓑⓒⓓ	85. ⓐⓑⓒⓓ	86. ⓐⓑⓒⓓ	87. ⓐⓑⓒⓓ

88. How many isomeric nitroalkanes are possible for the molecular formula $C_4H_9NO_2$?

(a) 1 (b) 2

(c) 3 (d) 4

89. The total number of bicyclic isomeric compounds for the formula C_7H_{12} is

(a) 2 (b) 3

(c) 4 (d) 5

90. Which of the following statement is not true?

(i) Chain as well as position isomerism is possible between two isomers.

(ii) Tautomerism is considered as constitutional isomerism

(iii) Diastereomers are possible in geometrical as well as optical isomers.

(iv) Optical isomerism is possible only in compounds having chiral carbon atom

(a) only (i) (b) (i) and (iv)

(c) (i), (iii) and (iv) (d) None of these

91. The number of stereocenters in fumaric acid is

(a) 1 (b) 2

(c) either of the two (d) zero

92. Which of the following statement is false?

(a) Structural isomers have same bonding sequence

(b) Stereoisomers have different bonding sequence

(c) Both of the two

(d) None of the two

93. Which of the following statement is true?

(i) Conversion of one conformational isomer to other requires less energy than configurational isomers

(ii) Conversion of one configurational isomer to other requires more energy than conformational isomers

(iii) Conversion of one geometrical isomer to other requires more energy than conformational isomers

(iv) Energy requirement is same in all the above three cases

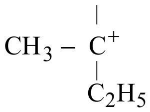
(a) (i) and (iii) (b) (ii) and (iii)

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

94. Which of the following statement is true ?

(i) All stereocenters are chiral centers

(ii) All chiral centers are stereocenters

(iii) 
$CH_3-\overset{\overset{H}{|}}{\underset{\underset{C_2H_5}{|}}{C^+}}$ has one chiral carbon

(iv) The term chiral center can be applied to other atoms too

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

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

95. Which of the following reactions occur with inversion of configuration?

(a) $CH_3CH_2CH(Cl)CH_3 + OH^- \longrightarrow CH_3CH_2CH(OH)CH_3 + Cl^-$

(b) $CH_3CH_2CH(OH)CH_2Br + OH^- \longrightarrow CH_3CH_2CH(OH)CH_2OH + Br^-$

(c) $CH_3CH_2CH(OH)CH_3 + CH_3COCl \longrightarrow CH_3CH_2CH(OCOCH_3)CH_3 + HCl$

(d) $CH_3CH_2CH = CH_2 + D_2 \xrightarrow{\text{catalyst}} CH_3CH_2CH(D)CH_2D$

96. Which of the following is true?

(a) An achiral compound can have chiral centers

(b) An optically inactive species must be achiral

(c) A compound with the R configuration is always the (+) – enantiomer

(d) The change from R configuration of a reactant to S configuration of the product always indicates an inversion of configuration

97. Pick up the correct statement(s)

(i) A reaction catalyzed by an enzyme always gives an optically active product

(ii) When an achiral molecule is conveted to a chiral molecule, the product is always racemic

(iii) Racemization of an enantiomer can only occur by breaking of at least one bond to the chiral center

(iv) Conversion of an erythro to threo stereoisomer always occurs by inversion at one chiral carbon

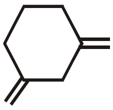
(v) A D enantiomer rotates the plane of polarized light to the right and an L enantiomer to the left

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

(c) (i), (ii), (iii) and (iv) (d) all of these

MARK YOUR RESPONSE					
	88. ⓐⓑⓒⓓ	89. ⓐⓑⓒⓓ	90. ⓐⓑⓒⓓ	91. ⓐⓑⓒⓓ	92. ⓐⓑⓒⓓ
	93. ⓐⓑⓒⓓ	94. ⓐⓑⓒⓓ	95. ⓐⓑⓒⓓ	96. ⓐⓑⓒⓓ	97. ⓐⓑⓒⓓ

98. The number of stereoisomers formed by the catalytic hydrogenation of both double bonds in the following compound will be



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

99. How many *meso* forms are possible for an organic compound of the formula $C_6H_{12}Cl_2$?

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

100. A racemic alcohol is treated with (S) – lactic acid. The possible number of products and their relation to each other will be

(a) 1, racemates (b) 1, S–lactate
(c) 2, diastereomers (d) 2, racemates

101. Which of the following is false?

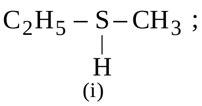
(a) The value of specific rotation of a molecule can be deduced from its structure
(b) The sign of specific rotation of a molecule can be deduced from its structure
(c) Both of the above
(d) None of the two

102. Which of the following is true?

(i) The observed rotation of a solution of an optically active compound doubles on doubling the concentration of the solution
(ii) The observed rotation of a solution of an optically active compound doubles on doubling the length of the tube of polarimeter.
(iii) Both of the above statements are true also for specific rotation
(iv) None of the above statements is true for specific rotation

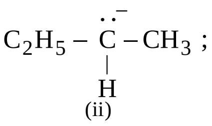
(a) (i), (ii) and (iii) (b) (i), (ii) and (iv)
(c) only (i) (d) only (ii)

103. Which of the following can be resolved?



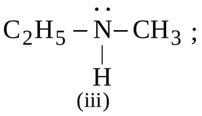
$C_2H_5-\underset{\underset{H}{|}}{S}-CH_3$;

(i)



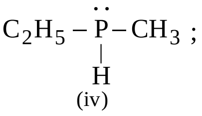
$C_2H_5-\underset{\underset{H}{|}}{\overset{\cdot\cdot\,-}{C}}-CH_3$;

(ii)



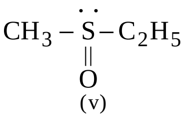
$C_2H_5-\underset{\underset{H}{|}}{\overset{\cdot\cdot}{N}}-CH_3$;

(iii)



$C_2H_5-\underset{\underset{H}{|}}{\overset{\cdot\cdot}{P}}-CH_3$;

(iv)



$CH_3-\underset{\underset{O}{\|}}{\overset{\cdot\cdot}{S}}-C_2H_5$

(v)

(a) (i), (iv) and (v) (b) (i), (iii) and (iv)
(c) (i), (ii), (iii) and (iv) (d) None of these

104. Which of the following does not exhibit *cis-trans* isomerism?

(a) $C_6H_5CH \quad NOH$ (b) $C_6H_5N \quad NC_6H_5$
(c)  (d) None of the three

105. If 50 ml methanol is mixed with 50 ml water, the volume of the resulting solution is

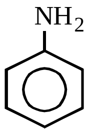
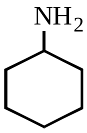
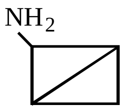
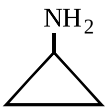
(a) exactly 100 ml
(b) slightly more than 100 ml
(c) slightly less than 100 ml
(d) not certain

106. Which of the following is polar aprotic solvent ?

HCOOH	$(CH_3)_2CO$	SO_2	$HCONH_2$
I	II	III	IV

(a) only III (b) II and III
(c) II, III and IV (d) None

107. Which of the following is most basic ?

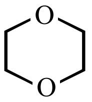
(a) 
(b) 
(c) 
(d) 

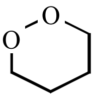
108. pK_a value of trifluoroacetic acid is likely to be

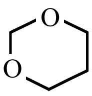
(a) zero (b) 1 – 3
(c) 3 – 5 (d) 5 – 7

MARK YOUR RESPONSE					
	98.ⓐⓑⓒⓓ	99.ⓐⓑⓒⓓ	100.ⓐⓑⓒⓓ	101.ⓐⓑⓒⓓ	102.ⓐⓑⓒⓓ
	103.ⓐⓑⓒⓓ	104.ⓐⓑⓒⓓ	105.ⓐⓑⓒⓓ	106.ⓐⓑⓒⓓ	107.ⓐⓑⓒⓓ
	108.ⓐⓑⓒⓓ				

109. Which of the following is liable to explode on heating ?


I

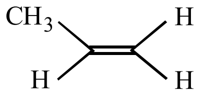

II

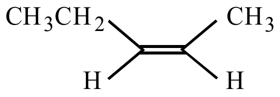

III

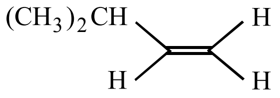
(a) II (b) III
(c) II and III (d) None

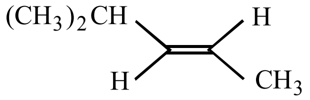
110. Directing influence of the methyl group can be explained on the basis of
(a) inductive effect (b) electromeric effect
(c) resonance effect (d) no-bond resonance

111. Which of the following is most stable ?

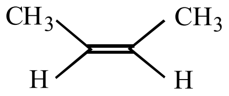
(a) 

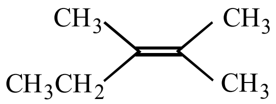
(b) 

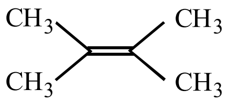
(c) 

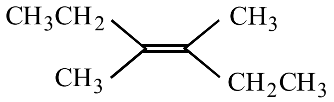
(d) 

112. Most stable alkene is

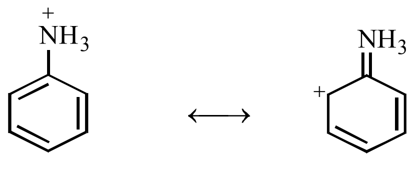
(a) 

(b) 

(c) 

(d) 

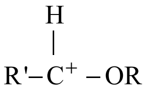
113. Pick up the correct statement regarding the following resonating structures of the anilinium ion

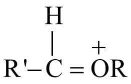

I II

(a) Structure II is not acceptable because carbonium ions are less stable than ammonium ions
(b) II is not acceptable because it is non-aromatic
(c) II is not acceptable because here nitrogen has 10 valence electrons
(d) II is an acceptable canonical structure.

114. Which type of delocalization of electrons is not possible ?
(a) π-electrons to σ-bond
(b) π-electrons to an electronegative atom
(c) σ-electrons to σ-bond
(d) all the three are possible

115. Which of the cations in more stable ?

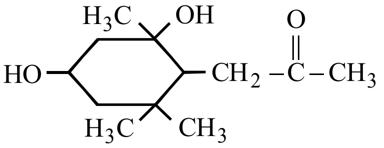
(a) 
$R'-\overset{\overset{H}{|}}{C^{+}}-OR$

(b) 
$R'-\overset{\overset{H}{|}}{C}=\overset{+}{O}R$

(c) both equal (d) both are unstable

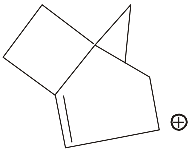
116. The number of isomers of the compound C_2BrFCl is
(a) 3 (b) 4
(c) 5 (d) 6

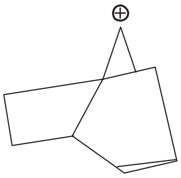
117. Total number of stereoisomers for the compound

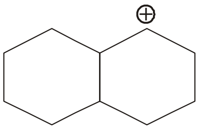

is

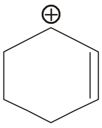
(a) 2 (b) 4
(c) 8 (d) 16

118. Which of the following is non-classical carbocation?

(a) 

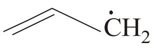
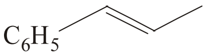
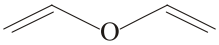
(b) 

(c) 

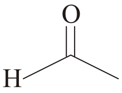
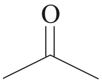
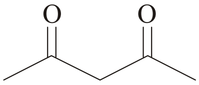
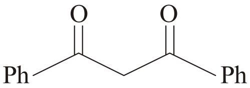
(d) 

MARK YOUR RESPONSE	109.ⓐⓑⓒⓓ	110.ⓐⓑⓒⓓ	111.ⓐⓑⓒⓓ	112.ⓐⓑⓒⓓ	113.ⓐⓑⓒⓓ
	114.ⓐⓑⓒⓓ	115.ⓐⓑⓒⓓ	116.ⓐⓑⓒⓓ	117.ⓐⓑⓒⓓ	118.ⓐⓑⓒⓓ

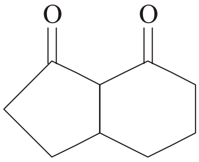
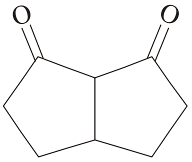
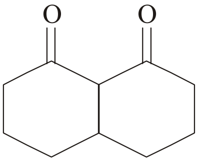
119. Which of the following compounds has a cross conjugation?

(a) 
(b) 
(c) 
(d) CO_3^{2-}

120. Maximum enol content is in

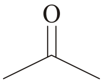
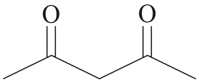
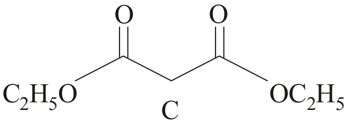
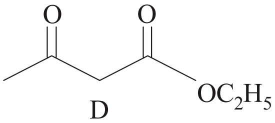
(a) 
(b) 
(c) 
(d) 

121. The correct order of the enol content in following molecules is


(i)

(ii)

(iii)

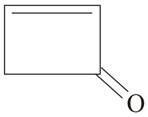
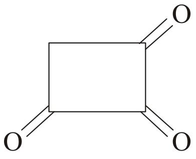
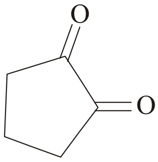
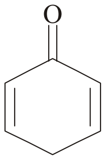
(a) (i) > (ii) > (iii)
(b) (iii) > (ii) > (i)
(c) (iii) > (i) > (ii)
(d) All equal

122. The correct order of enol content in the four compounds A to D is


A

B

C

D

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

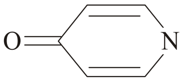
123. The enol form of which structure is unstable?

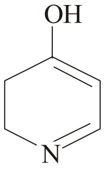
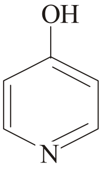
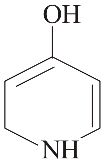
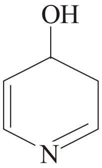
(a) 
(b) 
(c) 
(d) 

124. The correct IUPAC name of

$CH_3-O-CH_2-O-CH_2-O-CH_2CH_3$ is

(a) methoxyethoxy ethylene oxide
(b) 2, 4, 6–trioxaoctane
(c) 3, 5, 7–trioxaoctane
(d) 2, 4, 6–trietherpentane

125. The enol form of  is

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

126. Which of the following statement is true?

(a) $CH_3CH_2S^-$ is a weaker base and less nucleophilic than $CH_3CH_2O^-$
(b) $CH_3CH_2S^-$ is a weaker base but stronger nucleophile than $CH_3CH_2O^-$
(c) $CH_3CH_2S^-$ is a stronger base but weaker nucleophile than $CH_3CH_2O^-$
(d) $CH_3CH_2S^-$ is a stronger base as well as stronger nucleophile than $CH_3CH_2O^-$

127. Which of the following are isoelectronic ?

(a) $HC\equiv CH$ and HCN
(b) CH_3CH_2CN and $CH_3C\equiv CCH_3$
(c) Both
(d) None

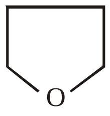
128. $Me_2CHOCMe_3 \xrightarrow{HI} X+Y$

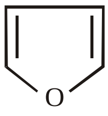
Predict the nature of product and the type of reaction involved in their formation.

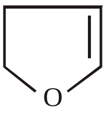
(a) Me_2CHI and Me_3COH, formed by S_N1 reaction
(b) Me_2CHOH and Me_3CI, formed by S_N1 reaction
(c) Me_2CHI and Me_3COH, formed by S_N2 reaction
(d) Me_2CHOH and Me_3CI, formed by S_N2 reaction

MARK YOUR RESPONSE					
	119.ⓐⓑⓒⓓ	120.ⓐⓑⓒⓓ	121.ⓐⓑⓒⓓ	122.ⓐⓑⓒⓓ	123.ⓐⓑⓒⓓ
	124.ⓐⓑⓒⓓ	125.ⓐⓑⓒⓓ	126.ⓐⓑⓒⓓ	127.ⓐⓑⓒⓓ	128.ⓐⓑⓒⓓ

129. Arrange the following in decreasing order of solubility in water


I


II


III

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

(c) II > III > I (d) All are equally soluble

130. The decreasing order of acidic character of the compounds is

$CH_3C \equiv CH$, MeOH, Me_2CHOH, Me_3COH, H_2O

(a) $CH_3C \equiv CH$ Me_3COH Me_2CHOH MeOH H_2O

(b) MeOH Me_2CHOH Me_3COH H_2O $CH_3C \equiv CH$

(c) Me_3COH Me_2CHOH MeOH H_2O $CH_3C \equiv CH$

(d) H_2O MeOH Me_2CHOH Me_3COH $CH_3C \equiv CH$

131. Which of the following statement is true regarding aspirin, a commonly used antipyretic and analgesic? Given pK_a for aspirin = 3.5 ; pH in stomach and small intestine is 2.5 and 8 respectively.

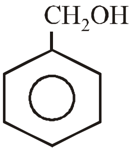
(a) It is completely ionized in the stomach and almost unionized in the small intestine

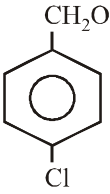
(b) It is ionized in the small intestine and almost unionized in the stomach.

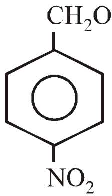
(c) It is ionized in the stomach and almost unionized in the small intestine

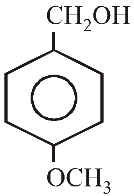
(d) It is ionized neither in stomach nor in intestine

132. The basic character of the following alcohols is


I


II


III


IV

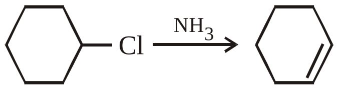
(a) IV > I > II > III (b) II > III > IV > I

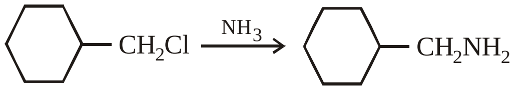
(c) IV > II > III > I (d) I > II > III > IV

133. Which reaction seems to be incorrect?

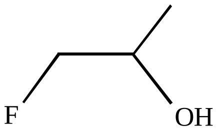
(a) $Me_3CCl \xrightarrow{NH_3} Me_3CNH_2$

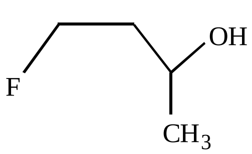
(b) $Me_3CCl \xrightarrow{NH_3} Me_2C \quad CH_2$

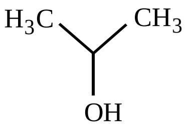
(c) 

(d) 

134. Arrange the following alcohols in order of their decreasing tendency to form carbocation.


I


II


III

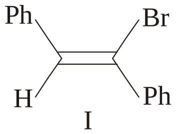
$C_6H_5CH_2OH$

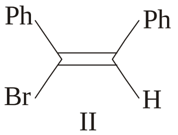
IV

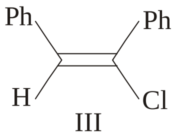
(a) I > II > III > IV (b) IV > III > I > II

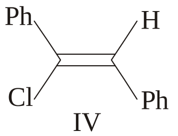
(c) IV > III > II > I (d) II > I > IV > III

135. Pick up the correct order about the rate of E2 reaction of the following four compounds


I


II

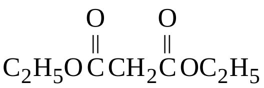

III


IV

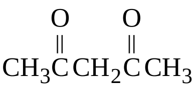
(a) II > I > III > IV (b) II > IV > I > III

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

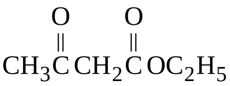
136. The correct decreasing order of the pK_a values of the compounds (i), (ii) and (iii) should be


$C_2H_5O\overset{\overset{O}{\|}}{C}CH_2\overset{\overset{O}{\|}}{C}OC_2H_5$

(i)


$CH_3\overset{\overset{O}{\|}}{C}CH_2\overset{\overset{O}{\|}}{C}CH_3$

(ii)


$CH_3\overset{\overset{O}{\|}}{C}CH_2\overset{\overset{O}{\|}}{C}OC_2H_5$

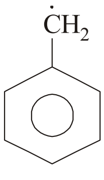
(iii)

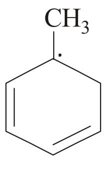
(a) (i) > (ii) > (iii) (b) (ii) > (iii) > (i)

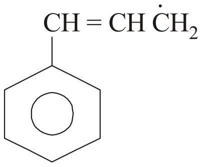
(c) (i) = (iii) > (ii) (d) (i) > (iii) > (ii)

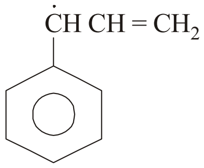
MARK YOUR RESPONSE	129.ⓐⓑⓒⓓ	130.ⓐⓑⓒⓓ	131.ⓐⓑⓒⓓ	132.ⓐⓑⓒⓓ	133.ⓐⓑⓒⓓ
	134.ⓐⓑⓒⓓ	135.ⓐⓑⓒⓓ	136.ⓐⓑⓒⓓ		

137. Which of the following is most stable?

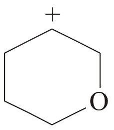
(a) 

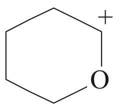
(b) 

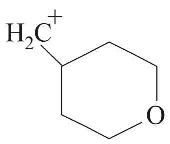
(c) 

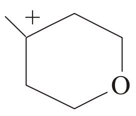
(d) 

138. Which of the following is most stable?

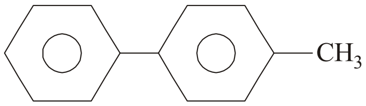
(a) 

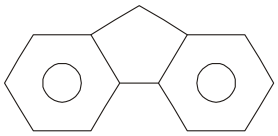
(b) 

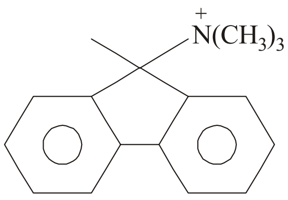
(c) 

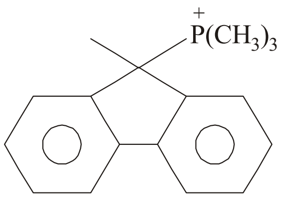
(d) 

139. Which of the following is most acidic?

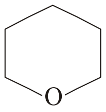
(a) 

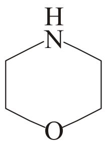
(b) 

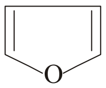
(c) 

(d) 

140. In which of the following, oxygen atom is sp^2 hybridized ?

(a) $CH_3CH_2-O-CH_2CH_3$ (b) 

(c) 

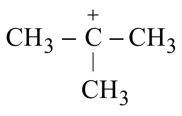
(d) 

141. Which of the following alkyl halide gives E1cB elimination reaction readily ?

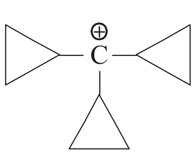
(a) CH_3CH_2F (b) F_3CCHF_2

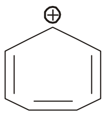
(c) $(CH_3)_2CHCH_2I$ (d) $(CH_3)_3CBr$

142. Which of the following carbocations is most stable ?

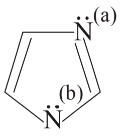
(a) 
$CH_3-\overset{+}{\underset{CH_3}{C}}-CH_3$

(b) $C_6H_5-\overset{+}{C}H-C_6H_5$

(c) 

(d) 

143. Pick up the correct statement regarding imidazole (I)



(a) It is an aromatic compound and both lone pair of electrons on N are delocalised

(b) Lone pair marked (*a*) undergoes protonation more readily than marked (*b*)

(c) Lone pair marked (*b*) is protonated more readily than (*a*)

(d) Both lone pairs are protonated easily

MARK YOUR RESPONSE	137.ⓐⓑⓒⓓ	138.ⓐⓑⓒⓓ	139.ⓐⓑⓒⓓ	140.ⓐⓑⓒⓓ	141.ⓐⓑⓒⓓ
	142.ⓐⓑⓒⓓ	143.ⓐⓑⓒⓓ			

B

COMPREHENSION TYPE

This section contains groups of questions. Each group is followed by some multiple choice questions based on a paragraph. Each question has 4 choices (a), (b), (c) and (d) for its answer, out of which ONLY ONE is correct.

PASSAGE - 1

A mixture of two isomeric carboxylic acids can't be separated by usual methods. However, when this mixture is treated with optically active quinine, it forms two isomeric salts X and Y. The two salts are separated by fractional crystallisation and separately acidified with hydrochloric acid to form amine and carboxylic acids.

1. The compounds A and B can be
- (a) Succinic acid and methylmalonic acid
- (b) Maleic and fumaric acids
- (c) (+)-Tartaric acid and (–)-tartaric acid
- (d) Any of the above

2. The mixture of the two compounds X and Y formed in the above reaction is
- (a) optically acitive and one is the mirror image of other
- (b) optically active but one is not the mirror image of other
- (c) optically inactive becaus--
- (d) optically inactive because of absence of chirality

3. The separation of the two compounds X and Y is due to
- (a) Difference in their melting points
- (b) Difference in their boiling points
- (c) Difference in their solubility
- (d) Difference in their specific rotation

PASSAGE - 2

Amines are derivatives of ammonia and are classified as 1°, 2°, and 3°. Primary and secondary (but not tertiary amines) form intermolecular hydrogen bonds and thus they boil at higher temperatures than expected. Like ammonia, all amines are basic, although they differ in their basic nature. As amines are considered as derivatives of ammonia, quaternary ammonium salts are considered as derivatives of ammonium salts. Only the quaternary ammonium salts can show optical activity.

4. Which of the following statement is correct?
- (a) All classes of amines form hydrogen bonds with each other
- (b) Only primary and secondary amines form hydrogen bonds with water
- (c) All classes of amines can form hydrogen bonds with water
- (d) All amines are completely soluble in water

5. Which of the following statement is false about $NR_1\,R_2\,R_3$ molecule ?
- (a) The molecule is optically inactive
- (b) N is tetrahedrally hybridised
- (c) The molecule is not superimposable on its mirror image
- (d) None of the three

6. Which of the following shows configurational isomerism?
- (a) Diethyldimethylammonium iodide
- (b) Methylethylpropylamine
- (c) Methylallylphenylbenzyl ammonium bromide
- (d) None of the above

7. Methylethylpropyl amine is optically inactive because
- (i) It is not tetrahedral
- (ii) Its molecule is superimposable on its mirror image
- (iii) The enantiomers are rapidly interconverted
- (iv) The nitrogen is sp^2 hybridized

Which of the above statement(s) is(are) true?
- (a) Only (i)
- (b) Only (iii)
- (c) (ii) and (iii)
- (d) All the four

8. Aniline is less basic than ethyl amine because
- (a) Electron pair on N is sterically hindered.
- (b) The aromatic ring donates electrons to the nitrogen via resonance
- (c) The aromatic ring produces positive charge on N via resonance
- (d) Every C in aniline is sp^2 hybridized

PASSAGE - 3

Although the carboxyl group consists of C=O and – OH, it is the – OH that undergoes change, either loss of H^+ or replacement by another group. However, the carbonyl group markedly influences the reactions of carboxylic acids. The presence of the C = O part is also responsible for nucleophilic substitution reactions in acid derivatives.

Presence of an electron withdrawing group increases the acidity of aliphatic as well as aromatic acids. On the other hand, electron releasing groups imparts opposite effect.

9. The marked acidity of RCOOH over ROH is due to the presence of
- (a) – OH
- (b) C = O
- (c) Both
- (d) None

MARK YOUR RESPONSE	1. ⓐⓑⓒⓓ	2. ⓐⓑⓒⓓ	3. ⓐⓑⓒⓓ	4. ⓐⓑⓒⓓ	5. ⓐⓑⓒⓓ
	6. ⓐⓑⓒⓓ	7. ⓐⓑⓒⓓ	8. ⓐⓑⓒⓓ	9. ⓐⓑⓒⓓ	

10. Chloroacetic acid is more acidic than acetic acid because
- (a) Electron withdrawing group destabilizes the acid
- (b) Electron donating group stabilizes the acid
- (c) Electron withdrawing group stabilizes the carboxylate ion
- (d) All the three

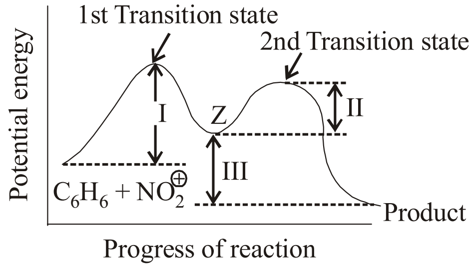
11. Which statement is correct when an acid weakening group is present in benzoic acid?
- (a) Acid weakening groups activate the ring towards electrophilic substitution
- (b) Acid weakening groups deactivate the ring towards electrophilic substitution
- (c) Acid weakening groups activate the ring toward nucleophilic substitution
- (d) None of the above

12. The C = O part in carboxylic acids and their derivatives make acyl compounds more reactive than alkyl compounds toward nucleophilic attack because
- (a) The carbonyl group is electron donating
- (b) The alkyl group is electron donating
- (c) Attack of a nucleophile on a flat acyl compound is less sterically hindered
- (d) Tetrahedral carbon atoms cannot have pentavalent transition states

13. Aldehydes and ketones react with nucleophiles to give addition product rather substituion because
- (a) They are more acidic
- (b) They are less acidic
- (c) They are sterically hindered
- (d) The C – H and C – C bonds do not break easily

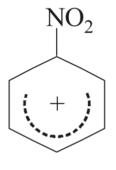
PASSAGE - 4

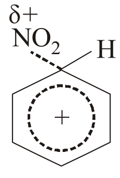
Many organic reactions proceed through more than one intermediates. The overall such reactions consist of two or more separate reactions, viz., (i) reactants ⟶ intermediate, and (ii) intermediate ⟶ products, and thus two or more activation energies will be involved. The energy profile diagram of nitration of benzene with nitrating mixture is given below.

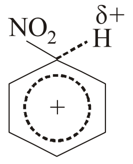


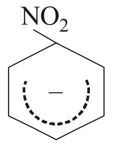
14. The rate determining step corresponds to
- (a) I
- (b) II
- (c) III
- (d) None of the three

15. The species *Z* lying at the assigned point has structure

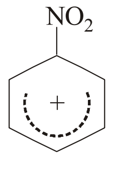
(a)


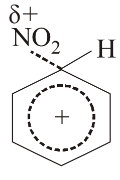
(b)


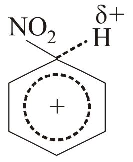
(c)


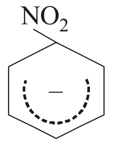
(d)


16. The first transition state has the structure

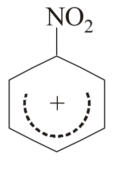
(a)


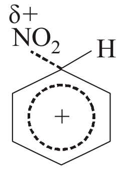
(b)


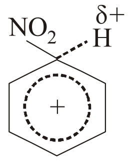
(c)


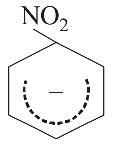
(d)


17. The second transition state has the structure

(a)


(b)


(c)


(d)


18. The reaction is
- (a) endothermic
- (b) exothermic
- (c) neither of the two
- (d) uncertain

MARK YOUR RESPONSE	10. ⓐⓑⓒⓓ	11. ⓐⓑⓒⓓ	12. ⓐⓑⓒⓓ	13. ⓐⓑⓒⓓ	14. ⓐⓑⓒⓓ
	15. ⓐⓑⓒⓓ	16. ⓐⓑⓒⓓ	17. ⓐⓑⓒⓓ	18. ⓐⓑⓒⓓ	

PASSAGE - 5

Hyperconjugation describes the orbital interaction between π-system and the adjacent σ bond of the substituent group in organic compounds. Thus the sufficient condition for the hyperconjugation are

(i) the presence of at least one sp^2-hybrid carbon as in alkenes, carbocation and alkyl free radical.
(ii) the presence of α-carbon, with at least one hydrogen, with respect to sp^2-carbon atom.

More the number of hydrogen atoms attached on the α-carbon(s) of the sp^2-hybrid carbon, more will the hyperconjugative, also called resonating structures of the compound.

Number of resonating structures due to hyperconjugation = $n + 1$, where n is the number of α-hydrogen.

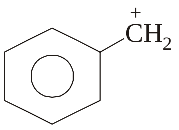
19. Hyperconjugation is possible in

(a) CH_3 (b) $C_6H_5CH_3$
(c) $CH \equiv CH$ (d) $(CH_3)_3CCH=CH_2$

20. Which of the following has highest number of hyperconjugative structures ?

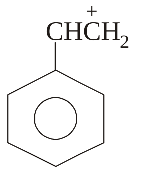
(a) 2-methylbut-2-ene (b) But-2-ene
(c) *tert*-Butyl cation (d) Hex-2-ene

21. Which of the following does not show hyperconjugation ?

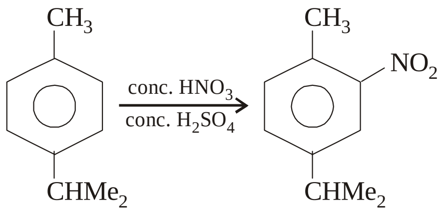
(a) 

(b) $CH_3\dot{C}H_2$

(c) $CH_3CH=CH_2$

(d) 

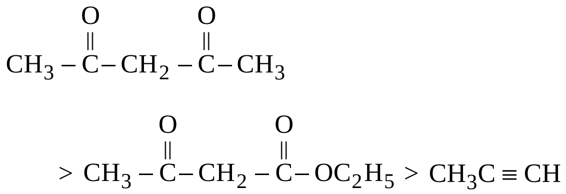
22. Nitration of *p*-isopropyltoluene occurs in the following way



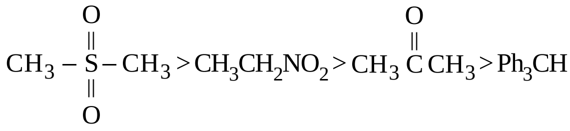
The above reaction can be explained on the basis of

(a) inductive effect of – CH_3 group
(b) inductive effect of – $CHMe_2$ group
(c) hyperconjugation due to – CH_3 group
(d) hyperconjugation due to – $CHMe_2$ group

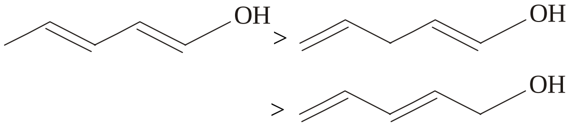
23. Which of the following is correct decreasing order of acidic strength ?

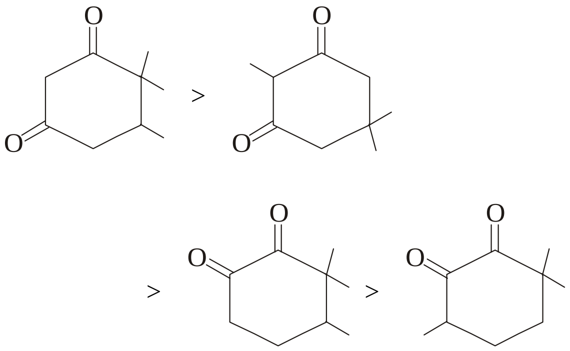
(a) 

$CH_3-\overset{\overset{O}{\|}}{C}-CH_2-\overset{\overset{O}{\|}}{C}-CH_3 > CH_3-\overset{\overset{O}{\|}}{C}-CH_2-\overset{\overset{O}{\|}}{C}-OC_2H_5 > CH_3C\equiv CH$

(b) 

$CH_3-\underset{\underset{O}{\|}}{\overset{\overset{O}{\|}}{S}}-CH_3 > CH_3CH_2NO_2 > CH_3\overset{\overset{O}{\|}}{C}CH_3 > Ph_3CH$

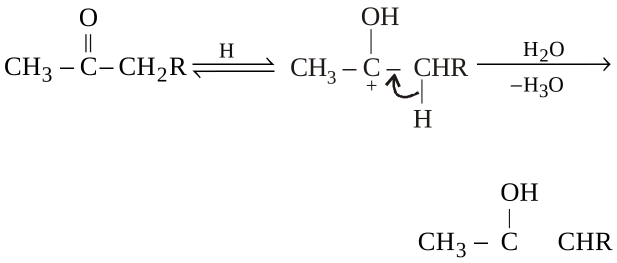
(c) 

(d) 

PASSAGE - 6

In keto-enol tautomerism, the two isomeric forms are interconvertible by the migration of a proton from one atom to other with the simultaneous shifting of bonds. Enolisation can be done in presence of acid or base.

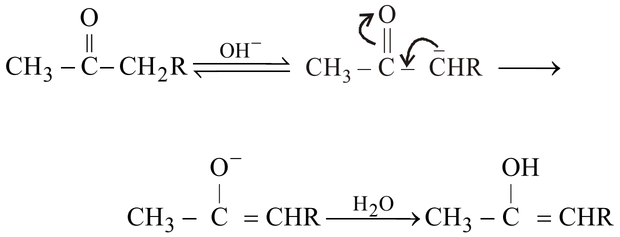
Acid-catalysed enolisation :



$$CH_3-\overset{\overset{O}{\|}}{C}-CH_2R \overset{H}{\rightleftharpoons} CH_3-\underset{+}{\overset{\overset{OH}{|}}{C}}-\underset{\underset{H}{|}}{CHR} \xrightarrow[-H_3O]{H_2O} CH_3-\overset{\overset{OH}{|}}{C}\quad CHR$$

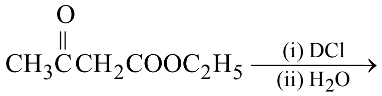
MARK YOUR RESPONSE	19. ⓐⓑⓒⓓ	20. ⓐⓑⓒⓓ	21. ⓐⓑⓒⓓ	22. ⓐⓑⓒⓓ	23. ⓐⓑⓒⓓ

Base-catalysed enolisation :



$$CH_3-\overset{O}{\overset{||}{C}}-CH_2R \overset{OH^-}{\rightleftharpoons} CH_3-\overset{O}{\overset{||}{C}}-\overset{-}{C}HR \longrightarrow$$

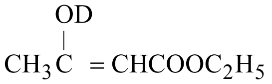
$$CH_3-\overset{O^-}{\overset{|}{C}}=CHR \xrightarrow{H_2O} CH_3-\overset{OH}{\overset{|}{C}}=CHR$$

24. 

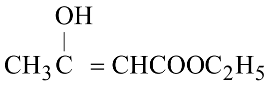
$CH_3\overset{O}{\overset{||}{C}}CH_2COOC_2H_5 \xrightarrow[\text{(ii) } H_2O]{\text{(i) DCl}}$ Product will be

(a) 

$CH_3\overset{OH}{\overset{|}{C}}=C(D)COOC_2H_5$

(b) 

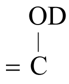
$CH_3\overset{OD}{\overset{|}{C}}=CHCOOC_2H_5$

(c) 

$CH_3\overset{OH}{\overset{|}{C}}=CHCOOC_2H_5$

(d) Mixture of (a), (b) and (c)

25. Conversion of acetylacetone to enolic tautomer having

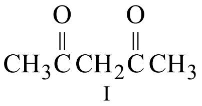


$=\overset{OD}{\overset{|}{C}}$ can be done by treating acetylacetone with

(a) H^+ followed by D_2O (b) D^+ followed by H_2O

(c) OH^- followed by D_2O (d) Both (b) and (c)

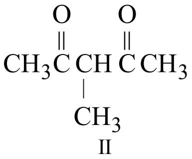
26. Which of the following statement is true regarding relative enolisation of



$CH_3\overset{O}{\overset{||}{C}}CH_2\overset{O}{\overset{||}{C}}CH_3$

I

and



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

II

(a) Both undergo enolisation at the same rate

(b) Enolisation of I is easy as compared to II due to less steric hindrance

(c) Enolisation of II is easy as compared to I due to +I effect of methyl group

(d) Only enolic form of I is stabilised due to hydrogen bonding, hence I undergoes enolisation at a rapid rate

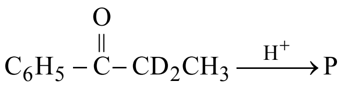
27. The two tautomeric forms of a compound can be differentiated by which reagent(s) ?

(i) Bromine water (ii) NH_2OH

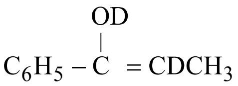
(iii) Neutral $FeCl_3$ (iv) Blue litmus solution

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

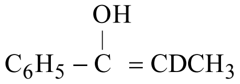
(c) (i), (iii) and (iv) (d) All the four

28. 

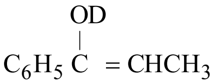
$C_6H_5-\overset{O}{\overset{||}{C}}-CD_2CH_3 \xrightarrow{H^+} P$ is

(a) 

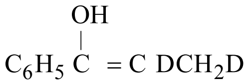
$C_6H_5-\overset{OD}{\overset{|}{C}}=CDCH_3$

(b) 

$C_6H_5-\overset{OH}{\overset{|}{C}}=CDCH_3$

(c) 

$C_6H_5\overset{OD}{\overset{|}{C}}=CHCH_3$

(d) 

$C_6H_5\overset{OH}{\overset{|}{C}}=C\,DCH_2D$

Mark Your Response					
	24. ⓐⓑⓒⓓ	25. ⓐⓑⓒⓓ	26. ⓐⓑⓒⓓ	27. ⓐⓑⓒⓓ	28. ⓐⓑⓒⓓ

C

REASONING TYPE

In the following questions two Statement-1 (Assertion) and Statement-2 (Reason) are provided. Each question has 4 choices (a), (b), (c) and (d) for its answer, out of which ONLY ONE is correct. Mark your responses from the following options:

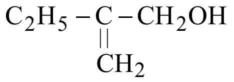
(a) Both Statement-1 and Statement-2 are true and Statement-2 is the correct explanation of Statement-1.

(b) Both Statement-1 and Statement-2 are true and Statement-2 is not the correct explanation of Statement-1.

(c) Statement-1 is true but Statement-2 is false.

(d) Statement-1 is false but Statement-2 is true.

1. **Statement-1** : The IUPAC name for the compound



$C_2H_5-\underset{\underset{CH_2}{||}}{C}-CH_2OH$ is 2-ethylprop-2-en-1-ol

Statement-2 : Ethyl (C_2H_5) rather than methylene (= CH_2) is considered as the substituent group because 'e' of ethyl comes first in alphabetical order than 'm' of methylene.

2. **Statement-1** : The compound, $C_6H_5CH = CHCl$ is called β-chlorostyrene.

Statement-2 : In organic halides, the carbon atom attached to the functional group (halogen atom) is designated as α.

3. **Statement-1** : Enol form of cyclohexane-1, 3, 5-trione is more stable than its keto-form.

Statement-2 : It contains α-hydrogen atoms.

4. **Statement-1** : In contrast to the six equivalent bonds in benzene, the C—C bonds in naphthalene have two lengths : $C_1 - C_2$ is considerably shorter than the $C_2 - C_3$ bond.

Statement-2 : In the resonating structures of napthalene $C_1 - C_2$ bond is double in two of the structures while $C_2 - C_3$ is double in one.

5. **Statement-1** : In benzyne, all the six carbon atoms are sp^2 hybridized.

Statement-2 : It contains a carbon-carbon triple bond.

6. **Statement-1** : Tertiary alkyl carbocations are generally formed more easily than primary carbocations.

Statement-2 : Hyperconjugative as well as inductive effect due to additional alkyl groups stabilize tertiary carbocations.

7. **Statement-1** : Carbanions like ammonia have pyramidal shape.

Statement-2 : The carbon atom carrying negative charge has an octet of electrons.

8. **Statement-1** : The carbocation $CF_3-\overset{+}{C}H_2$ is less stable $\overset{+}{C}F_3$.

Statement-2 : In case of $CF_3-\overset{+}{C}H_2$, the strongly electron-withdrawing $-CF_3$ group intensifies the +ve charge but in case of $\overset{+}{C}F_3$, the lone pairs of electrons on each of the three F-atoms overlap with the empty *p*-orbital of the carbocation carbon thereby dispersing the +ve charge.

9. **Statement-1** : A triplet carbene is more stable than a singlet carbene.

Statement-2 : In triplet carbene, carbon atom is *sp*-hybridized while in singlet carbene it is sp^2 -hybridized.

10. **Statement-1** : Allyl free radical is more stable than a simple alkyl free radical.

Statement-2 : The allyl free radical is stabilized by resonance.

11. **Statement-1** : Free radical chlorination of *n*-butane gives 72% 2-chlorobutane and 28% 1-chlorobutane though it has six primary and four secondary hydrogens.

Statement-2 : A secondary hydrogen is abstracted more easily than the primary hydrogen.

12. **Statement-1** : $CH_3CH_2OCH_2Cl$ reacts faster when treated with water than $CH_3CH_2OCH_2CH_2CH_2Cl$.

Statement-2 : Carbonium ion formed by the ionization of $CH_3CH_2OCH_2Cl$ is stabilized by resonance.

13. **Statement-1** : *p*-Dichlorobenzene is less soluble in organic solvents than the corresponding *o*-isomer.

Statement-2 : *o*-Dichlorobenzene is polar while *p*-dichlorobenzene is not.

MARK YOUR RESPONSE	1. ⓐⓑⓒⓓ	2. ⓐⓑⓒⓓ	3. ⓐⓑⓒⓓ	4. ⓐⓑⓒⓓ	5. ⓐⓑⓒⓓ
	6. ⓐⓑⓒⓓ	7. ⓐⓑⓒⓓ	8. ⓐⓑⓒⓓ	9. ⓐⓑⓒⓓ	10. ⓐⓑⓒⓓ
	11. ⓐⓑⓒⓓ	12. ⓐⓑⓒⓓ	13. ⓐⓑⓒⓓ		

14. Statement-1 : α-Hydrogen atoms in aldehydes and ketones are acidic.

Statement-2 : The anion left after the removal of α-hydrogen is stabilized by inductive effect.

15. Statement-1 : Although fluorine is more electronegative than chlorine, yet *p*-fluorobenzoic acid is a weaker acid than *p*-chlorobenzoic acid.

Statement-2 : Due to matching size of 2*p*-orbitals of F and C, F has a stronger +R-effect than Cl.

16. Statement-1 : Solubility of *n*-alcohols in water decreases with increase in molecular weight.

Statement-2 : The relative proportion of the hydrocarbon part in alcohols increases with increasing molecular weight which permits enhanced hydrogen bonding with water.

17. Statement-1 : Acetate ion is more basic than the methoxide ion.

Statement-2 : The acetate ion is resonance stabilized

18. Statement-1 : *p*-Nitrophenol is a stronger acid that *o*-nitrophenol.

Statement-2 : Intramolecular hydrogen bondings makes the *o*-isomer weaker than the *p*-isomer.

19. Statement-1 : Cyclopentadiene is as strong an acid as water.

Statement-2 : Cyclopentadienyl anion is aromatic and stabilised by resonance.

20. Statement-1 : *o*-Dichlorobenzene has lower dipole moment than expected.

Statement-2 : Dipole-dipole repulsion increases the bond angle.

21. Statement-1 : $CH_3CH_2^-$ is a stronger base than F^-.

Statement-2 : The negative charge density on carbon is greater than the negative charge density on F^-.

22. Statement-1 : Heterolytic fission of $CH_3CH_2CH_3$ gives

$$CH_3\overset{+}{C}H_2 \text{ and } CH_3^{\ominus}.$$

Statement-2 : $CH_3\overset{+}{C}H_2$ is more stable than $\overset{+}{C}H_3$, but $CH_3CH_2^{\ominus}$ is less stable than $CH_3^{\ominus}$.

23. Statement-1 : Rearrangement of a carbocation due to alkyl shift is an example of Lewis acid base reaction.

Statement-2 : Carbocation is an electrophile and can accept lone pair of electrons from alkyl group.

MARK YOUR RESPONSE					
	14. ⓐⓑⓒⓓ	15. ⓐⓑⓒⓓ	16. ⓐⓑⓒⓓ	17. ⓐⓑⓒⓓ	18. ⓐⓑⓒⓓ
	19. ⓐⓑⓒⓓ	20. ⓐⓑⓒⓓ	21. ⓐⓑⓒⓓ	22. ⓐⓑⓒⓓ	23. ⓐⓑⓒⓓ

D MULTIPLE CORRECT CHOICE TYPE

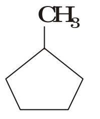
Each of these questions has 4 choices (a), (b), (c) and (d) for its answer, out of which ONE OR MORE is/are correct.

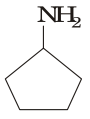
1. Rank the following compounds in order of decreasing solubility in water.

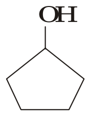
$$\underset{I}{CH_3CH_2F},\ \underset{II}{CH_3CH_2OH},\ \underset{III}{CH_3CH_2Cl},\ \underset{IV}{CH_3OCH_3}$$

(a) I is more soluble than II
(b) I is less soluble than II
(c) III is more soluble than IV
(d) III is less soluble than IV

2. Pick up the correct statement


(I),

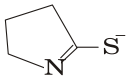

(II),


(III)

(a) II is more soluble than I in H_2O
(b) II is more soluble than III in H_2O
(c) II is less soluble than III in H_2O
(d) III is more soluble than I in H_2O

3. Which of the following nucleophile is ambident?

(a) OCN^- (b) $RCOCH_2^-$

(c) 

(d) $RCOO^-$

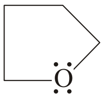
MARK YOUR RESPONSE					
	1. ⓐⓑⓒⓓ	2. ⓐⓑⓒⓓ	3. ⓐⓑⓒⓓ		

4. Which of the following orders is/are correct?

(a) $CH_3NH^- < CH_3O^- < CH_3CH_2^-$
(increasing basicity)

(b) $CH_3C \equiv C^- < CH_3CH = CH^- < CH_3CH_2CH_2^-$
(increasing basicity)

(c) $CH_3OCH_3 < CH_3CH_2OH < CH_3CH_2OH_2^+$
(increasing acidity)

(d)  $> C_2H_5 - \ddot{\underset{..}{O}} - C_2H_5$
(solubility in water)

5. Which name is not ambiguous?

(a) Pentane (b) Neopentane
(c) *sec*-Butanol (d) *sec*-Pentanol

6. Which of the following statement is true regarding the stability of following three dienes ?

$CH_2 = CH - CH = CH_2$

$CH_2 = CH - CH_2 - CH = CH_2$

$CH_2 = C = CH - CH_3$

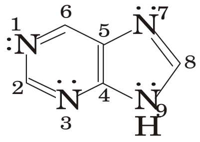
(a) 1,3-Butadiene (a conjugated diene) is more stable than 1,4-pentadiene (an isolated) due to resonance.

(b) 1,3-Butadiene is more stable than 1,4-pentadiene because the former has a strong carbon-carbon single bond; while the latter has, two weaker carbon-carbon single bonds

(c) 1,2-Butadiene is less stable than 1,3-butadiene because the former has *sp* hybridised carbon atom

(d) 1,4-Butadiene is more stable than 1,2-butadiene because of resonance

7. Purine has four nitrogens, which one you expect to be basic?



(a) N_1 (b) N_3
(c) N_7 (d) N_9

8. Which of the following represents pair of isomers?

(a) Benzene and fulvene

(b) Naphthalene and azulene

(c) Anthracene and phenanthrene

(d) Cyclopentadienyl cation and cyclopentadienyl anion

9. Which of the following statement is true ?

(a) Ethers are soluble in water

(b) Ethers are soluble in alcohols

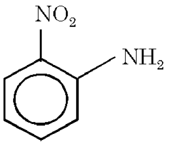
(c) Alcohols are soluble in ethers

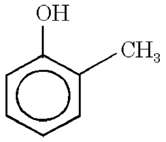
(d) All alcohols are soluble in water

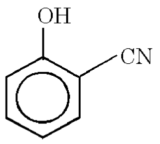
10. Which of the following is correct name for 

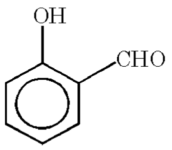
(a) Hydroquinone (b) *p*-Benzenediol
(c) Quinol (d) Resorcinol

11. Which of the following can't form intramolecular hydrogen bonding ?

(a) 

(b) 

(c) 

(d) 

12. $-NO_2$ group is acid-strengthening group ; when present in *para*-position of phenol and benzoic acid. Which statement is *false* about this ?

(*a*) It increases acidity of both to the same extent.

(*b*) It increases acidity of phenol more than that of benzoic acid.

(*c*) It increases acidity of benzoic acid more than that of the phenol.

(*d*) It does not increase acidity of any of the compound.

13. Which of the following statement is *true* regarding the following chemical reaction ?

$$CH_3CHO \xrightarrow{HCN} CH_3CHOHCN$$

(*a*) The product on hydrolysis gives a mixture of two compounds :

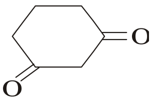
(*b*) The product is a mixture of two compounds which can be separated by fractional distillation.

(*c*) The product is a mixture of two compounds which can't be separated by fractional distillation.

(*d*) Two of the above three statements are false.

MARK YOUR RESPONSE	4. ⓐⓑⓒⓓ	5. ⓐⓑⓒⓓ	6. ⓐⓑⓒⓓ	7. ⓐⓑⓒⓓ	8. ⓐⓑⓒⓓ
	9. ⓐⓑⓒⓓ	10. ⓐⓑⓒⓓ	11. ⓐⓑⓒⓓ	12. ⓐⓑⓒⓓ	13. ⓐⓑⓒⓓ

14. Which of the following statement is *false* regarding enolization of



(a) It can form two enolic forms of equal stability

(b) It can form two enolic forms of different stability

(c) It can form more than two enolic forms of different stability

(d) It can form only one enolic form

15. Which of the following statement is *not true* ?

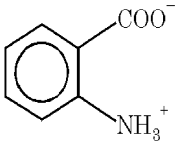
(*a*) Maleic acid and fumaric acid are similar in their acidic strength, same is true for their corresponding monoanions.

(*b*) Maleic acid is a stronger acid than fumaric acid, similarly maleate monoanion is a stronger acid than fumarate monoanion.

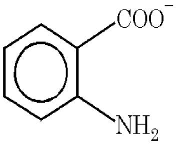
(*c*) Maleic acid is a stronger acid than fumaric acid, but maleate monoanion is a weaker acid than fumarate monoanion.

(*d*) Maleic acid is a stronger acid than fumaric acid, and the corresponding monoanions have similar acidic strength.

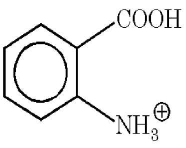
16. Anthranilic acid can exist in the form of following structures ?



I



II



III

Which of the following statement is not correct regarding anthranilic acid structure ?

(*a*) Structure I exists in neutral solution (pH = 7), structure II in acidic solution (pH < 7) and structure III exists in alkaline solution (pH > 7).

(*b*) Structure II exists when pH > 7 and structure III exists when pH < 7.

(*c*) Structures I and II exist when pH > 7 and structures I and III exist when pH < 7.

(*d*) All the thre structures exist in all the three mediums.

17. Which of the following is (are) considered as derivative of a carboxylic acid ?

(*a*) RCOCl (*b*) $RCONH_2$

(*c*) RCN (*d*) RNC.

18. Guanidine, $(NH_2)_2\ C = NH$, is said to be the strongest nitrogen containing organic base because

(*a*) it has two —NH_2 groups

(*b*) it has three nitrogen atoms that can be protonated

(*c*) its imino group is first protonated

(*d*) its conjugate acid is very much stable due to three equivalent structures.

19. Quaternary ammonium salts are used

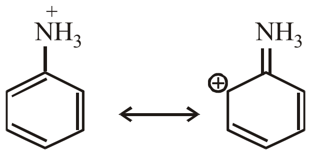
(*a*) as phase transfer catalysts

(*b*) in preparing alkenes

(*c*) for preparing 3° amines

(*d*) for preparing 2° amines

20. Examine the following two structures for the anilinium ion, predict which of the following statement is *false* regarding the two canonical structures for anilinium ion?



(I) (II)

(*a*) II is not an acceptable canonical structure because carbocations are less stable than ammonium ions.

(*b*) II is not acceptable canonical structure because nitrogen has 10 valence electrons.

(*c*) II is not acceptable canonical structure because it is non-aromatic.

(*d*) II is acceptable structure.

21. Which of the following shows tautomerism ?

(*a*) C_6H_5OH (*b*) CH_3NO_2

(*c*) $C_6H_5CH_2NO_2$ (*d*) $(CH_3)_3CNO_2$

22. The boiling point of a compound depends upon

(*a*) hydrogen bonding

(*b*) polarity of the molecule

(*c*) size of the molecule

(*d*) its solubility in water.

23. Which of the following is true ?

(a) A liquid has same boiling point at all conditions

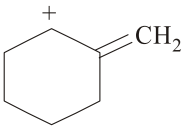
(b) A liquid can be made to boil at a temperature lower than its usual boiling point

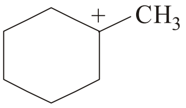
(c) A liquid can be made to boil at a temperature higher than its usual boiling point

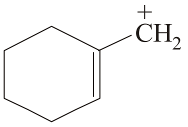
(d) Steam distillation means distillation under reduced pressure

Mark Your Response	14. ⓐⓑⓒⓓ	15. ⓐⓑⓒⓓ	16. ⓐⓑⓒⓓ	17. ⓐⓑⓒⓓ	18. ⓐⓑⓒⓓ
	19. ⓐⓑⓒⓓ	20. ⓐⓑⓒⓓ	21. ⓐⓑⓒⓓ	22. ⓐⓑⓒⓓ	23. ⓐⓑⓒⓓ

24. In which case(s) potential energy is decreased?

(a) 

(b) 

(c) 

(d) $CH_3\overset{+}{C}HCH=CH_2$

25. Pick up the correct statement(s)

(a) CHF_3 is more acidic than $CHCl_3$

(b) $:CF_2$ is more stable than $:CCl_2$

(c) CHF_3 is less acidic than $CHCl_3$

(d) $:CF_2$ is less stable than $:CCl_2$.

26. In which of the following potential energy is decreased?

(a) $CH_3CH_2\dot{C}HCH_3$

(b) 

$(CH_3)_2CH\dot{C}H_2$

(c) 

$(CH_3)_2\dot{C}CH_2CH_3$

(d) $(CH_3)_3C\dot{C}H_2$

27. Select the correct statement (s).

(a) Alkyl radical is more electron deficient than carbocation.

(b) Hyperconjugation explains greater stability of benzyl and allyl carbocations.

(c) Polar solvents stabilise the nucleophile

(d) The enthalpies of dissociation are much lower in solution

28. Primary alcohols may act as

(a) Lewis base (b) Bronsted acid

(c) reducing agent (d) oxidising agent

29. Which of the following is more acidic than phenol?

(a) *p*-Chlorophenol (b) *p*-Aminophenol

(c) *p*-Nitrophenol (d) *p*-Methoxyphenol

30. $CH_3CH_2\overset{+}{C}HCH_2CH_3$ $CH_3\overset{+}{C}HCH_2CH_2CH_3$

I II

Pick up the correct statement regarding above two carbocations.

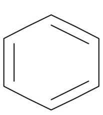
(a) I is more stable than II due to inductive effect

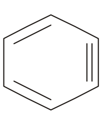
(b) I is more stable than II due to its symmetrical structure

(c) II is more stable than I due to hyperconjugation

(d) II is obtained from I due to 1, 2-hydride shift

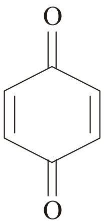
31. Which of the following compounds have only one type of hybrid carbon atom?

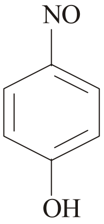
(a) 

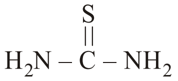
(b) 

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

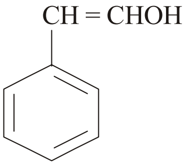
32. Which of the following compounds show tautomerism

(a) 

(b) 

(c) 

$H_2N-\overset{\overset{\displaystyle S}{\|}}{C}-NH_2$

(d) 

33. Which of the following are planar ?

(a) Phenyl acetylene (b) Styrene

(c) *p*-Xylene (d) 1, 3-Butadiene

34. Which of the following has *sp* hybridized carbon, but not a triple bond ?

(a) Allene (b) Acetonitrile

(c) Benzyne (d) Triplet carbene

35. Which of the following statements are correct ?

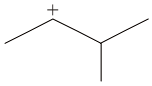
(a) Triplet carbene is linear while singlet carbene is bent

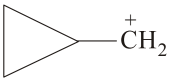
(b) Triplet carbene is less stable than singlet carbene

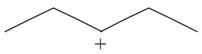
(c) Triplet carbene is paramagnetic

(d) CF_2 is more stable than CCl_2

36. Which of the carbocation(s) is/are stabilized due to hyperconjugation ?

(a) 

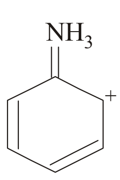
(b) 

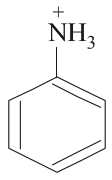
(c) 

(d) $\overset{+}{C}H_3$

MARK YOUR RESPONSE	24. ⓐⓑⓒⓓ	25. ⓐⓑⓒⓓ	26. ⓐⓑⓒⓓ	27. ⓐⓑⓒⓓ	28. ⓐⓑⓒⓓ
	29. ⓐⓑⓒⓓ	30. ⓐⓑⓒⓓ	31. ⓐⓑⓒⓓ	32. ⓐⓑⓒⓓ	33. ⓐⓑⓒⓓ
	34. ⓐⓑⓒⓓ	35. ⓐⓑⓒⓓ	36. ⓐⓑⓒⓓ		

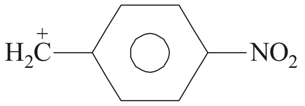
37. Which of the following statement(s) is/are true regarding the following structures of anilium ion ?

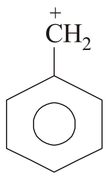

I

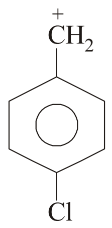

II

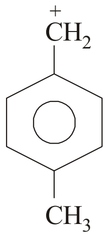
(a) I is one of the resonating structures
(b) I can't be regarded as a resonating structure because it is non-aromatic
(c) I can't be regarded as a resonating structure because here N has 10 valence electrons
(d) I can't be regarded as a resonating structure because carbocations are less stable than ammonium ions.

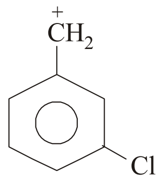
38. Which of the following is more stable than



(a) 

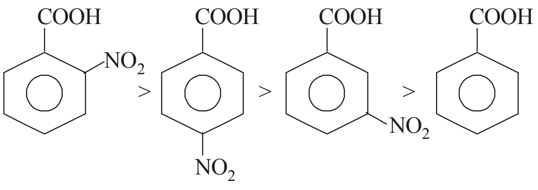
(b) 

(c) 

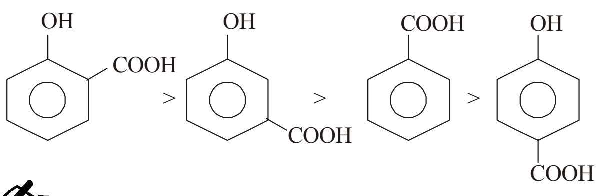
(d) 

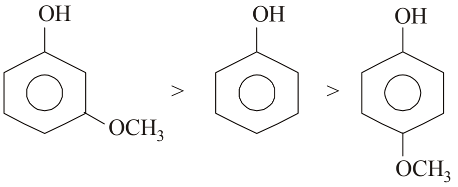
39. Which of the following order is/are true regarding acidic strength ?

(a) $CH \equiv CH > NH_3 > H_2O > HF$

(b) 

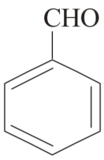
(c)

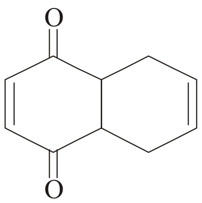


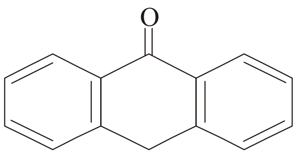
(d) 

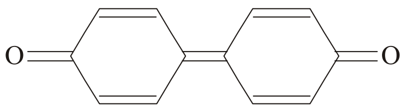
40. Which is less acidic than water ?
(a) CH_3OH
(b) CH_3CH_2OH
(c) $HC \equiv CH$
(d) C_6H_5OH

41. Which of the following exhibits the phenomenon of tautomerism ?

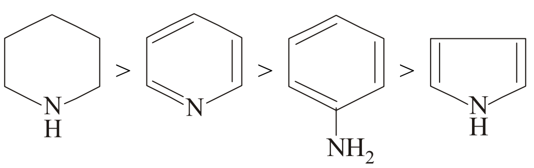
(a) 

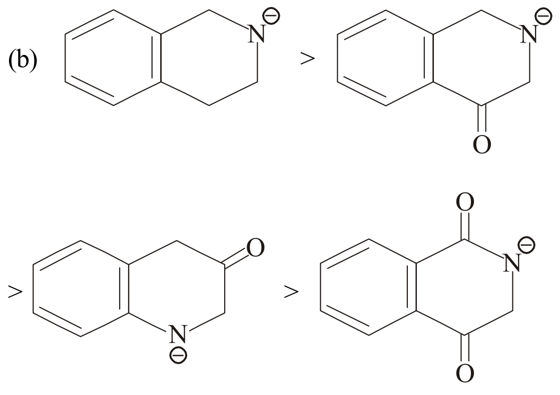
(b) 

(c) 

(d) 

42. Which of the following represents correct order of basic strength ?

(a) 

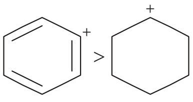
(b) 

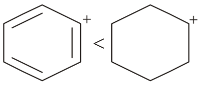
(c) $Me_3\overset{\ominus}{C} > Me_2\overset{\ominus}{N} > Me_3C\overset{\ominus}{O} > Me\overset{\ominus}{O}$

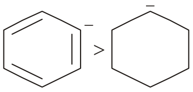
(d) None of these

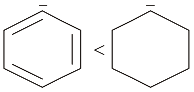
MARK YOUR RESPONSE	37. ⓐⓑⓒⓓ	38. ⓐⓑⓒⓓ	39. ⓐⓑⓒⓓ	40. ⓐⓑⓒⓓ	41. ⓐⓑⓒⓓ
	42. ⓐⓑⓒⓓ				

43. Pick up the correct choice.

(a) 

(b) 

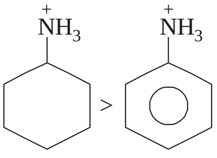
(c) 

(d) 

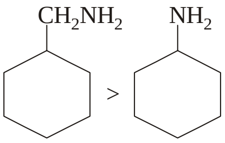
44. Select the correct statement(s) about crown ether [18] – crown – 6.

(a) It is a cyclic polyether (b) It has 12 carbon atoms
(c) It has 6 oxygen atoms (d) It has total 18 atoms

45. Pick up the correct statements.

(a) 

(Basic character)

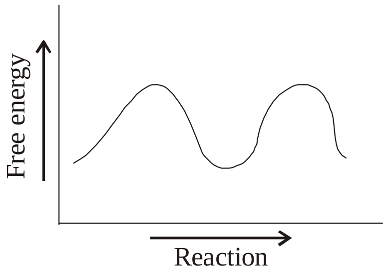
(b) 

(Basic character)

(c) Ammonium ion is stabilised by polarisation effect

(d) pK_a of $(CH_3)_3$ NH is higher than that of NH_4

46. Following diagram is applicable to which reaction ?



(a) $CH_3COCl + NH_2^- \longrightarrow$

(b) $CH_3COCl + CH_3COONa \longrightarrow$

(c) $CH_3COOCH_3 + NaCl \longrightarrow$

(d) $CH_3COOCOCH_3 + NaCl \longrightarrow$

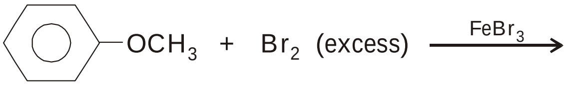
47. Which of the following reactions give quantitative yield?

(a) $(CH_3)_3COH + NaOH \longrightarrow (CH_3)_3CONa \quad H_2O$

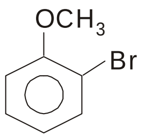
(b) $(CH_3)_3CONa + H_2O \longrightarrow (CH_3)_3COH \quad NaOH$

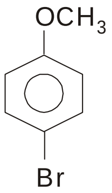
(c) $NH_4Cl + NaNH_2 \xrightarrow{\text{liq. } NH_3} 2NH_3 \quad NaCl$

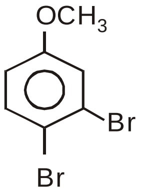
(d) $Me_3COH + CH_3CH_2Na \longrightarrow Me_3CONa \quad C_2H_6$

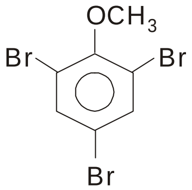
48. 

Product may be

(a) 

(b) 

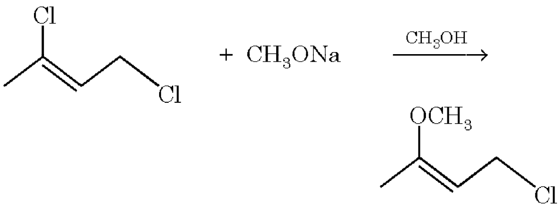
(c) 

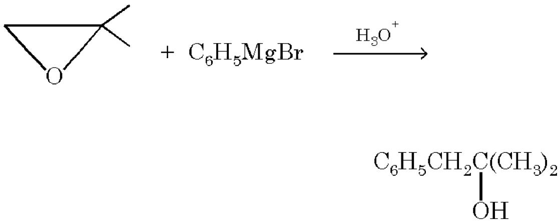
(d) 

49. Which of the following reaction is not possible ?

(*a*) $C_6H_5OH + HBr \longrightarrow C_6H_5Br + H_2O$

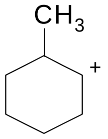
(*b*) $(CH_3)_3CCl + NaOCH_3 \longrightarrow (CH_3)_3COCH_3 + NaCl$

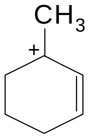
(*c*) 

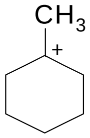
(*d*) 

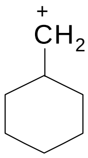
$$C_6H_5CH_2\underset{\displaystyle OH}{\overset{}{C}}(CH_3)_2$$

50. Which of the following carbocations can undergo rearrangement?

(a) 

(b) 

(c) 

(d) 

MARK YOUR RESPONSE	43. ⓐⓑⓒⓓ	44. ⓐⓑⓒⓓ	45. ⓐⓑⓒⓓ	46. ⓐⓑⓒⓓ	47. ⓐⓑⓒⓓ
	48. ⓐⓑⓒⓓ	49. ⓐⓑⓒⓓ	50. ⓐⓑⓒⓓ		

E

MATRIX-MATCH TYPE

Each question contains statements given in two columns, which have to be matched. The statements in Column-I are labeled 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.

	p	q	r	s	t
A	●	○	○	●	●
B	○	●	●	○	○
C	●	●	○	○	○
D	○	○	○	●	●

1.

	Column-I		**Column-II**
A.	$H_2C=C=CH_2$	p.	Most stable intermediate
B.	1° alkyl carbanion	q.	*sp*-hybridised
C.	3° alkyl free radical	r.	sp^2-hybridised
D.	Benzyne	s.	sp^3-hybridised

2.

	Column-I		**Column-II**
A.	Lewis acid	p.	SO_2
B.	Lewis base	q.	SiF_4
C.	Colour with $FeCl_3$	r.	Cyclohexanone
D.	Tautomerism	s.	Phenol

3.

	Column-I		**Column-II**
A.	CN^-	p.	Nucleophile
B.	RCN	q.	Electrophile
C.	C_6H_6	r.	Ambident nucleophile
D.	Benzyne	s.	Aromatic

4.

	Column-I		**Column-II**
A.	Hybridisation	p.	Bond length
B.	No-bond resonance	q.	Acidic character
C.	Inductive effect	r.	Electrophilic aromatic substitution
D.	Mesomeric effect	s.	Stability of free radicals

5.

	Column-I		**Column-II**
A.		p.	π-bond involved in conjugation
B.	$H_2\ddot{N}CH=CH-C\equiv CH$	q.	Every *lp* present in molecule involved in resonance
C.	$CH_2=CH-\underset{\cdot\cdot}{\ddot{O}}-CH_3$	r.	2π bonds involved in conjugation
D.	$CH_3CH=CHCH=CH_2$	s.	π, σ bond resonance

6.

	Column-I		**Column-II**
A.	$N_2CHCOOC_2H_5 \xrightarrow{heat}$	p.	Free radical
B.	$CH_2N_2 \xrightarrow{heat}$	q.	Carbene
C.	$CH_3N=NCH_3 \xrightarrow{heat}$	r.	Carbocations
D.	$C_6H_5N_2Cl \xrightarrow{heat}$	s.	Neutral species

MARK YOUR RESPONSE

1.

	p	q	r	s
A	○	○	○	○
B	○	○	○	○
C	○	○	○	○
D	○	○	○	○

2.

	p	q	r	s
A	○	○	○	○
B	○	○	○	○
C	○	○	○	○
D	○	○	○	○

3.

	p	q	r	s
A	○	○	○	○
B	○	○	○	○
C	○	○	○	○
D	○	○	○	○

4.

	p	q	r	s
A	○	○	○	○
B	○	○	○	○
C	○	○	○	○
D	○	○	○	○

5.

	p	q	r	s
A	○	○	○	○
B	○	○	○	○
C	○	○	○	○
D	○	○	○	○

6.

	p	q	r	s
A	○	○	○	○
B	○	○	○	○
C	○	○	○	○
D	○	○	○	○

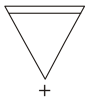
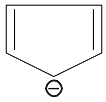
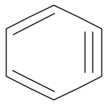
7.

	Column - I		**Column - II**
A.	CH_3 group attached to benzene ring	p.	Inductive effect
B.	Vinyl group attached to benzene ring	q.	Resonance effect
C.	CF_3 group attached to benzene ring	r.	Hyperconjugation
D.	NO_2 group attached to benzene ring	s.	Nucleophilic substitution

8.

	Column - I		**Column - II**
A.	Carbocations	p.	Diamagnetic
B.	Free radicals	q.	Paramagnetic
C.	Singlet carbene	r.	Linear geometry
D.	Triplet carbene	s.	sp^2 Hybrid carbon

9.

	Column - I		**Column - II**
A.	$(CH_3)_3C^+$	p.	Aromatic
B.		q.	Hyperconjugation
C.		r.	Diamagnetic
D.		s.	All carbon atoms are sp^3 hybridised

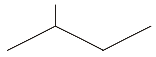
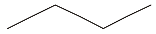
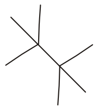
10.

	Column - I (Group)		**Column - II (Effect)**
A.	$-OH$	p.	+ I effect
B.	$-O^-$	q.	– I effect
C.	$-CN$	r.	+ M effect
D.	$-CH=CH_2$	s.	– M effect

11.

	Column - I		**Column - II**
A.	$ClCH=CHCl$	p.	Dipole moment (*cis* > *trans*)
B.	$CH_3CH=CHCl$	q.	Dipole moment (*cis* < *trans*)
C.	$CH_3CH=CHCH_3$	r.	M.P. (*cis* < *trans*)
D.	$CH_3CH=CHCN$	s.	B.P. (*cis* > *trans*)

12.

	Column - I (*Hydrocarbon*)		**Column - II** (*No. of monochloro structural isomers*)		**Column - III** (*No. of enantiomeric pair of monochloro derivatives*)
A.		p.	1	e.	0
B.		q.	2	f.	1
C.		r.	3	g.	2
D.		s.	4	h.	3

13.

	Column-I **Aromatic Compound**		**Column-II** **Factor responsible for electrophilic substitution**
A.	$C_6H_5CH=CH_2$	p.	+E
B.	$C_6H_5CCl_3$	q.	+ M
C.	$C_6H_5OCOCH_3$	r.	Hyperconjugation
D.	C_6H_5OH in presence of NaOH	s.	–I

14.

	Column A		**Column B**
A.	$-N^+Me_3$	p.	– I, + R
B.	$-CH=CHCHO$	q.	– I, – R
C.	$-OCH_3$	r.	– I only
D.	$-NO_2$	s.	Deactivating and *m* directing

MARK YOUR RESPONSE

7.
p q r s
A ⓟⓠⓡⓢ
B ⓟⓠⓡⓢ
C ⓟⓠⓡⓢ
D ⓟⓠⓡⓢ

8.
p q r s
A ⓟⓠⓡⓢ
B ⓟⓠⓡⓢ
C ⓟⓠⓡⓢ
D ⓟⓠⓡⓢ

9.
p q r s
A ⓟⓠⓡⓢ
B ⓟⓠⓡⓢ
C ⓟⓠⓡⓢ
D ⓟⓠⓡⓢ

10.
p q r s
A ⓟⓠⓡⓢ
B ⓟⓠⓡⓢ
C ⓟⓠⓡⓢ
D ⓟⓠⓡⓢ

11.
p q r s
A ⓟⓠⓡⓢ
B ⓟⓠⓡⓢ
C ⓟⓠⓡⓢ
D ⓟⓠⓡⓢ

12.
p q r s
A ⓟⓠⓡⓢ
B ⓟⓠⓡⓢ
C ⓟⓠⓡⓢ
D ⓟⓠⓡⓢ

13.
p q r s
A ⓟⓠⓡⓢ
B ⓟⓠⓡⓢ
C ⓟⓠⓡⓢ
D ⓟⓠⓡⓢ

14.
p q r s
A ⓟⓠⓡⓢ
B ⓟⓠⓡⓢ
C ⓟⓠⓡⓢ
D ⓟⓠⓡⓢ

F

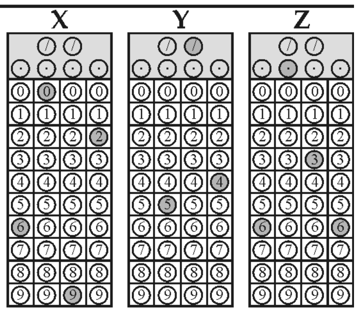
NUMERIC/INTEGER ANSWER TYPE

The answer to each of the questions is either numeric (eg. 304, 40, 3010, 3 etc.) or a fraction (2/3, 23/7) or a decimal (2.35, 0.546).

The appropriate bubbles below the respective question numbers in the response grid have to be darkened.

For example, if the correct answers to question X, Y & Z are 6092, 5/4 & 6.36 respectively then the correct darkening of bubbles will look like the following.

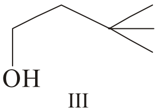
For single digit integer answer darken the extreme right bubble only.



Refer the following compounds and answer the questions that follows :

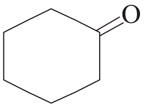
H – F
I

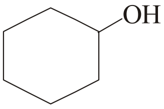
$CHCl_3$
II


III

CH_3COOH
IV

$CH_3COOC_2H_5$
V


VI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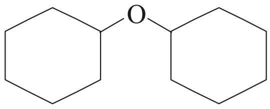
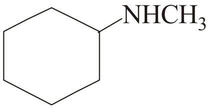
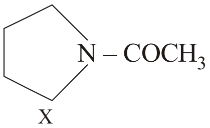

VIII


IX


X

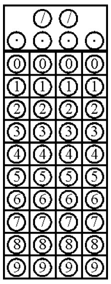
How many of the above compounds can

(1) serve only as H – bond acceptors ?

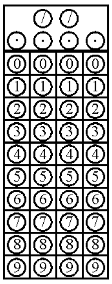
(2) serve both as H – bond acceptors as well as donors ?

MARK YOUR RESPONSE

1.



2.



Answerkey

A SINGLE CORRECT CHOICE TYPE

1.	(c)	**2.**	(c)	**3.**	(b)	**4.**	(c)	**5.**	(a)	**6.**	(c)	**7.**	(b)	**8.**	(d)	**9.**	(c)	**10.**	(d)
11.	(c)	**12.**	(d)	**13.**	(a)	**14.**	(c)	**15.**	(c)	**16.**	(c)	**17.**	(a)	**18.**	(d)	**19.**	(a)	**20.**	(d)
21.	d	**22.**	(a)	**23.**	(b)	**24.**	(c)	**25.**	(a)	**26.**	(c)	**27.**	(d)	**28.**	(b)	**29.**	(b)	**30.**	(c)
31.	(c)	**32.**	(b)	**33.**	(d)	**34.**	(c)	**35.**	(c)	**36.**	(c)	**37.**	(d)	**38.**	(b)	**39.**	(c)	**40.**	(d)
41.	(c)	**42.**	(b)	**43.**	(b)	**44.**	(c)	**45.**	(d)	**46.**	(c)	**47.**	(d)	**48.**	(c)	**49.**	(c)	**50.**	(d)
51.	(a)	**52.**	(d)	**53.**	(a)	**54.**	(c)	**55.**	(b)	**56.**	(b)	**57.**	(a)	**58.**	(c)	**59.**	(c)	**60.**	(c)
61.	(a)	**62.**	(b)	**63.**	(a)	**64.**	(c)	**65.**	(b)	**66.**	(c)	**67.**	(b)	**68.**	(b)	**69.**	(a)	**70.**	(d)
71.	(c)	**72.**	(a)	**73.**	(b)	**74.**	(b)	**75.**	(c)	**76.**	(c)	**77.**	(a)	**78.**	(b)	**79.**	(b)	**80.**	(d)
81.	(d)	**82.**	(c)	**83.**	(d)	**84.**	(d)	**85.**	(c)	**86.**	(c)	**87.**	(c)	**88.**	(d)	**89.**	(c)	**90.**	(b)
91.	(b)	**92.**	(c)	**93.**	(b)	**94.**	(c)	**95.**	(a)	**96.**	(a)	**97.**	(b)	**98.**	(c)	**99.**	(c)	**100.**	(c)
101.	(c)	**102.**	(b)	**103.**	(a)	**104.**	(d)	**105.**	(c)	**106.**	(c)	**107.**	(b)	**108.**	(a)	**109.**	(a)	**110.**	(d)
111.	(b)	**112.**	(c)	**113.**	(c)	**114.**	(d)	**115.**	(b)	**116.**	(d)	**117.**	(b)	**118.**	(b)	**119.**	(c)	**120.**	(d)
121.	(c)	**122.**	(b)	**123.**	(a)	**124.**	(b)	**125.**	(b)	**126.**	(b)	**127.**	(c)	**128.**	(b)	**129.**	(a)	**130.**	(d)
131.	(b)	**132.**	(a)	**133.**	(a)	**134.**	(c)	**135.**	(c)	**136.**	(b)	**137.**	(c)	**138.**	(b)	**139.**	(d)	**140.**	(d)
141.	(b)	**142.**	(c)	**143.**	(b)														

B COMPREHENSION TYPE

1	(c)	**6**	(c)	**11**	(a)	**16**	(b)	**21**	(a)	**26**	(b)
2	(b)	**7**	(b)	**12**	(c)	**17**	(c)	**22**	(c)	**27**	(d)
3	(c)	**8**	(c)	**13**	(d)	**18**	(b)	**23**	(a,b,c,d)	**28**	(b)
4	(c)	**9**	(b)	**14**	(a)	**19**	(b)	**24**	(b)		
5	(d)	**10**	(d)	**15**	(a)	**20**	(c)	**25**	(d)		

C REASONING TYPE

1	(c)	**5**	(c)	**9**	(b)	**13**	(b)	**17**	(d)	**21**	(a)
2	(b)	**6**	(a)	**10**	(a)	**14**	(c)	**18**	(a)	**22**	(a)
3	(b)	**7**	(b)	**11**	(a)	**15**	(a)	**19**	(a)	**23**	(a)
4	(a)	**8**	(a)	**12**	(a)	**16**	(c)	**20**	(a)		

D MULTIPLE CORRECT CHOICE TYPE

1.	(a,d)	**11.**	(b,c)	**21.**	(a,b,c)	**31.**	(a,b,d)	**41.**	(b,c)
2.	(a,b,d)	**12.**	(a,c,d)	**22.**	(a,b,c)	**32.**	(b,c,d)	**42.**	(a,b,c)
3.	(a,b,c)	**13.**	(a,c)	**23.**	(b,c,d)	**33.**	(a,b,d)	**43.**	(b,c)
4.	(b,c,d)	**14.**	(a,c,d)	**24.**	(a,c,d)	**34.**	(a,d)	**44.**	(a,b,c,d)
5.	(a,b,c)	**15.**	(a,b,d)	**25.**	(b,c)	**35.**	(a,c,d)	**45.**	(b,c,d)
6.	(a,b,c)	**16.**	(a,c,d)	**26.**	(b,d)	**36.**	(a,c)	**46.**	(c,d)
7.	(a,b,c)	**17.**	(a,b,c)	**27.**	(b,c,d)	**37.**	(c,d)	**47.**	(b,c,d)
8.	(a,b,c,d)	**18.**	(c,d)	**28.**	(a,b,c)	**38.**	(a,b,c,d)	**48.**	(a,b,d)
9.	(a,b,c)	**19.**	(a,b,c)	**29.**	(a,c)	**39.**	(b,c,d)	**49.**	(a,b,c)
10.	(a,b,c)	**20.**	(a,c,d)	**30.**	(c,d)	**40.**	(b,c)	**50.**	(a,d)

E MATRIX-MATCH TYPE

1. **A-q, r; B-p, s; C-p, r; D-r**
2. **A-p, q; B-p; C-r, s; D-r, s**
3. **A-p, r; B-p, q; C-p, s; D-q, s**
4. **A-p, q; B-p, r, s; C-q, r; D-p, r, s**
5. **A-p; B-p, q; C-p; D-p, r, s**
6. **A-q, s; B-p, s; C-p, s; D-r**
7. **A-p, r; B-q; C-p, s; D-p, q, s**
8. **A- p, s; B-q, s; C-p, s; D-q, r**
9. **A-q, r; B-p, r, s; C-p, r, s; D-p, r**
10. **A-q, r; B-p, r; C-q, s; D-q**
11. **A-p, r, s; B-q, r; C-p, r, s; D-q, r**
12. **A-s, h; B-q, f; C-q, f; D-p, e**
13. **A-q; B-r, s; C-p, q; D-p, q**
14. **A-r, s; B-q, s; C-p; D-q, s**

F NUMERIC/INTEGER ANSWER TYPE

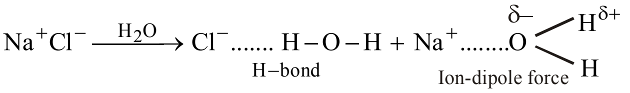
1	4	**2**	6

Solutions

A SINGLE CORRECT CHOICE TYPE

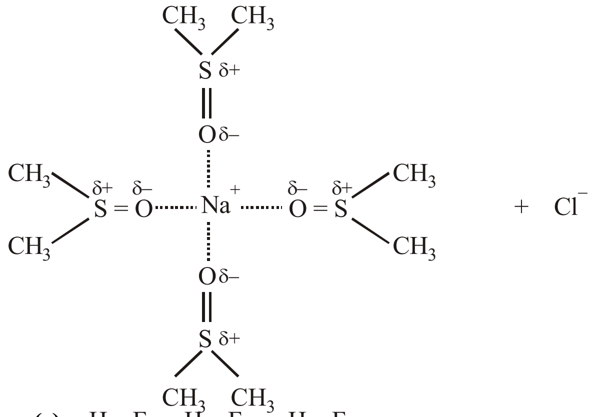
1. **(c)** Boiling point of NO (–152°C) is much higher than that of N_2 (–195°C) because NO is polar and its molecules are attracted intermolecularly by dipole-dipole forces, N_2 is nonpolar.

2. **(c)** For getting good result, a highly polar solvent must have the ability to form strong bonds to stabilize the ions. Here Cl^- (an anion) stabilizes via H-bonds with H of H_2O, and Na^+ (a cation) stabilizes via ion-dipole forces as it is attracted to additional H_2O molecules by the negative ends of the water dipole.



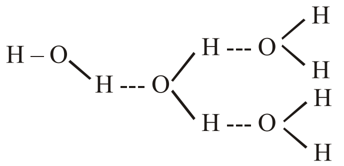
$$Na^+Cl^- \xrightarrow{H_2O} \underset{\text{H–bond}}{Cl^- \ldots\ldots H-O-H} + \underset{\text{Ion-dipole force}}{Na^+ \ldots\ldots \overset{\delta-}{O}(H^{\delta+})H}$$

3. **(b)** DMSO does not have the ability to form H-bond. Here, the solvent solvates the cation by ion-dipole attraction using the negative end (exposed end) of its dipole. However, the anion is essentially free because the positive end of the dipole is buried deeply within the molecule (steric hindrance).



4. **(c)** H – F --- H – F ---- H – F

One molecule of HF can form H-bonds at the most 2 other HF molecules



One molecule of H_2O can form H-bonds with 3 other molecules of H_2O

5. **(a)** For knowing the relative boiling point of different compounds of comparable molecular weights, consider following factors : dipole-dipole interaction, hydrogen bonding, van der Waal forces, etc. Here no specific compounds are given, so it is assumed that the vander waal forces are nearly similar in each case, hence other two factors are responsible for their following relative boiling points.

Amides > Carboxylic acids > Alcohols

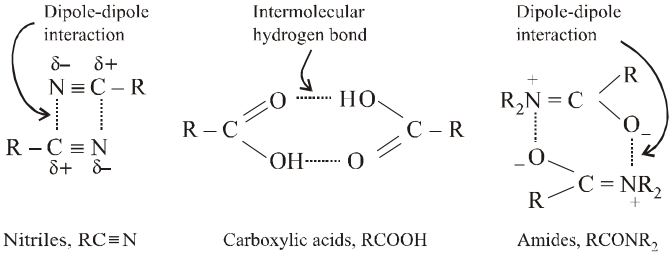
≈ Nitriles >>> Esters.

(i) Boiling points of esters are lower than the boiling points of alcohols because their molecules can't form hydrogen bonds with each other. However, boiling points of esters (also of acyl chlorides, aldehydes, and ketones) are higher than those of ethers because of polar carbonyl group. Further, due to resonance polarity is less than in nitriles.

(ii) Boiling point of nitriles are similar to that of alcohols becasue the former have a strong dipole-dipole interactions, while alcohols have strong hydrogen bonds.

(iii) Carboxylic acids have relatively high boiling points than alcohols because they can form hydrogen-bonded dimers, giving them larger effective molecular weight.

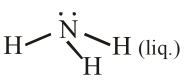
(iv) Amides have the highest boiling points, because here the dipole-dipole interactions are strong than in nitriles because here dipole-dipole interaction involves separated complete charges (recall that in an amide resonating structure having separated charges contribute *significantly* to the hydrid).



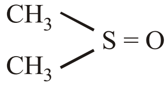
Nitriles, RC≡N   Carboxylic acids, RCOOH   Amides, $RCONR_2$

Further if an amide has a hydrogen, bonded to nitrogen as in $RCONH_2$ or RCONHR, the molecules also form intermolecular hydrogen bonds.

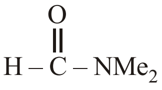
6. **(c)**



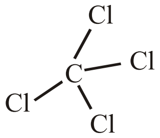
Protic polar



Aprotic polar



Aprotic polar



Aprotic nonpolar

In CCl_4, although the individual C–Cl bonds are polar, the molecule on the whole is non-polar.

7. **(b)** A *cis*-isomer has higher b.p. due to polar (or more polar) nature but lower m.p. due to asymmetry than the *trans*-isomer. Among three isomeric nitrophenols, *o*-isomer forms intramolecular bonding so H-bonding with water will be restricted.

8. **(d)** HON rule is valid for second period elements and with few exceptions for elements in higher periods.

9. **(c)** In $:PH_3$, P uses its 3*p* AO's for bonding with H, with the lone pair in the 3*s* AO. This is evident by the bond angle of 92° in PH_3. In $H_2\ddot{S}:$ too, S uses its *p* orbitals for bonding with H.

10. **(d)** The nature of hybridisation of a carbon can be ascertained by knowing the total number of electron pairs (*ep*) in the hybrid orbitals of that carbon atom :
$ep = \sigma bp + lp$
σbp is the number of bond pair in hybrid orbitals involved in σ bond formation, while *lp* is the number of lone pair in hybrid orbital. The nature of hybridisation is thus ascertained as sp^3 (when *ep* is 4), sp^2 (when *ep* is 3) and *sp* (when *ep* is 2).

	(i) $CH_2=\overset{+}{C}H$		(ii) $CH_3\overset{-}{C}HCH_3$		(iii) $CH_2=\overset{-}{C}H$	
σbp	3	2	4	3	3	2
lp	0	0	0	1	0	1
ep	3	2	4	4	3	3
Hybrid.	sp^2	sp	sp^3	sp^3	sp^2	sp^2

	(iv) $CH\equiv\overset{-}{C}$		(v) $CH_3\dot{C}(CH_3)_2$	
σbp	2	1	4	3
lp	0	1	0	0
ep	2	2	4	3
Hybrid.	sp	sp	sp^3	sp^2

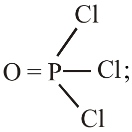
11. **(c)**

	(a) $CH_3\overset{+}{C}H\,CH_3$		(b) $CH_3C\equiv CH$		
σbp	4	3	4	2	2
lp	0	0	0	0	0
ep	4	3	4	2	2
Hybrid.	sp^3	sp^2	sp^3	sp	sp

	(c) $CH_2=CH\,\overset{+}{C}H_2$			(d) $CH_2=C=CH_2$		
σbp	3	3	3	3	2	3
lp	0	0	0	0	0	0
ep	3	3	3	3	2	3
Hybrid.	sp^2	sp^2	sp^2	sp^2	sp	sp^2

12. **(d)** $F-\underset{\cdot\cdot}{\ddot{X}}\ddot{e}-F$; Here $ep = 2 + 3 = 5$, hence sp^3d.

13. **(a)**



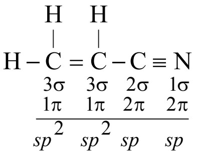
; Here $ep = 4 + 0 = 4$, hence sp^3

14. **(c)** Remember in pyrrole, the lone pair of electrons on N is present in *p* orbital which accounts for the aromatic sextet in pyrrole (an aromatic compound), hence it will not be counted in determining the number of *ep* for ascertaining hybridisation.

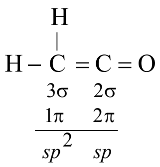
15. **(c)** Remember that in furan, one lone pair of electrons on O is present in atomic orbital (*p*) which accounts for the aromatic and the other pair of electrons is present in sp^2 orbital, thus only the second lone pair will be used to ascertain the nature of hybridisation of O.
Thus *ep* (for C) = 3 + 0 = 3, i.e. sp^2
and *ep* (for O) = 2 + 1 = 3, i.e. sp^2

16. **(c)** Write the expanded structure of the compound and count the total number of σ and π bonds with each carbon atom and assign hybridization state of each carbon atom, accordingly.

17. **(a)**



$$\begin{array}{cccc} H & H & & \\ | & | & & \\ H-C= & C- & C\equiv & N \\ 3\sigma & 3\sigma & 2\sigma & 1\sigma \\ 1\pi & 1\pi & 2\pi & 2\pi \\ sp^2 & sp^2 & sp & sp \end{array}$$



$$\begin{array}{ccc} H & & \\ | & & \\ H-C= & C= & O \\ 3\sigma & 2\sigma & \\ 1\pi & 2\pi & \\ sp^2 & sp & \end{array}$$

18. **(d)** Weak and feeble nature of an acid (or a base) is compared with H_2O which acts both as an acid as well as a base.
In general, Weak acid > H_2O > Feeble acid
Weak base > H_2O > Feeble base

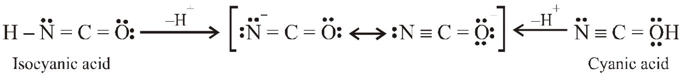
19. **(a)** Write down the acid-base equilibrium reactions of acetic acid in two solvents.

$$CH_3COOH + H_2O \rightleftharpoons CH_3COO^- + H_3O^+$$

$$CH_3COOH + CH_3OH \rightleftharpoons CH_3COO^- + CH_3\overset{+}{O}H_2$$

The more polar solvent (H_2O) is a better solvator of ions, thereby shifting the equilibrium more to the right.

20. **(d)** Conjugate bases of cyanic and isocyanic acids have similar contributing structures.



$$H-\ddot{N}=C=\ddot{O}: \xrightarrow{-H^+} \left[:\ddot{N}^- = C=\ddot{O}: \longleftrightarrow :N\equiv C=\ddot{O}:^-\right] \xleftarrow{-H^+} \ddot{N}\equiv C=\ddot{O}H$$

$H-C\equiv N:$ and $H-\overset{+}{N}\equiv C^-:$ form same conjugate base, $:^-C\equiv N:$

21. **(d)** Lower the pK_a value, higher is K_a value and thus stronger is acid, $HSbF_6$ is so strong that it is called **superacid**.

22. **(a)** Bond angle of 90° in $:PH_3$ indicates that in PH_3 formation of P–H bonds involves pure orbitals of P. Thus its three *p* orbitals form bonds with three H atoms and the electron pair of *s* orbitals remains unused. So here the nonbonding electrons belongs to *s* orbital, while in $:NH_3$, the nonbonding electron pair belongs to sp^3 orbital. Now since lesser the *s* character of an orbital, farther it is away from the nucleus and hence *s* electrons are readily available for protonation. Hence NH_3 will be more basic than PH_3.

23. **(b)** Sulphur is larger than oxygen due to which electrons on sulphur are more dispersed and hence lesser available than that on oxygen.

24. **(c)** When the basic site element belongs to same period, then more the lone pairs of electrons on the site atom $(:\ddot{\underset{..}{O}}H^-)$ more is charge spread out, hence lesser available for protonation.

25. **(a)** NH_2OH is less basic than NH_3 because of –I effect of OH. However $^-CF_3$ is more basic than $^-CCl_3$ because in $:^-CCl_3$ the unshared electron pair of C in the *p* orbital undergoes extented *p*–*d*π bonding into an empty *d* AO of the three chlorines, hence it is less available for protonation.

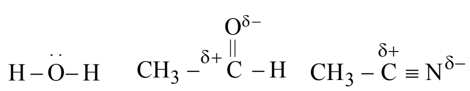
$$:\ddot{\underset{..}{Cl}}-\underset{\underset{:\underset{..}{Cl}:}{|}}{\bar{\ddot{C}}}-\ddot{\underset{..}{Cl}}: \longleftrightarrow :\bar{\ddot{C}}l=\underset{\underset{:\underset{..}{Cl}:}{|}}{C}-\ddot{\underset{..}{Cl}}: \longleftrightarrow \text{etc.}$$

Since F lies in the 2nd period, it has no *d* orbital, hence such dispersal of electrons of C is not possible. Remember resonance stabilization is generally more important than the inductive effect.

26. **(c)** Species having two nucleophilic centres, one is neutral and other is charged are known as ambident nucleophiles

$$:\bar{C}\equiv \ddot{N} \qquad \bar{O}-\ddot{N}=O$$

27. **(d)** Ambiphiles are reagents which behave as an electrophile as well as nucelophile.



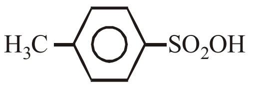
$$H-\ddot{O}-H \qquad CH_3-\overset{\overset{O^{\delta-}}{||}}{\overset{\delta+}{C}}-H \qquad CH_3-\overset{\delta+}{C}\equiv N^{\delta-}$$

	$H-\ddot{O}-H$	CH_3CHO	CH_3CN
Nucleophilic site	H	C	C
Electrophilic site	O	O	N

28. **(b)** Peroxide ion is more nucleophilic but less basic than OH^-.

29. **(b)** In general, the weaker the base, the better is its leaving tendency. Basic character of the species, in turn can be ascertained by knowing the acidic character of the corresponding conjugate acids.

F_3CSO_2OH >



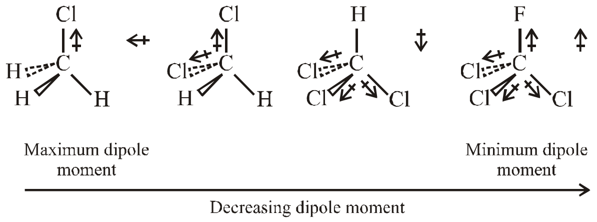
V_a IV_a

> H_3O^+ > HF > NH_3

III_a I_a II_a

30. **(c)** Steric hindrance (bulkiness) hinders nucleophilicity more than it does basicity, because a bulky base cannot approach the carbon atom easily.

31. **(c)**



32. **(b)** The higher dipole moment for CD_3F is due to higher charge because F pulls electrons from D more easily than from H, i.e., D is more electron-releasing than H.

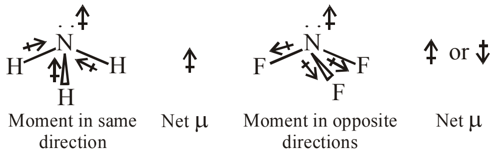
33. **(d)** (i) $CH_3Br > CH_3I$

μ is higher due to higher electronegativity of Br

(ii) $CH_3Cl > CH_3F$

μ is higher due to shorter C–F distance, although F is more electronegative than Cl

(iii)

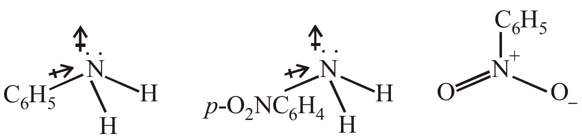


In NF_3, the opposing moments are approximately of the same size, hence the net moment is small in either of the two directions.

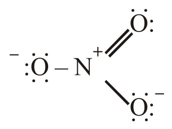
(iv) HF has larger dipole moment due to greater electronic charge which in turn is due to greater electronegativity difference between H and F.

34. **(c)** In P, the unshared electron pair is in *s* orbital which is spherically symmetrical. In order to affect the polarity of the molecule, the electrons must be in a directional orbital.

35. **(c)** Remember that dipole moment is due to difference in elctronegativities of the two concerned atoms and not due to group as a whole. *p*-$O_2N.C_6H_4$– group produces lesser polarity than C_6H_5– due to the presence of $–NO_2$ in the former.



36. **(c)** Consider any of the contributing structure of NO_3^- ion.



Formal charge = [Group number] –[No. of nonbonding electrons] –1/2 [No. of shared electrons]

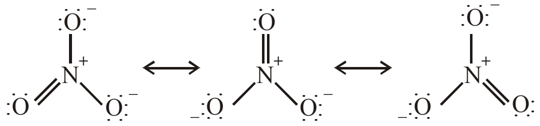
∴ Formal charge on N = 5 – 0 – 1/2 × 8 = + 1

Formal charge on one oxygen having double bond = 6 – 4 – 1/2 × 4 = 0

Formal charge on each of the two other oxygen atoms = 6 – 6 – 1/2 × 2 = – 1

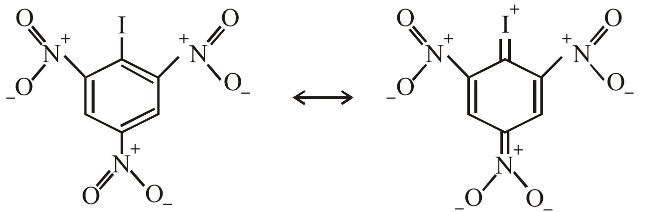
37. **(d)** All statements are ture.

38. **(b)**



Since the three resonating structures are equivalent, each should make an equal contribution to the overall hybrid. The three N–O bonds should therefore be of equal length, and each oxygen atom should bear equal (–2/3) charge, hence option (b) is correct.

39. **(c)** In resonance, only the group which is coplanar with the skeleton can participate in resonance, in case the group is out of plane of the ring (skeleton), it can't participate in resonance.



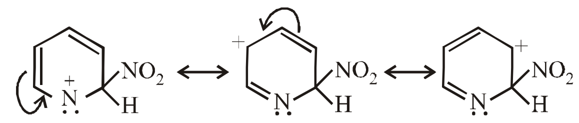
2,4,6 – Trinitroiodobenzene
(Picryl iodide)

Here only the p- nitro group is involved in resonance with the benzene, the two o-nitro groups do not participate in resonance as they are pushed out of the plane of the ring by **bulky iodine atom**, hence the C–N bond length of the o-nitro groups is very close to C–N single bond. Thus $a = b > c$.

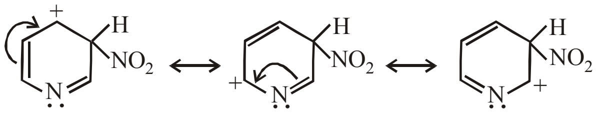
40. **(d)** In option (d), the $\ddot{N}Me_2$ group is out of the plane of the benzene ring due to the presence of two bulky –CMe_3 groups. Hence the lone pair of electrons on N is not delocalised.

41. **(c)** Refer the molecular orbital structure of pyridine where the six π electrons are derived from p orbitals lying parallel to each other, while the two nonbonding electrons on N belong to sp^2 orbital which lies perpendicular to the ring

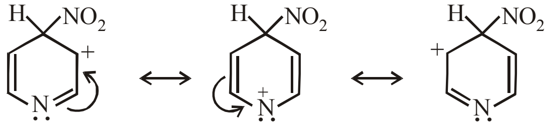
42. **(b)**



(Unstable)
Positive charge and only
6 electrons on N

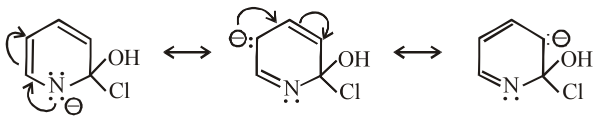


Every contributor has octet of electrons

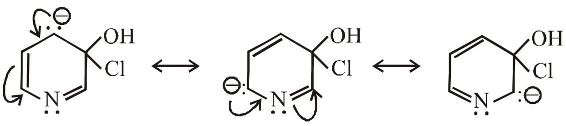


(Unstable)
Positive charge and only
6 electrons on N

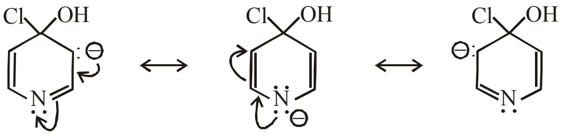
43. **(b)**



More stable
(–ve charge on
electronegative N)



None of the contributor has – ve charge on N, hence no structure is favourable or especially stable



(More stable)
(–ve charge on N)

44. **(c)** In heterolytic cleavage, both of the shared electrons of the two atoms are transferred only to one; a phenomenon reverse of coordinate covalent bonding.

45. **(d)** All the three are reaction intermediates.

$C_2H_5\overset{\cdot\cdot}{\overset{-}{C}}H_2$	$C_2H_5-\underset{\cdot}{\overset{\cdot}{C}}-H$	$C_2H_5-\overset{\cdot\cdot}{C}-H$
A carbanion	A carbene triplet	A carbene singlet

46. **(c)** The state of hybridisation of the important intermediates is

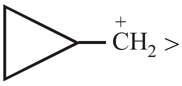
Carbocation	Carbanion	Free radical	Singlet carbene	Triplet carbene
sp^2	sp^3	sp^2	sp^2	sp

47. **(d)** Electron-withdrawing substituents disperse the electrons or negative charge, hence they stabilize carbanions, and destabilize carbocations.

48. **(c)** $$\underset{sp^3}{C_2H_5\overset{-}{C}H_2} < \underset{sp^2}{CH_2=\overset{-}{C}H} < \underset{sp}{CH\equiv\overset{-}{C}}$$

(least electronegative) (most electronegative)

49. **(c)** Cyclopropylmethyl carbocation is especially stable because of conjugation between the bent orbitals of the cyclopropyl ring and the vacant p-orbitals of the cationic carbon. Thus

 $\overset{+}{C}H_2$ > $\quad Ph_3C^+ \quad$ >

V $\qquad$ IV

$$\underset{\text{I}}{CH_2=CH\overset{+}{C}H_2} \;>\; \underset{\text{III}}{(CH_3)_3\overset{+}{C}} \;>\; \underset{\text{II}}{CH_2=\overset{+}{C}H}$$

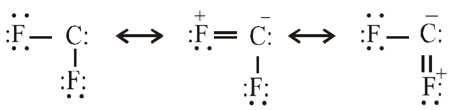
50. **(d)** $$\underset{\substack{\text{III}\\ \text{Least stable due}\\ \text{to +I effect}}}{(CH_3)_3\overset{-}{C}} < \underset{\text{V}}{\overset{-}{C}H_3} < \underset{\substack{\text{II}\\ \text{Stable due to –ve charge on}\\ \text{electronegative carbon}}}{CH_2=\overset{-}{C}H} <$$

$$\underset{\substack{\text{I}\\ \text{Stable due to delocalisation}}}{CH_2=CH-\overset{-}{C}H_2} < \underset{\substack{\text{IV}\\ \text{Most stable due to}\\ \text{extensive delocalization}}}{Ph_3\overset{-}{C}}$$

51. **(a)** $$\underset{\substack{\text{II}\\ \text{Benzyl radical extensive}\\ \text{delocalisation}}}{C_6H_5\overset{\bullet}{C}H_2} > \underset{\substack{\text{IV}\\ \text{3° Allylic radical}}}{CH_2=CH\overset{\bullet}{C}(CH_3)_2}$$

$$> \underset{\substack{\text{III}\\ \text{2° Allylic radical}}}{CH_2=CH\overset{\bullet}{C}HCH_3} > \underset{\substack{\text{I}\\ \text{No delocalisation}}}{(CH_3)_3\overset{\bullet}{C}}$$

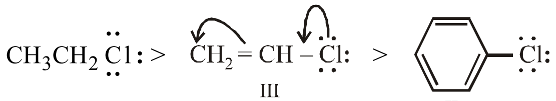
52. **(d)** In a triplet carbene, two electrons are present in different orbitals with the result there is less electrostatic repulsion than when both are in the same orbital as in a singlet carbene. Hence, generally a triplet carbene is more stable than the singlet. However, this is reverse in case of difluorocarbenes where a singlet cabene (having empty *p* atomic orbital) is more stable than the triplet (not having any empty orbital) because here the lone pair of electrons present in *p* atomic orbital of F overlaps laterally with the empty *p* atomic orbital of the singlet carbene (stabilization through resonance).



Resonance stabilization of singlet difluoro carbene

Thus, $\underset{\text{Triplet}}{(CH_3)_2\overset{\bullet}{\underset{\bullet}{C}}} > \underset{\text{Singlet}}{(CH_3)_2C:}$; $\underset{\text{Triplet}}{F_3\overset{\bullet}{\underset{\bullet}{C}}} < \underset{\text{Singlet}}{F_2C:}$

53. **(a)** Overlapping between *p* atomic orbital of carbon of carbene with the filled *p* orbital of F is maximum because of similar size of the two AO's, it is less between C and Cl and least between C and Br.

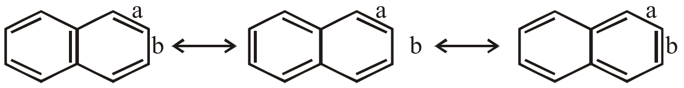
54. **(c)** 

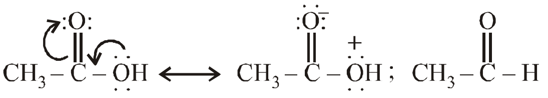
$$\underset{\substack{\text{I}\\ \text{No delocalisation}\\ \text{of } e \text{ pair}}}{CH_3CH_2\ddot{\underset{\cdot\cdot}{C}}l:} > \underset{\substack{\text{III}\\ \text{Delocalisation of } e \text{ pair,}\\ \text{hence C–Cl acquires}\\ \text{double bond character}}}{CH_2=CH-\ddot{\underset{\cdot\cdot}{C}}l:} > \underset{\substack{\text{II}\\ \text{Extensive}\\ \text{delocalisation}}}{C_6H_5-\ddot{\underset{\cdot\cdot}{C}}l:}$$

55. **(b)** $$H_3\overset{sp^3}{C}\underset{a}{-}\overset{sp^2}{C}H=\overset{sp^2}{C}H\underset{b}{-}\overset{sp^2}{C}H=\overset{sp^2}{C}H\underset{c}{-}\overset{sp^3}{C}H_3$$

C–C single bond formed by overlap of two sp^2 hybrid orbitals (*b*) is stronger than that formed by overlap of sp^3 and sp^2 hybrid orbitals (*a* and *c*)

56. **(b)** From the resonating structures of naphthalene, it is evident that the bond *a* is double bond in two of the three resonating structures, while bond *b* is a double bond only in one of the three resonating structures;

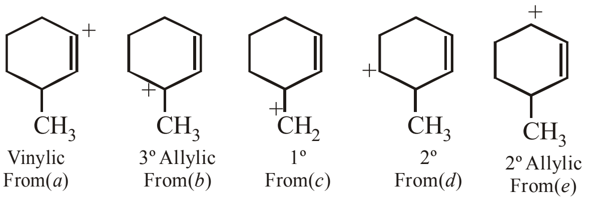


57. **(a)** 

$$CH_3-\overset{\overset{\ddot{O}:}{\|}}{C}-\ddot{O}H \longleftrightarrow CH_3-\overset{\overset{:\ddot{O}:^-}{|}}{C}=\overset{+}{O}H\;;\; CH_3-\overset{\overset{O}{\|}}{C}-H$$

$$\underset{\substack{\text{I}\\ \text{(It has C–O bond)}}}{CH_3-OH} \;>\; \underset{\substack{\text{II}\\ \text{(It has C–O as well C=O bond)}}}{CH_3-\overset{\overset{O}{\|}}{C}-OH} \;>\; \underset{\substack{\text{III}\\ \text{(It has C=O bond)}}}{CH_3-\overset{\overset{O}{\|}}{C}-H}$$

58. **(c)** Let us assume that the H is removed as H^- leaving compound as carbocation. More the stability of the carbocation, easy will be its formation hence less will be the bond energy of the concerned C–H bond. The type of corresponding carbocations in five different conditions is written below their structures.

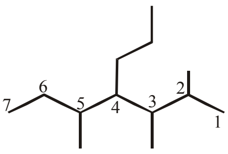


Thus the stability order of these carbocations will be

$$\underset{\text{From }(b)}{3^\circ\text{ Allylic}} > \underset{\text{From }(e)}{2^\circ\text{ Allylic}} > \underset{\text{From }(d)}{2^\circ} > \underset{\text{From }(c)}{1^\circ} > \underset{\text{From }(a)}{\text{Vinylic}}$$

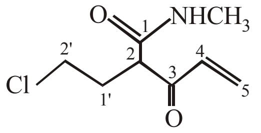
Thus the decreasing bond energy of the five C–H bonds will be $a > c > d > e > b$

59. **(c)** In case two or more chains are of equal length, then the chain with greater number of side chains is selected as the principal chain.



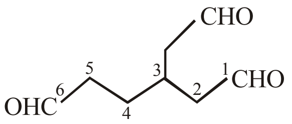
2, 3, 5-Trimethyl-4-propylheptane

60. **(c)**



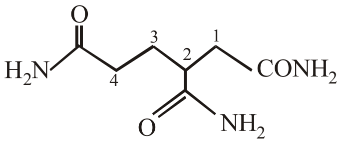
N-Methyl -2-(2'-chloroethyl) -3-keto-4-pentenamide

61. **(a)** When two –CHO (or CO, or –$CONH_2$, or –COOH) are present in the main chain, these are counted in the main chain.



3-(Formylmethyl)hexanedial

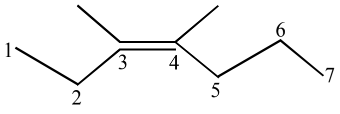
62. **(b)** When more than two –$CONH_2$ (–CHO, –CO, or –COOH) are present in the main chain their carbon atoms are not counted in the main chain.



Butane - 1, 2, 4-tricarboxamide

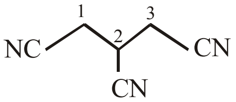
63. **(a)** None of the given names is IUPAC name, however among the given options, (a) is the correct common name.

64. **(c)**



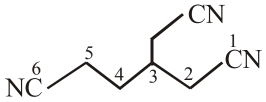
cis-3, 4-Dimethylhept-3-ene

65. **(b)** More than two –CN groups are present on the main chain, hence –CN not counted in the main chain.



Propane -1, 2, 3-tricarbonitrile

66. **(c)** Only two –CN groups are present on the main chain, hence these are counted in the main chain.

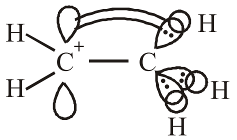


3-(Cyanomethyl) hexanedinitrile

67. **(b)** Compounds in which one carbon atom is common to two different rings are called spiro compounds.

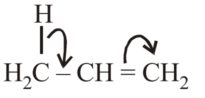
68. **(b)** In case benzene ring has a substituted side chain, C_6H_5– is named as a phenyl and the compound is named as an acyclic compound.

69. **(a)**

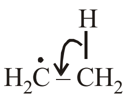


Carbocation Alkyl group

Hyperconjugation in $\overset{+}{C}H_2CH_3$



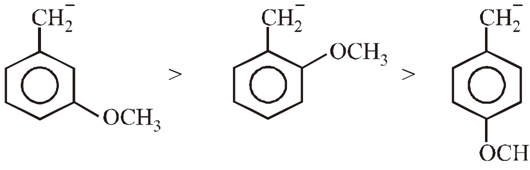
Hyperconjugation in propene



Hyperconjugation in free radical

70. **(d)** Hyperconjugation can explain the stability of cabocations and free radicals (refer above question).

71. **(c)**

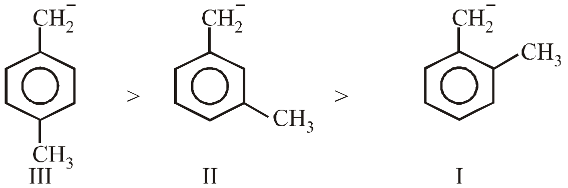


II Stabilised by –I effect

I Destabilised by +R′ stabilised by –I

III Destabilised by +R′ stabilised by –I effect which is minimum in *para* isomer

72. **(a)**

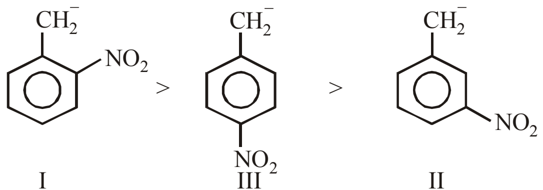


III Least destabilised by + I effect

II

I Maximum destabilised by +I effect which is maximum in *ortho* iosmer

73. **(b)**

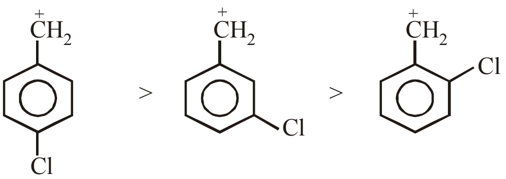


I Stabilised by –R as well as – I

III Stabilised by –R as well as – I,but – I is less than in I

II Stabilised only by –I

74. (b) Here although both effects (–I as well as + R) operate, but –I effect is powerful, so it dominates over the +R effect.

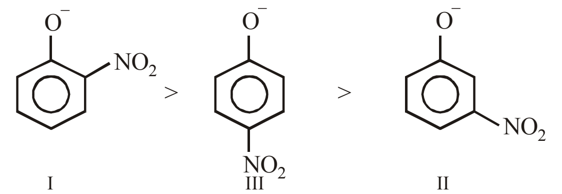


III Least destabilised by –I

II

I Most destabilised by –I

75. **(c)** Observe the relative stability of their corresponding conjugate bases.

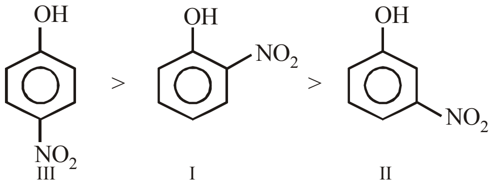


I
Stabilised by both –I and – R effects

III
Stabilised by both –I and – R effects, but – I is less than in I

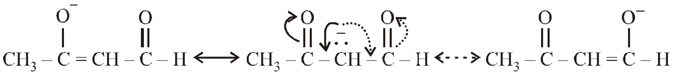
II
Stabilised only by –I effect

However, the acidity of the corresponding phenols will be different because of H–bonding in the ortho isomer.



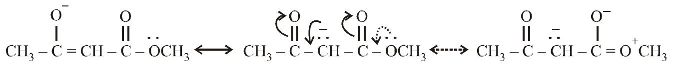
III I II

76. **(c)** More the stability of the corresponding carbanion, more will be the acidic character of the parent compound.



$$CH_3-\overset{O^-}{\overset{|}{C}}=CH-\overset{O}{\overset{\|}{C}}-H \longleftrightarrow CH_3-\overset{O}{\overset{\|}{C}}-\overset{-}{\ddot{C}}H-\overset{O}{\overset{\|}{C}}-H \longleftrightarrow CH_3-\overset{O}{\overset{\|}{C}}-CH=\overset{O^-}{\overset{|}{C}}-H$$

Due to possibility of delocalisation of electron pair of C = O group in $-COOCH_3$ to $-OCH_3$ group, the negative charge on C is relatively less delocalised than in the above carbanion, hence it is less stable.

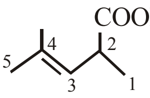


$$CH_3-\overset{O^-}{\overset{|}{C}}=CH-\overset{O}{\overset{\|}{C}}-\ddot{O}CH_3 \longleftrightarrow CH_3-\overset{O}{\overset{\|}{C}}-\overset{-}{\ddot{C}}H-\overset{O}{\overset{\|}{C}}-\ddot{O}CH_3 \longleftrightarrow CH_3-\overset{O}{\overset{\|}{C}}-\overset{-}{\ddot{C}}H-\overset{O^-}{\overset{|}{C}}=\overset{+}{O}CH_3$$

Carbanion from (d)

77. **(a)** Resonance energy = Theoretical heat of hydrogenation – Experimental heat of hydrogenation Benzene has 3 double bonds, so its theoretical heat of hydrogenation will be more than that of cyclobutadiene having 2 double bonds. Further, since all the double bonds in benzene form a delocalised π orbital over the complete ring, the molecule is quite stable with less experimental heat of hydrogenation. however, it is not in cycloheptatriene which has one sp^3 carbon, hence the 6π electrons are not delocalised over the complete ring with the result the difference between theoretical and experimental heat of hydrogenation (resonance energy) will be quite low.

78. **(b)**



. Here C_2 is chiral, hence optical isomerism is possible. However, the doubly bonded C_4 has two similar ($-CH_3$) groups, hence geometrical isomerism is not possible.

79. **(b)** Racemisation of optically active compounds is driven by entropy.

80. **(d)** $H_2C=CH-CH_2-N\overset{\rightarrow}{\equiv}C$ (Allyl isonitirile)

No. of C – H (σ) bonds = 5

No. of C – C π bonds = 3

No. of C – C or C – N (σ) bonds = 4

No. of non-bonding electrons = 2

81. **(d)** *sp* Hybrid carbon atom as well as carbon atom directly attached to it are linearly arranged.

$$H_3C-\overset{sp}{C}\equiv\overset{sp}{C}-CH_2-CH=\overset{sp}{C}=CH_2$$

82. **(c)** $C_2H_2Br_2$ has 1° of unsaturation, hence it can have following structures

$\underset{I\,(cis-\text{ and }trans-)}{BrCH=CHBr}$ $\underset{II}{CH_2=CHBr}$

Structures I and II are position isomers, further structure I (not II) can show geometrical isomerism

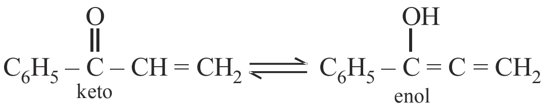
83. **(d)** Glucose has four dissimilar chiral carbon atoms (labelled as *)

$$OHC\overset{*}{C}HOH\overset{*}{C}HOH\overset{*}{C}HOH\overset{*}{C}HOH\,CH_2OH$$

Note that none of the four chiral carbon is similar, i.e. all the four are dissimilar

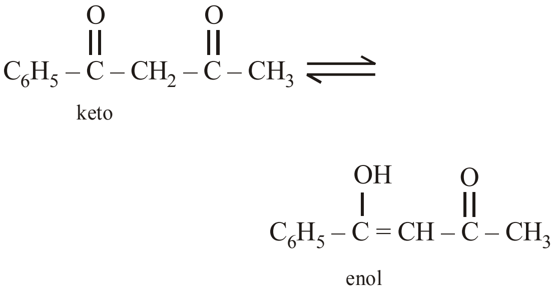
84. **(d)** Keto-enol tautomerism is possible in those keto compounds which have H atom on α-carbon.

(b)



$$\underset{\text{keto}}{C_6H_5-\overset{O}{\overset{\|}{C}}-CH=CH_2} \rightleftharpoons \underset{\text{enol}}{C_6H_5-\overset{OH}{\overset{|}{C}}=C=CH_2}$$

(c)



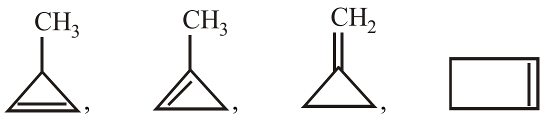
$$\underset{\text{keto}}{C_6H_5-\overset{O}{\overset{\|}{C}}-CH_2-\overset{O}{\overset{\|}{C}}-CH_3} \rightleftharpoons \underset{\text{enol}}{C_6H_5-\overset{OH}{\overset{|}{C}}=CH-\overset{O}{\overset{\|}{C}}-CH_3}$$

85. **(c)** C_4H_6 has 2° of unsaturation which can be in the form of two double bonds, or one triple bond

$CH_2=CH-CH=CH_2,\ CH_2=C=CHCH_3,$

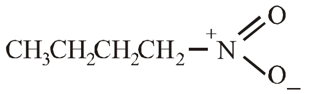
$CH\equiv CCH_2CH_3,\ CH_3C\equiv CCH_3$

86. **(c)** Of the 2° of unsaturation in C_4H_6, one is in the form of ring, the other will thus be in the form of one double bond which may be present in the ring or outside the ring in case tricyclic compound.

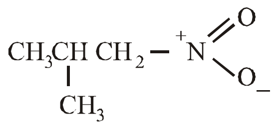


87. **(c)** Metamerism shown among compounds of the same functional group.

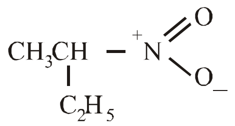
88. (d)



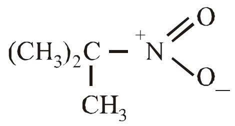
1° Nitroalkane



1° Nitroalkane

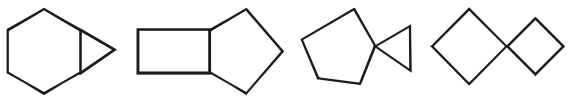


2° Nitroalkane



3° Nitroalkane

89. (c)

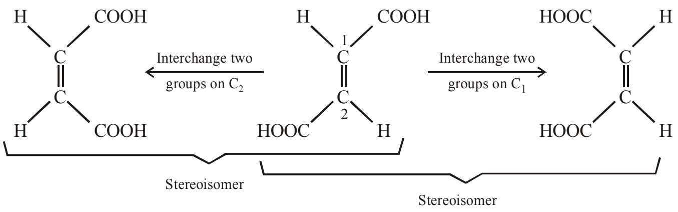


Spiro compounds

A spiro ring junction is that where two rings originate from a single carbon atom.

90. (b) Chain and position isomerism is not possible together between two isomers. Optical isomerism is possible in compounds containing achiral carbon atom too, and also in compounds containing chiral nitrogen atom.

91. (b) An atom in a molecule whose any two groups when interchanged produce a stereoisomer is known as stereocenter. Chiral carbon and the doubly-bonded carbon atoms in *cis-trans* isomers are common types of stereocenters. Thus, fumaric acid has two stereocenters.



92. (c) Stereoisomers have same bonding sequence, but differ in the orientation of their atoms (groups) in space, while constitutional isomers differ in their bonding sequence.

93. (b) Conformational isomers arise due to rotation about a C–C bond for which energy barrier is very small. Configurational isomers (stereoisomers) arise due to breaking and forming of chemical bonds which require high energy.

94. (c) A stereocenter may be chiral or achiral (e.g. maleic acid has two stereocenters, none of which is achiral). However, all chiral centers are stereocenters - an atom having tetrahedrally bonded four different atoms or groups is known as *chiral center*. The C^+ of a carbocation uses sp^2 HO's, i.e. it has a flat geometry and hence it has a plane of symmetry. A chiral center may be C, N, S, P, Si etc.

95. (a) S_N2 reaction proceeds with inversion of configuration, (b) and (c) reactions do not involve bond-cleavage at the chiral carbon, (d) D_2 adds to the enantiotropic faces of the alkene equally leading to racemization.

96. (a) An achiral molecule can have achiral (e.g. CH_3CH_2COOH) or chiral center (e.g. meso compound). (b) A racemate (having chiral centers) is always optically inactive. (c) The sign of rotation is not related to configuration. (d) The priority sequence of groups may change.

97. (b) (i) The product may be *meso* or achiral.

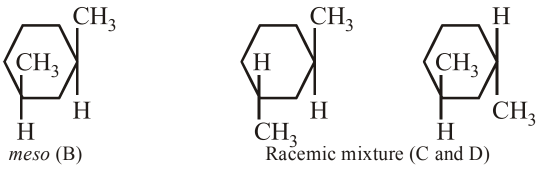
(ii) In case an optically active chiral reagent, solvent, or catalyst such as enzyme is used, the product will likely to be optically active.

(iii) The configuration can be changed only by breaking a bond.

(iv) Changing the configuration at one of the chiral carbons converts one diastereomer to the other.

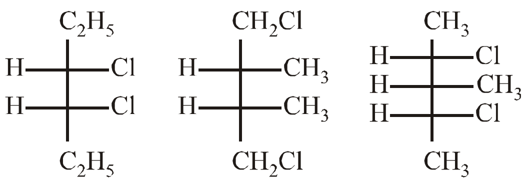
(v) The terms D and L do not refer to the sign of rotation. They refer to the configuration of a stereoisomer relative to that of D-glyceraldehyde.

98. (c) Hydrogen may add to both double bonds from the same face to form *meso* compound B. If H_2 adds to the two double bonds from opposite faces, the two enantiomers (C and D) are formed in equal amounts.



meso (B) Racemic mixture (C and D)

99. (c)



100. (c)

$$(R) - ROH + (S) - CH_3CH(OH)COOH \longrightarrow \underset{I}{CH_3CH(OH)COOR\ (R, S)}$$

$$(S) - ROH + (S) - CH_3CH(OH)COOH \longrightarrow \underset{II}{CH_3CH(OH)COOR\ (S, S)}$$

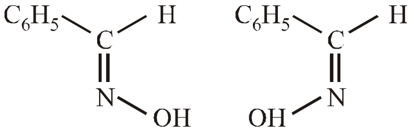
Both structures, I and II are diastereomers.

101. **(c)** Both the sign and value of observed rotation and hence specific rotation can be ascertained only by experiments, although, we can ascertain the absolute configuration (R or S) from the given structure. Remember that sign of rotation is a molecular property unrelated to configuration.

102. **(b)** $[\alpha]_{\text{obs.}} = [\alpha]_D \times \ell \times c$; hence observed rotation is directly proportional to the concentration of the optically active solution and length of the tube containing solution. However, the specific rotation is a constant and is independent of concentration and path length.

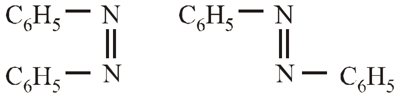
103. **(a)** A *tert*-amine (iii) and a carbanion (ii) can, although theoretically exist in enantiomeric forms, because here the N and C^- are sp^3 hybridised, but due to rapid umbrella type of inversion an enantiomer of each of the compound is converted into other causing unavoidable racemization. However, the energy required for inversion about third period elements (S and P) is sufficiently high (recall that C and N lie in the second period), hence one enantiomer can't be converted into other at ordinary temperature.

104. **(d)** (a)



syn *anti*

(b)



syn *anti*

(c)

cis *trans*

105. **(c)** Inermolecular H-bonding between CH_3OH and HOH is stronger than between CH_3OH and CH_3OH or between H_2O and H_2O leading to contraction in volume.

106. **(c)** All are polar, but only I is a protic solvent.

107. **(b)** Cyclohexyl is more electropositive due to + I effect than cyclopropyl and cyclobutyl.

108. **(a)** Trifluoroacetic acid is strongly acidic, hence it dissociates completely.

109. **(a)** 1, 2-Dioxan, II, being peroxide, explodes on heating.

110. **(d)** Methyl group can't produce electromeric and resonance effects. Inductive effect affects all the three positions of the ring in decreasing order of *ortho* > *meta* > *para.* It shows hyperconjugation (no-bond resonance) which explains beautifully the *o, p*-directing influence of the $-CH_3$ group.

111. **(b)** No. of hyperconjugative H's in (a), (b), (c) and (d) are 3, 5, 1 and 4 respectively. More the number of hyperconjugative structures, greater is its stability.

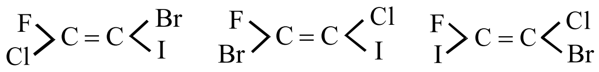
112. **(c)** Tetramethylethene has maximum number (12) of hyperconjugative structures, hence it is the most stable alkene known.

113. **(c)** N has no *d* orbital, hence it can't accommodate more than 8 electrons in its valence shell.

114. **(d)** (a) and (b) are involved in resonance, while (c) in hyperconjugation.

115. **(b)** Although (b) has positive charge on O (an electronegative element), it is more stable because here every atom has octet of electrons.

116. **(d)** Taking any two halogens, the possible structural isomers for the alkene can be three.

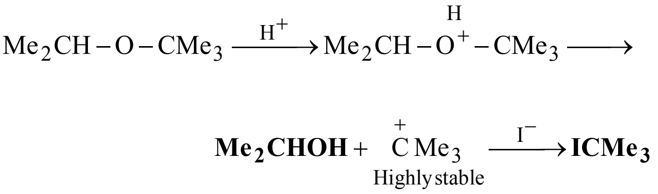


Each of the three alkene can exist as *E* and *Z* isomer, making total number of isomers as six.

117. **(b)** It has two chiral carbons, hence number of stereoisomers will be 4.

127. **(c)** The number of electrons in the two compounds of each pair is equivalent.

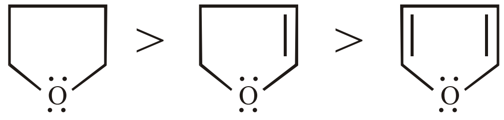
128. **(b)** Since both of these groups are bulky, steric hindrance will restrict S_N2 mechanism, hence the reaction will take place through S_N1 . Further, in S_N1 since carbocations are formed as intermediate, more stable cabocation corresponding from *tert*-butyl group will be formed.



$$Me_2CH-O-CMe_3 \xrightarrow{H^+} Me_2CH-\overset{H}{O^+}-CMe_3 \longrightarrow$$

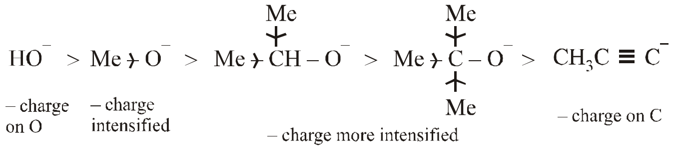
$$\mathbf{Me_2CHOH} + \underset{\text{Highly stable}}{\overset{+}{C}Me_3} \xrightarrow{I^-} \mathbf{ICMe_3}$$

129. **(a)** Higher the electron density on O, stronger is the H-bond with water and thus more is the solubility. Thus solubility of the three ethers follow the order



I electron pair localised > III e pair delocalised > II e pair more delocalised

130. **(d)** Observe the stability of their conjugate base, more the stability of the base easier will be its formation

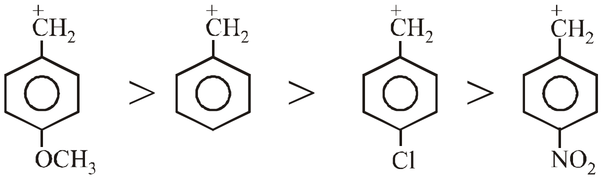


$$HO^- > Me \rightarrow O^- > Me \rightarrow \overset{\overset{Me}{\downarrow}}{C}H - O^- > Me \rightarrow \overset{\overset{Me}{\downarrow}}{\underset{\underset{Me}{\uparrow}}{C}} - O^- > CH_3C \equiv C^-$$

– charge on O; – charge intensified; – charge more intensified; – charge on C

131. **(b)** pK_a value (3.5) for aspirin indicates that it should be ionizable in basic medium (pH 8) and unionizable in acidic medium (pH 2.5)

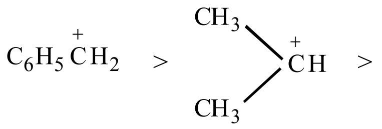
132. **(a)** On protonation, all compounds form benzyl cation which differ in their stability. More the stability of the carbocation, more will be the basic character of the parent compound.



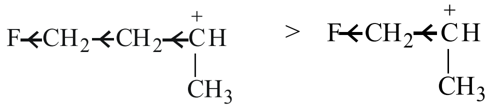
IV (Stabilised due to dispersal of charge) > I > II > III Destabilised due to intensification of + charge

133. **(a)** Ammonia, being a strong base, favours elimination reaction, rather substitution, when the alkyl halide is 2° or 3°.

134. **(c)**



Benzyl 3°



$$F \leftarrow CH_2 \leftarrow CH_2 \leftarrow \underset{\underset{CH_3}{|}}{\overset{+}{C}}H > F \leftarrow CH_2 \leftarrow \underset{\underset{CH_3}{|}}{\overset{+}{C}}H$$

2° (more stable)
F is more away from + ve charge

B COMPREHENSION TYPE

PASSAGE 1

1.(c) Enantiomers react with optically acitve (+)– or (–)– compound to form diastereomers.

2.(b) The two salts X and Y are diastereomers (stereoisomers which are not enantiomers).

3.(c) Diastereomers (X and Y) have different solubility.

PASSAGE 2

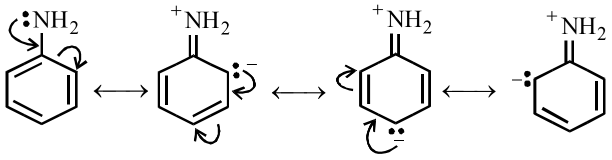
4.(c) All amines have a lone pair of electrons on N which enables them to form a H bond. However, tertiary amines although can form H–bond with water or other hydroxylic solvents, it does not form H-bond with its second molecule because of absence of H on N. Only lower amines (1°, 2° as well as 3°) are quite soluble in water, solubility in water decreases with the increase in the size of the alkyl group.

5.(d) Although the mirror image of $R_1R_2R_3\ddot{N}$ type of amine is not superimposable on its object, yet the molecule is optically inactive because of rapid inversion of configuration between the two arrangements i.e. the two enantiomers are only hypothetical, these are not isolated.

6.(c) Quaternary ammonium salts having four different groups have tetrahedral arrangement and therefore exist as configurational enantiomers.

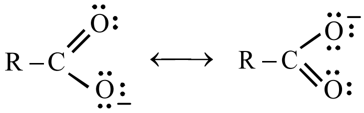
7.(b) Consult Q. 2

8.(c)



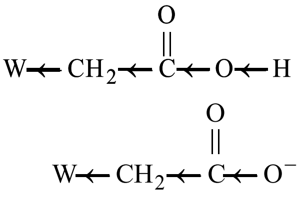
PASSAGE 3

9.(b) More acidic character of RCOOH over ROH is due to resonance stabilization of $RCOO^-$, while there is no such factor in RO^-.



So it is the C = O part of the – COOH group which makes resonance possible.

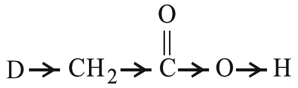
10.(d) Electron withdrawing group (W) destabilizes the carboxylic acid; but it stabilizes the carboxylate ion by dispersing (minimising) the negative charge on $–COO^-$. On the other, reverse is true for electron donating groups (D).



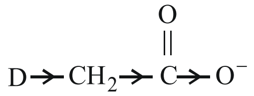
$$W \leftarrow CH_2 \leftarrow \overset{\overset{O}{\|}}{C} \leftarrow O \leftarrow H$$

$$W \leftarrow CH_2 \leftarrow \overset{\overset{O}{\|}}{C} \leftarrow O^-$$

Destabilization of – COOH due to deprotonation
Stabilization of –COO⁻ due to dispersal of –ve charge



$D \rightarrow CH_2 \rightarrow \overset{\overset{O}{\|}}{C} \rightarrow O \rightarrow H$



$D \rightarrow CH_2 \rightarrow \overset{\overset{O}{\|}}{C} \rightarrow O^-$

Stabilization of – COOH by restricting deprotonation
Destabilization of – COO⁻ by intensifying the –ve charge

11.(a) Acid weakening groups are electron donating and hence they activate the ring toward the attack by an electrophile.

12.(c) The carboxyl carbon is sp^2 hybridized so it is planar near the site of attack and therefore less sterically hindered.

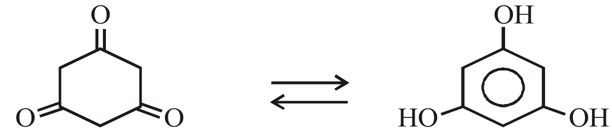
13.(d) The H^- (in aldehydes) formed due to C – H cleavage and CH_3^- (in ketones, e.g. acetone) formed due to C – C cleavage are very poor leaving groups, hence can't be removed.

C REASONING TYPE

1. **(c)** **Correct R :** The longest carbon chain containing the double bond and the functional group contains only three carbon atoms while ethyl is the substituent group.

2. **(b)** **Correct explanation :** In styrene, carbon atom attached to phenyl group is designated as α-carbon while that carrying Cl atom is designated as β-carbon.

3. **(b)** **Correct explanation :** Enol form of cyclohexane – 1, 3, 5-trione i.e. phloroglucinol is stabilized by resonance energy i.e. aromatic character.



Cyclohexane – 1, 3, 5-trione   Phloroglucinol

5. **(c)** **Correct R :** Two sp^2-hybridized orbitals overlap sideways or laterally to form a triple bond.

7. **(b)** **Correct explanation :** Carbon in carbanions is sp^3 hybridized with one orbital occupied by a lone pair of electrons.

9. **(b)** **Correct explanation :** Inter-electronic repulsions in triplet carbene are less than in singlet carbene since in triplet carbene, the two non-bonding electrons are present in different orbitals.

13. **(b)** **Correct explanation :** *p*-Dichlorobenzene being more symmetrical than the *o*-isomer fits closely in the crystal lattice and hence greater amount of energy in needed to break the crystal lattice. Thus, *p*-isomer is less soluble than the *o*-isomer.

14. **(c)** **Correct R :** The anion left after the removal of α hydrogen is stabilized by resonance effect.

15. **(a)** **R** is the correct explanation of **A**.

16. **(c)** **Correct R :** In higher alcohols the hydrocarbon character (alkyl chain) of the molecule increases and thus alcohols tend to resemble hydrocarbons (which are insoluble in water) and hence the solubility in water decreases. When the ratio of C to OH is more than 4, alcohols have little solubility in water.

17. **(d)** Assertion is not correct as conjugate base of a strong acid is weak. Since CH_3COOH is a stronger acid than CH_3OH, CH_3COO^- is a weaker base than OCH_3^-.

18. **(a)** Both the Assertion & Reason are correct. In *o*-nitrophenol intramolecular H-bonding is possible because OH and NO_2 group are closer. This is not possible in case of the *para*-isomer. This makes the *ortho* isomer less acidic as its capacity to donate a proton (H-atom) decreases.

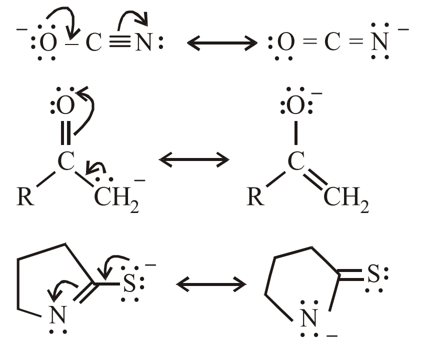
D MULTIPLE CORRECT CHOICE TYPE

1. **(a,d)** The difference is due to difference in the property of forming H bond with water.

2. **(a,b,d)** $-NH_2$ has two H's that can form H-bond, while –OH has only one.

3. **(a,b,c)** Ambident nucleophiles have two nucleophilic sites.

The site is primarily determined by nature of the solvent used in an S_N2 reaction, and the size of the atom.

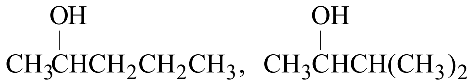


4. **(b,c,d)** The correct basic order is

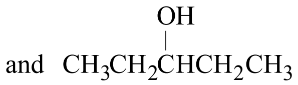
$$\underset{\text{–ve charge on most electronegative atom}}{CH_3O^-} > CH_3NH^- > \underset{\text{–ve charge on least electronegative atom}}{CH_3CH_2^-}$$

All others are correct.

5. **(a,b,c)** Three structures are possible for *sec.*-pentanol.



$$CH_3\underset{}{\overset{OH}{C}}HCH_2CH_2CH_3,\ CH_3\overset{OH}{C}HCH(CH_3)_2$$



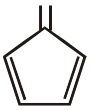
$$\text{and } CH_3CH_2\overset{OH}{C}HCH_2CH_3$$

6. **(a,b,c)** Fact based.

7. **(a,b,c)** Lone pair of electrons on N_9 belongs to p orbital, hence involved in delocalisation, while the lone pair of electrons on other N's lies in sp^2 orbitals; which being static are available for protonation.

8. **(a,b,c,d)**

and



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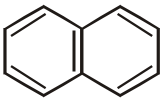

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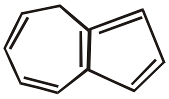

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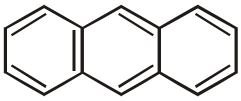

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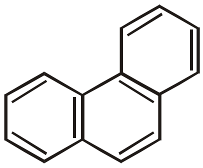

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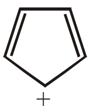

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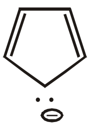
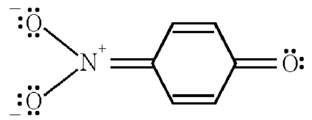


9. **(a,b,c)** Ethers are capable of forming hydrogen bonds with water as well as alcohols. Alcohols too can form H-bonds with ethers and water. In higher alcohols alkyl group dominates, hence H-bond not possible.

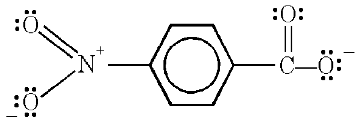
10. **(a,b,c)** All are correct name for the given structure, resorcinol is 1,3-isomer.

11. **(b,c)** Compound II has —CH_3 group in the *ortho* position to —OH, hence it can't form H-bond ; although III has —C ≡ N group which can form H–bond but due to its *sp* hybridized character, its carbon keeps N away from —OH group, hence here —C ≡ N can't form intramolecular H-bond.

12. **(a,c,d)** Charge delocalization in the *p*-nitrophenate ion is much more effective because of direct interaction between O^- and NO_2, which is not possible in the *p*-nitrobenzoate anion.



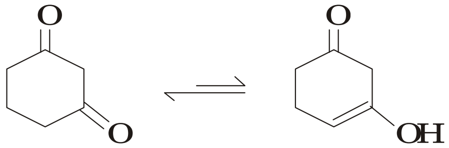
p-Nitrophenate anion
(direct extended π bonding)



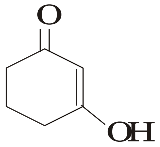
p-Nitrobenzoate anion
(no direct extended π bonding)

13. **(a,c)** Since the product, $CH_3CHOHCN$ has a chiral carbon and is a mixture of two enantiomers (racemic mixture) which can't be separated by fractional distillation.

14. **(a,c,d)**

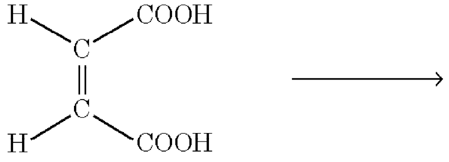


or

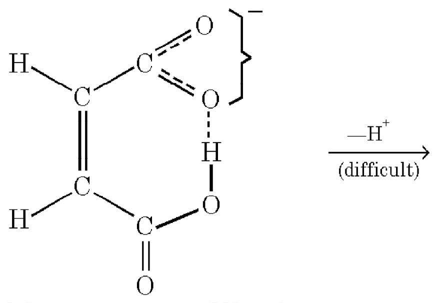


More stable (conjugated system)

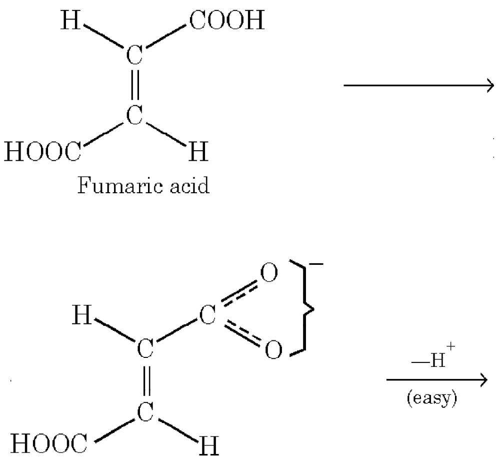
15. **(a,b,d)** Maleic acid is stronger because its monoanion is stabilized due to H-bonding between the *cis* COOH and COO^- ; while there is no such stabilization factor in fumarate monoanion (*trans* isomer), hence its formaton, *i.e.* dissociation of fumaric acid is less than that of maleic acid.



Maleic acid

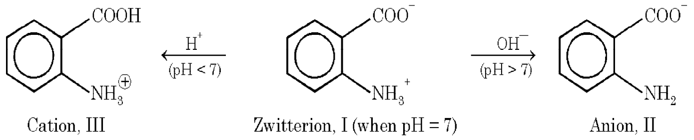


Maleate monoanion; (H-bonding makes its formation easier, however its deprotonation difficult)



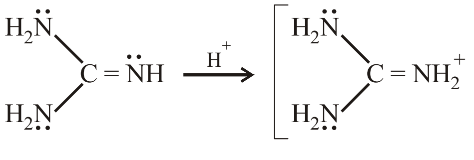
Fumarate monoanion ; (H-bonding not possible hence its formation is difficult). However, it undergoes deprotonation easily because COOH is not involved in H-bonding

16. **(a,c,d)** When pH is greater than seven, medium is alkaline hence the Zwitterion of anthranilic acid is converted to an anion.

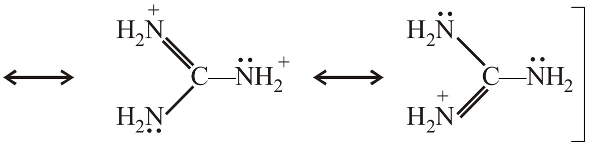


17. **(a,b,c)** Alkyl isonitriles are not hydrolysed to acids, all others give carboxylic acids on hydrolysis.

18. **(c,d)** On the basis of hybridisation, N (sp^3) of NH_2 with *s* less character should be more basic than N (sp^2) of the imino (= NH) group. However, N of imino group is more basic and it is this nitrogen which is protanated because its conjugate acid is resonance hybrid of three equivalent structures which accounts its unusual stability.



Guanidine



Conjugate acid of guanidine

Unusual stability of the conjugate acid of guanidine explains why guanidine is the strongest organic known base

19. **(a,b,c)** Consult text.

20. **(a,c,d)** Nitrogen (N) has no *d* orbital, hence it can't have more than 8 electorns in the outermost shell. All other three options are false.

21. **(a,b,c)** *tert*-Nitroalkanes do not have labile H (H in α-position to the —NO_2 group) and hence can't exhibit tautomerism.

22. **(a,b,c)** Boiling point of a liquid has no concern with its solubility ; however all the other three factors affect the boiling point of a compound.

23. **(b,c,d)** A liquid has a constant boiling point at atmospheric pressure, however the boiling point of a liquid may be (a) decreased by boiling it under reduced pressure, or (b) increased by boiling it at pressure higher than atmospheric pressure. Steam reduces atmospheric pressure, hence can be regarded as distillation under reduced pressure.

47. **(b,c,d)** $\underset{\text{Weaker acid}}{(CH_3)COH} + \underset{\text{Weaker base}}{Na^+OH^-} \longrightarrow$

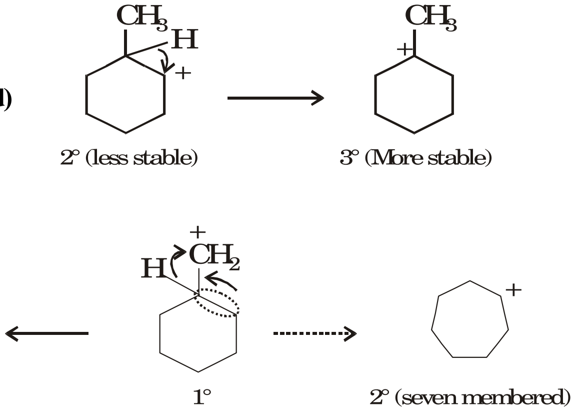
$$\underset{\text{Stronger base}}{(CH_3)_3CO^-Na^+} + \underset{\text{Stronger acid}}{H_2O}$$

Hence the reaction is not favourable to right side.

48. **(a,b,d)** Like –OH and –NH_2 groups, –OCH_3 is so strongly activating that the reaction goes to complete substitution in *o*- and *p*- positions, provided sufficient Br_2 is present.

49. **(a,b,c)** Phenol and HBr, both being acids, do not react with each other. Moreover, this reaction involves cleavage of the C—O bond which is difficult because C—O bond acquires double bond character due to resonance. Reaction (*b*) will lead to elimination reaction rather substitution. In reaction (*c*) vinylic chlorine will not be replaced, rather allylic chlorine will be replaced by —OCH_3.

50. **(a,d)**

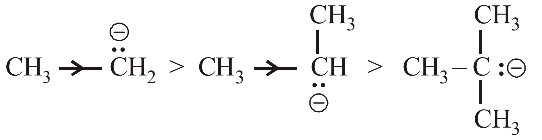


E MATRIX-MATCH TYPE

1. **A-q, r; B-p, s; C-p, r; D-r**

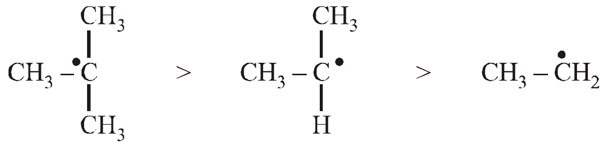
(A) $\overset{sp^2}{H_2C} = \overset{sp}{C} = \overset{sp^2}{CH_2}$, has sp^2 as well as sp hybridised carbon atoms.

(B) 1° Alkyl carbanion is more stable than a 2° which is more stable than a 3°.



A carbanion is sp^3 hybridised; the lone pair of electrons lies in unused sp^3 orbital.

(C) Relative stability order of alkyl free radicals can be explained on the basis of no bond resonance (hyperconjugation).



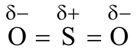
(9 hyperconjugative structures) (6 hyperconjugative structures) (3 hyperconjugative structures)

A free radical is sp^2 hybridised.

(D) Triple bond of arynes is different from that of acetylenes (sp hybridised). Only one of the π bonds of the triple bond is formed by p-p overlopping and forms a part of delocalized π system of the aromatic ring; the other π bond is formed by the overlap of the two sp^2 hybridised orbitals.

2. **A-p, q; B-p; C-r, s; D-r, s**

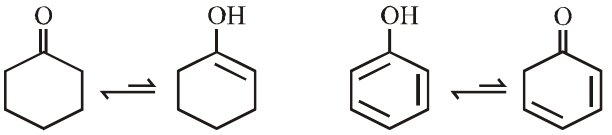
(A) Molecules with a multiple bond between atoms of dissimilar electronegativities behave as Lewis acids as well as Lewis bases. The positive end of the π bond dipole acts as an acid while the negative end of the π bond dipole acts as a base.



$$\overset{\delta-}{O} = \overset{\delta+}{S} = \overset{\delta-}{O}$$

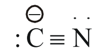
(B) In SiF_4, Si has d-orbitals and thus may expand its octet of valence electrons.

(C-D) Cyclohexanone as well as phenol can show tautomerism, hence they will produce colour with $FeCl_3$.



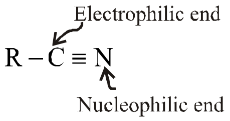
3. **A-p, r; B-p, q; C-p, s; D-q, s**

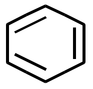
Species having two nucleophilic centres, one neutral (complete octet with at least one lp of electrons) and other negatively charged, are known as ambident nucleophiles. Organic compounds in which carbon is bonded with electronegative atom by multiple bond behave as an electrophile as well as nucleophile.

(A) 

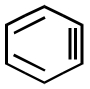
$$:\overset{\ominus}{C} \equiv \ddot{N}$$

Ambident nucleophile

(B) 

(C) 

Nucleophile, aromatic

(D) 

Electrophile, aromatic

4. **A-p, q; B-p, r, s; C-q, r; D-p, r, s**

(A) Higher the percentage of s character in a hybridised orbital, more will be its electronegativity and thus shorter the bond length and higher the acidic character.

(B) No bond resonance (hyperconjugation) explains the electrophilic aromatic substitution in certain compounds like $C_6H_5CH_3$ and $C_6H_5CCl_3$. Further, as the name indicates there is no bond between two atoms in a particular structure due to hyperconjugation, bond length is affected.

(C) Inductive effect governs electrophilic aromatic substitution in alkyl substituted benzenes.

(D) Mesomeric effect affects the bond lengths, and it also governs electrophilic aromatic substitution in most of organic compounds. Further we know that more the mesomeric structure of a compound, higher is its stability.

5. **A-p; B-p, q; C-p; D-p, r, s**

(A) In pyridine the lone pair of electrons on N is present in sp^2 orbital, hence not involved in aromatic sextet, while π electrons are involved in sextet and conjugation.

(B) The lp is conjugated with π bond. Further, the π bond of C = C is in conjugation with only one π bond of C ≡ C because its only one π bond is in the same plane of the π bond of C = C while the other π bond of C ≡ C is not in the same plane as that of the π bond of C = C.

(C) When an atom has more than one lp, its only one (not all) lp is in conjugation with the π bond.

(D) $CH_3CH = CH - CH = CH_2$ has three hyperconjugative hydrogens, so the compound will also show hyperconjugation (π, σ bond resonance).

6. A-q, s; B-p, s; C-p, s; D-r

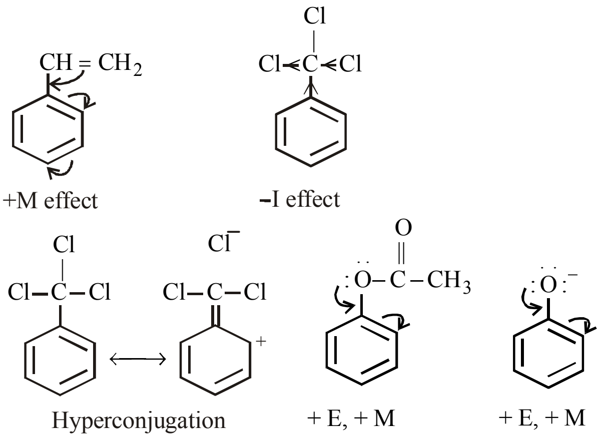
(A) $\underset{\text{Diazoacetic ester}}{N_2CHCOOC_2H_5} \xrightarrow{\text{heat}} \underset{\text{Carbene (neutral)}}{:CHCOOC_2H_5} + N_2$

(B) $\underset{\text{Diazomethane}}{CH_2N_2} \xrightarrow{\text{heat}} \underset{\text{Biradical (neutral)}}{:CH_2}$

(C) $CH_3N = NCH_3 \xrightarrow{\text{heat}} \underset{\text{Methyl radical}}{{}^{\bullet}CH_3} + N_2$

(D) $C_6H_5 - N^{+}\equiv NCl^{-} \longrightarrow \underset{\text{Carbocation (although, unstable)}}{C_6H_5^{+}} + N_2$

13. A-q; B-r, s; C-p, q; D-p, q



F NUMERIC/INTEGER ANSWER TYPE

1. **Explanation :** An electronegative element, viz., F, O, N, Cl and S having no H directly on it can only accept H in forming H – bond; while an electronegative element having H can serve as acceptor as well as H donor in forming H – bond. Thus

(a) (V), (VI), (VIII) and (X) can act as only H – bond acceptor.

(b) (I), (II), (III), (IV), (VII) and (IX) can act as H – bond acceptor as well as H – bond donor.

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