

Instructor : **Er. S.K. SINGH** (B.Tech, M.Tech) M.N.N.I.T. Alld.**I-HYBRIDISATION**

1. The molecular geometry of  $SF_6$  is octahedral. What is the geometry of  $SF_4$  (including lone pair(s) of electrons, if any)? **[JEE Main 2020]**

(a) Tetrahedral (b) Trigonal bipyramidal  
(c) Pyramidal (d) Square planar

**Ans. (b)**

2. The standard heat of formation ( $\Delta_f H_{298}^0$ ) of ethane (in kJ/mol), if the heat of combustion of ethane, hydrogen and graphite are -1560, -393.5 and -286 kJ/mol, respectively is ..... **[JEE Main 2020]**

(a) -192.50 (b) +192.50  
(c) +1560.50 (d) -1560.50

**Ans. (a)**

3. The structure of  $PCl_5$  in the solid state is  
(a) tetrahedral  $[PCl_4]^+$  and octahedral  $[PCl_6]^-$   
(b) trigonal bipyramidal

(c) square planar  $[PCl_4]^+$  and octahedral  $[PCl_6]^-$   
(d) square pyramidal **[JEE Main 2020]**

**Ans. (a)**

4. The ion that has  $sp^3d^2$  hybridisation for the central atom, is **[JEE Main 2019]**

(a)  $[ICl_2]^-$  (b)  $[BrF_2]^-$   
(c)  $[ICl_4]^-$  (d)  $[IF_6]^-$

**Ans. (c)**

5. The sum of the number of lone pairs of electrons on each central atom in the following species is

$[TeBr_6]^{2-}$ ,  $[BrF_2]^+$ ,  $SNF_3$  and  $[XeF_3]$   
(Atomic numbers : N = 7, F = 9, S = 16, Br = 35, Te = 52, Xe = 54) **[JEE Adv 2017]**

(a) 5 (b) 6  
(c) 7 (d) 8

**Ans. (b)**

6.  $BF_3$  is planar and electron deficient compound. Hybridization and number of electrons around the central atom, respectively are: **[NEET 2021]**

(a)  $sp^2$  and 4 (b)  $sp^3$  and 6  
(c)  $sp^2$  and 6 (d)  $sp^2$  and 8

**Ans. (C)**

7. Match List-I with List-II.

**Column I**

(a)  $PCl_3$   
(b)  $SF_6$   
(c)  $BrF_5$   
(d)  $BF_3$

**Column II**

(i) Square pyramidal  
(ii) Trigonal planar  
(iii) Octahedral  
(iv) Trigonal bipyramidal

Choose the correct answer from the options given

below:

**[NEET 2021]**

- (a) (a)-(iv), (b)-(iii), (c)-(i), (d)-(ii)  
(b) (a)-(ii), (b)-(iii), (c)-(iv), (d)-(i)  
(c) (a)-(iii), (b)-(i), (c)-(iv), (d)-(ii)  
(d) (a)-(iv), (b)-(iii), (c)-(ii), (d)-(i)

**Ans. (a)**

8. Match the compounds Xe in column I with the molecular structure in column II. **[NEET 2020]**

**Column I**

(a)  $XeF_2$   
(b)  $XeF_4$   
(c)  $XeO_3$   
(d)  $XeOF_4$

**Column II**

(i) Square planar  
(ii) Linear  
(iii) Square pyramidal  
(iv) Pyramidal

- (a) (a)-(ii), (b)-(i), (c)-(iii), (d)-(iv)  
(b) (a)-(ii), (b)-(iv), (c)-(iii), (d)-(i)  
(c) (a)-(ii), (b)-(iii), (c)-(i), (d)-(iv)  
(d) (a)-(ii), (b)-(i), (c)-(iv), (d)-(iii)

**Ans. (d)**

9. Match the coordination number and type of hybridisation with distribution of hybrid orbitals in space based on valence bond theory.

**Coordination number and type of hybridisation**

(a) 4,  $sp^3$   
(b) 4,  $dsp^2$   
(c) 5,  $sp^3d$   
(d) 6,  $d^2sp^2$

**Distribution of hybrid orbitals in space**

(i) trigonal bipyramidal  
(ii) octahedral  
(iii) tetrahedral  
(iv) square planar

Identify the correct metal. **[NEET 2020]**

- (a) (a)-(ii), (b)-(iii), (c)-(iv), (d)-(i)  
(b) (a)-(iii), (b)-(iv), (c)-(i), (d)-(ii)  
(c) (a)-(iv), (b)-(i), (c)-(ii), (d)-(iii)  
(d) (a)-(iii), (b)-(i), (c)-(iv), (d)-(ii)

**Ans. (b)**

10. Identify the wrongly matched pair. **[NEET 2020]**

**Molecule**

(a)  $PCl_5$   
(b)  $SF_6$   
(c)  $BeCl_2$   
(d)  $NH_3$

**Shape of geometry**

Trigonal planar  
Octahedral  
Linear  
Trigonal pyramidal

**Ans. (a)**

11. Among the triatomic molecules/ions  $BeCl_2$ ,  $N_3^-$ ,  $N_2O$ ,

$NO_2^+$ ,  $O_3$ ,  $SCl_2$ ,  $ICl_2^-$ ,  $I_3^-$  and  $XeF_2$ , the total number of linear molecules(s)/ion(s) where the hybridisation of the central atom does not have contribution from the  $d$ -orbital(s) is [atomic number of S = 16, Cl = 17, I = 53 and Xe = 54] **[JEE Adv. 2015]**

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

**Ans. (b)**

12. In allene ( $C_3H_4$ ), the type(s) of hybridization of the carbon atoms is (are) **[IIT]**

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

**Ans. (b)**

13. In hexa-1, 3-dien-5-yne, the number of C - C,  $\sigma$ , C - C  $\pi$  and C - H  $\sigma$  bonds respectively are

- (a) 5, 4 and 6 (b) 6, 3 and 5  
(c) 5, 3 and 6 (d) 6, 4 and 5

**Ans. (a)**

14. Considering the state of hybridisation of carbon atoms, find out the molecule among the following which is linear? **[CBSE AIPMT]**

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

**Ans. (c)**

15. Which of the two ions from the list given below that have the geometry that is explained by the same hybridisation of orbitals,  $NO_2^-$ ,  $NO_3^-$ ,  $NH_2^-$ ,

$NH_4^+$ ,  $SCN^-$ ? **[CBSE AIPMT]**

- (a)  $NO_2^-$  and  $NH_2^-$  (b)  $NO_2^-$  and  $NO_3^-$   
(c)  $NH_4^+$  and  $NO_3^-$  (d)  $SCN^-$  and  $NH_2^-$

**Ans. (b)**

16. The geometry of electron pairs around I in  $IF_5$  is **[DUMET]**

- (a) octahedral (b) trigonal bipyramidal  
(c) square pyramidal (d) pentagonal planar

**Ans. (c)**

17. Among the following molecules :  $SO_2$ ,  $SF_4$ ,  $ClF_3$ ,  $BrF_5$  and  $XeF_4$ , which of the following shapes does not describe any of the molecules mentioned? **[Kerala CEE]**

- (a) Bent  
(b) Trigonal bipyramidal  
(c) See-saw  
(d) Square pyramidal

**Ans. (b)**

18. Hybridisation shown by carbon and oxygen of -OH group in phenol are respectively,

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

**Ans. (a)**

19. In which of the following pairs of molecules/ions, the central atoms have  $sp^2$  hybridisation? **[AIPMT]**

- (a)  $BF_3$  and  $NH_2^-$  (b)  $NO_2^-$  and  $NH_3$   
(c)  $BF_3$  and  $NO_2^-$  (d)  $NH_2^-$  and  $H_2O$

**Ans. (c)**

20. In which one of the following species, the central atom has the type of hybridisation which is not the same as that present in the other three **[AIPMT]**

- (a)  $PCl_5$  (b)  $SF_4$   
(c)  $I_3^-$  (d)  $SbCl_5^{2-}$

**Ans. (d)**

21. The shape of  $IF_7$  molecule is **[AFMC]**

- (a) octahedral  
(b) trigonal bipyramidal  
(c) tetrahedral  
(d) pentagonal bipyramidal

**Ans. (d)**

22. Shape and hybridisation of  $SO_2$  are **[CPMT]**

- (a) V shape,  $sp$  (b) triangular planar,  $sp^2$   
(c) V shape,  $sp^2$  (d) tetrahedral,  $sp^2$

**Ans. (c)**

23. Which of the following represents the given mode of hybridisation  $sp^2-sp^2-sp^2-sp^2$  from left to right? **[RPMT, CG PMT, Haryana PMT]**

- (a)  $H_2C=CH-C\equiv N$  (b)  $HC\equiv C-C\equiv CH$   
(c)  $H_2C=C=C=CH_2$  (d)  $H_2C\text{---}CH=CH_2$

**Ans. (a)**

24. The  $AsF_5$  molecule is trigonal bipyramidal. The hybrid orbitals used by the As atoms for bonding are **[JCECE]**

- (a)  $d_{x^2-y^2}, d_{z^2}, s, p_x, p_y$  (b)  $d_{xy}, s, p_x, p_y, p_z$   
(c)  $s, p_x, p_y, p_z, d_{z^2}$  (d)  $d_{x^2-y^2}, s, p_x, p_y$

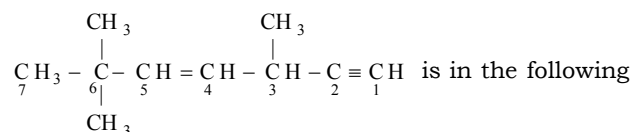
**Ans. (c)**

25. Which one of the following compounds has  $sp^2$ -hybridisation? **[BVP]**

- (a)  $CO_2$  (b)  $SO_2$   
(c)  $N_2O$  (d)  $CO$

**Ans. (b)**

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



sequence **[CBSE AIPMT]**

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

**Ans. (a)**

27. The geometry of sulphate ion is **[AFMC]**

- (a) square planar (b) tetrahedral  
(c) square pyramidal (d) octahedral

**Ans. (b)**

28. The five d-orbitals are designated as  $d_{xy}$ ,  $d_{yz}$ ,  $d_{xz}$ ,  $d_{x^2-y^2}$

and  $d_{z^2}$ . Choose the correct statement. **[AMU]**

- (a) The shapes of the first three orbitals are similar but that of the fourth and fifth orbitals are different.  
(b) The shape of all five d-orbitals are similar  
(c) The shapes of the first four orbitals are similar but that of the fifth orbital is different.

(d) The shapes of all the five d-orbitals are different.

**Ans. (c)**

29. Which of the following hybridisation has planar geometry ? **[AMU]**

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

**Ans. (c)**

30. The types of hybridisation on the five carbon atoms from left to right in the molecule  $CH_3-CH=C=CH-CH_3$  are **[Kerala CEE]**

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

**Ans. (c)**

31. The shape of  $XeOF_2$  on the basis of VSEPR theory is **[J&K CET]**

- (a) see saw (b) V-shaped  
(c) trigonal planar (d) T-shaped

**Ans. (d)**

32. The 'd' orbital involved in the hybridisation in the  $PCl_5$  molecule is **[J&K CET]**

- (a)  $3d_{x^2-y^2}$  (b)  $3d_{z^2}$   
(c)  $3d_{xy}$  (d)  $4d_{x^2-y^2}$

**Ans. (b)**

33. In the compound  $HC \equiv C - \overset{\text{CH}_3}{\underset{|}{C}} = CH_2$ , the hybridisation of C-2 and C-3 carbons are respectively **[WB JEE]**

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

**Ans. (c)**

34. Which of the following is incorrect match for hybridisation and geometry ? **[BHU]**

- | Hybridisation               | Geometry    |
|-----------------------------|-------------|
| (a) $dsp^2$                 | Planar      |
| (b) $d^3s$ and $sp^3$       | Tetrahedral |
| (c) $d^2sp^3$ and $sp^3d^2$ | Octahedral  |
| (d) $d^3s$                  | Planar      |

**Ans. (d)**

35. X, Y are anhydrides of sulphurous acid and sulphuric acid respectively. The hybridisation state and the shape of X and Y are **[EAMCET]**

- | Hybridisation        | Geometry                   |
|----------------------|----------------------------|
| (a) $sp^2$ , angular | $sp^3$ , tetrahedral       |
| (b) $sp^2$ , angular | $sp^2$ , angular           |
| (c) $sp^2$ , angular | $sp^2$ , planar triangular |
| (d) $sp^3$ , planar  | $sp^3$ , planar            |

**Ans. (c)**

36. The molecular shapes of  $SF_4$ ,  $SiF_4$  and  $ICl_4^-$  are **[Haryana PMT]**

- (a) different with 1, 0 and 2 lone pairs of electrons on the central atoms, respectively  
(b) different with 0, 1 and 2 lone pairs of electrons on the central atoms, respectively  
(c) the same with 1, 1 and 1 lone pair of

electrons on the central atoms, respectively  
(d) the same with 2, 0 and 1 lone pairs of electrons on the central atoms, respectively

**Ans. (a)**

37. The hybridisation of oxygen atom in  $H_2O_2$  is

- (a)  $sp^3d$  (b)  $sp$  **[Kerala CEE]**  
(c)  $sp^2$  (d)  $sp^3$

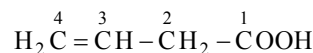
**Ans. (d)**

38. The compound in which underlined carbon uses only its  $sp^3$  hybrid orbitals for bond formation is

- (a)  $CH_3\underline{C}OOH$  (b)  $CH_3\underline{C}ONH_2$  **[RPMT]**  
(c)  $CH_3\underline{C}H_2OH$  (d)  $CH_3\underline{C}H=CH_2$

**Ans. (c)**

39. Which of the following carbon atoms is likely to possess tetrahedral geometry? **[RPMT]**



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

**Ans. (b)**

40. The correct order regarding the electronegativity of hybrid orbitals of carbon is **[RPMT]**

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

**Ans. (d)**

41. Which of the following species is non-linear?

- (a)  $ICl_2^-$  (b)  $I_3^-$  **[AMU]**  
(c)  $N_3^-$  (d)  $ClO_2^-$

**Ans. (d)**

42. In which of the following species, all the three types of hybrid carbons are present? **[Kerala CEE]**

- (a)  $CH_2=C=CH_2$  (b)  $CH_3-CH=CH-CH_2^+$   
(c)  $CH_3-C \equiv C-CH_2^+$  (d)  $CH_3-CH=CH-CH_2^-$

**Ans. (c)**

43. A covalent molecule  $AB_3$  has pyramidal structure. The number of lone pair and bond pair of electrons in the molecule are respectively. **[Manipal]**

- (a) 2 and 2 (b) 0 and 4  
(c) 3 and 1 (d) 1 and 3

**Ans. (d)**

44. The percentage of p-character in the orbitals forming P-P bonds in  $P_4$  is **[IIT JEE]**

- (a) 25 (b) 33  
(c) 50 (d) 75

**Ans. (d)**

45. The hybridisation of carbon atom in benzene is

- (a)  $sp$  (b)  $sp^2$  **[UP SEE]**  
(c)  $sp^3$  (d)  $dsp^2$

**Ans. (b)**

46. The hybridisation of P in  $PCl_5$  is **[AMU]**

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

**Ans. (b)**

47. Which one of the following is a correct set?

- (a)  $\text{H}_2\text{O}$ ,  $\text{sp}^3$ , angular  
(b)  $\text{H}_2\text{O}$ ,  $\text{sp}^2$ , linear  
(c)  $\text{NH}_4^+$ ,  $\text{dsp}^2$ , square planar  
(d)  $\text{CH}_4$ ,  $\text{dsp}^2$ , tetrahedral  
**Ans. (a)**
48.  $\text{sp}^3$  hybridisation is not found in **[BCECE]**  
(a)  $\text{H}_2\text{O}$  (b)  $\text{CH}_4$   
(c)  $\text{BCl}_3$  (d)  $\text{NH}_3$   
**Ans. (c)**
49. Which of the following statements is correct for carbon monoxide?  
(a) A double bond between carbon and oxygen  
(b)  $1\sigma$ ,  $1\pi$  and 1 coordinate bond between carbon and oxygen  
(c) One lone pair of electrons only on oxygen atom  
(d)  $1\sigma$  and  $2\pi$  bonds between carbon and oxygen.  
**Ans. (b)**
50. The hybridization in sulphur dioxide is  
(a)  $\text{sp}$  (b)  $\text{sp}^2$   
(c)  $\text{sp}^3$  (d)  $\text{dsp}^2$   
**Ans. (b)**
51. The specific in which the central atom uses  $\text{sp}^2$  hybrid orbitals in its bonding is  
(a)  $\text{PH}_3$  (b)  $\text{NH}_3$   
(c)  $\text{CH}_3^+$  (d)  $\text{SbH}_3$   
**Ans. (c)**
52. Among the following, the molecule that is linear is  
(a)  $\text{CO}_2$  (b)  $\text{NO}_2$   
(c)  $\text{SO}_2$  (d)  $\text{ClO}_2$   
**Ans. (a)**
53. The molecule which has a pyramidal shape is  
(a)  $\text{PCl}_3$  (b)  $\text{SO}_3$   
(c)  $\text{CO}_3^{2-}$  (d)  $\text{NO}_3^-$   
**Ans. (a)**
54. The linear structure is assumed by  
(a)  $\text{SnCl}_2$  (b)  $\text{NCO}^-$   
(c)  $\text{NO}_2^+$  (d)  $\text{SO}_2$   
**Ans. (b)**
55. The type of hybrid orbitals used by chlorine atom in  $\text{ClO}_2^-$  is  
(a)  $\text{sp}^3$  (b)  $\text{sp}^2$   
(c)  $\text{sp}$  (d)  $\text{dsp}^2$   
**Ans. (a)**
56. The state of hybridization of oxygen in  $\text{OF}_2$  is  
(a)  $\text{sp}$  (b)  $\text{sp}^2$   
(c)  $\text{sp}^3$  (d)  $\text{dsp}^2$   
**Ans. (c)**
57. Hybridization involves  
(a) Mixing of atomic orbitals centred on the same atom  
(b) Mixing of atomic orbitals centred on the different atoms  
(c) Addition of an electron to an atom  
(d) Addition of an electron pair to an atom  
**Ans. (a)**
58. Which of the following molecules has a tetrahedral shape?  
(a)  $\text{HgCl}_2$  (b)  $\text{CO}_2$   
(c)  $\text{NH}_4^+$  (d)  $\text{Ni}(\text{CN})_4^{2-}$   
**Ans. (c)**
59. The compound in which C uses its  $\text{sp}^3$  hybrid orbitals in bonding is  
(a)  $\text{HCOOH}$  (b)  $(\text{H}_2\text{N})_2\text{CO}$   
(c)  $(\text{CH}_3)_3\text{COH}$  (d)  $\text{CH}_3\text{CHO}$   
**Ans. (c)**
60. According to the VSEPR theory, the geometry of the molecule  $\text{OF}_2$  would be  
(a) linear (b) square planar  
(c) tetrahedral (d) octahedral  
**Ans. (c)**
61. The bonding of S in  $\text{SCl}_4$  molecule involves  
(a)  $\text{sp}$  orbitals (b)  $\text{sp}^2$  orbitals  
(c)  $\text{dsp}^3$  orbitals (d)  $\text{dsp}^2$  orbitals  
**Ans. (c)**
62. The structure of  $\text{XeF}_2$  is  
(a) square planar  
(b) tetrahedral octahedral  
(c) Octahedral (d) Distorted linear  
**Ans. (d)**
63. According to the VSEPR theory, the arrangement of lone pairs of an atom containing a total of four such pairs is  
(a) Linear (b) Tetrahedral  
(c) Square planar (d) Octahedron  
**Ans. (b)**
64. According to the VSEPR theory, the arrangement of lone pairs of an atom containing a total of three such pair is  
(a) Linear (b) Trigonal planar  
(c) Tetrahedral (d) Octahedron  
**Ans. (b)**
65. According to the VSEPR theory, the arrangement of lone pairs of an atom containing a total of five such pairs is  
(a) Triangular planar (b) Trigonal bipyramidal  
(c) Tetrahedron (d) Octahedron  
**Ans. (b)**
66. According to the VSEPR theory, the molecule  $\text{IF}_5$  has a shape of  
(a) trigonal bipyramid (b) tetrahedron  
(c) square pyramidal (d) pentagonal bipyramid  
**Ans. (c)**
67. Which of the following compounds has  $\text{sp}^2$  hybridisation?  
(a)  $\text{CO}_2$  (b)  $\text{SO}_2$   
(c)  $\text{N}_2\text{O}$  (d)  $\text{CO}$   
**Ans. (b)**
68. Match the entries of column I with appropriate entries of column II and choose the correct option out of the four options (a), (b), (c), (d) given at the end of each question

**Column I**

- (A)  $sp^2$   
 (B)  $dsp^2$   
 (C)  $sp^3d$   
 (D)  $sp^3d^2$   
 (a) A-r, B-s, C-q, D-p  
 (c) A-p, B-r, C-q, D-s

**Column II**

- (p)  $ICl_4^-$   
 (q)  $TeCl_4$   
 (r)  $SnCl_2$   
 (s)  $[Ni(CN)_4]^{2-}$   
 (b) A-r, B-p, C-q, D-s  
 (d) A-q, B-s, C-r, D-p

**Ans. (a)**

69. Match List I (Molecules) with List-II (Boiling points) and select the correct answer

**Column I**

- (A)  $NH_3$   
 (B)  $PH_3$   
 (C)  $AsH_3$   
 (D)  $SbH_3$   
 (E)  $BiH_3$   
 (a) A-r, B-q, C-t, D-s, E-p  
 (b) A-t, B-r, C-q, D-s, E-p  
 (c) A-p, B-s, C-t, D-q, E-r  
 (d) A-p, B-q, C-r, D-s, E-t

**Column II**

- (p) 290 K  
 (q) 211 K  
 (r) 186 K  
 (s) 264 K  
 (t) 240 K

**Ans. (b)**

70. Match the shape of molecules in Column I with the type of hybridisation in Column II.

**Column I**

- (i) Tetrahedral  
 (ii) Trigonal  
 (iii) Linear

**Column II**

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

**Ans. (i)-(c), (ii)-(a); (iii)-(b)**

71. Number of lone pair(s) present in the structure of  $HNO_3$  is

**Ans. (7)**

72. Total number of lone pairs and bond pairs of electrons present around xenon in  $XeF_4$  is

**Ans. (6)**

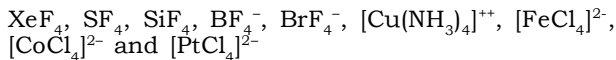
73. The number of  $90^\circ$  bond angles present in the molecules of  $SF_4$  is

**Ans. (0)**

74. Based on VSEPR theory, the number of  $90^\circ$  degree F-B-F angles in  $BrF_5$  is

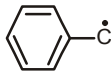
**Ans. (0)**

75. A list of species having the formula  $XZ_4$  is given below:



Defining shape on the basis of the location of X and Z atoms, the total number of species having a square planar shape is

**Ans. (4)**

76. The radical  is aromatic because it has

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

**Ans. (c)**

77. Any p-orbital can accommodate upto **(IIT 1983)**

- (a) four electrons (b) six electrons  
 (c) two electrons with parallel spins  
 (d) two electrons with opposite

**Ans. (d)**

78. The percentage of p-character in the orbitals forming P - P bonds in  $P_4$  is: **(IIT 2007)**

- (a) 25 (b) 33 (c) 50 (d) 75

**Ans. (d)**

79. Total number of lone pair of electrons in  $XeOF_4$  is: **(IIT 2004)**

- (a) 0 (b) 1 (c) 2 (d) 3

**Ans. (b)**

80. The compounds used as refrigerant are **(IIT 1990)**

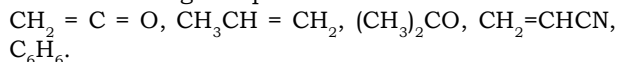
- (a)  $NH_3$  (b)  $CCl_4$  (c)  $CF_4$  (d)  $CF_2Cl_2$

**Ans. (a & d)**

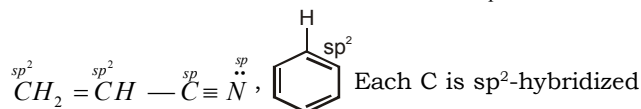
81. The total number of lone pair of electrons in melamine is: **(IIT 2013)**

**Ans. (6)**

82. What are hybridisation states of each carbon atom in the following compounds?

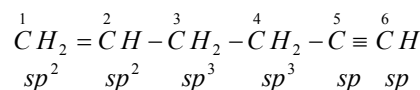


**Ans.**  $CH_2 = C = O$ ,  $CH_3 - CH = CH_2$ ,  $CH_3 - \overset{\overset{O}{||}}{C} - CH_3$



83. In the organic compound  $CH_2 = CH - CH_2 - CH_2 - C \equiv CH$ , the pair of hybridised orbitals involved in the formation of  $C_2 - C_3$  bond is :

**Ans.** When both double and triple bonds are present at equivalent positions, double bond is given preference while numbering the carbon chain. Thus,



$\therefore C_2 - C_3$  bond is formed by overlap of  $sp^2 - sp^3$  orbitals.

84. The species in which the N atom is in a state of  $sp$  hybridization is: **[JEE MAIN 2016]**

- (a)  $NO_2^-$  (b)  $NO_3^-$   
 (c)  $NO_2$  (d)  $NO_2^+$

**Ans. (d)**

85. Match the compounds given in column I with the hybridisation and shape given in column II and mark the correct option **[AIPMT 2016]**

Column I	Column II
A. $XeF_6$	(i) Distorted octahedral
B. $XeO_3$	(ii) Square planar
C. $XeOF_4$	(iii) Pyramidal
D. $XeF_4$	(iv) Square pyramidal

Code:

(A)	(B)	(C)	(D)	(A)	(B)	(C)	(D)
(a) (i)	(iii)	(iv)	(ii)	(b) (i)	(ii)	(iv)	(iii)
(c) (iv)	(iii)	(i)	(ii)	(d) (iv)	(i)	(ii)	(iii)

**Ans. (a)**

86. The pair of electron in the given carbanion,  $CH_3C \equiv C^\ominus$  is present in which of the following orbitals?

- (a) 2p (b)  $sp^3$  **[AIPMT 2016]**  
 (c)  $sp^2$  (d) sp

**Ans. (d)**



II-  $\sigma$  &  $\pi$  BONDS

1. The number of Cl = O bonds in perchloric acid is:  
 (a) 3.00 (b) 4.00 [JEE Main 2020]  
 (c) 7.00 (d) 11.00

Ans. (a)

2. The number of bonds between sulphur and oxygen atoms in  $S_2O_8^{2-}$  and the number of bonds between sulphur and sulphur atoms in rhombic sulphur, respectively, are [JEE Main 2020]

- (a) 4 and 6 (b) 8 and 8  
 (c) 4 and 8 (d) 8 and 6

Ans. (b)

3. The isoelectronic set of ions is [JEE Main 2019]

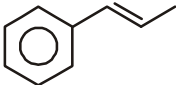
- (a)  $F^-$ ,  $Li^+$ ,  $Na^+$ ,  $Mg^+$  (b)  $N^{3-}$ ,  $Li^+$ ,  $Mg^{2+}$  and  $O^{2-}$   
 (c)  $Li^{3+}$ ,  $Na^+$ ,  $O^{2-}$  and  $F^-$  (d)  $N^{3-}$ ,  $O^{2-}$ ,  $F^-$  and  $Na^+$

Ans. (d)

4. Benzoic acid contains [CPMT]

- (a) 15  $\sigma$  and 2  $\pi$ -bonds (b) 15  $\sigma$  and 4  $\pi$ -bonds  
 (c) 14  $\sigma$  and 4  $\pi$ -bonds (d) 13  $\sigma$  and 4  $\pi$ -bonds

Ans. (b)

5. How many bonds are there in  ?

- (a) 14  $\sigma$ , 8  $\pi$  e (b) 19  $\sigma$ , 8  $\pi$  e [RPMT]  
 (c) 19  $\sigma$ , 4  $\pi$  e (d) 14  $\sigma$ , 2  $\pi$  e

Ans. (b)

6. Enolic form of acetone has [CPMT]

- (a) 8  $\sigma$ , 1  $\pi$ , 2 lone pairs (b) 9  $\sigma$ , 2  $\pi$ , 1 lone pairs  
 (c) 8  $\sigma$ , 2  $\pi$ , 1 lone pairs (d) 9  $\sigma$ , 1  $\pi$ , 2 lone pairs

Ans. (d)

7. The number of  $\pi$ -bonds in the following compound



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

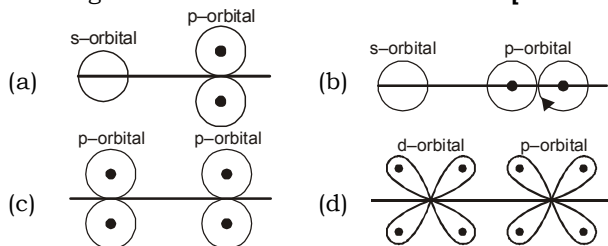
Ans. (c)

8. In  $[Ag(CN)_2]^{2-}$ , the number of  $\pi$  bonds is [AIIMS]

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

Ans. (c)

9. Which of the following overlaps leads to lateral bonding? [JCECE]



Ans. (c)

10. Number of electrons in the valence orbit of nitrogen in an ammonia molecule are [MHT CET]

- (a) 8 (b) 5  
 (c) 6 (d) 7

Ans. (a)

11. How many  $\sigma$  and  $\pi$ -bonds are in  $SO_4^{2-}$ ? [RPMT]

- (a) 4, 2 (b) 3, 2  
 (c) 4, 3 (d) none of these

Ans. (a)

12. Which of the following has  $p\pi-d\pi$  bonding?

- (a)  $NO_3^-$  (b)  $SO_3^{2-}$  [Punjab PMET]  
 (c)  $BO_3^{3-}$  (d)  $CO_3^{2-}$

Ans. (b)

13. Different structures generated due to rotation about, C-C axis, of an organic molecule, are the examples of [J&K CET]

- (a) geometrical isomerism  
 (b) conformational isomerism  
 (c) optical isomerism  
 (d) structural isomerism

Ans. (b)

14. Orbital interaction between the  $\sigma$ -bonds of a substituent group and a neighbouring  $\pi$ -orbital is known as [Kerala CEE]

- (a) hyperconjugation  
 (b) inductive effect  
 (c) steric effect  
 (d) dipole-dipole interactions

Ans. (a)

15. Hyperconjugation involves overlap of the following orbitals [IIT JEE]

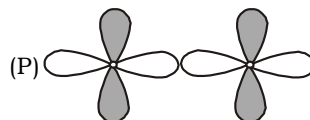
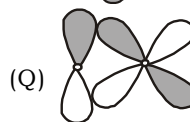
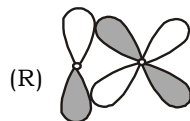
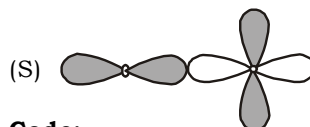
- (a)  $\sigma-\sigma$  (b)  $\sigma-\pi$   
 (c)  $\pi-\pi$  (d)  $\pi-\pi$

Ans. (b)

16. Match the orbital overlap figures shown in List-I with the description given in List-II and select the correct answer using the code given below the lists

List-I

List-II

1. p-d  $\pi$  antibonding2. d-d  $\sigma$  bonding3. p-d  $\pi$  bonding4. d-d  $\sigma$  antibonding

Code:

- |       |   |   |   |       |   |   |   |
|-------|---|---|---|-------|---|---|---|
| P     | Q | R | S | P     | Q | R | S |
| (a) 2 | 1 | 3 | 4 | (b) 4 | 3 | 1 | 2 |
| (c) 2 | 3 | 1 | 4 | (d) 4 | 1 | 3 | 2 |

Ans. (c)

17. **Column I (Compound)**
- (A)  $\text{CaC}_2$   
 (B)  $\text{SnCl}_2$   
 (C)  $[\text{CrCl}_2(\text{H}_2\text{O})_4]\text{Cl} \cdot 2\text{H}_2\text{O}$   
 (D)  $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$
- Column II (Type of bonds present)**
- (p) Ionic  
 (q) Covalent  
 (r) Coordinate  
 (s) Hydrogen bond

Ans. (A-p,q; B-q; C-p,q,r; D-p,q,r,s)

18. **Column I (Molecular orbital)**
- (A)  $\sigma_{2s}$   
 (B)  $\sigma_{2p_z}^*$   
 (C)  $\pi_{2p_x}^*$   
 (D)  $\pi_{2p_y}^*$
- Column II (Nodal planes present/Symmetry)**
- (p) 0  
 (q) 1  
 (r) 2  
 (s) gerade

(A)  $\sigma_{2s}$

(p) 0

(B)  $\sigma_{2p_z}^*$

(q) 1

(C)  $\pi_{2p_x}^*$

(r) 2

(D)  $\pi_{2p_y}^*$

(s) gerade

(take Z-axis as the internuclear axis)

Ans. (A-p,s; B-q; C-q,s; D-r,s)

19. Total number of  $\sigma$ -bonds present in the molecule of propyne is

Ans. (6)

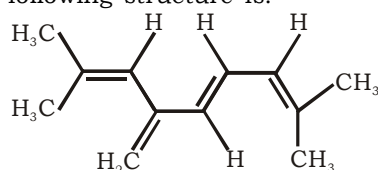
20. The bonds present in  $\text{N}_2\text{O}_5$  are (IIT 1986)

(a) only ionic (b) covalent and coordinate

(c) only covalent (d) covalent and ionic

Ans. (b)

21. The total number of  $\pi$ -bond electrons in the following structure is: (AIPMT 2015)



(a) 8

(b) 12

(c) 16

(d) 4

Ans. (a)

22. Maximum bond angle at nitrogen is present in which of the following? (AIPMT 2015)

(a)  $\text{NO}_2^-$

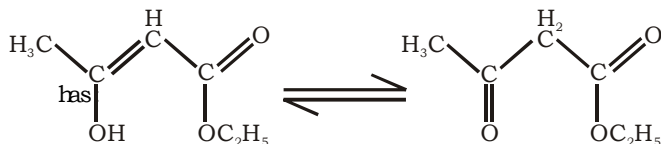
(b)  $\text{NO}_2^+$

(c)  $\text{NO}_3^-$

(d)  $\text{NO}_2$

Ans. (b)

23. The enolic form of ethyl acetoacetate as below



(a) 16 sigma bonds and 1 pi-bond (AIPMT 2015)

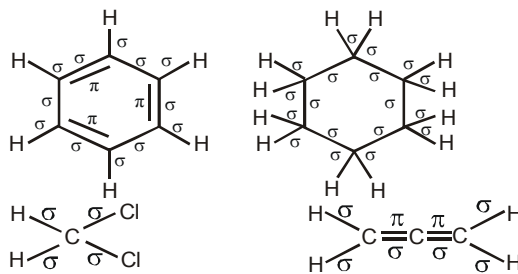
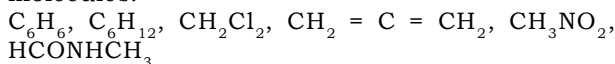
(b) 9 sigma bonds and 2 pi-bonds

(c) 9 sigma bonds and 1 pi-bond

(d) 18 sigma bonds and 2 pi-bonds

Ans. (d)

24. Indicate the  $\sigma$ - and  $\pi$ -bonds in the following molecules:

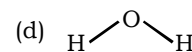
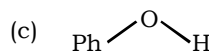
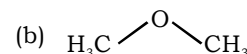
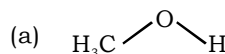


Ans.



### III-HYDROGEN BONDING

1. The compound that is most difficult to protonate is [NEET 2019]



Ans. (C)

2. Which is the correct thermal stability order of  $\text{H}_2\text{E}$  (E = O, S, Se, Te and Po)? [NEET 2019]

(a)  $\text{H}_2\text{O} < \text{H}_2\text{S} < \text{H}_2\text{Se} < \text{H}_2\text{Te} < \text{H}_2\text{Po}$

(b)  $\text{H}_2\text{Po} < \text{H}_2\text{Te} < \text{H}_2\text{Se} < \text{H}_2\text{S} < \text{H}_2\text{O}$

(c)  $\text{H}_2\text{Se} < \text{H}_2\text{Te} < \text{H}_2\text{Po} < \text{H}_2\text{O} < \text{H}_2\text{S}$

(d)  $\text{H}_2\text{S} < \text{H}_2\text{O} < \text{H}_2\text{Se} < \text{H}_2\text{Te} < \text{H}_2\text{Po}$

Ans. (B)

3. The typical range of molar enthalpies for the strongest intermolecular (hydrogen) bond is [DUMET]

(a) 200–300 kJ

(b) 300–500 kJ

(c) 4–25 kJ

(d) 4–25 kJ

Ans. (c)

4. The hydrogen bond is shortest in [Kerala CEE]

(a)  $\text{S}-\text{H} \cdots \text{S}$

(b)  $\text{N}-\text{H} \cdots \text{O}$

(c)  $\text{S}-\text{H} \cdots \text{O}$

(d)  $\text{F}-\text{H} \cdots \text{F}$

Ans. (d)

5. Maximum number of H-bonds in one molecule of water is [AFMC]

(a) 1

(b) 2

(c) 3

(d) 4

Ans. (d)

6. Which of the following is least volatile [Haryana PMT]

(a)  $\text{H}_2\text{O}$

(b)  $\text{H}_2\text{S}$

(c)  $\text{H}_2\text{Se}$

(d)  $\text{H}_2\text{Te}$

Ans. (a)

7. What is the dominant intermolecular force or bond that must be overcome in converting liquid  $\text{CH}_3\text{OH}$  to a gas? [CBSE AIPMT]

(a) hydrogen bonding

(b) dipole-dipole interaction

(c) covalent bonds

(d) London dispersion force

Ans. (a)

8. When two ice cubes are pressed over each other, they unite to form one cube. Which of the following forces is responsible to hold them together? [DUMET]

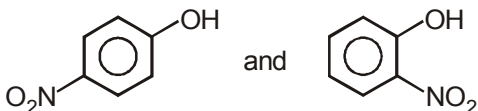
- (a) Dipole forces (b) van der Waals' forces  
(c) Covalent forces (d) Hydrogen bond forces

**Ans. (d)**

9.  $\text{NH}_3$  has higher boiling point than expected because  
(a) it forms  $\text{NH}_4\text{OH}$  with water [Manipal]  
(b) it has strong intermolecular hydrogen bonds  
(c) it has intramolecular hydrogen bonds  
(d) its density decreases on freezing

**Ans. (b)**

10. Out of the two compounds shown below, the vapour pressure of B at a particular temperature is expected to be [Manipal]



- (a) higher than that of A  
(b) lower than that of A  
(c) same as that of A  
(d) can be higher or lower depending upon the size of the vessel

**Ans. (b)**

11. Which of the following has strongest hydrogen bonding? [Manipal]  
(a) Ethylamine (b) Ammonia  
(c) Ethyl alcohol (d) Diethyl ether

**Ans. (c)**

12. H-bond is not present in [BCECE]  
(a) water (b) glycerol  
(c) hydrogen fluoride (d) hydrogen sulphide

**Ans. (d)**

13. The boiling point of methanol is greater than that of methyl thiol, because [Kerala CEE]  
(a) there is intramolecular hydrogen bonding in methanol and intermolecular hydrogen bonding in methyl thiol  
(b) there is intermolecular hydrogen bonding in methanol and no hydrogen bonding in methyl thiol  
(c) there is no hydrogen bonding in methanol and intermolecular hydrogen bonding in methyl thiol  
(d) there is intramolecular hydrogen bonding in methanol and no hydrogen bonding in methyl thiol

**Ans. (b)**

14.  $\text{H}_2\text{O}$  is liquid while  $\text{H}_2\text{S}$  is a gas due to [BHU]  
(a) covalent bonding  
(b) molecular attraction  
(c) H-bonding  
(d) both H-bonding and molecular attraction

**Ans. (c)**

15. Among  $\text{HF}$ ,  $\text{CH}_4$ ,  $\text{CH}_3\text{OH}$  and  $\text{N}_2\text{O}_4$  intermolecular hydrogen bond is expected [Manipal]  
(a) in two (b) in all  
(c) in all leaving one (d) none of these

**Ans. (a)**

16. Which compound shows hydrogen bonding? [Manipal]  
(a)  $\text{RCH}_2\text{NHCH}_3$  (b)  $\text{RCH}_2\text{CHO}$   
(c)  $\text{C}_2\text{H}_6$  (d)  $\text{HCl}$

**Ans. (a)**

17. Which molecule has hydrogen bonding? [Guj CET]

- (a)  $\text{CH}_4$  (b)  $\text{CH}_3\text{COOH}$   
(c)  $\text{GeH}_4$  (d)  $\text{H}_2\text{Te}$

**Ans. (b)**

18. Glycerine contains [Kerala CEE]  
(a)  $1^\circ$  carbon (b)  $2^\circ$  carbon  
(c)  $3^\circ$  carbon (d) both  $1^\circ$  and  $2^\circ$  carbon

**Ans. (d)**

19. Which one among the following does not have the hydrogen bond?  
(a) Phenol (b) Liquid  $\text{NH}_3$   
(c) Water (d) Liquid  $\text{HCl}$

**Ans. (d)**

20. The hydrogen bond is strongest in  
(a)  $\text{O}-\text{H} \dots \text{S}$  (b)  $\text{S}-\text{H} \dots \text{O}$   
(c)  $\text{F}-\text{H} \dots \text{F}$  (d)  $\text{F}-\text{H} \dots \text{O}$

**Ans. (c)**

21. The maximum number of hydrogen bonds a water molecule can form is  
(a) 2 (b) 4  
(c) 3 (d) 1

**Ans. (b)**

22. The order of strength of hydrogen bonds is  
(a)  $\text{ClH} \dots \text{Cl} > \text{NH} \dots \text{N} > \text{OH} \dots \text{O} > \text{FH} \dots \text{F}$   
(b)  $\text{ClH} \dots \text{Cl} < \text{NH} \dots \text{N} < \text{OH} \dots \text{O} < \text{FH} \dots \text{F}$   
(c)  $\text{ClH} \dots \text{Cl} < \text{NH} \dots \text{N} > \text{OH} \dots \text{O} > \text{FH} \dots \text{F}$   
(d)  $\text{ClH} \dots \text{Cl} < \text{NH} \dots \text{N} < \text{OH} \dots \text{O} > \text{FH} \dots \text{F}$

**Ans. (b)**

23. o-nitrophenol is more volatile than p-nitrophenol. It is due to  
(a) Intramolecular hydrogen bonding in o-nitrophenol and intermolecular hydrogen bonding in p-nitrophenol  
(b) Intermolecular hydrogen bonding in o-nitrophenol and intramolecular hydrogen bonding in p-nitrophenol  
(c) More stronger intramolecular hydrogen bonding in o-nitrophenol as compared to p-nitrophenol  
(d) More stronger intermolecular hydrogen bonding in o-nitrophenol as compared to p-nitrophenol.

**Ans. (a)**

24. Hydrogen bonding plays a central role in the following phenomena:  
(a) Ice floats in water  
(b) Higher Lewis basicity of primary amines than tertiary amines in aqueous solutions  
(c) Formic acid is more acidic than acetic acid  
(d) Dimerisation of acetic acid in benzene.

**Ans. (a, b, d)**

25. Match the items given in Column I with examples given in Column II.

**Column I**

- (i) Hydrogen bond  
(ii) Resonance  
(iii) Ionic solid  
(iv) Covalent solid

**Column II**

- (a) C  
(b)  $\text{LiF}$   
(c)  $\text{H}_2$   
(d)  $\text{HF}$   
(e)  $\text{O}_3$

**Ans. (i)-(d); (ii)-(c); (iii)-(b), (iv)-(a)**

26. (I) 1, 2-dihydroxybenzene  
(II) 1, 3-dihydroxybenzene  
(III) 1, 4-dihydroxybenzene



(IV) hydroxybenzene

The increasing order of boiling points of above mentioned alcohols is: **(IIT 2006)**

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

**Ans. (c)**27. The maximum possible number of hydrogen bonds, a water molecule can form is: **(IIT 1992)**

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

**Ans. (b)**28. Which of the following is soluble in water? **(IIT 1980)**

- (a) CS<sub>2</sub> (b) C<sub>2</sub>H<sub>5</sub>OH  
(c) CCl<sub>4</sub> (d) CHCl<sub>3</sub>

**Ans. (b)**29. Which one of the following statements about water is **FALSE**? **(JEE MAIN 2016)**

- (a) Water can act both as an acid and as a base.  
(b) There is extensive intramolecular hydrogen bonding in the condensed phase.  
(c) Ice formed by heavy water sinks in normal water.  
(d) Water is oxidized to oxygen during photosynthesis.

**Ans. (b)****IV-DIPOLE MOMENT**1. If AB<sub>4</sub> molecule is a polar molecule, a possible geometry of AB<sub>4</sub> is **[JEE Main 2020]**

- (a) square pyramidal (b) square planar  
(c) rectangular planar (d) tetrahedral

**Ans. (a)**2. H<sub>2</sub>O is dipolar, whereas BeF<sub>2</sub> is not. It is because (a) the electronegativity of F is greater than that of O. **[Manipal]**

- (b) H<sub>2</sub>O involves hydrogen bonding whereas BeF<sub>2</sub> is a discrete molecule.  
(c) H<sub>2</sub>O is linear and BeF<sub>2</sub> is angular  
(d) H<sub>2</sub>O is angular and BeF<sub>2</sub> is linear

**Ans. (d)**3. The correct decreasing order of dipole moment in CH<sub>3</sub>Cl, CH<sub>3</sub>Br and CH<sub>3</sub>F is **[DUMET]**

- (a) CH<sub>3</sub>F > CH<sub>3</sub>Cl > CH<sub>3</sub>Br  
(b) CH<sub>3</sub>F > CH<sub>3</sub>Br > CH<sub>3</sub>Cl  
(c) CH<sub>3</sub>Cl > CH<sub>3</sub>F > CH<sub>3</sub>Br  
(d) CH<sub>3</sub>Cl > CH<sub>3</sub>Br > CH<sub>3</sub>F

**Ans. (c)**4. In the given structure of a compound, the correct various bond moments direction involving are shown as **[DUMET]**

- (a) Br ≡ N ≡ CH<sub>2</sub> ≡ SiH<sub>2</sub> ≡ CH<sub>2</sub> ≡ O ≡ CH<sub>3</sub>  
(b) Br ≡ N ≡ CH<sub>2</sub> ≡ SiH<sub>2</sub> ≡ CH<sub>2</sub> ≡ O ≡ CH<sub>3</sub>  
(c) Br ≡ N ≡ CH<sub>2</sub> ≡ SiH<sub>2</sub> ≡ CH<sub>2</sub> ≡ O ≡ CH<sub>3</sub>  
(d) Br ≡ N ≡ CH<sub>2</sub> ≡ SiH<sub>2</sub> ≡ CH<sub>2</sub> ≡ O ≡ CH<sub>3</sub>

**Ans. (c)**5. Which of the following fluoride of xenon has zero dipole moment? **[AMU]**

- (a) XeF<sub>2</sub> (b) XeF<sub>3</sub>  
(c) XeF<sub>4</sub> (d) XeF<sub>6</sub>

**Ans. (c)**6. The units of dipole moment is **[CPMT]**

- (a) esu (b) C-m  
(c) pascal (d) S-m

**Ans. (b)**

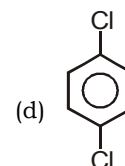
7. The molecule which has zero dipole moment is

- (a) CH<sub>3</sub>Cl (b) NF<sub>3</sub> **[JCECE]**  
(c) BF<sub>3</sub> (d) ClO<sub>2</sub>

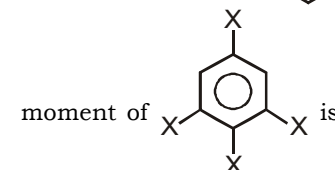
**Ans. (c)**8. Non-zero dipole moment is shown by **[OJEE]**

- (a) CCl<sub>4</sub> (b) CO<sub>2</sub>

- (c) H<sub>2</sub>O



(d)

**Ans. (c)**9. Dipole moment of  is 1.5 D. The dipolemoment of  is **[WB JEE]**

- (a) 1.5 D (b) 2.35 D  
(c) 1 D (d) 3 D

**Ans. (a)**10. Dipole moments of HCl = 1.03 D, HI = 0.38 D. Bond length of HCl = 1.3 Å and HI = 1.6 Å. The ratio of fraction of an electric charge, e existing on each atom in HCl and HI is **[EAMCET]**

- (a) 1.2 : 1 (b) 2.7 : 1  
(c) 3.3 : 1 (d) 1 : 3.3

**Ans. (c)**11. Among the following, the molecule possessing in highest dipole moment is **[J&K CET]**

- (a) CO<sub>2</sub> (b) BF<sub>3</sub>  
(c) SO<sub>2</sub> (d) Trans-2-butene

**Ans. (c)**12. In which of the following pairs, both molecules possess dipole moment? **[CPMT]**

- (a) CO<sub>2</sub>, SO<sub>2</sub> (b) BCl<sub>3</sub>, PCl<sub>3</sub>  
(c) H<sub>2</sub>O, SO<sub>2</sub> (d) CO<sub>2</sub>, CS<sub>2</sub>

**Ans. (c)**

13. The correct order of decreasing dipole moment of

- (I) toluene,  
(II) m-dichlorobenzene,  
(III) o-dichlorobenzene and  
(IV) p-dichlorobenzene is **[BHU]**

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

**Ans. (c)**14. The correct order of dipole moments for NH<sub>3</sub>, H<sub>2</sub>O and CO<sub>2</sub> molecule is **[EAMCET]**


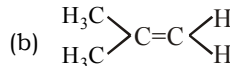
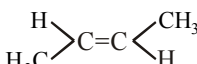
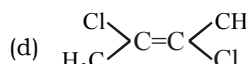
- (a) NH<sub>3</sub> > H<sub>2</sub>O > CO<sub>2</sub> (b) CO<sub>2</sub> > NH<sub>3</sub> > H<sub>2</sub>O

(c)  $H_2O > CO_2 > NH_3$  (d)  $H_2O > NH_3 > CO_2$ **Ans. (a)**15. The dipole moment of HBr is  $1.6 \times 10^{-30}$  C-m and interatomic spacing is  $1 \text{ \AA}$ . The percent ionic character of HBr is [Haryana PMT]

- (a) 7 (b) 10
- 
- (c) 15 (d) 27

**Ans. (b)**

16. Which has highest dipole moment ?

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

**Ans. (a)**

17. Which of the following has zero dipole moment?

- (a)
- $CH_2Cl_2$
- (b)
- $NH_3$
- [Manipal]
- 
- (c)
- $CH_4$
- (d)
- $PH_3$

**Ans. (a)**

18. Dipole moment is shown by [Manipal]

- (a) cis-1, 2-dichloro ethene
- 
- (b) trans-1, 2-dichloro ethene
- 
- (c) trans-1, 2-dichloro-2-pentene
- 
- (d) both (a) and (c)

**Ans. (d)**

19. The molecule having largest dipole moment among the following is [RPMT]

- (a)
- $CH_3$
- (b)
- $CH_4$
- 
- (c)
- $CHCl_3$
- (d)
- $CCl_4$

**Ans. (c)**

20. Which of the following would have a permanent dipole moment ? [CBSE AIPMT]

- (a)
- $BF_3$
- (b)
- $SiF_4$
- 
- (c)
- $SF_4$
- (d)
- $XeF_4$

**Ans. (c)**21. The dipole moment of  $H_2S$  is 0.95 D. If the bond angle is  $97^\circ$ , the S-H bond moment would be ( $\cos 48.5 = 0.662$ ) [Kerala CEE]

- (a) 0.95 D (b) 0.662 D
- 
- (c) 48.5 D (d) 0.72 D

**Ans. (d)**

22. Which of the following molecules has zero dipole moment ? [EAMCET]

- (a)
- $BeCl_2$
- (b)
- $HCl$
- 
- (c)
- $NH_3$
- (d)
- $H_2O$

**Ans. (a)**23. The geometry of  $H_2S$  and its dipole moment are

- (a) angular and non-zero [Haryana PMT]
- 
- (b) angular and zero
- 
- (c) linear and non-zero
- 
- (d) linear and zero

**Ans. (a)**24. Which bond angle  $\theta$  would result in the maximum dipole moment for the triatomic molecule  $YXY$ ?


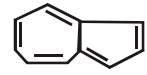

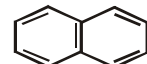
- (a)
- $\theta = 90^\circ$
- (b)
- $\theta = 120^\circ$
- [CPMT]
- 
- (c)
- $\theta = 160^\circ$
- (d)
- $\theta = 180^\circ$

**Ans. (a)**25. In a polar molecule, the ionic charge is  $4.8 \times 10^{-10}$  esu.If the inter ionic distance is  $1 \text{ \AA}$  unit, then the dipole moment is [MHT CET]

- (a) 41.8 D (b) 4.18 D
- 
- (c) 4.8 D (d) 0.48 D

**Ans. (c)**

26. Dipole moment of which compound is not zero?

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

**Ans. (a, b, c)**

27. Which has zero dipole moment

- (a) cis-2-butene (b) trans-2-butene
- 
- (c) 1-butene (d) 2-methyl-1-propene

**Ans. (b)**

28. Which compound shows dipole moment

- (a) 1,4-dichloro benzene
- 
- (b) 1, 2-dichloro benzene
- 
- (c) Trans-1, 2-dichloro ethene
- 
- (d) Trans-2-butene

**Ans. (b)**

29. Which of the following is a polar compound

- (a)
- $C_2H_6$
- (b)
- $CCl_4$
- 
- (c)
- $HCl$
- (d)
- $CH_4$

**Ans. (c)**

30. Polarisation of electrons in acrolein may be written as

- (a)
- $CH_2^{\delta-} = CH - CH^{\delta+} = O$
- (b)
- $CH_2^{\delta-} = CH - CH = O^{\delta+}$
- 
- (c)
- $CH_2^{\delta-} = CH^{\delta+} - CH = O$
- (d)
- $CH_2^{\delta+} = CH - CH = O^{\delta-}$

**Ans. (d)**

31. The molecule having nonzero dipole moment is

- (a)
- $CH_4$
- (b)
- $BF_3$
- 
- (c)
- $NF_3$
- (d)
- $CO_2$

**Ans. (c)**

32. The dipole moment of hydrogen chloride is 1.03 D. Its per cent ionic character is about 17%. Its bond distance in pm is about

- (a) 150 (b) 127
- 
- (c) 190 (d) 210

**Ans. (b)**33. The geometry of  $H_2S$  and its dipole moment are

- (a) Angular and nonzero
- 
- (b) Angular and zero
- 
- (c) Linear and nonzero
- 
- (d) Linear and zero

**Ans. (a)**

34. Per cent ionic character is maximum in

- (a) H-F (b) H-Cl
- 
- (c) H-Br (d) H-I

**Ans. (a)**

35. Carbon tetrahedral has no net dipole moment because of

- (a) Its planar structure
- 
- (b) Its regular tetrahedral structure
- 
- (c) similar sizes of carbon and chlorine atoms
- 
- (d) Similar electron affinities of carbon and chlorine

**Ans. (b)**

36. The compound with no dipole moment is

- (a) methyl chloride (b) carbon tetrachloride  
(c) methylene chloride (d) chloroform

**Ans. (b)**

37. The molecule having nonzero dipole moment is  
(a)  $\text{CH}_4$  (b)  $\text{BF}_3$   
(c)  $\text{NF}_3$  (d)  $\text{CO}_2$

**Ans. (c)**

38. The molecule which has zero dipole moment is  
(a)  $\text{CH}_2\text{Cl}_2$  (b)  $\text{BF}_3$   
(c)  $\text{NF}_3$  (d)  $\text{ClO}_2$

**Ans. (b)**

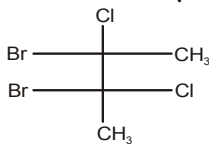
39. Which of the following contains both polar and non-polar bonds?  
(a)  $\text{NH}_4\text{Cl}$  (b)  $\text{HCN}$   
(c)  $\text{H}_2\text{O}_2$  (d)  $\text{CH}_4$

**Ans. (c)**

40. The molecules having dipole moment are .....  
(a) 2, 2-dimethylpropane  
(b) trans-pent-2-ene  
(c) cis-hex-3-ene  
(d) 2, 2, 3, 3-tetramethylbutane

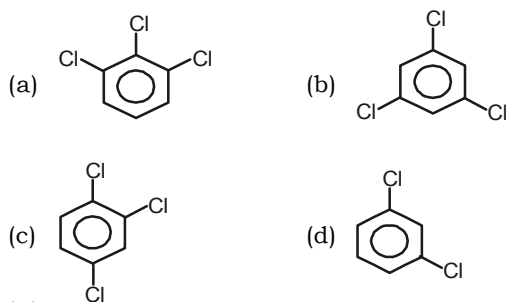
**Ans. (b, c)**

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



**Ans. (3)**

42. Which of the following has maximum dipole moment?

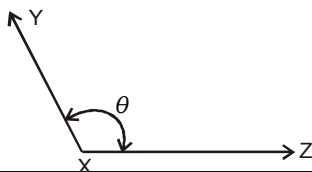


**Ans. (a)**

43. Which of the following are non-polar molecules?  
I.  $\text{NCl}_3$  II.  $\text{SO}_3$  III.  $\text{PCl}_5$   
(a) I only (b) II only  
(c) I and II only (d) II and III only

**Ans. (c)**

44. Which bond angle  $\theta$  would result in the maximum dipole moment for the triatomic molecule,  $\text{XY}_2$  shown below?

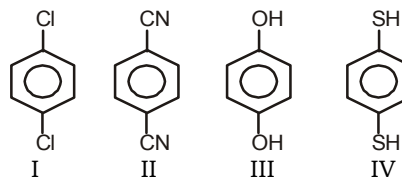


**CHEMICAL POINT**  
150°

**H.O. :** 2/2-B Kashi Gandhi Marg, Near Mayohall Crossing, Kutchery Road, Prayagraj  
(d) 180°

**Ans. (a)**

45. For which of the following molecule significant  $\mu \neq 0$ ?  
**(JEE Main 2014)**



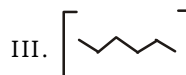
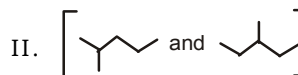
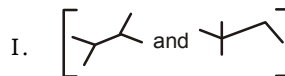
- (a) Only I (b) I and II  
(c) Only III (d) III and IV

**Ans. (d)**

46. Arrange the following in decreasing order of their boiling points.  
(A) n-butane (B) 2-methylbutane  
(C) n-pentane (D) 2, 2-dimethylpropane  
(a)  $A > B > C > D$  (b)  $B > C > D > A$   
(c)  $D > C > B > A$  (d)  $C > B > D > A$

**Ans. (d)**

47. Isomers of hexane, based on their branching, can be divided into three distinct classes as shown in the figure.  
**(JEE Advanced 2014)**



The correct order of their boiling point is

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

**Ans. (b)**

48. The intermolecular interaction that is dependent on the inverse cube of distance between the molecules is:  
**(JEE Main 2015)**

- (a) ion-ion interaction (b) ion-dipole interaction  
(c) London force (d) hydrogen bond

**Ans. (b)**

### V-APPLICATION OF VANDERWAAL'S FORCE

1. The treatment of aluminium carbide with water or dilute acid produces  
(a) acetylene (b) ethene  
(c) methane (d) ethane

**Ans. (c)**

2. The compound with the highest boiling point is  
(a) n-hexane (b) n-pentane  
(c) 2,2-dimethylpropane (d) 2-methylbutane

**Ans. (a)**

3. The highest boiling point is expected for  
(a) isooctane (b) n-octane  
(c) 2,2,3,3-tetrahydrobutane  
(d) n-butane

**Ans. (b)**

4. Which one of the following is expected to have minimum boiling point?

- (a) n-Butane (b) n-Pentane  
(c) 2-Methylbutane (d) 2,2-Dimethylpropane

**Ans. (d)**

5. When cyclohexane is poured on water, it floats, because :

- (a) cyclohexane is in 'boat' form  
(b) cyclohexane is in 'chair' form  
(c) cyclohexane is in 'crown' form  
(d) cyclohexane is less dense than water

**Ans. (d)**

6. The boiling point of the three isomers of pentane, namely, n-pentane, isopentane and neopentane follows the order

- (a) n-pentane > isopentane > neopentane  
(b) n-pentane > neopentane > isopentane  
(c) neopentane > isopentane > n-pentane  
(d) neopentane > n-pentane > isopentane

**Ans. (a)**

7. The increasing order of boiling point of the given alcohols is

- (a) 1-pentanol > 3-methyl-2-butanol > 2-methyl-2-butanol  
(b) 1-pentanol > 2-methyl-2-butanol > 3-methyl-2-butanol  
(c) 3-methyl-2-butanol > 2-methyl-2-butanol > 1-pentanol  
(d) 2-methyl-2-butanol > 3-methyl-2-butanol > 1-pentanol

**Ans. (a)**

8. Which of the following sequences regarding the acidic nature of alcohols is correct?

- (a)  $\text{CH}_3\text{OH} > 1^\circ > 2^\circ > 3^\circ$   
(b)  $\text{CH}_3\text{OH} < 1^\circ < 2^\circ < 3^\circ$   
(c)  $1^\circ > \text{CH}_3\text{OH} > 2^\circ < 3^\circ$   
(d)  $1^\circ < \text{CH}_3\text{OH} < 2^\circ < 3^\circ$

**Ans. (a)**

9. Match the hydrocarbons in Column I with the boiling points given in Column II

Column I	Column II
(i) n-Pentane	(a) 282.5 K
(ii) Isopentane	(b) 309 K
(iii) Neopentane	(c) 301 K

**Ans. (i)-(b); (ii)-(c); (iii)-(a)**

10. The compound with highest boiling point is

- (a) 2-methyl butane (IIT-1982)  
(b) n-pentane  
(c) 2, 2-dimethyl propane  
(d) n-hexane

**Ans. (d)**

11. The highest boiling point is expected for (IIT-1986)

- (a) iso-butane (b) n-octane  
(c) 2, 2, 3, 3-tetramethyl butane  
(d) n-butane

**Ans. (b)**

12. **Assertion:** Among isomeric pentanes, 2, 2-dimethylpentane has the highest boiling point

**Reason:** Branching does not affect the boiling point.

- (a) If both assertion and reason are true, and reason is the true explanation of the assertion  
(b) If both assertion and reason are true, but reason is not the true explanation of the assertion.  
(c) If assertion is true, but reason is false.  
(d) If both assertion and reason are false.

**Ans. (d)**

13. The correct order of boiling points of 2,2-dimethylpropane, 2-methylbutane and n-pentane is

- (a) n-pentane > 2, 2-dimethylpropane > 2-methylbutane (Kerala Pet 2011)  
(b) n-pentane > 2-methylbutane > 2, 2-dimethylpropane  
(c) 2, 2-dimethylpropane > 2-methylbutane > n-pentane  
(d) 2-methylbutane > n-pentane > 2, 2-dimethylpropane  
(e) 2-methylbutane > 2, 2-dimethylpropane > n-pentane

**Ans. (b)**

### VI-REACTIVITY OF HALOGEN & HYDROGEN

1. The order of reactivity of halogens towards halogenation of alkanes is

- (a)  $\text{F}_2 > \text{Br}_2 > \text{Cl}_2$  (b)  $\text{F}_2 > \text{Cl}_2 > \text{Br}_2$   
(c)  $\text{Cl}_2 > \text{F}_2 > \text{Br}_2$  (d)  $\text{Cl}_2 > \text{Br}_2 > \text{F}_2$

**Ans. (b)**

2. The chlorination of an alkane involves

- (a) Cl free radicals (b)  $\text{Cl}^+$  species  
(c)  $\text{Cl}^-$  species (d)  $\text{CH}_4^+$  free radicals

**Ans. (a)**

3. The reactivity of hydrogen atom in an alkane towards substitution by bromine atom is

- (a)  $1^\circ\text{H} > 2^\circ\text{H} > 3^\circ\text{H}$  (b)  $1^\circ\text{H} < 2^\circ\text{H} < 3^\circ\text{H}$   
(c)  $1^\circ\text{H} > 2^\circ\text{H} < 3^\circ\text{H}$  (d)  $1^\circ\text{H} < 2^\circ\text{H} > 3^\circ\text{H}$

**Ans. (b)**

4. Bromination of an alkane as compared to chlorination proceeds

- (a) at a slower rate (b) at a faster rate  
(c) with equal rates  
(d) with equal or different rate depending upon the temperature

**Ans. (a)**

5. Chlorination of n-butane produces

- (a) 1-chlorobutane as the chief product  
(b) 2-chlorobutane as the chief product  
(c) 1-chlorobutane more than 2-chlorobutane  
(d) 2-chlorobutane more than 1-chlorobutane

**Ans. (d)**

6. Which of the following sequences regarding relative stability of free radicals is correct?

- (a)  $3^\circ < 2^\circ < 1^\circ$  (b)  $3^\circ > 2^\circ > 1^\circ$   
(c)  $3^\circ > 2^\circ < 1^\circ$  (d)  $3^\circ < 2^\circ > 1^\circ$

**Ans. (b)**

7. Which of the following sequences regarding ease of abstraction of hydrogen atom is correct?

- (a)  $3^\circ < 2^\circ < 1^\circ$  (b)  $3^\circ > 2^\circ > 1^\circ$   
(c)  $3^\circ < 2^\circ > 1^\circ$  (d)  $3^\circ > 2^\circ < 1^\circ$

**Ans. (b)**

## VII-NEWMANN PROJECTION AND CONFORMATION

8. Which of the following radicals has maximum stability?

- (a)  $3^\circ$  (b)  $2^\circ$   
(c) vinyl (d) benzyl

**Ans. (d)**

9. Which of the following radicals has least stability?

- (a)  $3^\circ$  (b)  $2^\circ$   
(c) vinyl (d) benzyl

**Ans. (c)**

10. Which of the following molecules has the maximum bond energy of the indicated C-H bond?

- (a)  $\text{H}_3\text{C}-\text{H}$  (b)  $\text{CH}_3\text{CH}_2-\text{H}$   
(c)  $(\text{CH}_3)_2\text{CH}-\text{H}$  (d)  $(\text{CH}_3)_3\text{C}-\text{H}$

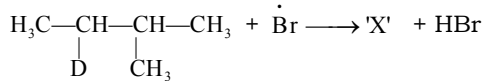
**Ans. (a)**

11. Which of the following molecules has the minimum bond energy of the indicated C-H bond?

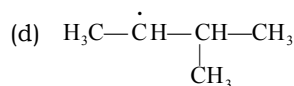
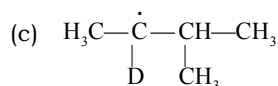
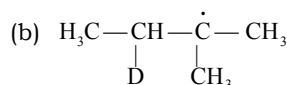
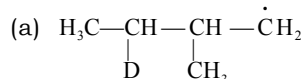
- (a)  $\text{CH}_3-\text{H}$  (b)  $\text{CH}_3\text{CH}_2-\text{H}$   
(c)  $(\text{CH}_3)_2\text{CH}-\text{H}$  (d)  $(\text{CH}_3)_3\text{C}-\text{H}$

**Ans. (d)**

12. Consider the following reaction :



Identify the structure of the major product 'X'



**Ans. (d)**

13. The reactivity of alcohols towards active metals is

- (a)  $3^\circ > 2^\circ > 1^\circ$  (b)  $3^\circ < 2^\circ < 1^\circ$   
(c)  $3^\circ < 1^\circ < 2^\circ$  (d)  $2^\circ < 3^\circ < 1^\circ$

**Ans. (b)**

14. Given below are conformations of butane. Which conformation is the most stable? **[Kerala CEE]**

- (a) Staggered-anti  
(b) Methyl-hydrogen eclipse  
(c) Hydrogen-hydrogen eclipse  
(d) Staggered-guache

**Ans. (a)**

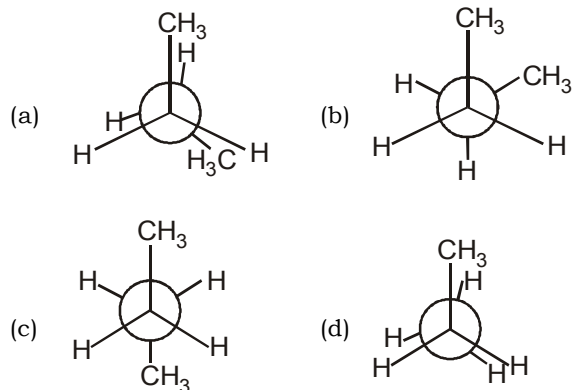
15. The most likely protonation site in the following molecule is



- (a) C-1 (b) C-2 (c) C-3 (d) C-6

**Ans. (a)**

1. In the following the most stable conformation of n-butane is **[CBSE AIPMT]**



**Ans. (c)**

2. At room temperature, the eclipsed and staggered forms of ethane cannot be isolated because **[AFMC]**

- (a) they interconvert rapidly  
(b) both the conformers are equally stable  
(c) the energy difference between the conformers is large  
(d) there is a large energy barrier of rotation about the  $\sigma$ -bond

**Ans. (a)**

3. Which one of the following conformations of cyclohexane is the least stable? **[KCET]**

- (a) Half-chair (b) Boat  
(c) Twisted-boat (d) Chair

**Ans. (a)**

4. The most stable conformation of n-butane is

**[CG PMT, Haryana PMT]**

- (a) skew (b) eclipsed  
(c) staggered (d) none of these

**Ans. (c)**

5. Which of the following will have least hindered rotation about carbon-carbon bond?

- (a) Ethane (b) Ethylene  
(c) Acetylene (d) Hexachloroethane

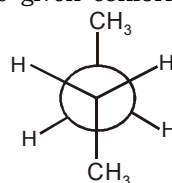
**Ans. (a)**

6. Which of the following conformations of cyclohexane has the minimum strain energy?

- (a) Chair (b) Half-chair  
(c) Twist-boat (d) Boat

**Ans. (a)**

7. In the given conformation



$\text{C}_2$  is rotated about  $\text{C}_2-\text{C}_3$  bond clockwise by an angle of  $120^\circ$ . The obtained conformation is

- (a) anti conformation



- (b) gauche conformation  
 (c) partially eclipsed conformation  
 (d) fully eclipsed conformation

**Ans. (b)**

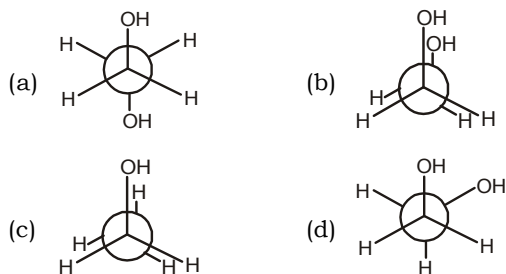
8. Which of the following conformations of cyclohexane is most stable?  
 (a) Chair (b) Boat  
 (c) Twist-boat (d) Half-chair

**Ans. (a)**

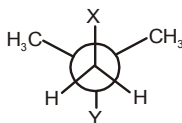
9. Which of the following conformation of cyclohexane is least stable?  
 (a) Chair (b) Boat  
 (c) Twist-boat (d) Half-chair

**Ans. (d)**

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

**Ans. (d)**

11. In the Newmann projection for 2,2-dimethylbutane



X and Y can respectively be

- (a) H and H (b) H and C<sub>2</sub>H<sub>5</sub>  
 (c) C<sub>2</sub>H<sub>5</sub> and H (d) CH<sub>3</sub> and CH<sub>3</sub>

**Ans. (b, d)**

12. The correct statement regarding the comparison of staggered and eclipsed conformations of ethane, is:  
**[AIPMT 2016]**

- (a) The staggered conformation of ethane is less stable than eclipsed conformation, because staggered conformation has torsional strain  
 (b) The eclipsed conformation of ethane is more stable than staggered conformation, because eclipsed conformation has no torsional strain  
 (c) The eclipsed conformation of ethane is more stable than staggered conformation even though the eclipsed conformation has torsional strain  
 (d) The staggered conformation of ethane is more stable than eclipsed conformations, because staggered conformation has no torsional strain

**Ans. (d)****VIII-STERIC HINDRANCE EFFECT**

1. Which of the following sequences of relative rates of alkaline hydrolysis of esters is correct?  
 (a) CH<sub>3</sub>COOCH<sub>3</sub> > CH<sub>3</sub>COOC<sub>2</sub>H<sub>5</sub> > CH<sub>3</sub>COOC<sub>3</sub>H<sub>7</sub>  
 (b) CH<sub>3</sub>COOCH<sub>3</sub> < CH<sub>3</sub>COOC<sub>2</sub>H<sub>5</sub> < CH<sub>3</sub>COOC<sub>3</sub>H<sub>7</sub>  
 (c) CH<sub>3</sub>COOCH<sub>3</sub> < CH<sub>3</sub>COOC<sub>2</sub>H<sub>5</sub> > CH<sub>3</sub>COOC<sub>3</sub>H<sub>7</sub>

- (d) CH<sub>3</sub>COOCH<sub>3</sub> > CH<sub>3</sub>COOC<sub>2</sub>H<sub>5</sub> < CH<sub>3</sub>COOC<sub>3</sub>H<sub>7</sub>

**Ans. (a)**

2. Which of the following sequences of relative rates of alkaline hydrolysis of esters is correct?  
 (a) CH<sub>3</sub>COOC<sub>3</sub>H<sub>7</sub> > CH<sub>3</sub>COOCH(CH<sub>3</sub>)<sub>2</sub> > CH<sub>3</sub>COOC(CH<sub>3</sub>)<sub>3</sub>  
 (b) CH<sub>3</sub>COOC<sub>3</sub>H<sub>7</sub> < CH<sub>3</sub>COOCH(CH<sub>3</sub>)<sub>2</sub> < CH<sub>3</sub>COOC(CH<sub>3</sub>)<sub>3</sub>  
 (c) CH<sub>3</sub>COOC<sub>3</sub>H<sub>7</sub> < CH<sub>3</sub>COOCH(CH<sub>3</sub>)<sub>2</sub> < CH<sub>3</sub>COOC(CH<sub>3</sub>)<sub>3</sub>  
 (d) CH<sub>3</sub>COOC<sub>3</sub>H<sub>7</sub> > CH<sub>3</sub>COOCH(CH<sub>3</sub>)<sub>2</sub> < CH<sub>3</sub>COOC(CH<sub>3</sub>)<sub>3</sub>

**Ans. (a)**

3. Which of the following sequences of relative rates of alkaline hydrolysis of esters is correct?  
 (a) HCOOCH<sub>3</sub> < CH<sub>3</sub>COOCH<sub>3</sub> < (CH<sub>3</sub>)<sub>2</sub>CHCOOCH<sub>3</sub>  
 (b) HCOOCH<sub>3</sub> > CH<sub>3</sub>COOCH<sub>3</sub> < (CH<sub>3</sub>)<sub>2</sub>CHCOOCH<sub>3</sub>  
 (c) HCOOCH<sub>3</sub> < CH<sub>3</sub>COOCH<sub>3</sub> < (CH<sub>3</sub>)<sub>2</sub>CHCOOCH<sub>3</sub>  
 (d) HCOOCH<sub>3</sub> > CH<sub>3</sub>COOCH<sub>3</sub> > (CH<sub>3</sub>)<sub>2</sub>CHCOOCH<sub>3</sub>

**Ans. (d)**

4. Which of the following sequences of rates of alkaline hydrolysis of esters is correct?  
 (a) CH<sub>3</sub>CH<sub>2</sub>COOCH<sub>3</sub> < (CH<sub>3</sub>)<sub>2</sub>CHCOOCH<sub>3</sub> < (CH<sub>3</sub>)<sub>3</sub>CCOOCH<sub>3</sub>  
 (b) CH<sub>3</sub>CH<sub>2</sub>COOCH<sub>3</sub> > (CH<sub>3</sub>)<sub>2</sub>CHCOOCH<sub>3</sub> > (CH<sub>3</sub>)<sub>3</sub>CCOOCH<sub>3</sub>  
 (c) CH<sub>3</sub>CH<sub>2</sub>COOCH<sub>3</sub> > (CH<sub>3</sub>)<sub>2</sub>CHCOOCH<sub>3</sub> < (CH<sub>3</sub>)<sub>3</sub>CCOOCH<sub>3</sub>  
 (d) CH<sub>3</sub>CH<sub>2</sub>COOCH<sub>3</sub> < (CH<sub>3</sub>)<sub>2</sub>CHCOOCH<sub>3</sub> > (CH<sub>3</sub>)<sub>3</sub>CCOOCH<sub>3</sub>

**Ans. (b)**

5. The rate of esterification with the three different alcohols CH<sub>3</sub>OH, C<sub>2</sub>H<sub>5</sub>OH, and CH<sub>3</sub>CH<sub>2</sub>CH<sub>2</sub>OH will follow the order  
 (a) CH<sub>3</sub>OH > C<sub>2</sub>H<sub>5</sub>OH > C<sub>3</sub>H<sub>7</sub>OH  
 (b) CH<sub>3</sub>OH < C<sub>2</sub>H<sub>5</sub>OH < C<sub>3</sub>H<sub>7</sub>OH  
 (c) CH<sub>3</sub>OH > C<sub>3</sub>H<sub>7</sub>OH > C<sub>2</sub>H<sub>5</sub>OH  
 (d) C<sub>2</sub>H<sub>5</sub>OH > C<sub>3</sub>H<sub>7</sub>OH > CH<sub>3</sub>OH

**Ans. (a)**

6. The increasing order of boiling point of the given alcohols is  
 (a) 1-pentanol > 3-methyl-2-butanol > 2-methyl-2-butanol  
 (b) 1-pentanol > 2-methyl-2-butanol > 3-methyl-2-butanol  
 (c) 3-methyl-2-butanol > 2-methyl-2-butanol > 1-pentanol  
 (d) 2-methyl-2-butanol > 3-methyl-2-butanol > 1-pentanol

**Ans. (a)**

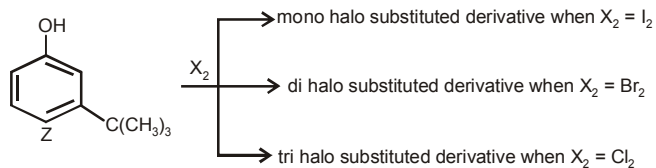
7. Which of the following sequences regarding the acidic nature of alcohols is correct?  
 (a) CH<sub>3</sub>OH > 1° > 2° > 3°  
 (b) CH<sub>3</sub>OH < 1° < 2° < 3°  
 (c) 1° > CH<sub>3</sub>OH > 2° < 3°  
 (d) 1° < CH<sub>3</sub>OH < 2° < 3°

**Ans. (a)**

8. The reactivity of alcohols towards active metals is  
 (a) 3° > 2° > 1° (b) 3° < 2° < 1°  
 (c) 3° < 1° < 2° (d) 2° < 3° < 1°

**Ans. (b)**

9. The reactivity of compound Z with different halogens under appropriate conditions is given below:



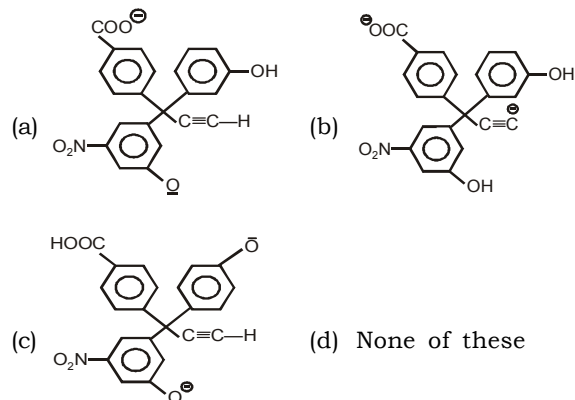
The observed pattern of electrophilic substitution can be explained by

- The steric effect of the halogen
- The steric effect of the tert-butyl group
- The electronic effect of the phenolic group
- The electronic effect of the tert-butyl group

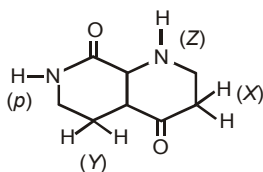
Ans. (a, b, c)

### IX-ACIDIC HYDROGEN

1.  $\xrightarrow{2 \text{ Mole NaNH}_2}$  A; Product A will be



2. Which of the indicated H in the following is most acidic?



- X
- Y
- Z
- p

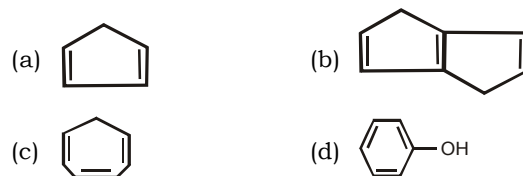
Ans. (d)

3. Among the following compounds, the strongest acid is

- $HC \equiv CH$
- $C_6H_6$
- $C_2H_6$
- $CH_3OH$

Ans. (d)

4. Which of the following will not react with Na metal?



Ans. (c)

5. Among the following compounds, the strongest acid is :

- $HC \equiv CH$
- $C_6H_6$
- $C_2H_6$
- $CH_3OH$

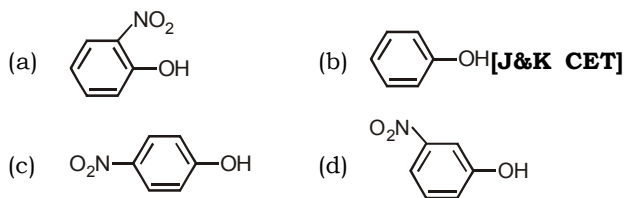
Ans. (d)

6. Which is the strongest acid? [CPMT]

- $C_2H_6$
- $CH_2=CH_2$
- $CH \equiv CH$
- $CH_3-O-CH_3$

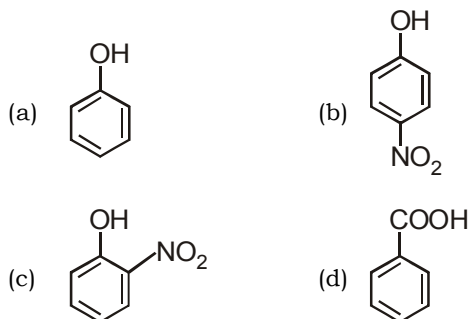
Ans. (c)

7. Which one of the following, is more acidic?



Ans. (c)

8. Most acidic is



Ans. (d)

9. Which one of the following have least  $pK_a$  value?

- $CCl_3COOH$
- $CH_2ClCOOH$
- $CF_3COOH$
- $CH_3COOH$

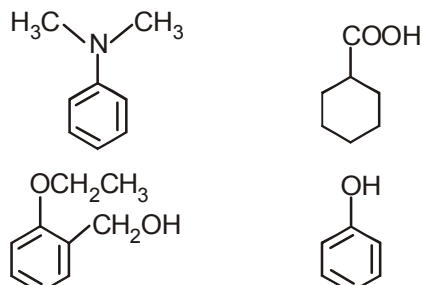
Ans. (c)

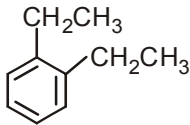
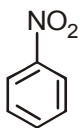
10. A strong base can abstract an  $\alpha$ -hydrogen from

- alkene
- amine [CBSE AIPMT]
- ketone
- alkane

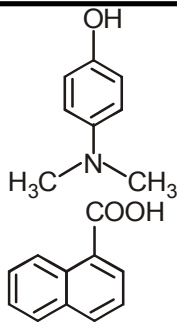
Ans. (c)

11. Amongst the following, the total number of compounds soluble in aqueous NaOH is [IIT JEE]





- (a) 1  
(c) 3



- (b) 2  
(d) 4

Ans. (d)

12. Acidic hydrogen is present in  
(a) ethyne (b) ethene  
(c) benzene (d) ethane

Ans. (a)

13. Ethene can be separated from ethyne by passing the mixture through  
(a) concentrated  $H_2SO_4$   
(b) ammoniacal  $Cu_2Cl_2$   
(c) pyrogallol (d) charcoal powder

Ans. (b)

14. Which of the following compounds react with an aqueous solution of  $Ag(NH_3)_2OH$ ?  
(a) Ethane (b) Ethene  
(c) 1-Butyne (d) 2-Butyne

Ans. (c)

15. The compounds 1-butyne and 2-butyne can be distinguished by using  
(a) bromic water (b)  $KMnO_4$  solution  
(c) Tollens reagent (d) Chlorine gas

Ans. (c)

16. Propyne and propene can be distinguished by  
(a) Conc.  $H_2SO_4$  (b)  $Br_2$  in  $CCl_4$   
(c) dil  $KMnO_4$  (d)  $AgNO_3$  in ammonia

Ans. (d) [IIT-2000]

17. Identify a reagent from the following list which can easily distinguish between 1-butyne and 2-butyne :  
(a) bromine,  $CCl_4$   
(b)  $H_2$ , Lindlar catalyst  
(c) dilute  $H_2SO_4$ ,  $HgSO_4$   
(d) Ammoniacal  $Cu_2Cl_2$  solution

Ans. (d)

18. The reaction of  $CH_3CHBrCH_2Br$  with one equivalent of alcoholic KOH gives  
(a)  $CH_3\overset{Br}{C}=CHBr$  as the major product and  $CH_3-C=CH_2$  as the minor product  
(b)  $CH_3CH=CHBr$  as the minor product and  $CH_3CBr=CH_2$  as the major product  
(c)  $CH_2=CHCH_2Br$  as the major product  
(d) 50% each of  $CH_3CH=CHBr$  and  $CH_3CBr=CH_2$

Ans. (a)

19. When benzene sulphonic acid and p-nitrophenol are treated with  $NaHCO_3$ , the gases released respectively are  
(a)  $SO_2$ ,  $NO_2$  (b)  $SO_2$ , NO  
(c)  $SO_2$ ,  $CO_2$  (d)  $CO_2$ ,  $CO_2$

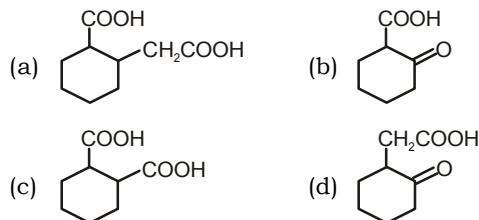
Ans. (d)

20. Acidic hydrogen is present in (IIT-1985)

- (a) ethyne (b) ethene  
(c) benzene (d) ethane

Ans. (a)

21. The compound that undergoes decarboxylation most readily under mild condition is (JEE Main 2012)



Ans. (b)

22. The compound that does not liberate  $CO_2$ , on treatment with aqueous sodium bicarbonate solution, is (JEE Advance 2013)

- (a) benzoic acid  
(b) benzenesulphonic acid  
(c) salicylic acid  
(d) carboic acid (Phenol)

Ans. (d)

23. Assertion : Acetylene on treating with  $NaNH_2$  gave sodium acetylide and ammonia

Reason: sp-Hybridized carbon atoms of acetylene are considerably electronegative.

- (a) If both assertion and reason are true, and reason is the true explanation of the assertion  
(b) If both assertion and reason are true, but reason is not the true explanation of the assertion.  
(c) If assertion is true, but reason is false.  
(d) If both assertion and reason are false.

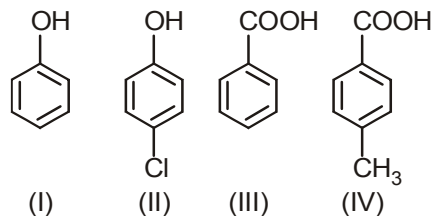
Ans. (b)

### X-COMPARISON OF ACIDIC STRENGTH

1. Among the following compounds, the most acidic is [IIT JEE]  
(a) p-nitrophenol  
(b) p-hydroxybenzoic acid  
(c) o-hydroxybenzoic acid  
(d) p-toluic acid

Ans. (c)

2. The correct acidity order of the following is



[IIT JEE]

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

Ans. (a)

3. What is the decreasing order of strength of the bases  $OH^-$ ,  $NH_2^-$ ,  $HC\equiv C^-$  and  $CH_3CH_2^-$ ?  
(a)  $CH_3-CH_2^- > NH_2^- > H-C\equiv C^- > OH^-$   
(b)  $H-C\equiv C^- > CH_3-CH_2^- > NH_2^- > OH^-$   
(c)  $OH^- > NH_2^- > HC\equiv C^- > CH_3-CH_2^-$   
(d)  $NH_2^- > H-C\equiv C^- > OH^- > CH_3-CH_2^-$

Ans. (a)

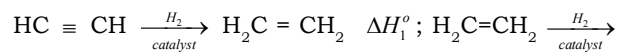
4. Which of the following orders regarding acid strength is correct?  
 (a)  $\text{CH}_3\text{COOH} > \text{CH}_3\text{CH}_2\text{OH} > \text{HC}\equiv\text{CH}$   
 (b)  $\text{CH}_3\text{COOH} > \text{HC}\equiv\text{CH} > \text{CH}_3\text{CH}_2\text{OH}$   
 (c)  $\text{HC}\equiv\text{CH} > \text{CH}_3\text{COOH} > \text{CH}_3\text{CH}_2\text{OH}$   
 (d)  $\text{HC}\equiv\text{CH} > \text{CH}_3\text{CH}_2\text{OH} > \text{CH}_3\text{COOH}$

Ans. (a)

5. Which of the following orders regarding base strength is correct?  
 (a)  $\text{CH}_3\text{COO}^- > \text{CH}_3\text{CH}_2\text{O}^- > \text{HC}\equiv\text{C}^-$   
 (b)  $\text{CH}_3\text{COO}^- < \text{CH}_3\text{CH}_2\text{O}^- < \text{HC}\equiv\text{C}^-$   
 (c)  $\text{HC}\equiv\text{C}^- > \text{CH}_3\text{COO}^- > \text{CH}_3\text{CH}_2\text{O}^-$   
 (d)  $\text{HC}\equiv\text{C}^- > \text{CH}_3\text{CH}_2\text{O}^- > \text{CH}_3\text{COO}^-$

Ans. (a)

6. For the following reactions



which of the following facts is expected to be correct?

- (a)  $|\Delta H_1^\circ| = |\Delta H_2^\circ|$       (b)  $|\Delta H_1^\circ| > |\Delta H_2^\circ|$   
 (c)  $|\Delta H_1^\circ| < |\Delta H_2^\circ|$       (d)  $|3\Delta H_1^\circ| = |2\Delta H_2^\circ|$

Ans. (b)

7. From the following reactions



predict which of the following orders regarding base strength is correct?

- (a)  $\text{R}^- < \text{NH}_2^- < \text{HC}\equiv\text{C}^-$  (b)  $\text{R}^- > \text{NH}_2^- > \text{HC}\equiv\text{C}^-$   
 (c)  $\text{R}^- > \text{NH}_2^- < \text{HC}\equiv\text{C}^-$  (d)  $\text{R}^- < \text{NH}_2^- > \text{HC}\equiv\text{C}^-$

Ans. (b)

### XI-GENERAL TERMS

1. The compound containing coordinate bond is [AFMC]  
 (a)  $\text{SO}_3$       (b)  $\text{O}_3$   
 (c)  $\text{H}_2\text{SO}_4$       (d) All of these

Ans. (d)

2. Which of the following substance has the highest melting point? [VMMC]  
 (a) BaO      (b) MgO  
 (c) KCl      (d) NaCl

Ans. (a)

3. HCl molecule contains [AFMC]  
 (a) ionic bond      (b) covalent bond  
 (c) hydrogen bond      (d) coordinate bond

Ans. (b)

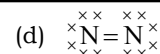
4. Which of the following does not have coordinate bond? [CPMT]  
 (a)  $\text{SO}_2$       (b)  $\text{HNO}_3$   
 (c)  $\text{H}_2\text{SO}_3$       (d)  $\text{HNO}_2$

Ans. (d)

5. Which compound is most covalent? [AFMC]  
 (a) LiCl      (b) LiF  
 (c) LiBr      (d) LiI

Ans. (d)

6. Which of the following represents the Lewis structure of  $\text{N}_2$  molecule? [KCET]  
 (a)  $\overset{\times}{\times}\text{N}\equiv\text{N}\overset{\times}{\times}$       (b)  $\overset{\times}{\times}\text{N}\equiv\overset{\times}{\times}\text{N}$



Ans. (a)

7. Which of the following is polar? [DUMET]

- (a)  $\text{I}_3^-$       (b)  $\text{CO}_3^{2-}$   
 (c)  $\text{XeF}_4$       (d)  $\text{PF}_3$

Ans. (d)

8. Metallic bond is [Manipal]

- (a) similar to ionic bond  
 (b) similar to covalent bond  
 (c) neither similar to ionic nor covalent bond  
 (d) formed by movement of positive charged spheres in a sea of electrons.

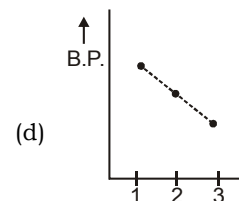
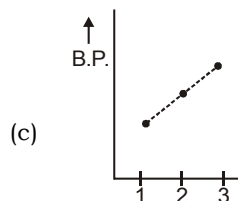
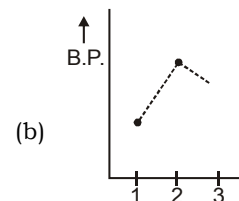
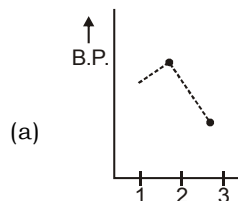
Ans. (c)

9. Malleability and ductility of metals can be accounted due to [KCET]

- (a) the presence of electrostatic force  
 (b) the crystalline structure in metal  
 (c) the capacity of layers of metal ions to slide over the other.  
 (d) the interaction of electrons with metal ions in the lattice.

Ans. (c)

10. Which one of the following graphs represent the correct order of boiling points (b.p) of ethane (1), ethyl alcohol (2) and acetic acid (3)? [EAMCET]



Ans. (c)

11. The comparatively high boiling point of HF is due to [MHT CET]  
 (a) high reactivity of fluorine  
 (b) small size of hydrogen atom  
 (c) formation of hydrogen bonds and consequent association  
 (d) high IE of fluorine

Ans. (c)

12. What is the energy gap between valence band and conduction band in crystals of insulators? [Guj. CET]  
 (a) Very small  
 (b) Both the bands are overlapped with each other  
 (c) Very large      (d) Infinite

Ans. (c)

13. The energy gaps ( $E_g$ ) between valence band and conduction band for diamond, silicon and germanium

- are in the order **[AIIMS]**
- (a)  $E_g$  (diamond)  $>$   $E_g$  (silicon)  $>$   $E_g$  (germanium)  
 (b)  $E_g$  (diamond)  $<$   $E_g$  (silicon)  $<$   $E_g$  (germinium)  
 (c)  $E_g$  (diamond)  $=$   $E_g$  (silicon)  $=$   $E_g$  (germinium)  
 (d)  $E_g$  (diamond)  $>$   $E_g$  (germanium)  $>$   $E_g$  (silicon)
- Ans. (a)**
14. Synthetic petrol is prepared by **[Kerala CEE]**
- (a) fisher-tropsch process  
 (b) wurtz reaction  
 (c) distillation  
 (d) fractional distillation
- Ans. (a)**
15. The number of primary, secondary, tertiary and quaternary carbons in neopentane are respectively, **[Kerala CEE]**
- (a) 4, 3, 2 and 1 (b) 5, 0, 0 and 1  
 (c) 4, 0, 0 and 1 (d) 4, 0, 1 and 1
- Ans. (c)**
16. Benzene does not undergo addition reactions easily because **[BVP]**
- (a) it has a cyclic structure  
 (b) double bonds in it are very strong  
 (c) resonance stabilized system is to be preserved  
 (d) it has six hydrogen atoms
- Ans. (c)**
17. A fruity smell is obtained by the reaction of ethanol with **[BCECE]**
- (a)  $\text{CH}_3\text{COCH}_3$  (b)  $\text{PCl}_5$   
 (c)  $\text{CH}_3\text{COOH}$  (d)  $\text{CH}_3\text{CHO}$
- Ans. (c)**
18.  $\text{BCl}_3$  is a planar molecule, while  $\text{NCl}_3$  is pyramidal, because **[WB JEE]**
- (a) N-Cl bond is more covalent than B-Cl bond  
 (b) nitrogen atom is smaller than boron atom  
 (c) B-Cl bond is more polar than N-Cl bond  
 (d)  $\text{BCl}_3$  has no lone pair of electrons but  $\text{NCl}_3$  has a lone pair of electrons
- Ans. (d)**
19. Metallic lusture is explained by **[DCE]**
- (a) diffusion of metal ions  
 (b) oscillation of loose electrons  
 (c) excitation of free protons  
 (d) existence of bcc lattice
- Ans. (b)**
20. The general formula  $\text{C}_n\text{H}_{2n}\text{O}_2$  could be for open chain **[AIEEE]**
- (a) diketones (b) carboxylic acids  
 (c) diols (d) dialdehydes
- Ans. (b)**
21. What will be the octane number of best fuel?  
 (a) 80 (b) 81 **[MP PET]**  
 (c) 74 (d) 65
- Ans. (d)**
22. TEL is a compound used as **[RPET]**
- (a) antibiotic (b) antiseptic  
 (c) antiknocking (d) antioxidant
- Ans. (c)**
23. Natural gas is a mixture of **[MP PET]**
- (a)  $\text{CO} + \text{CO}_2$  (b)  $\text{CO} + \text{H}_2$
- (c)  $\text{CO} + \text{N}_2$  (d)  $\text{CH}_4 + \text{C}_2\text{H}_6 + \text{C}_3\text{H}_8$
- Ans. (d)**
24. The types of bonds present in  $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$  are only
- (a) Electrovalent and covalent  
 (b) Electrovalent and coordinate covalent  
 (c) Electrovalent, covalent and coordinate covalent  
 (d) Covalent and coordinate covalent
- Ans. (c)**
25. The molecule having one unpaired electron is
- (a) NO (b) CO  
 (c)  $\text{CN}^-$  (d)  $\text{O}_2$
- Ans. (a)**
26. Which of the following resonating structures is not correct for  $\text{CO}_2$ ?
- (a)  $:\ddot{\text{O}} = \text{C} = \ddot{\text{O}}:$  (b)  $:\ddot{\text{O}} - \text{C} \equiv \ddot{\text{O}}:^+$   
 (c)  $^+:\ddot{\text{O}} - \text{C} \equiv \ddot{\text{O}}^-$  (d)  $:\text{O} \equiv \text{C} - \ddot{\text{O}}^-$
- Ans. (c)**
27. The bond between two identical nonmetal atoms has a pair of electrons
- (a) Unequally shared between the two  
 (b) Transferred fully from one atom to another  
 (c) With identical spins  
 (d) Equally shared between them
- Ans. (d)**
28. The bonds present in  $\text{N}_2\text{O}_5$  are
- (a) Only ionic  
 (b) Covalent and coordinate  
 (c) Only covalent  
 (d) Covalent and ionic
- Ans. (b)**
29. The ion that is isoelectronic with CO is
- (a)  $\text{CN}^-$  (b)  $\text{O}_2^+$   
 (c)  $\text{O}_2^-$  (d)  $\text{N}_2^+$
- Ans. (a)**
30. The octet rule is not obeyed by the molecule
- (a)  $\text{CO}_2$  (b)  $\text{H}_2\text{O}$   
 (c)  $\text{O}_2$  (d) CO
- Ans. (b)**
31. Most favourable conditions for the formation of ionic bonds are
- (a) Large cation and small anion  
 (b) Large cation and large anion  
 (c) Small cation and small anion  
 (d) Small cation and large anion
- Ans. (a)**
32. Which of the following combinations would lead to a covalent bond?
- (a) Electronegative element + electropositive element  
 (b) Electronegative element + electronegative element  
 (c) Electropositive element + electropositive element  
 (d) Inert gas + electropositive element.
- Ans. (b)**
33. The bonds present in  $\text{N}_2\text{O}_4$  are
- (a) only ionic  
 (b) covalent and coordinate  
 (c) only covalent



(d) covalent and ionic

**Ans. (b)**

34. Most favourable conditions to form a covalent bond is

- (a) Large cation and small anion  
 (b) Large cation and large anion  
 (c) Small cation and small anion  
 (d) Small cation and large anion

**Ans. (d)**

35. Which of the following statements regarding valence-bond method is not true?

- (a) The molecule is considered to be the collection of atoms and then interactions between different atoms is considered  
 (b) For a molecule to be stable, the electrostatic attractions must predominate over the repulsions  
 (c) The potential energy of a diatomic molecule is less than the sum of potential energies of free atoms  
 (d) The net force of attraction acting on the atoms in a molecule is not zero

**Ans. (d)**

36. Arrange the halogens  $F_2$ ,  $Cl_2$ ,  $Br_2$ ,  $I_2$ , in order of their increasing reactivity with alkanes **(AIPMT 2010)**

- (a)  $I_2 < Br_2 < Cl_2 < F_2$       (b)  $Br_2 < Cl_2 < F_2 < I_2$   
 (c)  $F_2 < Cl_2 < Br_2 < I_2$       (d)  $Br_2 < I_2 < Cl_2 < F_2$

**Ans. (a)**

37. Which of the following is basic? **(IIT-1980)**

- (a)  $CH_3CH_2OH$       (b)  $H_2O_2$   
 (c)  $HOCH_2CH_2OH$       (d)  $CH_3COOH$

**Ans. (a)**

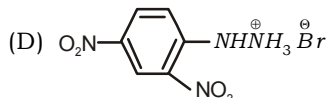
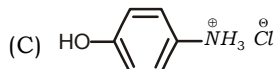
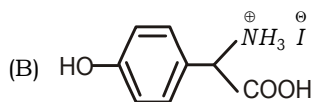
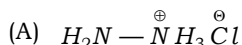
38. Hydrogenation of benzoyl chloride in the presence of Pd on  $BaSO_4$  gives **(IIT-1992)**

- (a) Benzyl alcohol      (b) Benzaldehyde  
 (c) Benzoic acid      (d) Phenol

**Ans. (b)**

39. Match the compounds in Column I with their characteristic test(s)/reaction(s) given in Column II.

**Column I**



**Column II**

- (p) Sodium fusion extract of the compound gives Prussian blue colour with  $FeSO_4$   
 (q) Gives positive  $FeCl_3$  test

(r) Gives white precipitate with  $AgNO_3$

(s) reacts with aldehydes to form the corresponding hydrazone derivative

**Ans. A-r,s; B-p,q; C-p,q,r; D-p**

40. **Assertion :** Calcium carbide on hydrolysis gives ethylene.

**Reason:** Calcium carbide contains  $C^{4-}$  anions.

(a) If both assertion and reason are true, and reason is the true explanation of the assertion

(b) If both assertion and reason are true, but reason is not the true explanation of the assertion.

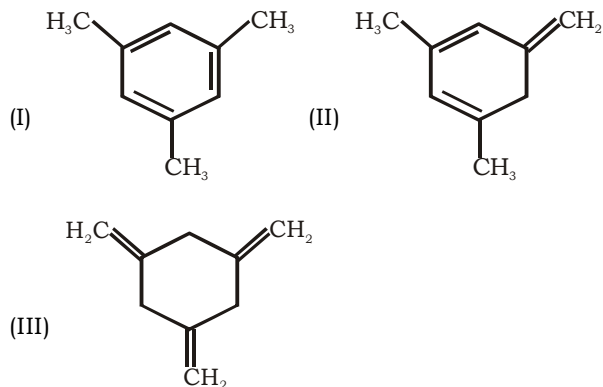
(c) If assertion is true, but reason is false.

(d) If both assertion and reason are false.

**Ans. (d)**

41. Given:-

**(AIPMT 2015)**

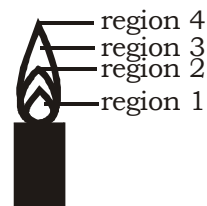


The enthalpy of the hydrogenation of these compounds will be in the order as:-

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

**Ans. (a)**

42. The hottest region of Bunsen flame shown in the figure below is: **[JEE MAIN 2016]**



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

**Ans. (a)**

43. The concentration of fluoride, lead, nitrate and iron in a water sample from an underground lake was found to be 1000 ppb, 40 ppb, 100 ppm and 0.2 ppm, respectively. This water is unsuitable for drinking due to high concentration of: **[JEE MAIN 2016]**

- (a) Lead      (b) Nitrate  
 (c) Iron      (d) Fluoride

**Ans. (b)**

## XII-BOND LENGTH

1. Identify the incorrect statement related to  $PCl_5$  from the following: **[NEET 2019]**

- (a) Two axial P - Cl bonds make an angle of  $180^\circ$  with each other

- (b) Axial P - Cl bonds are longer than equatorial P - Cl bonds  
 (c)  $\text{PCl}_5$  molecule is non-reactive  
 (d) Three equatorial P - Cl bonds make an angle of  $120^\circ$  with each other

**Ans. (c)**

2.

The correct order of increasing bond length of C-H, C-O, C-C and C=C is

**[CBSE AIPMT]**

- (a)  $\text{C-H} < \text{C-O} < \text{C-C} < \text{C=C}$   
 (b)  $\text{C-H} < \text{C=C} < \text{C-O} < \text{C-C}$   
 (c)  $\text{C-C} < \text{C=C} < \text{C-O} < \text{C-H}$   
 (d)  $\text{C-O} < \text{C-H} < \text{C-C} < \text{C=C}$

**Ans. (b)**

3. The covalent bond length is the shortest in which one of the following bonds ?

**[Kerala CEE]**

- (a) C-O (b) C-C  
 (c)  $\text{C}\equiv\text{N}$  (d) O-H

**Ans. (d)**

4. The C-H bond distance is the longest in

**[AFMC]**

- (a)  $\text{C}_2\text{H}_2$  (b)  $\text{C}_2\text{H}_4$   
 (c)  $\text{C}_2\text{H}_4\text{Br}_2$  (d)  $\text{C}_6\text{H}_6$

**Ans. (c)**

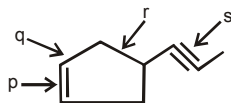
5. The bond length between C-C bond in  $\text{sp}^2$  hybridised molecule is

**[BCECE]**

- (a)  $1.2 \text{ \AA}$  (b)  $1.39 \text{ \AA}$   
 (c)  $1.33 \text{ \AA}$  (d)  $1.54 \text{ \AA}$

**Ans. (b)**

6. What is the increasing order of bond lengths of bonds indicated as p, q, r and s in following compound?



- (a)  $p < q < r < s$  (b)  $q < r < s < p$   
 (c)  $s < q < r < p$  (d)  $s < p < q < r$

**Ans. (d)**

7. The bond order of individual carbon-carbon bonds in benzene is:

**(IIT 1981)**

- (a) one (b) two  
 (c) between one and two  
 (d) one and two, alternately

**Ans. (c)**

8. **Assertion:** C-H bond in ethyne is shorter than C-H bonds in ethene.

**Reason:** Carbon atom in ethene is  $\text{sp}$  hybridised while it is  $\text{sp}^2$  in ethyne.

- (a) If both assertion and reason are true, and reason is the true explanation of the assertion  
 (b) If both assertion and reason are true, but reason is not the true explanation of the assertion.  
 (c) If assertion is true, but reason is false.  
 (d) If both assertion and reason are false.

**Ans. (c)**

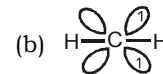
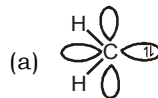
9. Which of the following has longest C-O bond length? (Free C-O bond length in CO is  $1.128 \text{ \AA}$ )

**[AIPMT2016]**

- (a)  $\text{Ni}(\text{CO})_4$  (b)  $[\text{Co}(\text{CO})_4]^{\ominus}$   
 (c)  $[\text{Fe}(\text{CO})_4]^{2-}$  (d)  $[\text{Mn}(\text{CO})_6]^+$

**Ans. (c)****XIII-CARBENE**

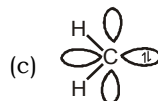
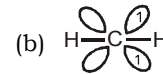
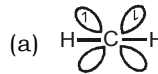
1. Find out correct representation of singlet carbene:



- (c) Both (a) and (b) (d) None of these

**Ans. (a)**

2. Find out correct representation of triplet carbene:



- (d) None of these

**Ans. (b)****XIV-BOND ANGLE**

1. The compound that has the largest H - M - H bond angle (M = N, O, S, C) is

**[JEE Main 2020]**

- (a)  $\text{H}_2\text{O}$  (b)  $\text{NH}_3$   
 (c)  $\text{H}_2\text{S}$  (d)  $\text{CH}_4$

**Ans. (d)**

2. What is the correct order of decreasing bond angle?

**[VMMC]**

- (a)  $\text{NH}_4^+ > \text{NH}_3 > \text{NH}_2^-$  (b)  $\text{NH}_3 > \text{NH}_2^- > \text{NH}_4^+$   
 (c)  $\text{NH}_2^- < \text{NH}_3 > \text{NH}_4^+$  (d)  $\text{NH}_3 > \text{NH}_4^+ > \text{NH}_2^-$

**Ans. (a)**3. H-O-H bond angle in  $\text{H}_2\text{O}$  is  $104.5^\circ$  and not  $109^\circ 28'$  because of**[CPMT]**

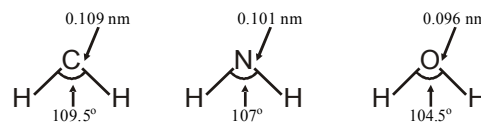
- (a) lone pair-lone pair repulsion  
 (b) lone pair-bond pair repulsion  
 (c) bond pair-bond pair repulsion  
 (d) high electronegative of oxygen

**Ans. (a)**4. The bond angle in  $\text{AsH}_3$  is greater than that in

- (a)  $\text{NH}_3$  (b)  $\text{H}_2\text{O}$  **[Punjab PMET]**  
 (c)  $\text{BCl}_3$  (d) none of these

**Ans. (d)**

5. The bond lengths and bond angles in the molecules of methane, ammonia and water are given below



The variation in bond angle is a result of

- (i) the increasing repulsion between hydrogen atoms as the bond length length decreases  
 (ii) the number of non-bonding electron pairs in the molecule  
 (iii) a non-bonding electron pair having a greater repulsive force than a bonding electron pair

**[Kerala CEE]**

- (a) (i), (ii) and (iii) are correct

- (b) (i) and (ii) only are correct  
 (c) (ii) and (iii) only are correct  
 (d) (iii) only is correct

**Ans. (c)**

6. In a regular octahedral molecule  $MX_6$ , the number of X-M-X bonds at  $180^\circ$  is [Manipal]

- (a) three (b) two  
 (c) six (d) four

**Ans. (a)**

7. The C-O-H bond angle in ethanol is nearly

- (a) 90 (b) 107  
 (c) 120 (d) 180

**Ans. (b)**

8. Consider the molecules  $CH_4$ ,  $NH_3$  and  $H_2O$ . Which of the given statement is false?

- (a) The H-C-H bond angle in  $CH_4$ , the H-N-H bond angle in  $NH_3$ , and the H-O-H bond angle in  $H_2O$  are all greater than  $90^\circ$ .  
 (b) The H-O-H bond angle in  $H_2O$  is larger than the H-C-H bond angle in  $CH_4$ .  
 (c) The H-O-H bond angle in  $H_2O$  is smaller than the H-N-H bond angle in  $NH_3$ .  
 (d) The H-C-H bond angle in  $CH_4$  is larger than the H-N-H bond angle in  $NH_3$ . [AIPMT 2016]

**Ans. (b)**

9. Predict the correct order among the following

- (a) Lone pair - lone pair > lone pair - bond pair > bond pair - bond pair [AIPMT 2016]  
 (b) Lone pair - lone pair > bond pair - bond pair > lone pair > bond pair  
 (c) Bond pair - bond pair > lone pair - bond pair > lone pair - lone pair  
 (d) Lone pair - bond pair > bond pair - bond pair > lone pair - lone pair

**Ans. (a)****XV-BOND ENERGY**

1. Arrange the following bonds according to their average bond energies in descending order

C - Cl, C - Br, C - F, C - I [JEE Main 2020]

- (a) C - F > C - Cl > C - Br > C - I  
 (b) C - Br > C - I > C - Cl > C - F  
 (c) C - I > C - Br > C - Cl > C - F  
 (d) C - Cl > C - Br > C - I > C - F

**Ans. (a)**

2. If enthalpy of atomisation for  $Br_2(l)$  is  $x$  kJ/mol and bond enthalpy for  $Br_2$  is  $y$  kJ/mol, the relation between them [JEE Main 2020]

- (a) is  $x < y$  (b) does not exist  
 (c) is  $x > y$  (d) is  $x = y$

**Ans. (c)**

3. Strongest C-H bond is present in [RPMT]

- (a) ethane (b) ethene  
 (c) ethyne (d)  $CH_3OH$

**Ans. (c)**

4. Which of the following compounds possesses the C-H bond with the lowest bond dissociation energy?

- (a) Toluene (b) Benzene [AIIMS]  
 (c) n-pentane (d) 2,2-dimethyl propane

**Ans. (a)**

5. Which one of the following orders is correct for the bond dissociation enthalpy of halogen molecules?

**[AIPMT 2016]**

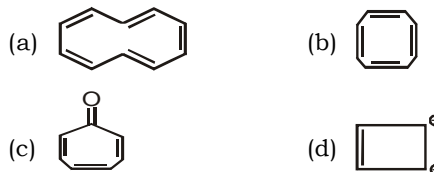
- (a)  $I_2 > Br_2 > Cl_2 > F_2$  (b)  $Cl_2 > Br_2 > F_2 > I_2$   
 (c)  $Br_2 > I_2 > F_2 > Cl_2$  (d)  $F_2 > Cl_2 > Br_2 > I_2$

**Ans. (b)****XVI-Co-planarity & Co-Linearity**

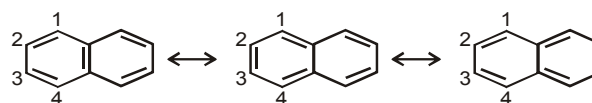
1. Which of the following is not a planar molecule?  
 (a)  $H_2C=C=CH_2$  (b)  $H_2C=C=C=CH_2$   
 (c)  $H_2C=C=O$  (d)  $NC-HC=CH-CN$

**Ans. (a)**

2. Which of the following compounds are not planar?

**Ans. (a, b)**

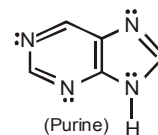
3. There are three canonical structures of naphthalene. Examine them and find correct statement among the following :



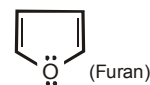
- (a) All C-C bonds are of same length  
 (b)  $C_1-C_2$  bond is shorter than  $C_2-C_3$  bond  
 (c)  $C_1-C_2$  bond is larger than  $C_2-C_3$  bond  
 (d) None of the above

**Ans. (b)****XVII-CONJUGATION**

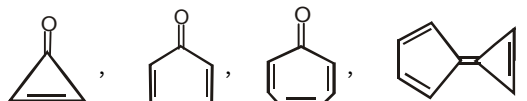
1. The purine heterocycle occurs mainly in the structure of DNA. Identify number of 'N' atoms having localised lone pair of electron.

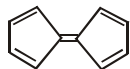
**Ans. (3)**

2. How many resonating structures are possible for the compound.

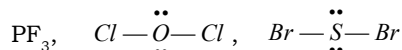
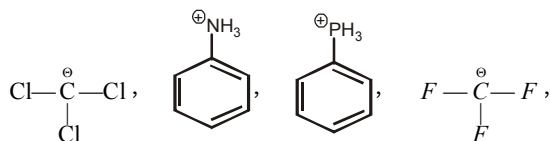
**Ans. (5)**

3. Find out number of compounds which are more stabilised in ionic structure, from following.

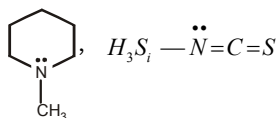
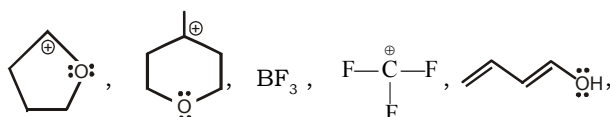



**Ans. (3)**

4. How many compounds from following exhibit d-orbital resonance.

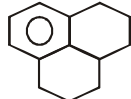

**Ans. (4)**

5. Among the following, find out number of ions or molecules that can show back bonding.

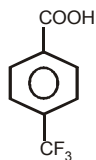
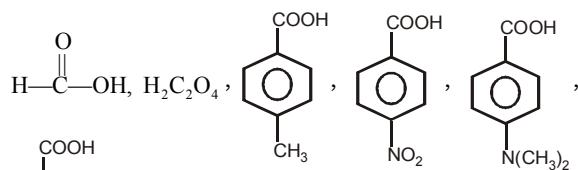

**Ans. (5)**

### XVIII- ACIDIC HYDROGEN

1. Find out number of benzylic hydrogen in


**Ans. (5)**

2. Find out number of compounds which are more acidic than benzoic acid, from following.

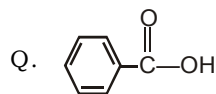
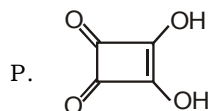

**Ans. (4)**

3. **Column (I)**

(a) NaHCO<sub>3</sub> will react.

(b) Na will react with

**Column (II)**

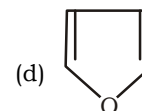
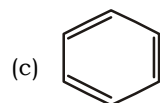
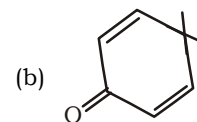
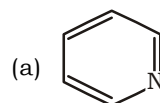


(c) NaOH will react with R.

(d) NaNH<sub>2</sub> will react with S.

**Ans. (a) - P, Q, S (b) - P, Q, R, S**  
**(c) - P, Q, R, S (d) - P, Q, R, S**

4. Which of the following molecules is least resonance stabilized?


**Ans. (b)**

### XIX-SECONDARY FORCES

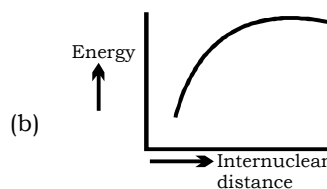
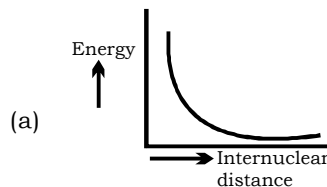
1. Match the type of interaction in column A with the distance dependence of their interaction energy in column B:

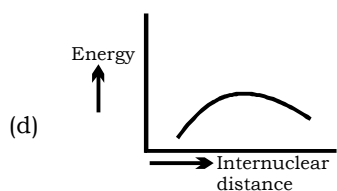
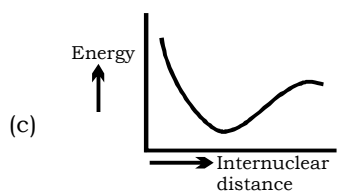
A	B
(I) Ion-ion	(a) $\frac{1}{r}$
(II) Dipole-dipole	(b) $\frac{1}{r^2}$
(III) London dispersion	(c) $\frac{1}{r^3}$
	(d) $\frac{1}{r^6}$ [JEE Main 2020]

- (a) (I) - (b), (II) - (d), (III) - (c)  
 (b) (I) - (a), (II) - (b), (III) - (d)  
 (c) (I) - (a), (II) - (b), (III) - (c)  
 (d) (I) - (a), (II) - (c), (III) - (d)

**Ans. (a)**

2. The potential energy curve for the H<sub>2</sub> molecule as a function of internuclear distance is [JEE Main 2020]



**Ans. (c)****XX-MOLECULAR ORBITAL THEORY**

1. The bond order and the magnetic characteristics of  $\text{CN}^-$  are **[JEE Main 2020]**

- (a) 3, diamagnetic      (b)  $2\frac{1}{2}$ , paramagnetic  
 (c) 3, paramagnetic      (d)  $2\frac{1}{2}$ , diamagnetic

**Ans. (a)**

2. If the magnetic moment of a dioxygen species is 1.73 B.M, it may be. **[JEE Main 2020]**

- (a)  $\text{O}_2, \text{O}_2^-$  or  $\text{O}_2^+$       (b)  $\text{O}_2^-$  or  $\text{O}_2^+$   
 (c)  $\text{O}_2$  or  $\text{O}_2^-$       (d)  $\text{O}_2$  or  $\text{O}_2^+$

**Ans. (a)**

3. Among the following molecules ions  $\text{C}_2^{2-}$ ,  $\text{N}_2^{2-}$ ,  $\text{O}_2^{2-}$ ,  $\text{O}_2$  Which one is diamagnetic and has the shortest bond length? **[JEE Main 2019]**

- (a)  $\text{C}_2^{2-}$       (b)  $\text{O}_2$   
 (c)  $\text{O}_2^{2-}$       (d)  $\text{N}_2^{2-}$

**Ans. (a)**

4. Among the following the molecule expected to be stabilised by anion formation is  $\text{C}_2$ ,  $\text{O}_2$ ,  $\text{NO}$ ,  $\text{F}_2$ .

- (a)  $\text{C}_2$       (b)  $\text{O}_2$  **[JEE Main 2019]**  
 (c)  $\text{NO}$       (d)  $\text{O}_2$

**Ans. (a)**

5. Among the following species, the diamagnetic molecule is **[JEE Main 2019]**

- (a)  $\text{CO}$       (b)  $\text{B}_2$   
 (c)  $\text{NO}$       (d)  $\text{O}_2$

**Ans. (a)**



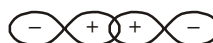
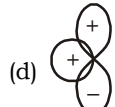
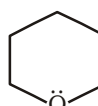
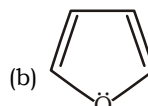
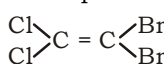
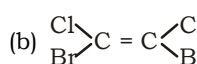
6. Two pi and half sigma bonds are present in

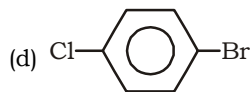
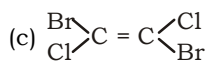
- (a)  $\text{O}_2^+$       (b)  $\text{N}_2$  **[JEE Main 2019]**  
 (c)  $\text{N}_2^+$       (d)  $\text{O}_2$

**Ans. (c)**



**Miscellaneous Problems****Choose the correct option. Only one option is correct.**

1. In which of the following species does the central atom bear a formal charge of -1?
- (a)  $\text{H}_3\text{C}-\overset{\text{H}}{\underset{\cdot\cdot}{\text{O}}}-\text{CH}_3$  (b)  $\text{Cl}-\overset{\text{Cl}}{\underset{\cdot\cdot}{\text{C}}}-\text{Cl}$
- (c)  $\text{Br}-\overset{\cdot\cdot}{\underset{\cdot\cdot}{\text{C}}}-\text{Br}$  (d)  $\text{H}_3\text{C}-\overset{\text{CH}_3}{\underset{\cdot\cdot}{\text{C}}}-\text{CH}_3$
2. In which of the following anions does the central atom bear a formal charge of +1?
- (a)  $\text{NO}_3^-$  (b)  $\text{CO}_3^{2-}$  (c)  $\text{BF}_4^-$  (d)  $\text{SO}_4^{2-}$
3. An  $\text{sp}^3$  hybrid orbital possesses
- (a) one-fourth s character (b) one-half s character  
(c) one-third s character (d) two-third s character
4. Which of the following molecules has a regular tetrahedral shape?
- (a)  $\text{CH}_2\text{Cl}_2$  (b)  $\text{CHCl}_3$  (c)  $\text{CCl}_4$  (d)  $\text{CBrClFI}$
5. Which of the following molecules has a linear shape?
- (a)  $\text{C}_3\text{O}_2$  (b)  $:\text{CH}_2$  (c)  $\text{H}_2\text{N}_2$  (d)  $\text{H}_2\text{O}_2$
6. Which of the following molecules has zero dipole moment?
- (a) *cis*-2-Butene (b) *trans*-2-Butene  
(c) 1-Butene (d) 2-Methylpropene
7. Which of the following species has a pyramidal shape?
- (a)  $\text{CH}_3^+$  (b)  $\text{BF}_3$  (c)  $\text{CH}_3^-$  (d)  $\text{CH}_3$
8. Which of the following molecules has the shortest carbon-carbon bond length?
- (a) Diamond (b) Ethane  
(c) Benzene (d) Acetylene
9. In which of the following molecules are all the carbon atoms  $\text{sp}^3$  hybridized?
- (a) Graphite (b) Diamond  
(c)  $\text{C}_{60}$ -Fullerene (d) Benzene
10. In which of the following molecules are all the carbon atoms in  $\text{sp}^2$  hybridization state?
- (a) Graphite (b) 1, 3, 5-Hexatriene  
(c)  $\text{C}_{60}$ -Fullerene (d) All the above
11. Which of the following molecules has a regular tetrahedral shape?
- (a)  $\text{BF}_4^-$  (b)  $\text{SO}_4^{2-}$  (c)  $\text{NH}_4^+$  (d) All the above
12. Which of the following molecules has the highest dipole moment?
- (a)  $\text{CH}_3\text{Cl}$  (b)  $\text{CH}_2\text{Cl}_2$  (c)  $\text{CHCl}_3$  (d)  $\text{CCl}_4$
13. Which of the following molecules possesses only one  $\pi$  bond?
- (a)  $\text{CH}\equiv\text{CH}$  (b)  $\text{CH}_2=\text{CHCHO}$   
(c)  $\text{CH}_3\text{CH}=\text{CHCOOH}$  (d)  $\text{CH}_3\text{CH}=\text{CH}_2$
14. In which of the following molecules/ions is the lone pair of electrons accommodated in  $\text{sp}^2$  orbital?
- (a)  $\text{NH}_3$  (b)  $\text{H}_2\text{O}$  (c)  $\text{CH}_3^-$  (d)  $:\text{CH}_2$
15. The dipole moment of chlorobenzene is 1.69 D. The dipole moment of *m*-dichlorobenzene is expected to be approximately
- (a) 1.69 D (b)  $1.69\sqrt{2}$  D (c) 0.0 D (d)  $1.69\sqrt{3}$  D
16. The  $\sigma$  bond in the carbonyl group of aldehydes and ketones is formed by the orbital overlap of the type
- (a)  $\text{sp}^2-\text{sp}^2$  (b)  $\text{sp}^2-\text{sp}$  (c)  $\text{sp}-\text{sp}$  (d)  $\text{sp}^2-p$
17. The most stable diene among the following is
- (a) 1, 4-pentadiene (b) 1, 2-butadiene  
(c) 1, 3-butadiene (d) 1, 4-cyclohexadiene
18. The  $\text{C}_{60}$  molecule has
- (a) 14 pentagons and 18 hexagons  
(b) 12 pentagons and 20 hexagons  
(c) 10 pentagons and 20 hexagons  
(d) 12 pentagons and 18 hexagons
19. Which of the following would require the largest amount of energy for dissociation?
- (a)  $\text{C}-\text{H}$  in  $\text{CH}_4$  (b)  $\text{C}\equiv\text{C}$  in  $\text{C}_2\text{H}_2$   
(c)  $\text{N}-\text{N}$  in  $\text{N}_2\text{H}_4$  (d)  $\text{N}\equiv\text{N}$  in  $\text{N}_2$
20. In the reaction  $\text{Cl}_2 + \text{ClF} + \text{SbF}_5 \longrightarrow [\text{Cl}_3][\text{SbF}_6]$  the role of the chlorine molecule is to
- (a) stabilize  $\text{Cl}^+$   
(b) function as a Lewis base  
(c) function as a Lewis acid  
(d) form the cation
21. Which of the following molecules is expected to have a permanent dipole moment?
- (a)  $\text{SiF}_4$  (b)  $\text{XeF}_4$  (c)  $\text{SF}_4$  (d)  $\text{BF}_3$
22. Which of the following compounds contains more than one kind of hybridized carbons?
- (a)  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_3$  (b)  $\text{CH}_3\text{CH}=\text{CHCH}_3$   
(c)  $\text{CH}_2=\text{CH}-\text{CH}=\text{CH}_2$  (d)  $\text{HC}\equiv\text{CH}$
23. In which of the following does the overlap of two orbitals give a nonbonding (neither bonding nor antibonding) interaction?
- (a)  (b) 
- (c)  (d) 
24. In which of the following molecules is the oxygen atom in a state of  $\text{sp}^2$  hybridization?
- (a)  (b) 
- (c)  $\text{CH}_3\ddot{\text{O}}\text{CH}_3$  (d)  $(\text{C}_2\text{H}_5)_2\ddot{\text{O}}-\text{BF}_4$
25. Which of the following molecules is expected to have no net dipole moment?
- (a)  (b) 



26. Which of the following orbital overlaps is involved in the formation of the carbon-carbon single bond in the molecule  $\text{HC} \equiv \text{C} - \text{CH} = \text{CH}_2$  ?

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

27. Which of the following molecules possesses  $sp$  hybridized carbons only?

- (a) 1, 3-Butadiyne (b) Propynenitrile  
(c) Carbon suboxide ( $\text{C}_3\text{O}_2$ )  
(d) All of these

28. Which of the following molecules contains all the three types of hybridized carbons:  $sp$ ,  $sp^2$  and  $sp^3$ ?

- (a) Propadiene (b) 1, 3-Butadiene  
(c) 1, 2-Butadiene (d) 1, 3-Butadiyne

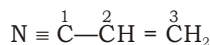
29. Examine the following molecules for the hybridization states of carbons and answer the question given below:

- (A)  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_3$  (B)  $\text{CH}_3\text{CH} = \text{CHCH}_3$   
(C)  $\text{CH}_2 = \text{CHC} \equiv \text{CH}$  (D)  $\text{HC} \equiv \text{CH}$

Which of the above molecules possesses more than one type of hybridized carbon?

- (a) B (b) D (c) B and C (d) C and D

30. The hybridization states of the carbon atom (1) and carbon atom (2) in the compound



are respectively

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

31. Which of the following species (A), (B), (C) and (D) has an  $sp^2$  hybridized carbon?



- (a) A only (b) A and B only  
(c) A and C only (d) A, C and D

32. Which of the following possesses  $sp^2$  hybridized carbons only?

- (a)  $\text{PhCH} = \text{CH}_2$  (b)  $\text{PhCH} = \text{CHPh}$   
(c) Ph - Ph (d) All of these

33. Which of the following molecules can adopt a planar shape?

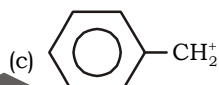
- (a) Benzoic acid (b) Propenal  
(c) Ethanedial (d) All of these

34. Which of the following arrangements gives the correct order of decreasing dipole moment values of  $\text{CH}_3\text{Cl}$ ,  $\text{CH}_2\text{Cl}_2$ ,  $\text{CHCl}_3$  and  $\text{CCl}_4$ ?

- (a)  $\text{CH}_3\text{Cl} > \text{CH}_2\text{Cl}_2 > \text{CHCl}_3 > \text{CCl}_4$   
(b)  $\text{CH}_2\text{Cl}_2 > \text{CH}_3\text{Cl} > \text{CHCl}_3 > \text{CCl}_4$   
(c)  $\text{CHCl}_3 > \text{CH}_2\text{Cl}_2 > \text{CH}_3\text{Cl} > \text{CCl}_4$   
(d)  $\text{CHCl}_3 > \text{CH}_3\text{Cl} > \text{CH}_2\text{Cl}_2 > \text{CCl}_4$

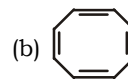
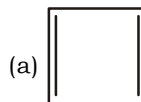
35. Which of the following ions possesses  $sp^2$  carbons only?

- (a)  $\text{CH}_2 = \text{CH} - \text{CH}_2^+$  (b)  $\text{CH}_2 = \text{CH} - \text{CH}_2^-$



- (d) All of these

36. Which of the following molecules does not have a planar shape?



- (c)  $\text{CH}_2 = \text{C} = \text{O}$  (d)  $\text{HN} = \text{NH}$

37. The carbon-carbon bond lengths of the following molecules follow the order:

- (a)  $\text{C}_2\text{H}_6 > \text{C}_2\text{H}_4 > \text{C}_6\text{H}_6 > \text{C}_2\text{H}_2$   
(b)  $\text{C}_2\text{H}_2 < \text{C}_2\text{H}_4 < \text{C}_6\text{H}_6 > \text{C}_2\text{H}_6$   
(c)  $\text{C}_2\text{H}_6 > \text{C}_2\text{H}_2 > \text{C}_6\text{H}_6 > \text{C}_2\text{H}_4$   
(d)  $\text{C}_2\text{H}_4 > \text{C}_2\text{H}_6 > \text{C}_2\text{H}_2 > \text{C}_6\text{H}_6$

38. The hydrogen bond is strongest in

- (a)  $\text{O} - \text{H} \cdots \text{S}$  (b)  $\text{S} - \text{H} \cdots \text{O}$   
(c)  $\text{F} - \text{H} \cdots \text{F}$  (d)  $\text{F} - \text{H} \cdots \text{O}$

39. Which of the following has a trigonal planar shape?

- (a)  $\text{CH}_3$  (b)  $\text{CH}_3^+$  (c)  $\text{BF}_3$  (d) All of these

40. Which of the following represents the correct order of decreasing C - H bond lengths in the following molecules?

- (a)  $\text{CH}_4 > \text{C}_2\text{H}_4 > \text{C}_2\text{H}_6 > \text{C}_2\text{H}_2$   
(b)  $\text{C}_2\text{H}_6 > \text{CH}_4 > \text{C}_2\text{H}_4 > \text{C}_2\text{H}_2$   
(c)  $\text{CH}_4 > \text{C}_2\text{H}_6 > \text{C}_2\text{H}_4 > \text{C}_2\text{H}_2$   
(d)  $\text{C}_2\text{H}_2 > \text{C}_2\text{H}_4 > \text{C}_2\text{H}_6 > \text{CH}_4$

41. Which of the following molecules possesses a bond formed by the overlap of  $sp$  and  $sp^3$  hybrid orbitals of carbon?

- (a)  $\text{CH}_3\text{C} \equiv \text{CH}$  (b)  $\text{CH}_3\text{CH} = \text{CHCH}_3$   
(c)  $\text{CH}_2 = \text{CHCH} = \text{CH}_2$  (d)  $\text{HC} \equiv \text{CH}$

42. Which of the following is not a planar molecule?

- (a)  $\text{CH}_2 = \text{C} = \text{CH}_2$  (b)  $\text{CH}_2 = \text{C} = \text{C} = \text{CH}_2$   
(c)  $\text{CH}_2 = \text{C} = \text{O}$  (d)  $\text{NCCH} = \text{CHCN}$

43. Which of the following statements is not true about the resonance contributing structures of a resonance hybrid?

- (a) Contributing structures contribute to the resonance hybrid in proportion of their energies  
(b) Equivalent contributing structures make the resonance very important.  
(c) Contributing structures represent hypothetical molecules having no real existence.  
(d) Contributing structures are less stable than the resonance hybrid.

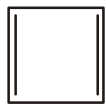

44. Which of the following arrangements represents the correct order of increasing dipole moments of the compounds given below?


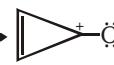
Toluene	m-Dichlorobenzene
(I)	(II)
o-Dichlorobenzene	p-Dichlorobenzene
(III)	(IV)

- (a)  $\text{I} < \text{IV} < \text{II} < \text{III}$  (b)  $\text{IV} < \text{I} < \text{II} < \text{III}$   
(c)  $\text{IV} < \text{I} < \text{III} < \text{II}$  (d)  $\text{IV} < \text{II} < \text{I} < \text{III}$

45. Which of the following compounds has only one type of hybridized carbon?

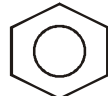
- (a) Propadiene (b) Propenenitrile  
(c) Propenal (d) 1, 4-Pentadiene

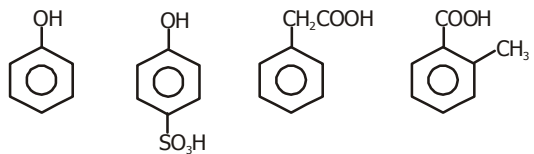
46. All the carbon-carbon bond lengths are equal in  
 (a) 1-butene (b) benzene  
 (c) 2-butene (d) propyne
47. Which of the following molecules has a linear shape?  
 (a)  $(\text{CN})_2$  (b)  $\text{C}_3\text{O}_2$  (c)  $\text{CH}\equiv\text{CCN}$  (d) All of these
48. Which of the following molecules is not stabilized by resonance?  
 (a)  (b)   
 (c)  $\text{CH}_2 = \text{CHCH} = \text{CH}_2$  (d)  $\text{CH}_2 = \text{CHCHO}$
49. In the reaction  

$$\text{CH}_3\text{CH} = \text{N} - \text{OH} \xrightarrow[\text{heat}]{(\text{CH}_3\text{CO})_2\text{O}} \text{CH}_3\text{CN}$$
 the hybridization state of the functional carbon changes from  
 (a)  $sp^2$  to  $sp^3$  (b)  $sp^2$  to  $sp$   
 (c)  $sp^3$  to  $sp$  (d)  $sp^3$  to  $sp^2$
50. Which of the following molecules does not show resonance?  
 (a) Benzene (b) Aniline  
 (c) Ethylamine (d) Toluene
51. Which of the following compounds has the highest boiling point?  
 (a)  $\text{CH}_3\text{CH}_2\text{CH}_3$  (b)  $\text{CH}_3\text{NH}_2$   
 (c)  $\text{CH}_3\text{SH}$  (d)  $\text{CH}_3\text{OH}$
52. Which of the following molecules will have the highest dipole moment?  
 (a) Cyclohexane (b) Cyclohexanone  
 (c) 1, 2-Cyclohexanedione (d) 1, 4-Cyclohexanedione
53. Which of the following structures possesses a cross-conjugated system?  
 (a)  $\text{CH}_2 = \text{CH} - \text{CH} = \text{CH} - \text{CH} = \text{CH}_2$   
 (b) 
$$\begin{array}{c} \text{CH}_2 = \text{CH} - \text{C} = \text{CH}_2 \\ | \\ \text{CH}_2\text{CH}_3 \end{array}$$
  
 (c) 
$$\begin{array}{c} \text{CH}_2 = \text{CH} - \text{CH} - \text{CH} = \text{CH}_2 \\ | \\ \text{CH} = \text{CH}_2 \end{array}$$
  
 (d) 
$$\begin{array}{c} \text{CH}_2 = \text{CH} - \text{C} = \text{CH}_2 \\ | \\ \text{CH} = \text{CH}_2 \end{array}$$
54. Which of the following can act as a Lewis acid?  
 (a)  $\text{CH}_3^+$  (b)  $(\text{C}_3\text{H}_5)_3\text{Al}$   
 (c)  $\text{TiCl}_4$  (d) All of these
55. Which of the following can act as a Lewis base?  
 (a)  $\text{CH}_2 = \text{CH}_2$  (b)  $\text{HCHO}$   
 (c)  $(\text{C}_2\text{H}_5)_3\text{N}$  (d) All of these
56. The maximum number of hydrogen bonds a molecule of water can form is:  
 (a) one (b) two (c) three (d) four
57. Which of the following molecules has zero dipole moment?  
 (a) Benzene (b) Ethane (c) Neopentane (d) All of these
58. Which of the following pairs does not represent resonance structures?  
 (a)  $\text{CH}_3 - \text{C} \equiv \text{N} - \ddot{\text{O}}^-$  and  $\text{CH}_3 - \overset{+}{\text{C}} = \ddot{\text{N}} - \ddot{\text{O}}^-$   
 (b)  $\text{CH}_2 = \overset{+}{\text{N}} \begin{array}{l} \diagup \ddot{\text{O}}^- \\ \diagdown \ddot{\text{O}}^- \end{array}$  and  $\overset{-}{\text{C}}\text{H}_2 - \overset{+}{\text{N}} \begin{array}{l} \diagup \ddot{\text{O}}^- \\ \diagdown \ddot{\text{O}}^- \end{array}$   
 (c)  $\text{CH}_2 = \overset{+}{\text{N}} = \ddot{\text{N}}^-$  and  $\overset{-}{\text{C}}\text{H}_2 - \overset{+}{\text{N}} \equiv \text{N}$   
 (d)  $\text{C}_6\text{H}_5 - \overset{+}{\text{C}} = \ddot{\text{O}}^-$  and  $\text{C}_6\text{H}_5 - \overset{+}{\text{C}} = \overset{-}{\text{O}} - \text{H}$
59. Which of the following is not a nucleophile?  
 (a)  $\text{OH}^-$  (b)  $\text{NH}_3$  (c)  $\text{BF}_3$  (d)  $\text{HSO}_3^-$
60. Which of the following molecules can behave both as a nucleophile and an electrophile?  
 (a)  $\text{CH}_3\text{NH}_2$  (b)  $\text{CH}_3\text{Cl}$  (c)  $\text{CH}_3\text{CN}$  (d)  $\text{CH}_3\text{OH}$
61. In which of the following pairs is the structure on the right a major resonance contributor?  
 (a)  $\text{CH}_3 - \overset{+}{\text{C}} = \overset{-}{\text{O}} \longleftrightarrow \text{CH}_3 - \overset{-}{\text{C}} = \overset{+}{\text{O}}$   
 (b)  $\text{CH}_2 = \text{CH} - \overset{-}{\text{Cl}} \longleftrightarrow \overset{-}{\text{C}}\text{H}_2 - \text{CH} = \overset{+}{\text{Cl}}$   
 (c)  $\begin{array}{c} \text{CH}_3 \\ \diagdown \\ \text{C} = \overset{-}{\text{O}} \\ \diagup \\ \text{CH}_3 \end{array} \longleftrightarrow \begin{array}{c} \text{CH}_3 \\ \diagdown \\ \overset{+}{\text{C}} - \overset{-}{\text{O}} \\ \diagup \\ \text{CH}_3 \end{array}$   
 (d)   $\longleftrightarrow$  
62. The resonance stabilization is highest in  
 (a) 1, 3-butadiene (b) cyclobutadiene  
 (c) 1, 3-cyclohexadiene (d) benzene
63. Which of the following can act both as a Lewis and a Lewis base?  
 (a)  $\text{CH}_3^-$  (b)  $\text{CH}_3\text{NH}_2$  (c)  $\text{CH}_2 = \text{CH}_2$  (d)  $\text{HCHO}$
64. In the compound  $\text{CH}_2 = \text{CHCH}_2\text{CH}_2\text{C}\equiv\text{CH}$ , the bond between C - 2 and C - 3 is of the type.  
 (a)  $sp - sp^2$  (b)  $sp^3 - sp^3$  (c)  $sp - sp^3$  (d)  $sp^2 - sp^3$
65. In the reaction  

$$\text{CH}_3\text{CN} \xrightarrow[\text{heat}]{\text{H}_3\text{O}^+} \text{CH}_3\text{COOH}$$
 the hybridization state of the functional carbon changes from  
 (a)  $sp^3$  to  $sp^2$  (b)  $sp^2$  to  $sp^3$   
 (c)  $sp$  to  $sp^2$  (d)  $sp^2$  to  $sp$
66. Which of the following molecules forms the strongest hydrogen bond with its fellow molecules?  
 (a)  $\text{CH}_3\text{CH}_2\text{NH}_2$  (b)  $\text{CH}_3\text{CH}_2\text{OH}$   
 (c)  $\text{CH}_3\text{COOH}$  (d)  $\text{CH}_3\text{SH}$
67. Which of the following molecules can act as a hydrogen-bond acceptor but not as a hydrogen bond donor?  
 (a)  $\text{CH}_3\text{CH}_2\text{OH}$  (b)  $\text{CH}_3\text{NH}_2$   
 (c)  $\text{CH}_3\text{COCH}_3$  (d)  $\text{CH}_3\text{COOH}$
68. Which of the following compounds cannot form intermolecular hydrogen bonds among its own molecules but can do so with other hydrogen-bond donor compounds?  
 (a)  $\text{CH}_3\text{CH}_2\text{OH}$  (b)  $\text{CH}_3\text{OCH}_3$   
 (c)  $\text{CH}_3\text{CH}_2\text{NH}_2$  (d)  $\text{CH}_3\text{COOH}$

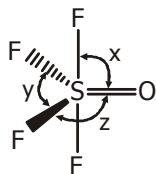
69. The numbers of  $\sigma$  and  $\pi$  bonds in *o*-xylene are  
 (a)  $12\sigma$  and  $3\pi$  (b)  $18\sigma$  and  $3\pi$   
 (c)  $9\sigma$  and  $3\pi$  (d)  $15\sigma$  and  $3\pi$
70. Which of the following molecules has three different bond-angle values?  
 (a)  $\text{CCl}_4$  (b)  $\text{CH}_2\text{Cl}_2$  (c)  $\text{CHCl}_3$  (d)  $\text{HCHO}$
71. The carbon atoms in allene ( $\text{CH}_2 = \text{C} = \text{CH}_2$ ) involve the hybridizations  
 (a)  $sp^2$  and  $sp^3$  (b)  $sp^2$  and  $sp$   
 (c)  $sp^3$  and  $sp$  (d)  $sp^2$  only
72. The numbers of  $\pi$  bonds and  $\sigma$  bonds present in a molecule of benzaldehyde are, respectively,  
 (a)  $4\pi$  and  $13\sigma$  (b)  $4\pi$  and  $8\sigma$   
 (c)  $4\pi$  and  $14\sigma$  (d)  $8\pi$  and  $10\sigma$
73. When the hybridization state of a carbon atom changes from  $sp^3$  to  $sp^2$  and finally to  $sp$ , the angle between the hybridized orbitals  
 (a) decreases gradually (b) decreases considerably  
 (c) is not affected (d) increases progressively
74. The numbers of  $\sigma$  and  $\pi$  bonds in 1-buten-3-yne are  
 (a)  $5\sigma$  and  $5\pi$  (b)  $7\sigma$  and  $3\pi$   
 (c)  $8\sigma$  and  $2\pi$  (d)  $8\sigma$  and  $4\pi$
75. In which of the following hybridizations does the interorbital angle have the highest value?  
 (a)  $sp^3$  (b)  $sp^2$  (c)  $sp$  (d)  $sp^3d$
76. Which of the following hydrocarbon groups designated as I, II, III, IV and V has planar geometry?  
 Phenyl Cyclohexyl Cyclopentyl Butyl Vinyl  
 I II III IV V  
 (a) IV (b) I and V  
 (c) II and III (d) II, III and IV
77. Which of the following arrangements represents the correct order of decreasing bond-angle values in  $\text{NH}_3$ ,  $\text{NF}_3$  and  $\text{NH}_4^+$ ?  
 (a)  $\text{NH}_4^+ > \text{NH}_3 > \text{NF}_3$  (b)  $\text{NF}_3 > \text{NH}_4^+ > \text{NH}_3$   
 (c)  $\text{NH}_4^+ > \text{NF}_3 > \text{NH}_3$  (d)  $\text{NH}_3 > \text{NF}_3 > \text{NH}_4^+$
78. Which of the following molecules possesses  $sp^2$  hybridized carbons only?  
 (a)  $\text{CH}_2 = \text{C} = \text{O}$  (b)  $\text{CH}_2 = \text{C} = \text{CH}_2$   
 (c)  $\text{CH}_2 = \text{CH} - \text{CHO}$  (d)  $\text{CH}_2 = \text{CHCN}$
79. In the protonated formaldehyde molecule ( $\text{CH}_2 = \text{O}^+ - \text{H} \leftrightarrow \overset{+}{\text{C}}\text{H}_2 - \overset{-}{\text{O}}\text{H}$ ), the  $\text{C}-\text{O}-\text{H}$  bond-angle value is expected to be closer to  
 (a)  $120^\circ$  (b)  $109^\circ$  (c)  $180^\circ$  (d)  $90^\circ$
80. Which of the following has a three-centre three-electron  $\pi$ -bond?  
 (a)  $\text{CH}_2 = \text{CH} - \overset{+}{\text{C}}\text{H}_2$  (b)  $\text{CH}_3\text{CH} = \text{CH}_2$   
 (c)  $\text{CH}_2 = \text{CH} - \overset{-}{\text{C}}\text{H}_2$  (d)  $\text{CH}_2 = \text{CH} - \overset{+}{\text{C}}\text{H}_2$
81. Which of the following is a linear molecule?  
 (a)  $\text{N}_2\text{O}$  (b)  $\text{H}_2\text{O}$  (c)  $\text{SO}_2$  (d)  $\text{CH}_4$
82. Which of the following molecules has the lowest value of bond angle?  
 (a)  $\text{CH}_4$  (b)  $\text{NH}_3$  (c)  $\text{H}_2\text{O}$  (d)  $\text{PH}_3$
83. What is the hybridization state of the nitrogen atom in the  $\text{NOCl}$  molecule?  
 (a)  $sp^2$  (b)  $sp^3$   
 (c)  $sp$  (d) No hybridization
84. Which of the following pairs does not represent the resonance contributors of the same species?  
 (a)  $\text{CH}_2 = \text{CH} - \overset{-}{\text{O}}$  and  $\overset{-}{\text{C}}\text{H}_2 = \text{CH} - \overset{+}{\text{O}}$   
 (b)  $\text{CH}_2 = \overset{+}{\text{C}}\text{H} - \overset{-}{\text{C}}\text{H}_2$  and  $\text{H}_2\text{C} - \overset{+}{\text{C}}\text{H} - \overset{-}{\text{C}}\text{H}_2$   
 (c)  $\begin{array}{c} \text{CH}_2 \\ | \\ \text{CH}_2 \end{array} \text{CH} - \overset{+}{\text{C}}\text{H}_2$  and  $\begin{array}{c} \overset{+}{\text{C}}\text{H}_2 \\ | \\ \text{CH}_2 \end{array} \text{CH} = \text{CH}_2$   
 (d)  $\text{CH}_3 - \overset{+}{\text{N}} \begin{array}{l} \text{O} \\ \text{O} \end{array}$  and  $\text{CH}_3 - \overset{-}{\text{N}} \begin{array}{l} \text{O} \\ \text{O} \end{array}$
85. Which of the following is the weakest nucleophile?  
 (a)  $\text{C}_2\text{H}_5\text{O}^-$  (b)  $\text{C}_2\text{H}_5\text{S}^-$  (c)  $\text{CH}_3\text{COO}^-$  (d)  $\text{CO}_3^{2-}$
86. Which of the following is the weakest Lewis base?  
 (a)  $\text{NH}_3$  (b)  $\text{NF}_3$  (c)  $\text{NH}_2^-$  (d)  $\text{CH}_3\text{O}^-$
87. Which of the following is an ambident nucleophile?  
 (a)  $\text{CH}_3^-$  (b)  $\text{OH}^-$  (c)  $\text{C}_2\text{H}_5\text{O}^-$  (d)  $\text{NO}_2^-$
88. Which of the following molecules can form intramolecular hydrogen bonds?  
 (a)  $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$  (b)  $\text{CH}_3\text{CHOHCHOHCH}_3$   
 (c)  $\text{CH}_3\text{CH}_2\text{NH}_2$  (d)  $\text{CH}_3\text{COOH}$
89. Which of the following molecules has the highest dipole moment?  
 (a)  $\text{CH}_3\text{COCH}_3$  (b)  $\text{CH}_3\text{OH}$   
 (c)  $\text{H} - \overset{\text{O}}{\parallel} \text{C} - \text{N}(\text{CH}_3)_2$  (d)  $(\text{CH}_3)_2\text{S} = \text{O}$
90. Which of the following is a polar aprotic solvent?  
 (a)  $\text{C}_2\text{H}_5\text{OH}$  (b)  $\text{H}_2\text{O}$   
 (c)  $(\overset{-}{\text{C}}\text{H}_3)_2\text{SO}$  (d)  $\text{CCl}_4$
91. Examine the following resonating structures of formic acid for their individual stability and then answer the question given below  

$$\text{H} - \overset{\text{O}}{\parallel} \text{C} - \text{OH} \leftrightarrow \text{H} - \overset{\text{O}^-}{\text{C}} = \overset{+}{\text{O}} - \text{H} \leftrightarrow \text{H} - \overset{\text{O}^-}{\overset{+}{\text{C}}} - \text{OH} \leftrightarrow \text{H} - \overset{\text{O}^+}{\overset{-}{\text{C}}} - \text{OH}$$
 I II III IV  
 Which of the following arrangements gives the correct order of decreasing stability of the above mentioned resonance contributors?  
 (a)  $\text{II} > \text{I} > \text{III} > \text{IV}$  (b)  $\text{I} > \text{II} > \text{III} > \text{IV}$   
 (c)  $\text{III} > \text{II} > \text{IV} > \text{I}$  (d)  $\text{IV} > \text{III} > \text{I} > \text{II}$
92. Which of the following pairs can undergo a Lewis acid-base reaction?  
 (a)  $\text{CH}_2 = \text{CH}_2 + \text{NO}_2^+ \longrightarrow$   
 (b)  +  $\text{CH}_3 - \overset{+}{\text{C}} \equiv \text{O} \longrightarrow$   
 (c)  $\text{C}_2\text{H}_5\text{OH} + \text{PCl}_3 \longrightarrow$  (d) All of these

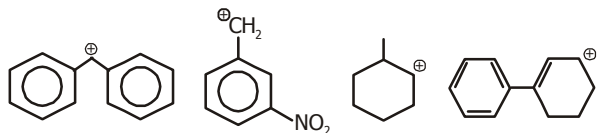
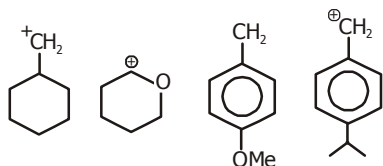
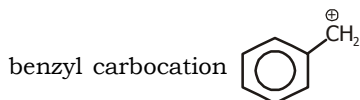
93. Which of the following molecules has the shortest carbon-carbon single bond length?  
 (a)  $\text{CH}_2 = \text{CH} - \text{C} \equiv \text{CH}$  (b)  $\text{CH}_2 = \text{CH} - \text{C} \equiv \text{N}$   
 (c)  $\text{CH}_2 = \text{CH} - \text{CH} = \text{O}$  (d)  $\text{CH}_2 = \text{CH} - \text{CH} = \text{CH}_2$
94. The length of the carbon-carbon single bond of the compounds  
 I.  $\text{CH}_2 = \text{CH} - \text{C} \equiv \text{CH}$  II.  $\text{CH} \equiv \text{C} - \text{C} \equiv \text{CH}$   
 III.  $\text{CH}_3 - \text{CH} = \text{CH}_2$  IV.  $\text{CH}_2 = \text{CH} - \text{CH} = \text{CH}_2$   
 is expected to decrease in the order  
 (a) III > II > I > IV (b) I > III > II > IV  
 (c) III > IV > I > II (d) II > IV > I > III
95. Which of the following compounds is expected to have the highest boiling point?  
 (a) *n*-Octane (b) Isooctane  
 (c) *n*-Butane (d) 2, 2, 3, 3-Tetramethylbutane
96. In which of the following pairs of resonance contributors is the structure on the right a more important contributor?  
 (a)  $\text{H}-\overset{+}{\text{C}} = \overset{-}{\text{O}}: \longleftrightarrow \text{H}-\text{C} \equiv \overset{+}{\text{O}}$   
 (b)  $\overset{-}{\text{C}}\text{H}_2 - \overset{+}{\text{N}} \equiv \text{N}: \longleftrightarrow \text{CH}_2 - \overset{+}{\text{N}} \equiv \overset{-}{\text{N}}:$   
 (c)  $\text{CH}_3 - \overset{+}{\text{C}}\text{H} - \overset{-}{\text{O}}\text{H} \longleftrightarrow \text{CH}_3\text{CH} = \overset{+}{\text{O}} - \text{H}$   
 (d) All the above
97. In which of the following pairs are the two structures not resonance contributors to the same hybrid structure?  
 (a)  $\text{CH}_3 - \text{N} = \text{C} = \text{S}$  and  $\text{CH}_3 - \text{S} - \text{C} \equiv \text{N}$   
 (b)  $\text{CH}_3 - \overset{+}{\text{C}} = \text{O}$  and  $\text{CH}_3 - \text{C} \equiv \overset{+}{\text{O}}$   
 (c)  $\text{CH}_3 - \overset{\text{O}}{\parallel} \text{C} - \text{OH}$  and  $\text{CH}_3 - \overset{\text{O}^-}{\parallel} \text{C} = \overset{+}{\text{O}} - \text{H}$   
 (d)  $\text{CH}_2 = \text{CH} - \text{C} \equiv \text{N}$  and  $\overset{+}{\text{C}}\text{H}_2 - \text{CH} = \text{C} = \text{N}^-$
98. In the reaction  
 $\text{CH}_3\text{CHO} + \text{HCN} \longrightarrow \text{CH}_3\text{CH}(\text{OH})\text{CN}$   
 the hybridization of the carbonyl carbon changes from  
 (a)  $\text{sp}^2$  to  $\text{sp}^3$  (b)  $\text{sp}$  to  $\text{sp}^3$   
 (c)  $\text{sp}^2$  to  $\text{sp}$  (d)  $\text{sp}$  to  $\text{sp}^2$
99. Which of the following arrangements correctly represents the order of decreasing boiling points of ethyl methyl ether (A), acetone (B), isopropyl alcohol (C) and ethylene glycol (D)?  
 (a) C > B > D > A (b) C > D > B > A  
 (c) D > C > B > A (d) D > C > A > B
100. Which of the following molecules cannot form intramolecular hydrogen bonds?  
 (a) 2-Hydroxybenzaldehyde  
 (b) 3-Amino-2-butanol  
 (c) 2-Fluorophenol (d) 4-Nitrophenol
101. In the molecule  $\text{CH}_3\text{C} \equiv \text{CCH} = \text{CH}_2$ , the maximum number of carbon atoms arranged linearly is  
 (a) 2 (b) 3 (c) 4 (d) 5
102. Which of the following compounds has the highest boiling point?  
 (a) Ethane (b) Butane (c) 2-Butanol (d) Pentane
103. Point out the incorrect statement about resonance.  
 (a) All the resonance structures must have equal energy  
 (b) In all the resonance structures, the constituent atoms should be in the same relative positions.  
 (c) All the resonance structures must have the same number of electrons with their spins paired.  
 (d) Resonance structures should differ only in the location of electrons around the constituent atoms.
104. The nature of intermolecular forces among benzene molecules is  
 (a) dipole-dipole attraction (b) dispersion forces  
 (c) ion-dipole attraction (d) hydrogen bonding
105. Which of the following is an electrophile?  
 (a)  $\text{H}_2\text{O}$  (b)  $\text{NH}_3$  (c)  $\text{AlCl}_3$  (d)  $\text{C}_2\text{H}_5\text{NH}_2$
106. Which one of the following statements is not true?  
 (a) Each carbon in ethylene is  $\text{sp}^2$  hybridized  
 (b) Each carbon in acetylene is  $\text{sp}^3$  hybridized  
 (c) Each carbon in benzene is  $\text{sp}^2$  hybridized  
 (d) Each carbon in ethane is  $\text{sp}^3$  hybridized
107. Among the molecules of ethane, ethylene and acetylene, the C - H bond energy is the  
 (a) highest in ethane (b) highest in ethylene  
 (c) highest in acetylene (d) same in all the three
108. The Cl - C - Cl bond angles in tetrachloroethene and tetrachloromethane are, respectively, about  
 (a)  $120^\circ$  and  $109.5^\circ$  (b)  $90^\circ$  and  $109.5^\circ$   
 (c)  $109.5^\circ$  and  $90^\circ$  (d)  $109.5^\circ$  and  $120^\circ$
109. The number of  $\pi$  bonds in 1, 3-hexadien-5-yne is  
 (a) 2 (b) 3 (c) 4 (d) 5
110. In the straight-chain hydrocarbon  $\text{C}_8\text{H}_{10}$ , the carbon atoms beginning from one end have the hybridizations  $\text{sp}^3$ ,  $\text{sp}^2$ ,  $\text{sp}^2$ ,  $\text{sp}^3$ ,  $\text{sp}^2$ ,  $\text{sp}^2$ ,  $\text{sp}$  and  $\text{sp}$  respectively. The hydrocarbon is  
 (a)  $\text{CH}_3\text{C} \equiv \text{CCH}_2\text{CH} = \text{CHCH} = \text{CH}_2$   
 (b)  $\text{CH}_3\text{CH}_2\text{CH} = \text{CHCH}_2\text{C} \equiv \text{CCH} = \text{CH}_2$   
 (c)  $\text{CH}_3\text{CH} = \text{CHCH}_2\text{C} \equiv \text{CCH} = \text{CH}_2$   
 (d)  $\text{CH}_3\text{CH} = \text{CHCH}_2\text{CH} = \text{CHC} \equiv \text{CH}$
111. The numbers of compounds which give  $\text{NaHCO}_3$  test are  

112. Match Column I and Column II.  
**Column I (Reaction)**  
 A.  $\text{CrO}_4^-$   
 B.  $\text{BH}_4^-$   
 C.  $\text{ICl}_4^-$   
 D.  $\text{PtCl}_4^-$   
**Column II (Mechanism)**  
 1.  $\text{sp}^3\text{d}^2$   
 2.  $\text{sp}^3$   
 3.  $\text{d}^3\text{s}$   
 4.  $\text{dsp}^2$   
 5.  $\text{sp}^3\text{d}$   
 Codes



113. The correct order of bond angle in the following molecule is



- (a)  $y = z > x$  (b)  $z > y > x$  (c)  $y > x > z$  (d)  $x > y > z$
114. Which of the following set of compounds have similar structure?
- (a)  $\text{ClF}_3$ ,  $\text{I}_3^-$ ,  $\text{BrF}_3$  and  $\text{NO}_3^-$   
 (b)  $\text{SF}_4$ ,  $\text{XeF}_4$ ,  $\text{TeF}_4$  and  $\text{NO}_3^-$   
 (c)  $\text{BF}_3$ ,  $\text{SO}_3$ ,  $\text{BrF}_3$  and  $\text{CO}_3^{2-}$   
 (d)  $\text{SO}_3$ ,  $\text{BF}_3$ ,  $\text{BH}_3$  and  $\text{CO}_3^{2-}$
115. Which of the following set of compounds have similar structure?
- (a)  $\text{ClF}_3$ ,  $\text{I}_3^-$ ,  $\text{BrF}_3$  and  $\text{NO}_3^-$   
 (b)  $\text{SF}_4$ ,  $\text{XeF}_4$ ,  $\text{TeF}_4$  and  $\text{NO}_3^-$   
 (c)  $\text{BF}_3$ ,  $\text{SO}_3$ ,  $\text{BrF}_3$  and  $\text{CO}_3^{2-}$   
 (d)  $\text{SO}_3$ ,  $\text{BF}_3$ ,  $\text{BH}_3$  and  $\text{CO}_3^{2-}$
116. Number of carbocation which are more stable than

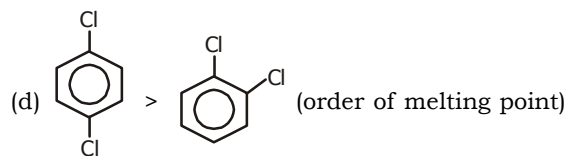


117.  $\text{Na}_2\text{SO}_3$ ,  $\text{NaCl}$ ,  $\text{Na}_2\text{C}_2\text{O}_4$ ,  $\text{Na}_2\text{HPO}_4$ ,  $\text{Na}_2\text{CrO}_4$ ,  $\text{NaNO}_2$ ,  $\text{CH}_3\text{COONa}$  are separately treated with  $\text{AgNO}_3$  solution. In how many cases white ppt. is/are obtained?

**Answer**

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

118. The oxidation state of sulphur in Caro's acid, marshal acid and oleum are
- (a) 6, 6 and 5 respectively (b) 4, 5 and 6 respectively  
 (c) 6, 6 and 6 respectively (d) 4, 6 and 6 respectively
119. In  $\text{BFClBr}$  molecule which of the following bond have minimum 1% s character provided to the central atom?
- (a) B—Cl (b) B—F  
 (c) B—Br (d) Cannot be predicted
120. What percentage of s character is used by the C-atom in the orbitals of  $\text{CH}_2\text{F}_2$  molecule directed towards H-atom?
- (a) 37.29% (b) 27.1% (c) 29% (d) 29.99%
121. What is the number of  $\text{sp}^2$  hybridised atoms present in the product obtained by reaction between benzaldehyde and acetic anhydride in presence of weak base?
- (a) 6 (b) 8 (c) 9 (d) 10
122. Which of the following statement(s) is/are correct regarding fool's gold?
- (a) It contain 8% of gold (b) It is not an ore of copper  
 (c) It contain 0% of gold (d) Chemical name of fool's gold is Iron-pyrites
123. Choose the correct statement(s)
- (a)  $\text{CH}_3\text{-F} > \text{CH}_3\text{-Cl} > \text{CH}_3\text{-Br} > \text{CH}_3\text{-I}$   
 (order of bond dissociation energy of C—X bond)  
 (b)  $\text{CH}_3\text{-Cl} > \text{CH}_3\text{F} > \text{CH}_3\text{Br} > \text{CH}_3\text{I}$   
 (order of dipole moment)  
 (c)  $\text{CH}_3\text{I} > \text{CH}_3\text{Br} > \text{CH}_3\text{Cl} > \text{CH}_3\text{F}$   
 (order of rate of  $\text{S}_{\text{N}}2$ )



124. Which of the following will not show test of unsaturation?

