N.B.Navale

Date : 01.04.2025
Time : 00:56:42
Marks : 63

TEST ID: 69
CHEMISTRY

CHEMICAL BONDING AND MOLECULAR STRUCTURE

Single Correct Answer Type

1. Isostructural species are those, which have the same shape and hybridisation. Among the given species, identify the isostructural pairs.
   a) NF_3 and BF_3 b) BF_4^- and NH_4^+
   c) BCl_3 and $BrCl_3$ d) NH_3 and NO_3^-
2. What is the H - S - H bond angle in H_2S?
   a) 104.5^0 b) 92.1^0
   c) 91^0 d) 90^0
3. The bond angles of NH_3, NH_4^+ and NH_2^- are in the order
   a) $NH_2^- > NH_3 > NH_4^+$ b) $NH_4^+ > NH_3 > NH_2^-$
   c) $NH_3 > NH_2^- > NH_4^+$ d) $NH_3 > NH_4^+ > NH_2^-$
4. In accordance to molecular theory,
   a) O_2^+ is diamagnetic and bond order is more than O_2 O_2^+ is paramagnetic
   b) O_2^+ is diamagnetic and bond order is less than O_2 O_2^+ is paramagnetic
   c) and bond order is more than O_2
   d) and bond order is less than O_2
5. Bond energy of $H-H, F-F$ and $H-F$ bonds are 104,38 and 135 kcal mol^{-1}, respectively. The resonance energy in the $H-F$ molecule will be
   a) 142kcalmol^{-1} b) 66 kcal mol^{-1}
   c) 72.14 kcal mol^{-1} d) 79.26 kcal mol^{-1}
6. Which of the following molecule will be stabilized by losing one electron from its HOMO?
   a) C_2 b) N_2
   c) CN d) O_2
7. Which of following bonds has maximum bond length?
   a) C - O b) C - H
   c) C - C d) C - N
8. The number of π - bonds present in benzoic acid molecule are
   a) 5 b) 4
   c) 3 d) 6
9. Which is the most covalent?
   a) $C-F$ b) $C-O$
   c) $C-S$ d) $C-Br$
10. Which of the following is correct decreasing order of the repulsive interaction of electron pairs in a molecule?
    a) bond pair - bond pair > lone pair - bond pair > lone pair - lone pair
    b) lone pair - bond pair > lone pair - lone pair > bond pair - bond pair
    c) bond pair - bond pair = bond pair - lone pair > lone pair - lone pair
    d) lone pair - lone pair > lone pair - bond pair > bond pair - bond pair
11. What is the geometry of water molecule?
    a) distorted tetrahedral b) Tetrahedral
    c) Trigonal planar d) diagonal
12. Among the following molecules, which one have trigonal planar structure?
    XeO_3, SO_3, BF_3, NH_3
    a) XeO_3 and BF_3 b) BF_3 and SO_3
    c) NH_3 and SO_3 d) All of these
13. In which of the following compounds intramolecular hydrogen bonding is present?
    a) Ammonia b) Ethanol
    c) Water d) O-nitrophenol
14. Which of the following statements is correct regarding $BeCl_2$ molecule?
    a) It violates octet rule and has sp^2 hybridisation
    b) It has sp hybridization and follows octet rule
    c) It violates octet rule and has linear structure
    d) All of the above are true
15. Arrange the following molecules in the increasing order of bond angle.
    H_2O H_2S H_2Se H_2Te
    I II IIII IV
    a) I < II < III < IV b) IV < III < II < I
    c) I < III < II < IV d) IV <II < III < I
16. In NO_3^- ion, the number of bond pairs and lone pairs of electrons on nitrogen atom are
    a) 2,2 b) 3,1
    c) 1,3 d) 4,0
17. Which one among the following does not have the hydrogen bond?
    a) Phenol b) Water

c) Liquid NH_3 d) Liquid HCL

18. Given : Dipole moment of HCl = 1.03D
Bond length = 127pm, dipole moment of HI = 0.38D
Bond length = 161pm
The ratio of partial positive charge on H-atom in HCl to that in Hl will be
a) 2 : 1 b) 3.42 : 1
c) 2.39 : 1 d) 4 : 1

19. Among the following, choose the correct pair, which is is Isostructural and isoelectronic?
a) NO_3^-, CO_3^{2-} b) SO_3, NO_3^-
c) ClO_3^-, CO_3^{2-} d) CO_3^{2-}, ClO_3^-

20. The compound having maximum dipole moment is
a) NH_3 b) NF_3
c) NCl_3 d) Nl_3

21. Of the three molecules XeF_6, SF_4, SiF_4, which have tetrahedral structure?
a) All the three b) SiF_4 and SF_4
c) Only SiF_4 d) Only SF_4

22. Which of the following pairs has zero dipole moment?
a) CH_2Cl_2 and NF_3 b) SiF_4 and BF_3
c) PCl_3 and CIF d) BF_3 and NF_3

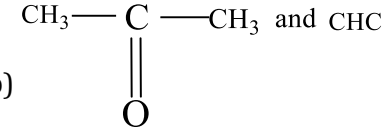
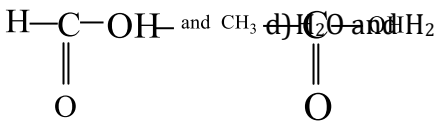
23. In gas phase H - O - O - H bond angle in H_2O_2 is
a) 94.8^0 b) 111.5^0
c) 98.4^0 d) 147.5^0

24. In which of the following molecules the van der Waals' forces is likely to be the most important in determining the melting and boiling point?
a) CO b) H_2S
c) Br_2 d) HCL

25. Arrange the following in the correct order of bond length : N_2, O_2 and Cl_2.
a) $N_2 > Cl_2 > O_2$ b) $N_2 < Cl_2 < O_2$
c) $N_2 < O_2 < Cl_2$ d) $Cl_2 < N_2 < O_2$

26. The bond order of H_2 ion is $\frac{1}{2}$. If it has 2 bonding electrons, how many antibonding electrons it will have?
a) 3 b) 1
c) 2 d) 4

27. Which of the following set possess sp^3-hybridisation?
a) IO_4^-, ICl_4^-, IF_4^+ b) XeO_3, XeO_4, XeF_4
c) $SO_3^{2-}, SO_4^{2-}, SO_5^{2-}$ d) PCl_4^+, BF_4^-, ICl_4^-

28. The pair of molecules forming strongest hydrogen bonds is
a) SiH_4 and SiF_6
b)  and CHC
c)  and

29. The molecule having zero dipole moment is
a) CIF_3 b) CH_4
c) PH_3 d) CH_2Cl_2

30. Which of the following is correct regarding bond energies of NO, $NO^+$and NO^-?
a) $NO^- > NO > NO^+$ b) $NO^+ > NO^- > NO$
c) $NO > NO^- > NO^+$ d) $NO^+ > NO > NO^-$

31. The percentage ionic character in Cs − Cl bond present in CsCI molecule will be, if the electronegativities values for Cs and Cl are 0.8 and 3.0, respectively
a) 62.9% b) 60%
c) 75% d) 52.14%

32. The compound MX_4 is tetrahedral. The number of ∠XMX formed in the compound is
a) three b) four
c) five d) six

33. Ortho - nitrophenol is less soluble in water than p-and m-nitrophenols because
a) O- nitrophenol is more steam volatile than those of m-and p-isomers
b) O- nitrophenol shows intramolecular H-bonding
c) O-nitrophenol showsd) intermolecular H-bonding
d) melting point of O-nitrophenol is lower than those of m- and p-isomers

34. Which of the following compounds has the smallest bond angle in its molecule?
a) H_2O b) H_2S
c) NH_3 d) SO_2

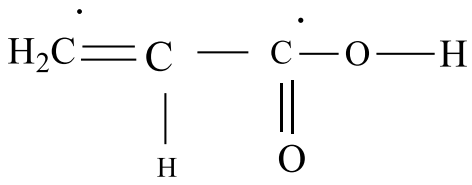
35. Which of the following is paramagnetic?
a) NO^- b) O_2^{2-}
c) CN^- d) CO

36. What is standard N = N bond enthalpy from following reaction,
$N_2(g) + 3H_2(g) \longrightarrow 2NH_3(g); \Delta H^\circ = -83$ kJ
$(\Delta H^\circ(H-H) = 435$ kJ; $\Delta H^\circ(N-H) = 389$ kJ)
a) 435 kJ b) 1305 kJ
c) 2334 kJ d) 946 kJ

37. Which of following requires maximum energy to undergo decomposition?

a) O_2 b) C_2
c) O_2^+ d) N_2

38. What is the type of hybridization of carbon atoms marked with star?



a) sp^2, sp b) sp^2, sp^2
c) sp, sp^2 d) None of these

39. Which of the following is correct order of bond angle?
a) $H_2O > OF_2 > SF_2 > H_2S$ b) $H_2O > SF_2 > OF_2 > H_2S$
c) $H_2O > OF_2 > H_2S > F_2S$ d) $H_2O > H_2S > OF_2 > SF_2$

40. The shape of BrF_5 molecule is
a) trigonal pyramidal b) square pyramidal
c) trigonal bipyramidal d) square planar

41. Match the type of bond (given in Column I) with method of formation (given in Column II) and choose the correct option from the codes given below.

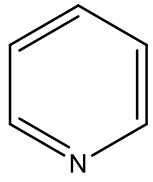
Column I	Column II
A. σ-bond	1. Lateral overlapping
B. Covalent bond	2. Sharing of electrons
C. Ionic bond	3. Transfer of electrons
D. π-bond	4. Donating an electron
	5. Accepting an electron
	6. Axial overlapping

Codes

A B C D
a) 6 2 3 1 b) 3 2 6 1
c) 1 2 3 4 d) 2 4 5 6

42. What is the bond angle of H - O - H in ice (answer approx.. value)?
a) 120°28 b) 109°
c) 90° d) 60°

43. Hybridisation of the nitrogen atom and electronic geometry around nitrogen atom in pyridine is



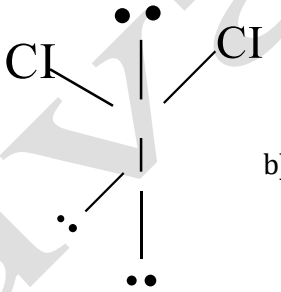
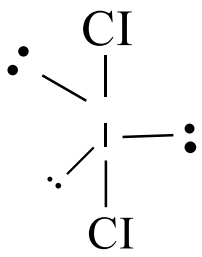
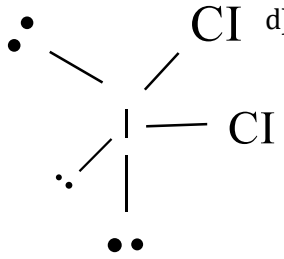
a) sp^3, pyramidal b) sp^2, trigonal planar
c) sp^2, linear d) sp^3, tetrahedral

44. What is the structure of XeF_6 ?
a) Tetrahedral b) Distorted octahedral
c) Octahedral d) None of these

45. Which concept best explains that o-nitrophenol is more volatile than p-nitrophenol?
a) Resonance b) Steric hinderance
c) Hydrogen bond d) Hperconjugation

46. If molecule MX_3 has zero dipole moment, the sigma bonding orbitals used by M (atomic number < 21) are
a) sp-hybridised b) sp^2-hybridised
c) sp^3-hybridised d) None of these

47. Which of the following show correct structure of ICl_2 ?

a) 
b) 
c) 
d) None of these

48. The correct order of decreasing polarity is
a) $HF > SO_2 > H_2O > NH_3$ b) $HF > H_2O > SO_2 > NH_3$
c) $HF > NH_3 > SO_2 > H_2O$ d) $H_2O > NH_3 > SO_2 > HF$

49. Consider the following compounds,
I. 1,2 hydroxybenzene
II. 1, 3-dihydroxybenzene
III. 1 , 4-dihydroxybenzene
IV. Hydroxybenzene
The increasing order of their boiling points is
a) I <‖< I ‖< IV b) IV < I <‖< III
c) IV <‖< I < I ‖ d) I < II < IV < III

50. Which of the following molecule contain 50% p - character of hybrid orbital in C atom?
a) Acetylene b) Methane
c) Ethane d) Propene

51. In which of the following ionization processes,

the bond order has increased and magnetic behaviour has changed?

a) $C_2 \rightarrow C_2^+$ b) $NO \rightarrow NO^+$

c) $O_2 \rightarrow O_2^+$ d) $N_2 \rightarrow N_2^+$

52. Match the following and choose the correct option.

	Column I		Column II
A.	SF_4	1.	sp^3d^2
B.	IF_5	2.	sp^3
C.	NO_2^+	3.	sp
D.	NH_4^+	4.	sp^3d

Codes

	A	B	C	D		A	B	C	D
a)	4	1	3	2	b)	1	3	2	4
c)	3	2	4	1	d)	3	1	2	4

53. The molecular shapes of SF_4, CF_4 and XeF_4 are

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 pairs of electrons on the central atoms, respectively

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

54. Which set of molecules are paramagnetic?

a) B_2, C_2 and O_2 b) C_2, O_2 and B_2

c) O_2, N_2 and B_2 d) B_2, O_2 and NO

55. In XeF_2, XeF_4 and XeF_6, the number of lone pairs of X_e, respectively are

a) 2,3,1 b) 1,2,3

c) 4,1,2 d) 3,2,1

56. The d-orbital involved in sp^3 d-hybridisation is

a) d_{xy} b) d_{zx}

c) d_{z^2} d) $d_{x^2-y^2}$

57. The number of σ and π-bonds in 2 - formylbenzoic acid are respectively

a) 10, 3 b) 14, 3

c) 12, 5 d) 17, 5

58. What is the value of C-O-H bond angle in CH_3 - OH?

a) 107^0 b) 108.9^0

c) 109.5^0 d) 110^0

59. Which of the following statement(S) is / are true?

a) HF is less polar than HBr

b) Absolutely pure water does not contain any ions

c) Chemical bond formation takes place when forces of attraction overcome the forces of repulsion

d) In covalency , transference of electrons take place

60. The correct order of increasing covalent character of the following is

a) $SiCl_4 < AlCl_3 < CaCl_2 < KCl$

b) $KCl < CaCl_2 < AlCl_3 < SiCl_4$

c) $AlCl_3 < CaCl_2 < KCl < SiCl_4$

d) None of the above

61. Hydrogen bonding is maximum in

a) ethyl chloride b) triethyl amine

c) ethanol d) diethyl ether

62. What is the bond order of B_2 molecule?

a) 3 b) 0

c) 1 d) 2

63. The bond dissociation energy of $B-F$ in BF_3 is 646 kJ mol^{-1}, whereas that of $C-F$ in CF_4 is 515 kJ mol^{-1}. The correct reason for higher $B-F$ bond dissociation energy as compared to that of C-F is

a) smaller size of B-atom as compared to that of C-atom

b) BF_3 as compared to that between C and F is CF_4 stronger σ-bond between B and F in

c) whereas there is no possibility of such interaction between C and F in CF_4 significant $p\pi - p\pi$ interaction between B and F in BF_3

d) BF_3 than that of between C and F in CF_4. lower degree of $p\pi - p\pi$ interaction between B and F in

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: ANSWER KEY :

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

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: HINTS AND SOLUTIONS :

Single Correct Answer Type

1 **(b)**

(a)$NF_3 \Rightarrow 3bp + 1/p \Rightarrow$ pyramidal

$BF_3 \Rightarrow 3bp + 0/p \Rightarrow$ trigonal planar

(b)$BF_4^- \Rightarrow 4bp + 0/p \Rightarrow$ tetrahedral

$NH_4^+ \Rightarrow 4bp + 0/p \Rightarrow$ tetrahedral

(c)$BCl_3 \Rightarrow 3bp + 0/p \Rightarrow$ trigonal planar

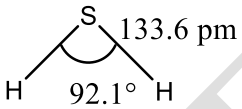
$BrCl_3 \Rightarrow 3bp + 2/p \Rightarrow$ T-shaped

(d) $NH_3 \Rightarrow 3bp + 1/p \Rightarrow$ pyramidal

$NO_3^- \Rightarrow 3bp + 0/p \Rightarrow$ trigonal planar

2 **(b)**

The H - S - H bond angle in H_2S is 92.1^0 which is slightly lesser than the tetrahedral angle. As sulphur is less electronegative and hence less repulsion is present.



3 **(b)**

As the number of lone pairs of electrons increases, bond angle decreases. Therefore, the order of bond angle

$NH_4^+ > NH_3 > NH_2$

No lp 1/p 2/p

4 **(c)**

O_2^+ contains one unpaired electron and therefore it has bond order of 2.5, while O_2 contains only 2 unpaired electrons. So, it posses bond order of 2.

5 **(c)**

Resonance energy;

$$\Delta_{H-F} = (BE)_{H-F} - \sqrt{(BE)_{H_2}(BE)_{F_2}}$$

$$= 135 - \sqrt{104 \times 38}$$

$$= 135 - 62.86 = 72.14 \text{ kcal mol}^{-1}$$

6 **(c)**

MOEC of CN[6 + 7 = 13]

$= \sigma 1s^2, \sigma^* s^2, \sigma 2s^2, \sigma^* 2s^2, \pi 2p_x^2 \approx \pi 2p_y^2, \sigma 2p_z^1$

One unpaired electron present on HOMO (highest occupied molecular orbital). Hence, loss of electron from unpaired HOMO give stable electronic configuration.

7 **(b)**

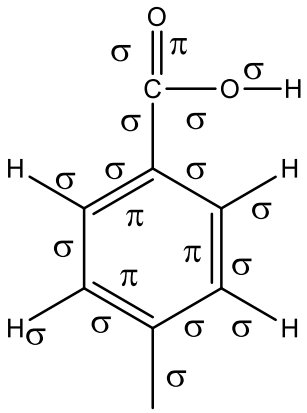
Since, C - H bond have less difference in their electronegativities as compared to C - O,

C - C and C - N bonds.

This results in less polarity of C - H bond and thus, have maximum bond length.

8 **(b)**

The number of pi- bonds present in benzoic acid molecule are 4 (four). Structure of benzoic acid is as follows :



4π-bond, 15σ-bond

9 **(c)**

∵ Covalent character

$$\propto \frac{1}{\text{lonic character}}$$

$$\propto \frac{1}{\text{Difference in electronegativity}}$$

$\therefore$ C − S is the most covalent.

10 **(d)**

Correct decreasing order of the repulsive interection of electron pairs in a molecule is,

lone pair- lone pair > lone pair-bond pair > bond pair- bond pair

The bond pairs of electrons is shared by two atoms whereas the lone pair of electrons is only under the influence of central atom. So, the electron cloud of lone pair occupies more space as compared the bond pair. This causes greater repulsion between the lone pair-lone pair.

11 **(a)**

Geometry of a molecule can be predicted by using the formula

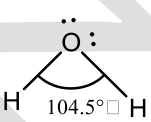
$$H = \frac{1}{2}[VE + V - C + A]$$

VE = valence shell electrons of the central atom

V = number of monovalent atom,
C = total positive charge, A = total negative charge In case of H_2O molecule,

$$H = \frac{1}{2}[6 + 2 - 0 + 0] = 4$$

Hybridisation of H_2O molecule comes out to be sp^3. Thus the geometry of H_2O molecule is tetrahedral but the shape is distorted tetrahedral or angular due to presence of two lone pair of electrons.



Geometry - tetrahedral shape Angular

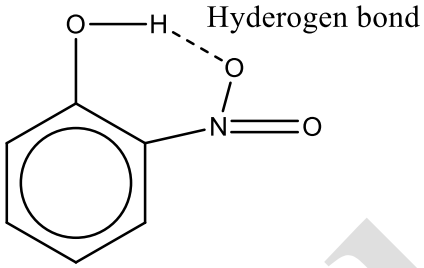
12 **(b)**

$\ln BF_3$, $H = \frac{3+3}{2} = 3(sp^2)$

In SO_3, $H = \frac{6+0}{2} = 3(sp^2)$

13 **(d)**

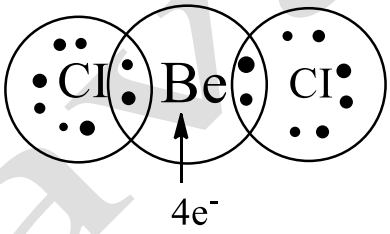
Intramolecular hydrogen bonding is found in O - nitro phenol the hydrogen bonding is between hydrogen of - OH group and oxygen of - NO_2 group which result decrease in its boiling point.



o-nitrophenol

14 **(c)**

Here Be has
$4e^-$ instead of $8e^-$ and hence it violets the octet ru



For $BeCl_2$, $H = \frac{2+2}{2} = 2$

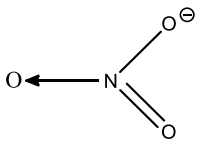
$\Rightarrow$ Hybridisation = sp $\Rightarrow$ Linear shape

15 **(b)**

Ip-bp repulsion is maximum in H_2 Te due to least electronegativity of Te and minimum in H_2O due to high electronegativity of O.

16 **(d)**

For NO_3^- ion,



Bond pairs = $4(3\sigma + 1\pi)$ and lone pair = 0

17 **(d)**

Liquid HCl does not form H- bond.

18 **(b)**

Dipole moment (μ) = q × a

$$\text{or} \quad q = \frac{\mu_{HCl}}{d} S = \frac{1.03 \times 10^{-18} \text{ esu cm}}{127 \times 10^{-10} \text{ cm}}$$

$$= 0.81 \times 10^{-10} \text{ esu}$$

Fractional charge $(\delta) = \frac{q}{e} = \frac{0.81\times10^{-10}\text{ esu}}{4.8\times10^{-10}\text{ esu}} = 0.168$

Dipole moment $\mu_{HI} = \frac{0.38\times10^{-18}\text{ esu cm}}{161\times10^{-10}\text{ cm}}$

$= 0.236 \times 10^{-10}\text{esu}$

Fractional charge $(\delta) = \frac{0.236\times10^{-10}\text{esu}}{4.8\times10^{-10}\text{esu}}$

$= 0.049$

Ratio of partial positive charge on HCl and HI

$= \frac{0.168}{0.049} = 3.42:1$

19 **(a)**

For NO_3^- ion, number of electrons

$= 7 + 3 \times 8 + 1 = 32$

$H = \frac{V + Y - C + A}{2} = \frac{5+1}{2} = 3$

$\Rightarrow$ Hybridisation $= sp^2$

For CO_3^{2-} ion, number of electrons $= 6 + 3 \times 8 + 2 = 32$

$H = \frac{4+2}{2} = 3 \Rightarrow$ Hybridisation $= sp^2$

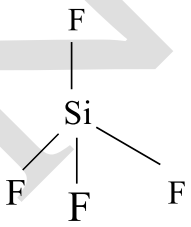
$\therefore$ Both NO_3^- and CO_3^{2-} are isoelectronic and isostructural species.

20 **(a)**

All are isostructural but NH_3 is made up of N and H. Electronegativity difference between N and H is maximum among all, hence,NH_3 has highest dipole moment.

21 **(c)**

For SiF_4,



$\therefore$ σ-bond $= 4, Ip = 0$

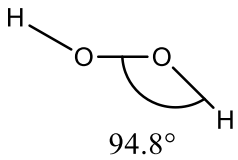
$\therefore$ Structure is tetrahedral.

22 **(b)**

SiF_4 is a symmetrical tetrahedral molecule and BF_3 is a triangular planar (symmetrical) structure and hence, have zero dipole moment.

23 **(a)**

In gas phase H - O - O - H bond angle in H_2O_2 is 94.8^0



24 **(c)**

Br_2 is a non-polar molecule and hence, its melting point and boiling point depend only upon van der Waals' force of attraction , while all the remaining molecules have dipole moments and hence, their melting points and boiling points depend upon dipole-dipole interactions.

25 **(c)**

Molecule	Bond multiplicity
Cl–Cl	1
O=O	2
N≡N	3

As bond multiplicity increases, bond length decreases,

26 **(b)**

As bond order $= \frac{1}{2}(N_b - N_a)$

$\therefore N_a = N_b - 2 \times$ bond order $= 2 - 2 \times 1/2$ or $N_a = 1$

27 **(c)**

For SO_3^{2-}, $H = \frac{6+2}{2} = \frac{8}{2} = 4(V = 6, A = 2)$

SO_4^{2-}, $H = \frac{6+2}{2} = 4(V = 6, A = 2)$

SO_5^{2-}, $H = \frac{6+2}{2} = 4(V = 6, A = 2)$

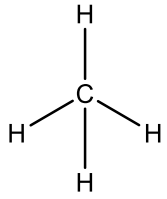
All have same value of H. So, each one has sp^3-hybridisation.

28 **(c)**

Strongest H- bonds are formed in between HCOOH and CH_3COOH. This is because H-bonding increases with electronegativity and decreases with size of atom.

29 **(b)**

For CH_4 molecule,



All dipole moment value of C - H bond cancel out each other. Hence, $\mu = 0$.

30 **(d)**
Higher the bond order, higher is its bond energy.

	NO^+	NO	NO^-
Bond order	3	2.5	2.0

31 **(d)**
Percentage ionic character

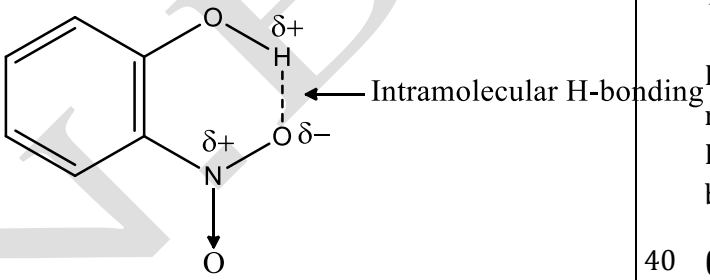
$= [16(X_{Cl} - X_{Cs}) + 3.5(X_{Cl} - X_{Cs})^2]$

$= [16(3.0 - 0.8) + 3.5(3.0 - 0.8)^2]$

$= [16 \times 2.2 + 3.5 \times (2.2)^2] = [35.2 + 16.94]$
$= 52.14\%$

32 **(d)**
Since, MX_4 is tetrahedral, therefore total number of $\angle XMX$ is six.

33 **(b)**
Three is intramolecular H-bonding in o-nitrophenol and thus, solubility in water is decreased



34 **(b)**
Bond angle of H_2 S is smallest, because S-atom is larger in size and has low electronegativity.

35 **(a)**
Number of electrons in $NO^- = 7 + 8 + 1 = 16$

$\therefore$ MOEC of $NO^- =$

$\sigma 1\,s^2, \sigma^* 1\,s^2, \sigma 2\,s^2, {}^*\,\tilde{\sigma} 2\,s^2, \sigma 2p_z^2,$

$\pi 2p_x^2 \approx \pi 2p_y^2, \pi^* 2p_x^1 \approx \pi^* 2p_y^1$

Hence, paramagnetic due to the presence of unpaired electron in $\pi 2p_x$ and $\pi 2p_y$ orbitals.

36 **(d)**
Given, $\Delta H^\circ = -83$ kJ

$\Delta H^\circ(H - H) = 435$ kJ

$\Delta H^\circ(N - H) = 389$ kJ

We know that, $\Delta H^\circ =$ bond enthalpy of reactant
$-$ bond enthalpy of product

$\Delta H^\circ = (BE \text{ of } N \equiv N + 3 \times BE \text{ of } H - H) - (6 \times BE \text{ of N - H})$

$-83 = (BE \text{ of } N \equiv N + 3 \times 435) - (6 \times 389)$

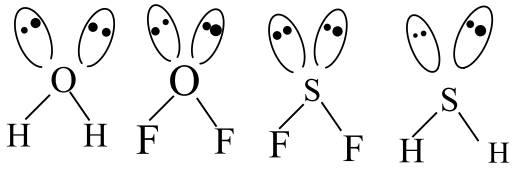
$-83 = BE \text{ of } N \equiv N + 1305 - 2234$

$\Rightarrow$ Be of $N \equiv N = 946$ kJ

37 **(d)**
N_2 has BO = 3

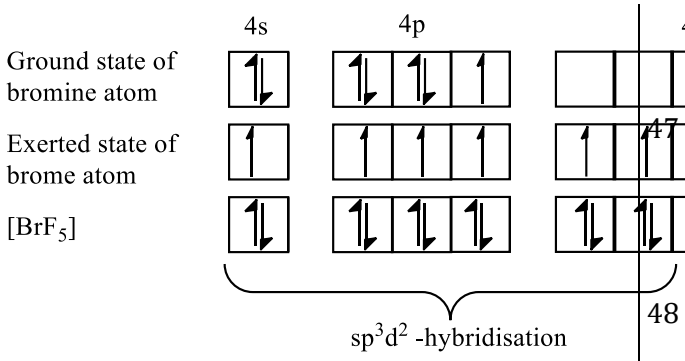
So, it will require maximum energy for decomposition.

39 **(a)**



H_2O has more bond angle than OF_2 due to bent rule. OF_2 has greater bond angle than SF_2 due to Drago rule, according to which, on moving top to bottom along a group, bond angle decreases.

40 **(b)**
The shape of BrF_5 molecule is square pyramidal. It has sp^3d^2 - hybridization using VBT theory.



The shape of BrF_5 having sp^3d^2 - hybridization is square pyramidal.

41 **(a)**

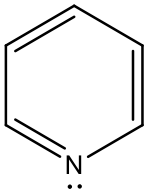
$A \rightarrow 6, B \rightarrow 2, C \rightarrow 3, D \rightarrow 1$

σ-bond	Axial overlapping
Covalent bond	Sharing of electrons
lonic bond	Transfer of electrons
π-bond	Lateral overlapping

42 **(b)**

O-atom of ice is bonded to four H-atoms, two of same H_2O molecule and two of other H_2O molecule. Hence, has tetrahedral structure with bond angle of 109°.

43 **(b)**



sp^2 - hybridized with trigonal planar structure.

44 **(b)**

For XeF_6,

$$H = \frac{1}{2}[V + Y - C + A] = \frac{1}{2}[8 + 6 + 0 + 0] = 7$$

$\Rightarrow$ Hybridisation = sp^3d^3

Due to the presence of one lone pair of electron, XeF_6 has distorted octahedral geometry.

45 **(c)**

Hydrogen bonding explains the more volatile nature of o- nitrophenol than that of p-nitrophenol best.

46 **(b)**

Since, the molecule (MX_3) has zero dipole moment, therefore it must have triangular planar geometry and accordingly the hybridisation of central metal atom (M) must be sp^2.

47 **(b)**

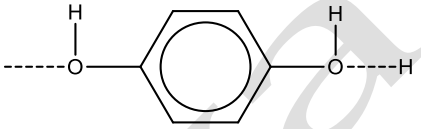
To minimize lp - lp repulsion, both the Cl are at trans position as shown in option (b) and is stable in this form of structure.

48 **(b)**

$\because$ Polarity $\propto$ difference in electronegativity

$\therefore$ Correct order of polarity is $HF > H_2O > SO_2 > NH_3$.

49 **(b)**



1, 4- dihydroxybenzene, and isomer of dihydroxybenzene shows highest boiling point due to intermolecular

H- bonding followed by meta and ortho isomer.

Hence, correct option is (b).

50 **(a)**

Acetylene molecule contain 50% p- character of hybrid orbital in C atom because in the hybrid orbital of acetylene both carbons are sp-hybridised. An sp- orbital is composed of one s-orbital, and thus, it has 50% S - character and 50% p - character.

51 **(b)**

$NO \longrightarrow NO^+$

NO^+;total electrons $= 14 = \sigma is^2, \dot{\sigma} is^2, \sigma 2\, s^2, \dot{\sigma} 2\, s^2, \pi 2p_x^2 \approx \pi 2p_y^2, \sigma 2p_z^2$

$\therefore$ Diamagnetic Bond order $= \frac{10-4}{2} = 3$

NO; total electrons $= 15$

$$= \sigma 1s^2, \dot{\sigma} 1s^2, \sigma 2s^2, \dot{\sigma} 2s^2, \sigma 2p_z^2, \pi 2p_x^2$$

$$\approx \pi 2p_y^2, \pi 2p_x^1$$

$\therefore$ Paramagnetic bond order $= \frac{10-5}{2} = \frac{5}{2} = 2.5$

Electron is taken away from non-bonding molecular orbital, that's why bond order increases.

52 **(a)**

(a) $SF_4 = 4bp + 1/p = sp^3d$-hybridisation

(b) $IF_5 = 5bp + 1/p = sp^3d^2$-hybridisation

(c) $NO_2^+ = 2bp + 0/p = sp$-hybridisation

(d) $NH_4^+ = 4bp + 0/p = sp^3 -$ hybridisation

53 **(a)**

$SF_4(sp^3d)$, $CF_4(sp^3)$ and $XeF_4(sp^3d^2)$ contain 1,0 and 2 lone pairs, respectively. Therefore, their shapes are also different.

54 **(d)**

MOEC of

$B_2(10) = \sigma s^2, \sigma^* 1s^2, \sigma 2s^2, {}^* 2s^2, \pi 2p_x^1, \approx \pi 2p_y^1$

MOEC of $O_2(16) = \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, {}^*2s^2, \sigma 2p_z^2, \pi 2p_x^2 \approx \pi 2p_z^2, \pi 2p_x^1 \approx \pi 2p_y^*$

MOEC of NO (15) $=$
$\sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \sigma 2p_Z^2, \pi 2p_x^2 \approx \pi 2p_y^2, \pi 2p_x^1 \approx \pi 2p_y$

Due to the presence of unpaired electron, B_2, O_2 and NO all are paramagnetic.

55 **(d)**

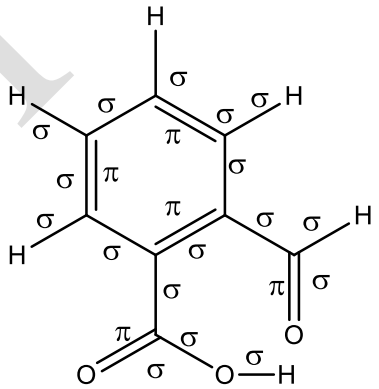
Xe-atom has 8 electrons in its outermost shell. In case of XeF_2, out of these 8 electrons 2 are used for bond formation, while 3 pairs remains as such, i.e. it has 3 lone pairs. In case of XeF_4, 4 electrons of Xe are used for bonding, therefore number of lone pairs (non-bonding electrons) is 2 . In case of XeF_6, 6 electrons are involved for bond formation, thus, number of lone pair is only one.

56 **(b)**

The d_{zx} orbital is involved in sp^3d-hybridisation.

57 **(d)**

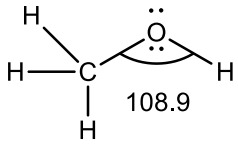
Structure of 2- formyl benzoic acid is



Thus, it has 17 σ and 5 π bonds.

58 **(b)**

The value of C - O - H bond angle in CH_3 - OH (methanol) is 108.9^0 due to repulsion between lone pair electrons of oxygen atom. It can be easily shown as below :



59 **(c)**

A chemical bond is formed when forces of attraction are greater than the forces of repulsion.

60 **(b)**

EN difference in $SiCl_4 = 3.0 - 1.8 = 1.2$

in $AlCl_3 = 3.0 - 1.5 = 1.5$

in $CaCl_2 = 3.0 - 1.0 = 2.0$ and in $KCl = 3.0 - 0.8 = 2.2$

$\therefore$ $KCl < CaCl_2 < AlCl_3 < SiCl_4$

This order is also obtained by applying Fajans' rule.
i.e. covalent character $\propto$ charge on ion.

61 **(c)**

Hydrogen bonding is maximum in ethanol.

62 **(c)**

The bond order of B_2 molecule is 1, The ground state electron configuration of B is $1s^2 2s^2 2p^1$. So,

B_2 molecule has a total of ten electrons, which are arranged in MOs.

$(\sigma 1s)^2 (\sigma^* 1s)^2 (\sigma 2s)^2 (\sigma^* 2s)^2 \left(\pi_{2p_y^1} = \pi_{2p_y^1}\right)$

Bond order $= \frac{1}{2}$ (Number of bonding electrons -number of anti-bonding electrons)

$= \frac{1}{2}(6 - 4) = 1$

63 **(c)**

In BF_3 there is significant pπ - pπ interaction between unshared p-orbital (having no electron) over boron and the lone pair of electron over

fluorine in 2p-orbital.