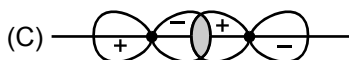
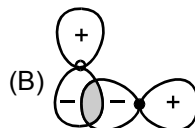
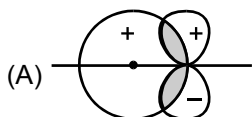
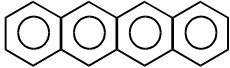


CHEMICAL BONDING

- Pick out the incorrect statement.
 (A) BO_3^{2-} ion is triangular planar in which boron is sp^2 hybridised.
 (B) Boric acid contains planar triangular BO_3^{2-} units which are bonded together through hydrogen bonds into two dimensional sheets.
 (C) Borozine is isoelectronic with benzene. In both compounds, the π electrons are delocalised.
 (D) The structure of boron nitride resembles that of diamond.
- Which of the following statements regarding the structure of SOCl_2 is not correct ?
 (A) The sulphur is sp^3 hybridised and it has a tetrahedral shape.
 (B) The sulphur is sp^3 hybridised and it has a trigonal pyramid shape.
 (C) The sulphur - oxygen bond is $d\pi - p\pi$ bond.
 (D) It contain one lone pair of electrons in the sp^3 hybrid orbital of sulphur.
- Which of the following orders is correct in respect of bond dissociation energy ?
 (A) $\text{N}_2^+ > \text{N}_2^-$ (B) $\text{O}_2^+ > \text{O}_3$ (C) $\text{NO}^+ > \text{NO}$ (D) All of those
- Which of the following should have pyramidal shape :
 (A) $[\text{ClOF}_2]^+$ (B) ICl_3 (C) $[\text{BrICl}]^-$ (D) All of these
- In which of the following species peroxide group is not present :
 (A) $[\text{B}_4\text{O}_5(\text{OH})_4]^{2-}$ (B) $[\text{S}_2\text{O}_8]^{2-}$ (C) CrO_5 (D) HNO_4
- Which of the following solids is a good conductor of electrically
 (A) $(\text{BN})_x$ (B) SiO_2 (C) SiC (D) none of these
- Which of the following pairs is not isomorphous
 (A) $\text{BaSO}_4, \text{KMnO}_4$ (B) $\text{KClO}_4, \text{KBF}_4$
 (C) $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}, \text{MgSO}_4 \cdot 7\text{H}_2\text{O}$ (D) $\text{NaClO}_3, \text{NaNO}_3$
- Which of the following can be best explained on the basis of hydration of ions.
 (A) $\text{Mg}(\text{ClO}_4)_2$ is a powerful water absorbant
 (B) LiClO_4 forms a stable hydrate but other alkali metals perchlorates do not.
 (C) Electrical conductivity of Li^+ in aqueous solution is much less than expected.
 (D) All the above
- Which of the following orbital overlappings is not possible according to VBT.

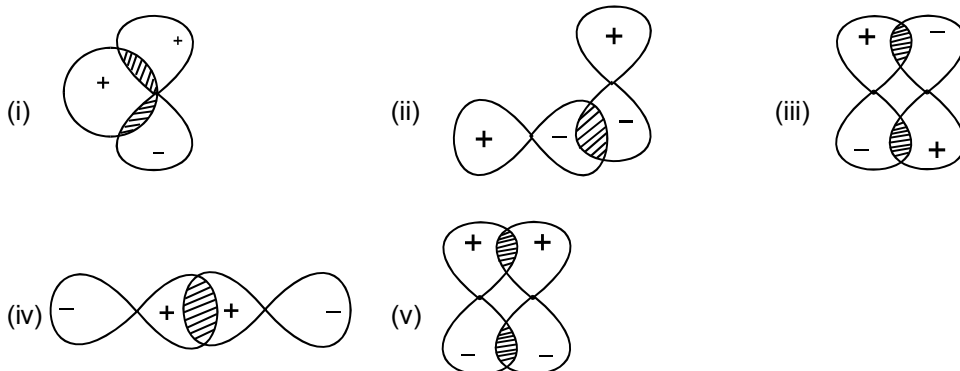


- Which of the following is expected to have resultant dipole moment equal to zero.
 (A) H_2O_2 (B) O_3 (C) SO_2 (D) XeF_4

11. Among the following compounds the one that is polar and has central atom with sp^3 hybridisation is
 (A) H_2CO_3 (B) SiF_4 (C) BF_3 (D) $HClO_2$
12. Which of the following is ionic ?
 (A) $KHF_2(s)$ (B) $CaC_2(s)$ (C) $PCl_5(s)$ (D) All
13. Dipole moment is higher for
 (A) CH_3F (B) CD_3F (C) equal for both (D) nothing can be said
14. Pauling developed an equation relating bond and the electronegativity difference. $|x_A - x_B|$ of the bonded atoms A and B viz : percentage ionic character = $16(Dx) - 3.5(Dx)^2$. Calculate $(Dx) = |x_A - x_B|$ for 15% ionic character.
 (A) 0.6 (B) 0.5 (C) 0.8 (D) 1.2
15. In O_2F_2 , which of the following statement is incorrect.
 (A) O–F bond length in O_2F_2 is longer than O–F bond length in OF_2 .
 (B) The O.N. of oxygen in O_2F_2 is +1.
 (C) The O–O bond length in O_2F_2 is shorter than O–O bond length in H_2O_2 .
 (D) None of these
16. Which of the following is wrong :
 (A) XeO_3 is an explosive substance
 (B) Carbon, oxygen bond length is more in acetone than in $COCl_2$
 (C) H_2O_2 (aq.) can turn blue litmus red
 (D) O–D–O bond is stronger than O–H–O bond
17. Which of the following is wrong :
 (A) Bond order of O_2 is greater than bond order of O_2^-
 (B) Bond order of O_2^+ is less than bond order of O_2
 (C) Bond order of N_2^+ is less than that of N_2
 (D) O_2^{2-} is diamagnetic while O_2^- is paramagnetic.
18. Two types of carbo-carbon covalent bond lengths are present in
 (A) diamond (B) graphite (C) C_{60} (D) benzene
19. Assuming C–C bond distance equal to that found in benzene (1.37Å), the length of the following aromatic molecule will be nearly :

 (A) 9.69 Å (B) 11.2 Å (C) 12.32 Å (D) 15 Å
20. A diatomic molecule has a dipole moment of 1.2 D. If its bond distance is equal to 1.0Å then the fraction of an electronic charge on each atom is :
 (A) 25% (B) 37% (C) 52% (D) 42%
21. Which of the following carbides will give $CH_3-C \equiv C-H$ on reaction with water :
 (A) Be_2C (B) SrC_2 (C) Mg_2C_3 (D) None of these
22. Which is correct about the cyclic silicate $[Si_6O_{18}]^{n-}$:
 (A) The value of n is 12
 (B) each Si atom is bonded with three oxygen atoms
 (C) each oxygen atom is bonded with two Si atoms
 (D) all the above are correct.

23. In which of the following compounds B atoms are in sp^2 and sp^3 hybridisation states :
 (A) Borax (B) Diborane (C) Borazole (D) All
24. Which is correct about D_2O
 (A) Its boiling point is higher than that of H_2O (ℓ)
 (B) $O - D - - - - O$ bond is stronger than $O - H - - - - O$ bond.
 (C) $D_2O(s)$ sinks in H_2O (ℓ).
 (D) all the above are correct.
25. Which of the following is ionic solid :
 (A) $XeF_6(s)$ (B) $PBr_5(s)$ (C) $CaC_2(s)$ (D) All
26. Which one among the following does not have hydrogen bonds ?
 (A) boric acid (solid) (B) N_2H_4 (liquid) (C) H_2O_2 (liquid) (D) C_6H_6 (liquid)
27. In H_2SO_4 molecule
 (A) s-atom is sp^3d^2 hybridised and there are 4 lone pair electrons on 'O' atoms.
 (B) s-atom is sp^3 hybridised and there are no lone pair of electrons in the molecule.
 (C) s-atom is sp^3 hybridised and there are 8 lone pair of electrons on the 'O' atoms.
 (D) s-atom is sp^2 hybridised and these are 8 lone pair of electrons 'O' atoms
28. Which of the following is a planar molecule :
 (A) XeF_4 (B) $\ddot{N}H_3$ (C) CH_3^- (D) CF_3
29. In which of following vacant orbitals take part in hybridisation.
 (A) BF_3 (B) CH_4 (C) B_2H_6 (D) $\ddot{N}H_3$
30. The hybridisation of P in phosphate ion (PO_4^{3-}) is the same as in :
 (A) I in ICl_4^- (B) S in SO_3 (C) N in NO_3^- (D) S in SO_3^{2-}
31. Which of the following electronic configurations indicates the biggest jump between the second and third ionization energy values ?
 (A) $1s^2 2s^2 2p^2$ (B) $1s^2 2s^2 2p^6 3s^1$ (C) $1s^1 2s^2 2p^6 3s^2$ (D) $1s^2 2s^2 2p^1$
32. The correct order of decreasing electron affinity of B, C, N and O is.
 (A) $O > C > N > B$ (B) $B > N > C > O$ (C) $O > C > B > N$ (D) $O > B > C > N$
33. The hydrogen bonding is strongest in
 (A) $O - H - - - S$ (B) $S - H - - - O$ (C) $F - H - - - F$ (D) $F - H - - - O$
34. Among the following, the pair in which the two species are not isostructural is
 (A) IO_3^- and XeO_3 (B) BH_4^- and NH_4^+ (C) PF_6^- and SF_6 (D) SiF_4 and SF_4
35. In case of 'HCN'
 (A) N atom is in + 5 state (B) C - atom is in - 2 state
 (C) C - atom is in + 2 state (D) C - atom is in - 1 state
36. Specify the hybridisations of central atom in the following species respectively $\{N_3^-, NOCl, N_2O\}$
 (A) sp, sp^2, sp (B) sp, sp, sp^3 (C) sp^2, sp, sp (D) sp^2, sp^2, sp

37. Which of the following atomic orbital overlappings are not allowed



- (A) All (B) (i) (ii) (iii) (C) (i) (iii) (v) (D) (ii) only

38. Which is wrong about P_4O_{10} molecule

- (A) each 'P' atom can be considered to be sp^3 hybridised
 (B) there are six P-O bonds in the molecule
 (C) there are two types of P-O bond lengths
 (D) P-O-P angle is 180°

39. If the dipole moment of AB molecule is given by 1.2 D and A-B the bond length is 1\AA then % covalent character of the bond is

- (A) 25% (B) 75% (C) 30% (D) 70%

40. Which is a correct statement?

- (A) The \widehat{BrPB} bond angle must be exactly 120° in the molecule of PBr_3Cl_2 .
 (B) Bond angle in PF_3 is more than in NF_3 .
 (C) Bond angle in PH_3 is more than in NH_3 .
 (D) none of the above is correct

41. Which is a correct statement?

- (A) The \widehat{BrPB} bond angle must be exactly 120° in the molecule of PBr_3Cl_2 .
 (B) Bond angle in PF_3 is more than in NF_3 .
 (C) Bond angle in PH_3 is more than in NH_3 .
 (D) $XeF_4 < H_2O < NH_3 < BF_3$ (bond angle)

42. According to VSEPR theory in $[IO_2F_2]^-$ ion the \widehat{FIF} bond angle will be nearly

- (A) 120° (B) 90° (C) $109^\circ 28'$ (D) 180°

43. Hydrogen bond is strongest in

- (A) $S-H \cdots O$ (B) $O-H \cdots S$ (C) $F-H \cdots F$ (D) $O-H \cdots N$

44. Which of the following overlaps is **incorrect** [assuming z-axis to be the internuclear axis]

- (a) $2p_y + 2p_y \rightarrow \pi 2p_y$ (b) $2p_z + 2p_z \rightarrow \sigma 2p_z$
 (c) $2p_x + 2p_x \rightarrow \pi 2p_x$ (d) $1s + 2p_y \rightarrow \pi (1s-2p_y)$
 (A) 'a' & 'b' (B) 'b' & 'd' (C) only 'd' (D) None of these

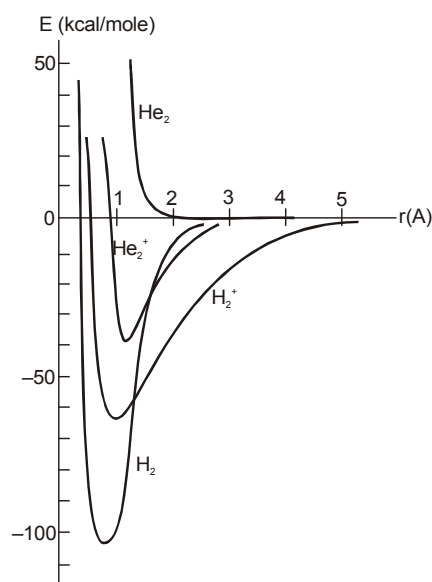
45. Consider the following statements

- In $CH_2 = \overset{I}{CH} - \overset{II}{C} = \overset{III}{C} \equiv \overset{IV}{C} - H$
- There are 6 σ and '3' π and
 - Carbon I & II are sp^2 hybridised
 - Carbon III & IV are sp hybridised,

The above statements 1, 2, 3 respectively are (T = True, F = False)

- (A) TTT (B) FTT (C) FTF (D) TFT

46. Consider the following statements
1. Steric number '7' gives 'sp³d³ hybridisation.
 2. In CℓF₃ at least one bond angle is exactly 180°
 3. Lone pair does not cause any distortion in the bond angle.
- The above statements 1, 2, 3 respectively are (T = True, F = False)
- (A) T F F (B) T T F (C) F T F (D) T T T
47. Increasing order of carbon-oxygen bond length in CO, CO₂ and CO₃²⁻ is
- (A) CO < CO₂ < CO₃²⁻ (B) CO < CO₃²⁻ < CO₂ (C) CO₃²⁻ < CO₂ < CO (D) CO₃²⁻ < CO₂ = CO
48. Hybridisation of central atom in the following species respectively are (N₃⁻, NOCl, N₂O)
- (A) sp, sp², sp (B) sp, sp, sp³ (C) sp², sp, sp (D) sp², sp², sp
49. C₃⁴⁺ has
- (A) two σ and two π bond (B) three σ and one π bond
(C) two σ and one π bond (D) two σ and three π bond
50. The following graph is given, between total energy and distance between the two nuclei for species H₂⁺, H₂, He₂⁺ & He₂, which of the following statements is correct :



- (A) He₂⁺ is more stable than H₂⁺.
- (B) Bond dissociation energy of H₂⁺ is more than bond dissociation energy of He₂⁺.
- (C) Since bond orders of He₂⁺ and H₂⁺ are equal hence both will have equal bond dissociation energy.
- (D) Bond length of H₂⁺ is less than bond length of H₂.
51. Regarding first ionisation energy which of the following is **correct** :
- (A) O₂ > H₂ (B) O₂ < N₂ (C) O₂ = N₂
(D) Molecules do not have ionisation energies.
52. Which of the following cannot be explained on the basis of Fajan's Rules.
- (A) Ag₂S is much less soluble than Ag₂O
(B) Fe(OH)₃ is much less soluble than Fe(OH)₂
(C) BaCO₃ is much less soluble than MgCO₃
(D) Melting point of AlCl₃ is much less than that of NaCl

53. According to molecular orbital theory which of the following is correct :
 (A) LUMO level for C_2 molecule is a $\sigma 2p$ orbital (B) In C_2 molecule both the bonds are π bonds
 (C) In C_2^{2-} ion there is one σ and two π bonds (D) all the above are correct.
54. Which of the following is correct order for solubility in water
 (A) $NaClO_4 < KClO_4$ (B) $NaBF_4 > NaF$ (C) $MgSO_4 < SrSO_4$ (D) all the above
55. Which of the following is correct statement
 (A) Diamond is a good conductor of heat (B) Ozonide ion is diamagnetic
 (C) Hydroazoic acid is a linear molecule (D) None of the above is correct
56. Which of the following is correct -
 (A) N_2F_2 can exhibit geometrical isomerism
 (B) In C_2H_4 the bond angle $\angle HCC < \text{bond angle } \angle HCH$
 (C) In solid state nitryl chloride (O_2NCl) will be consisting of NO^+ and OCl^- ions
 (D) The correct order of C – O bond length is $CO < CO_3^{2-} < CO_2$
57. Which of the following about SF_4 , SOF_4 , CH_2SF_4 and OCF_2 molecules is correct-
 (A) Equatorial FSF bond angle in SOF_4 will be less than in SF_4 molecule
 (B) The two hydrogens, carbon, sulphur and two fluorines (of equatorial positions) in molecule CH_2SF_4 will be lying in the same plane
 (C) The bond angle FCO will be $< 120^\circ$ in molecule OCF_2
 (D) The axial FSF bond angle in $SF_4 = 180^\circ$
58. In the cation $[H-C-N-Xe-F]^+$ which is linear, the hybridisations of C, N & Xe atoms respectively are -
 (A) sp, sp, sp (B) sp, sp^2 , sp^3d (C) sp, sp, sp^3d (D) sp^2 , sp, sp^3d
59. Which of the following is a **wrong** order with respect to the property mentioned against each -
 (A) $(NO)^- > (NO) > (NO)^+$ [bond length] (B) $H_2 > H_2^+ > He_2^+$ [bond energy]
 (C) $O_2^{2-} > O_2 > O_2^{++}$ [Paramagnetic moment] (D) $NO_2^+ > NO_2 > NO_2^-$ [bond angle]

ANSWER AND SOLUTION

1. (D)

Sol. Boron nitride has layered lattice structure. Each layer consists of a hexagonal arrangement of B and atoms and this structure resembles that of graphite.

2. (A)

Sol. In SOCl_2 , sulphur atom is sp^3 hybridised. Due to the presence of one lone pair of electrons on 'S' atom, the molecule has distorted tetrahedral shape. i.e., trigonal pyramidal shape. This shape contains two chlorine and one oxygen atom in a triangle. The S – O – pi bond is dp – pp bond.

3. (D)

Sol. From MOT & bond order values.

4. (A)

5. (A)

Sol. (A) Is anion of borax and does not contain any peroxide in it.

6. (D)

Sol. All are nonconductors

7. (D)

Sol.

ClO_3^-	NO_3^-
pyramidal	planar

 \therefore cannot be isomorphous.

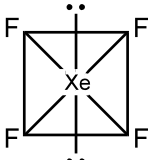
8. (D)

Sol. Since a bigger cation prefer bigger anion for the stability of ionic compound (lattice).
 \therefore Mg^{++} & Li^+ undergo hydration to be comparable with ClO_4^- .

9. (D)

Sol. Net overlapping will zero in 'A'.
'B' is ruled out as it is neither σ nor π -bond.
'C' is not allowed due to opposite signs of ψ functions.
Hence, Ans. (D).

10. (D)

Sol.  \therefore net D.M. = zero Ans (D)

11. (D)

Sol. $\text{H}-\text{O}-\overset{\text{O}}{\parallel}{\underset{\cdot\cdot}{\text{Cl}}}$; Cl is sp^3 and molecule is polar Cl, sp^3
Ans (D)

12. (D)

Sol. $\text{K}^+ [\text{HF}_2]^-$; $\text{Ca}^{++} (\text{C}_2)^{--}$; $\text{PCl}_4^+ \text{PCl}_6^-$ hence Ans (D)

13. (B)

Sol. 'D' is less negative than H hence D.M. of CD_3F will be more

14. (D)

Sol. $35(Dx)^2 - 160 Dx + 150 = 0$

so $Dx = \frac{160 \pm \sqrt{25600 - 21000}}{70} = \frac{160 \pm \sqrt{4600}}{70} = 1.2$

15. (D)

Sol. All are correct.

16. (B)

Sol. Due to partial double bond character of Cl-C bond in COCl_2 .

17. (B)

Sol. Bond order of O_2^+ is less than bond order of O_2

18. (C)

Sol. diamond (1.54 Å)
graphite (1.42 Å) . (\perp to the sheets there is no covalent bonding)
 C_{60} (1.45 Å and 1.38 Å)
benzene (1.36 Å).

19. (A)

Sol. Total length of molecule
 $= 4 \times 2 \times \sin 60^\circ \times 1.37 \text{ \AA} = 9.69 \text{ \AA}$

20. (A)

Sol. Assuming complete charge transfer then dipole moment = $(4.8 \times 10^{-10} \text{ esu})(10^{-8} \text{ cm})$
 $= 4.8 \text{ D}$

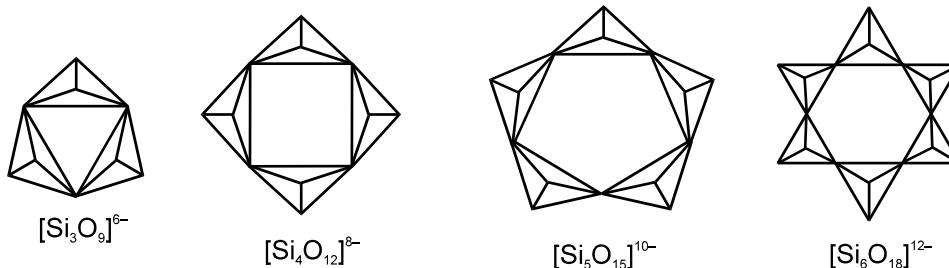
so % ionic character = $\frac{1.2}{4.8} \times 100 \% = 25\%$

21. (C)

Sol. Mg_2C_3 , while Be_2C gives CH_4 and SrC_2 gives acetylene (ethyne)

22. (A)

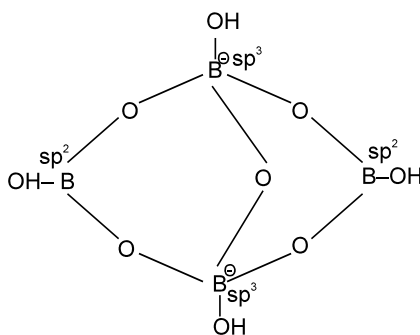
Sol.



general formula of cyclic silicates is $[\text{Si}_n\text{O}_{3n}]^{2n-}$

23. (A)

Sol. The correct formula of borax is $\text{Na}_2[\text{B}_4\text{O}_5(\text{OH})_4] \cdot 8\text{H}_2\text{O}$. The structures of anion is

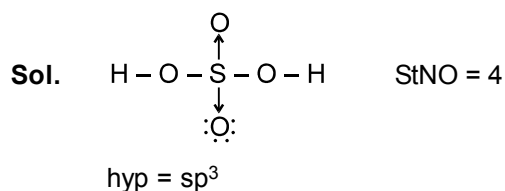


24. (D)
Sol. D is less electronegative than H-atom so the results

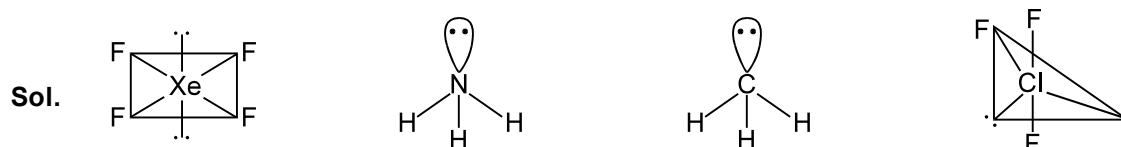
25. (D)
Sol. All are ionic solids
XeF₆ (S) consists XeF₅⁺ & F⁻
PBr₅ (s)..... PBr₄⁺ & Br⁻
CaC₂(s) Ca⁺⁺ & C₂⁻⁻⁻

26. (D)
Sol. Benzene has hydrogens connected to carbons and the bonds are almost non polar. Hence no question of hydrogen bonding. It is a liquid owing to van der waals forces.

27. (C)



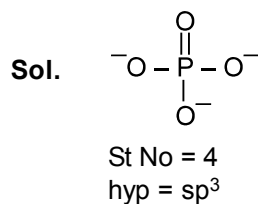
28. (D)



29. (C)

Sol. Because in B₂H₆ there is 3 centre two electron bond.

30. (D)



31. (C)

Sol. In 1s² 2s² 2p⁶ 3s² after losing two e⁻ it will acquire inert gas configuration. So the jump in I.E. is high.

32. (C)

Sol. 'N' has least E.A. since it has half filled configuration (i.e., p³).

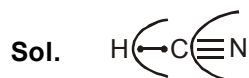
33. (C)

Sol. ΔE.N ↑ strength of hydrogen bonding ↑.

34. (D)

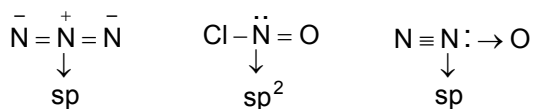
Sol. SF₄ St NO = 5 hybrid = sp³d → distorted trigonal bipyramidal
SiF₄ St. NO = 4 hybrid = sp³ → Tetrahedral

35. (C)



36. (A)

Sol. N^{3-}



37. (B)

38. (D)

Sol. POP 127°

39. (B)

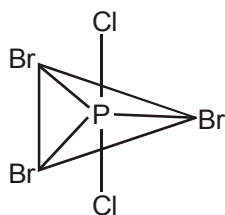
Sol. $N_{cal.} = 4.8 \times 10^{-10} \text{ e.s.u.} \times 10^{-8} \text{ cm}$
 $= 4.8 \times 10^{-18} \text{ esu cm}$
 $= 4.8 \text{ D.}$

$$\therefore \% \text{ ionic character} = \frac{1.2}{4.8} \times 100 = 25\%$$

$$\therefore \% \text{ co-valent character} = 75\%$$

40. (D)

Sol. Structure of PBr_3Cl_2 to minimize repulsion will be

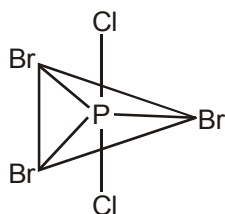


So $Br\hat{P}Br$ angle will be 120° .

In PF_3 and NF_3 , $\therefore E_N > E_P$ so angle of $PF_3 > NF_3$.
Similarly angle of $PH_3 < NH_3$.

41. (A, D)

Sol. Structure of PBr_3Cl_2 to minimize repulsion will be

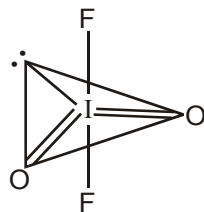


So $Br\hat{P}Br$ angle will be 120° .

In PF_3 and NF_3 , $\therefore E_N > E_P$ so angle of $PF_3 < NF_3$.
Similarly angle of $PH_3 < NH_3$.

42. (D)

Sol. Structure of $IO_2F_2^-$ is



$$F\hat{I}F = 180^\circ.$$

43. (C)

Sol. Fluorine, having the highest value of electronegativity, forms the strongest hydrogen bonds.

44. (C)

Sol. Only P – P lateral overlapping can form p-bond.

45. (B)

46. (A)

47. (A)

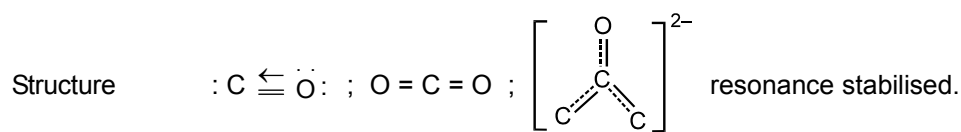
Sol. Bond order of carbon-oxygen

in CO is 3

in CO₂ is 2

in CO₃²⁻ is 1.33 (Due to resonance)

$$\text{Bond order} \propto \frac{1}{\text{Bond length}}$$



48. (A)

Sol. Steric no. of N₃⁻ = 2 ; Steric no. of NOCl = 3

Steric no. of N₂O = 2 ; so hybridisation of N₃⁻ & N₂O is sp² & NOCl is sp³.

49. (A)

Sol. Structure of C₃⁴⁻ is (C²⁻ = C = C²⁻)

50. (B)

Sol. From the graph

B.E. of H₂ > B.E. of H₂⁺ > B.E. of He₂⁺ > BE of He₂ where BE = bond energy or bond dissociation energy

and B.L. of H₂ < B.L. of H₂⁺ < B.L. of He₂⁺ < B.L. of He₂

where B.L. bond length

so stability order = H₂ > H₂⁺ > He₂⁺ > He₂

51. (B)

Sol. Electron will be removed from anti-bonding π type of orbital in case of O₂. While It will be removed from σ_{2p} in case of N₂. Hence

52. (C)

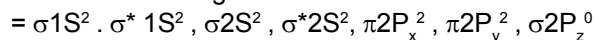
Sol. The order of solubility of



can only be explained on the basis of lattice energy rest others can be explained by Fajan's rule.

53. (D)

Sol. For C₂ the electronic configuration is



Hence the result follows.

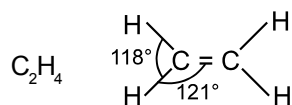
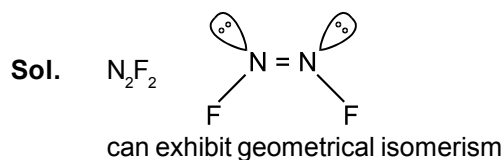
54. (B)

Sol. BF₄⁻ is much bigger than F⁻.

55. (A)

Sol. Diamond is certainly a good conductor of heat but non-conductor of electricity.

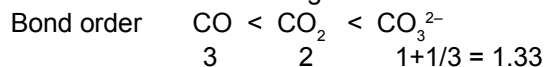
56. (A)



double bond distorts the bond angle to 121° .

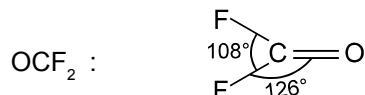
O_2NCl ionic in solid state would be consisting of NO_2^+ & Cl^- ions

The correct order of C-O bond length will be

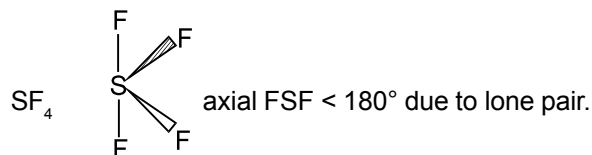


57. (B)

Sol. Generally lone pair causes more distortion than a double bond so equatorial $\angle FSE$ in $SOF_4 >$ equatorial $\angle FSE$ in SF_4 in CH_2SF_4 two axial fluorine atoms S & two hydrogen will be lying in one plane. The π -bond and two equatorial fluorines along with C & S will lie in perpendicular plane.



due to low bond pair bond pair repulsion because of fluorine & large repulsion due to double bond.



58. (C)

Sol. The cation should be $[H - C \equiv N - Xe - F]^+$

Hybridisations sp sp sp^3d

59. (C)

Sol. Easy

Bond order $NO^- > NO > NO^+$ (bond length)
 2.0 2.5 3

Bond order $H_2 > H_2^+ > He_2^+$ (bond energy)
 1 0.5 0.5

(more antibonding)

Bond angle $NO_2^+ > NO_2 > NO_2^-$ (bond length)
 180° 133° 115°

No. of unpaired e^- $O_2^{2-} > O_2^{2+} > O_2$ (paramagnetic moment)
 0 0 2