SRIGAYATRI EDUCATIONAL INSTITUTIONS

INDIA

CHEMICAL BONDING

1. According to lewis which of the following is correct

1) Nucleus plus inner electrons form the kernel and outer shell can accommodate at the most 8 electrons

2) These eight electrons of the octet surround the kernel occupying corners of a cube.

3) In Na only one corner while in noble gases all eight corners of the cube are occupied by one electron.

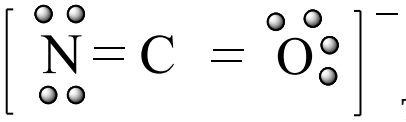
4) All of the above

2. For Hydrazoic acid which of the following resonating structure will be least stable?

$$\underset{(I)}{H-N=N^{+}=N^{-}} \leftrightarrow \underset{(II)}{H-N^{+}-N^{+}=N^{-2}} \leftrightarrow \underset{(III)}{H-N^{-}-N^{+}\equiv N}$$

1) I 2) II 3) III 4) Both I and III

3. From the consideration of the Lewis structure



The formal charges are

1) $N=-1, C=O, O='O'$ 2) $N=O, C=O, O=-1$

3) $N=-1, C=1, O=1$ 4) $N=1, C=-1, O=1$

4. In PO_4^{-3}, the formal charge on each oxygen atom and the P-O bond order respectively are

1) -0.75, 0.6 2) -0.75, 1.0 3) -0.75, 1.25 4) -3, 1.25

5. Polarisation is the distortion of the shape of anion by an adjacently placed cation which of the following statement is correct?

1) Maximum polarisation is brought about by cation of high charge

2) Maximum polarisation is brought about by cation of low charge

3) A large cation is likely to bring about a large degree of polarisation

4) A small anion is likely undergo a large degree of polarisation

6. Which of the following combination of ion will exhibit highest polarisation?

1) Fe^{+2}, Br^{-} 2) Ni^{+2}, Br^{-} 3) Ni^{+4}, Br^{-} 4) Fe, Br

7. Among the following the maximum covalent character is shown by the compound

1) $MgCl_2$ 2) $FeCl_2$ 3) $AlCl_3$ 4) $SnCl_2$

8. The types of hybrid orbitals of nitrogen in NO_2^{+}, NO_3^{-} and NH_4^{+} respectively are expected to be

1) sp, sp^3 *and* sp^2 2) sp, sp^2 *and* sp^3

3) sp^2, sp *and* sp^3 4) sp^2, sp^3 *and* sp

9. The correct order of hybridisation of the central atom in the following species?

$NH_3, XeO_2F_2, \mathrm{SeF_4}, XeF_4$

1) $sp^3, sp^3d, sp^3d, sp^3d^2$ 2) sp^3, sp^3, sp^3d, sp

3) $sp^3, sp^3d^2, sp^3d, sp^3d$ 4) $sp^3, sp^3, sp^3d^2, sp^3d$

10. Carbon atoms in $C_2(\mathrm{CN})_4$ *are*:

1) sp hyrbidised 2) sp^2 hyrbidised

3) sp & sp^2 4) sp, sp^2 and sp^3 hybridized

11. Which of the following molecular orbitals have two nodal planes? (ignore nodal planes of atomic orbitals)

1) $\sigma 2S$ 2) $\pi 2py$ 3) $\pi^{*} 2py$ 4) $\sigma^{*} 2Pa$

12. What is the sequence of bond orders?

1) $O_2^{+} > O_2^{-} > O_2$ 2) $O_2^{+} > O_2 > O_2^{-}$

3) $O_2 > O_2^{-} > O_2^{+}$ 4) $O_2^{-} > O_2^{+} > O_2$

13. Anti-bonding molecular orbital is formed by

1) Addition of wave function of atomic orbitals
2) Substruction of wave function of atomic orbitals
3) Multiplication of wave function of atomic orbitals
4) Finding the arthemetic mean

14. N_2 *and* O_2 **are converted into mono anions** N_2^- *and* O_2^- **respectively. Which of the following statements is wrong?**

1) In N_2^-, N-N bond weakens
2) O_2^-, O-O bond order increases
3) In O_2^-, O-O bond order decreases
4) N_2^- becomes paramagnetic

15. Which of the following molecular is polar?

1) XeF_4 2) IF_5 3) SbF_5 4) CF_4

16. The correct order of increasing C-O bond length of CO, CO_3^{-2}, CO_2 is

1) $CO_3^{-2} < CO_2 < CO$ 2) $CO_2 < CO_3^{-2} < CO$
3) $CO < CO_3^{-2} < CO_2$ 4) $CO < CO_2 < CO_3^{-2}$

17. Strongest hydrogen bond is present in

1) Ammonia 2) Hydrogen Fluoride
3) Water 4) Ethyl alcohol

18. Which of the following is correct order related to double bond character of B-X (where X is halogen)

1) $BF_3 > BCl_3 > BBr_3 > BI_3$ 2) $BI_3 > BBr_3 > BCl_3 > BF_3$
3) $BI_3 > BBr_3 > BF_3 > BCl_3$ 4) $BCl_3 > BF_3 > BBr_3 > BI_3$

19. The maximum number of molecules that one water molecule can hold through hydrogen bonding is

1) 2 2) 4 3) 6 4) 8

20. Which one is most ionic?

1) P_2O_5 2) CrO_3 3) MnO 4) Mn_2O_7

21. CaO and NaCl have the same crystal structure and approximately the same ionic radii. If U is the lattice energy of NaCl, the approximate lattice energy of CaO is

1) U 2) $\frac{U}{2}$ 3) $4U$ 4) 2U

22. Hybridisation of the underlined atom is affected when

1) $\underline{C}H_3COOH$ is decarboxylated 2) $CH_3\underline{C}H_2OH$ is dehydrated
3) $\underline{C}_6H_6$ is nitrated 4) $CH_3\underline{C}H_3$ is chlorinated

23. Among the following state ments:

I) PCl_5 is trigonal bipyramidal where as IF_5 is square pyramidal

II) Bond enthalpy of O-H bond in water and ethanol is different

III) All carbon atoms have same hyrbidisation in carbon suboxide (C_3O_2)

Find out the correct statements

1) I and II only 2) II and III only
3) I and III 4) I, II, and III

24. The dipolement of $AX_3, BX_3,$ *and* CX_3 **are 1.5 D, 0.5 D and O B respectively. The possible shapes of molecules may be (sonsider C has no lone pair) (A, B and C are more electronegative than X)**

1) Pyramidal, T-shape, Trigonal plannar
2) T-shape, Pyramidal, Square plannar
3) T-shape, Pyramidal, trigonal plannar
4) Pyramidal, T-shaped, square plannar

25. **Select correct order**

1) $LiF < NaF < KF < RbF$ (lattice energy)

2) $NaI < NaBr < NaCl > NaF$ (Ionic character)

3) $K^{+} < Ca^{+2} < Cd^{+2}$ (polarizing power)

4) $S^{-2} < O^{2-} < F^{-}$ (Polarizability)

26. **In which of the following bond angle is maximum**

1) NH_3 2) PCl_3 3) SCl_2 4) NH_4^{+}

27. **The molecular weight of an oxide of hydrogen is 34. Therefore the number of covalent bond in its molecule are**

1) 3 2) 4 3) 5 4) 2

28. CO_2 **has the same geometry as:**

A) $HgCl_2$ B) NO_2 C) $SnCl_2$ D) C_2H_2

1) A and C 2) B and D 3) A and D 4) C and D

29. **In allene** (C_3H_4) the type of hybridization of the carbon atom is

1) Sp *and* Sp^3 2) Only Sp^2 3) Sp^2 and Sp 4) Sp^2 and Sp^3

30. **Among the following molecules / ions** $C_2^{2-}, N_2^{-2}, O_2^{2-}, O_2$ which one is diamagnetic and has the shortest bond length.

1) O_2 2) N_2^{-2} 3) O_2^{-2} 4) C_2^{-2}

31. **Two elements A and B contains three and six valence electrons then the formula of the compound formed between them is**

1) AB 2) A_2B_3 3) A_3B_2 4) AB_2

32. **In which of the following solvents should KCl be soluble at** 25°C (D $\rightarrow$Dielectric constant value)

1) $C_6H_6 (D = 0)$ 2) $CH_3COCH_3 (D = 2)$

3) $CH_3OH \quad (D = 32)$ 4) $CCl_4 (D = 0)$

33. **Arrange the following compounds in order of increasing dipolemoment.**

I) Toluene **II) m dichloro benzene**

III) O-dichloro benzene **IV) P dichlorobenzene**

1) $I < IV < II < III$ 2) $IV < I < III < II$

3) $IV < I < II < III$ 4) $IV < II < I < III$

34. **The number and type of bonds between two C-atom is** SrC_2 are

1) $1\sigma, 1\pi$ 2) $1\sigma, 2\pi$ 3) $1\sigma, 5\pi$ 4) $1\sigma, 3\pi$

35. **Identity the pair that is not isostructural**

1) PCl_5, BrF_5 2) $CH_4, SiCl_4$ 3) CO_3^{-2}, NO_3^{-} 4) AlF_6^{-3}, SF_6

36. **The correct statement for the molecule** CsI_3 is

1) It is a covalent molecule

2) It contains Cs^{+3} and I^{-} ions

3) It contains Cs^{+} *and* I_3^{-}

4) It contains Cs^{+}, I^{-} and Lattice I_2 molecule

37. **Which of the following compounds contain no covalent bond?** $KCl, PH_3, O_2, B_2H_6, H_2SO_4$

1) KCl 2) H_2SO_4 3) KCl, B_2H_6 4) KCl, B_2H_6, PH_3

38. **Ortho-nitro phenol is less soluble in water than P and m –nitro phenols because.**

1) O-Nitrophenol shows inter molecular H-bonding

2) Melting point of O-nitrophenol is lower than those of m and p isomers

3) O-Nitrophenol is more volatile in steam than those of m and p isomers

4) O-nitrophenol shows intia molecular H-bonding

39. **Amongst** ClF_3, BF_3 **and** NH_3 **molecules, the one with non-planar geometry is**

1) ClF_3 2) NH_3 3) BF_3 4) None of these

40. Which one is least ionic in the following compounds?

1) KCl 2) AgCl 3) $BaCl_2$ 4) $CaCl_2$

41. Highest melting point would be of

1) BaO *2) MgO* *3) KCl* *4) NaCl*

42. The most stable compound is

1) LiF *2) LiCl* *3) LiBr* *4) LiI*

43. The correct order of the Lattice energies of the following ionic compounds is

1) $NaCl > MgBr_2 > CaO > Al_2O_3$ 2) $NaCl > CaO > MgBr_2 > Al_2O_3$

3) $Al_2O_3 > MgBr_2 > CaO > NaCl$ 4) $Al_2O_3 > CaO > MgBr_2 > NaCl$

44. *NaF* shows isomorphism with

1) K_2S 2) $CaCl_2$ 3) $MgCl_2$ 4) MgO

45. Among the following the compound that doesn't possess dative bond is

1) O_3 2) H_2SO_4 3) $CuSO_4$ 4) SF_4

46. The correct decreasing order of dipole moment is

1) $CH_3F > CH_3Cl > CH_3Br$ 2) $CH_3F > CH_3Br > CH_3Cl$

3) $CH_3Cl > CH_3F > CH_3Br$ 4) $CH_3Cl > CH_3Br > CH_3F$

47. The bond order of the N-O bonds in NO_3^- ion is

1) 0.33 2) 1.33 3) 1.00 4) 1.50

48. Which bond angle θ would result in the maximum dipolemoment for the tri atomic molecule $y \times y$

1) $\theta = 120^0$ 2) $\theta = 90^0$ 3) $\theta = 150^0$ 4) $\theta = 180^0$

49. The correct decreasing order of bond angles is

1) $ClF_3 > PF_3 > NF_3 > BF_3$ 2) $BF_3 > PF_3 > NF_3 > ClF_3$

3) $BF_3 > ClF_3 > PF_3 > NF_3$ 4) $BF_3 > NF_3 > PF_3 > ClF_3$

50. The sum of $p\pi - d\pi$ bonds in the gases obtained by strong heating of ferrous sulphate

1) 1 2) 2 3) 3 4) 4

Integer type

51. In $HC \equiv C - C \equiv CH$ molecule. How many carbon atoms are involved in sp hybridization ___

52. Among the following how many molecular are paramagnetic in nature.

$B_2, N_2, Li_2, H_2^+, He_2^+, O_2, O_2^-, O_2^+$

53. Calculate the sum of bond length of $C-C$, $C=C$, $C \equiv C$ in _____ A^0.

54. Among the following, how many possess bond order 2.5, $N_2, N_2^+, N_2^-, O_2^+, CN^-$.

55. The number of water molecule(s) directly bonded to the metal ion in $CuSO_4.5H_2O$ is

56. Find the total number of non polar compounds among the following?

$BCl_2F, BF_3SF_6, SOCl_2, COCl_2, B_3N_3H_6, PCl_3F_2, PF_3Cl_2$

57. The number of species which consists of sp^3d hybridized central atom in the following species, molecules is / are

$PCl_5, XeF_4, ICl_2^-, XeO_3F_2, SF_4, SOF_4$

58. The $H-OH$ bond angle in water molecule is 105^0. The $H-OH$ bond distance being $0.94A^0$. The dipolemoment for molecule is 1.85 D. Calculate the charge on oxygen atom $\left[\cos 105^0 = 0.259\right] in\ csu$ _____

59. Standard heat of formation of KJ is $-78.31 K\,Cal\,mol^{-1}$. Calculate its lattice energy in $K\,Cal\,mol^{-1}$ from following information. $I_1(K) = 4.3ev, E_1(I) = 73.4K\,cal\,mol^{-1}$. Bond dissociation energy of I_2 is $36.1K\,cal/mol$. Sublimation energy of K is $21.51K\,cal$.

60. Species like $SbCl_6^-, SnCl_6^{-2}, XeF_5^+$ and IO_6^{5-} has hybridisation as sp^3d^{x-1}. The value of "x" is

61. How many of the following species have sp^2 hybrid atoms?

Diamond, Graphite, $C_{60}, (SiH_3)_3N, AlCl_3, Al_2(CH_3)_6, SiC, H_3BO_3$, Layered BN, Borazine.

62. **What is the ratio of number of nodal planes present in π^*_{2p} and σ^*_{1s} molecular orbitals?**

63. **Number of molecules among the following having non-zero dipole moment is $O_3, SO_3, SF_4, SF_6, H_2S, CS_2, SO_2, H_2O$ and H_2O_2**

64. **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 / ions where the hybridisation of the central atom does not have contribution from the d-orbitals is**

65. **The dipolemoment of HBr is 7.95 D and inter atomic separation is $1.94\times10^{-10}m$. Find the % of the ionic character in HBr**

66. **The dipolemoment of HBr is $1.6\times10^{-30}cm$ and inter atomic spacing is $1A^0$. The % of the ionic character is**

67. **In a polar molecule, the ionic charge is $4.8\times10^{-10}csu$. If the inter distance is $1A^0$ then the dipolemoment is**

68. **A diatomic molecule has $\mu = 1.8D$. Its bond distance is $2.0A^0$. What fraction of electronic charge exists on each atom**

69. **Dipolemoment of H_2S is 0.95 D. Find the S-H bond moment, bond angle in H_2S is 96^0. $\left(\cos 48^0 = 0.66\right)$ _____ D**

70. **$Cl-O$ bond order in perchlorate ion is**

KEY

CHEMISTRY

1) **4**	2) **2**	3) **1**	4) **3**	5) **1**	6) **3**	7) **3**	8) **2**	9) **1**	10) **3**
11) **3**	12) **2**	13) **2**	14) **2**	15) **2**	16) **4**	17) **2**	18) **1**	19) **2**	20) **3**
21) **3**	22) **2**	23) **4**	24) **1**	25) **3**	26) **4**	27) **1**	28) **3**	29) **3**	30) **4**
31) **2**	32) **3**	33) **3**	34) **2**	35) **1**	36) **2**	37) **2**	38) **4**	39) **2**	40) **2**
41) **2**	42) **1**	43) **4**	44) **4**	45) **4**	46) **3**	47) **2**	48) **2**	49) **4**	50) **3**
51) **4**	52) **6**	53) **4.08**	54) **3**	55) **4**	56) **4**	57) **5**	58)	59) **-143.49**	60) **3**
61) **7**	62) **2**	63) **6**	64) **4**	65) **85.37**	66) **10**	67) **4.8**	68) **0.1875**	69) **0.72**	70) **1.75**

SOLUTIONS

2. More the changes lesses will be the stability

3. Formal charge – valence electrons – no of bonds – number of nonbonding electrons

4. In PO_4^{-3} ion, formal charge on each O-atom of P-O bond $\dfrac{\text{Total charge}}{\text{number of } 'O' \text{atom}}$

$= \dfrac{3}{-4} = -0.75$

Bond order $= \dfrac{No\ of\ \text{covalent}\ bond}{Surrounding\ atom}$

5. Polarisation α charge of ion

6. i) Polarising power of cation α charge of cation $\alpha \frac{1}{size}$

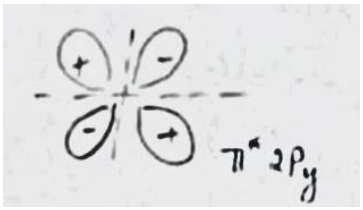
   ii) Polarizability of anion α charge $\propto$ size

7. As charge on the ion increase covalent character increases

8. No. of hybrid orbitals = $\frac{1}{2}$ [No. of monovalent atoms + No of valence electrons – charge on cation + charge on anion]

10. $N \equiv C - \underset{\|}{C} - C \equiv N$

    $N \equiv C - C - C \equiv N$

11. 

12. B.O of $O_2 = 2$, O_2^+, 2.5, $O_2^- = 1.5$
13. Anti bonding molecular orbitals are formed by destructive interference of the electron waves.
14. B.O of $O_2 = 2$

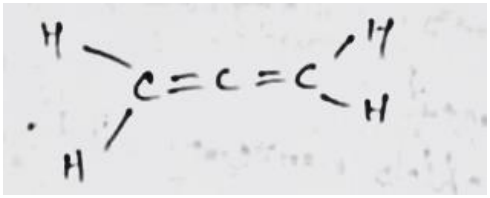
    $O_2^- = 1.5$
15. Square pyramid structure.
16. B.L $\propto \frac{1}{B.O}$
17. Fluorine has high E.N.
18. As the size of the halogen atom increases tendency of back bonding decreases
20. Oxidation state $\propto \frac{1}{\text{ionic nature}}$
21. Lattice energy = Inter ionic dixtance $\frac{\text{product of charges}}{\text{Inter ionic distance}}$

    In NaCl the product of charges = 1×1=1

    In CaO the product of charges = 2×2=4

    As the inter ionic distance is almost same in both. Hence lattice energy of *CaO* is almost four times the lattice energy of *NaCl*.
22. $CH_3 - \underline{C}H_2OH \longrightarrow H_2C = CH_2 \left[Sp^3 \rightarrow Sp^2 \right]$
23. Bond enthalpy of O-H bond is different in H_2O and C_2H_5OH as C_2H_5OH has electron donating ethyl group.

    $C_3O_2 \Rightarrow O = \underset{\downarrow Sp}{C} = \underset{\downarrow Sp}{C} = \underset{\downarrow Sp}{C} = O$
24. Maximum dipole moment for MX_3 type structures would be pyramidal while least would be in trigonal planar.
26. NH_4^+ **has tetrahedral structure because of no lone pairs bond angle is** $109^\circ 28'$
27. **The oxide of Hydrogen with mol. Wt.** at 34 is $H_2O_2 \left[H - O - O - H \right]$
28. **Both** $HgCl_2$ and C_2H_2 possess linear structure like CO_2 because of SP hybridization.
29. The structure of allene:



30. The B.O and Magnetic nature of C_2^{-2} :3 and diamagnetic
The B.O and Magnetic nature of N_2^{-2} =2 and para diamagnetic
The B.O and Magnetic nature of $O_2 = 2$ and para diamagnetic
The B.O and Magnetic nature of $O_2^{-2} = 1$ and diamagnetic
$\left[B.O\alpha \frac{1}{B \cdot L} \right]$.

31. A forms cation i.e. A^{+3}
B forms anion i.e. B^{-2}
$\therefore$ Compound is A_2B_3

32. Salts are more soluble in solvents having high dielectric constant value

33. .

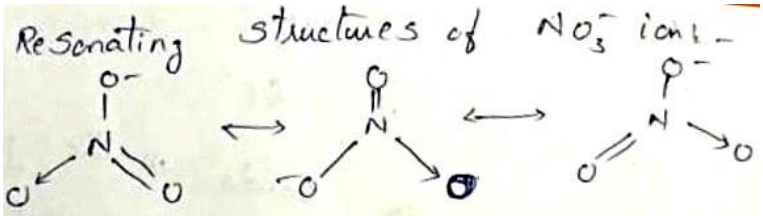
34. SrC_2 is an ionic compound which produces acetylene on reacting with water. The structure of C^{-2} is $C \equiv C$

35. PCl_5 has trigonal bipyramidal shape $\left(sp^3d\right)$
BrF_5 has square pyramidal shape $\left(sp^3d^2\right)$

40. **Ag^+** has pseudo octet configuration hence possess covalent nature.
41. Melting point depends upon lattice energy [MP $\propto$ LE]
Lattice energy $\propto$ charge of ion
Lattice energy $\propto \frac{1}{size\ of\ ion}$
42. Among all the halogens fluorine has high electronegativity.
43. $U = \frac{z^+ z^-}{r_c^+ + r_a^-}$
44. NaF and MgO are isomorphous due to similar electronic structure

$$\begin{bmatrix} Na^+ & F^- \\ 2,8 & 2,8 \\ Mg^{+2} & O^{-2} \\ 2,8 & 2,8 \end{bmatrix}$$

46. C-F bond length is smaller than C-Cl bond length
47.



$$'N-O'\ Bond\ order = \frac{No.\ of\ bonds\ between\ two\ atoms}{Total\ no.\ of\ resonating\ structures}$$

$$= \frac{4}{3} = 1.33$$

48. $\mu = \sqrt{x^2 + y^2 + 2xy\cos\theta}$

As the angle increases from 90-180, the value of $\cos\theta$ becomes more and more –ve and hence resultant value decreases.

49. BF_3 Bond angle 120^0

NF_3 Bond angle $106^0 45^1$

PF_3 Bond angle 102^0

ClF_3 Bond angle 86^0

50. $2FeSO_4 \xrightarrow{\Delta} Fe_2O_3 + SO_2 + SO_3$

SO_2 has one $p\pi - d\pi$ bond

SO_3 has two $p\pi - d\pi$ bonds

51. Carbon atoms involved in by triple bond formation undergo sp hybridization.

52. N_2 and Li_2 are diamagnetic.

53. $C-C$ bond length is $1.54A^0$

$C=C$ bond length is $1.34A^0$

$C \equiv C$ bond length is $1.2A^0$

54. Bond order of $N_2^+, N_2^- \& O_2^+$ is 2.5

55. $\left[Cu\left(H_2O\right)_4\right]SO_4H_2O$

i.e, in $CuSO_4$ four H_2O act as ligand and one H_2O molecule is bonded to SO_4^{-2} through hydrogen bond.

56. $BF_3, SF_6, B_3N_3H_6, PCl_3F_2$

57. $PCl_5, ICl_2^-, XeO_3F_2, SF_4, SOF_4$

58. $\mu = \sqrt{\mu_{OH}^2 + \mu_{OH}^2 + 2\mu_{OH}^2\cos\theta}$

$1.85 = \sqrt{2\mu_{OH}^2\left[1+\cos 105^0\right]}$

$\mu_{OH} = 1.52$ *debye.*

$\mu_{OH} = \delta \times d$

$\delta = \mu_{OH} / d$

$$= \frac{1.52\times10^{-18}}{0.94\times10^{-8}} = 1.6\times10^{-10}\ esu$$

59. $\Delta H = S + I + \frac{D}{2} + EA + LE$

$-78.31 = 21.51 + 4.3\left(23.06\right) + \frac{36.1}{2} - 73.4 + LE$

Lattice energy = -143.49

60. $H.O = \frac{1}{2}\left(V + M - C + A\right)$

61. Graphite, $C_{60}, \left(SiH_3\right)_3 N, AlCl_3, H_3BO_3$, Layered BN, Borazine.

62. No. of Nodal planes in $\pi_{2p}^* = 2,\ \sigma_{1s}^* = 1$

63. SO_3, SF_6 *and* CS_2 are molecules with symmetrical shapes and have zero dipole moment.

64. $BeCl_2, N_3^-, N_2O, NO_2^+$ are linear molecules with sp hybridisation.

65. % ionic character = $\frac{7.95\times10^{-18}}{1.94\times10^{-8}\times4.8\times10^{-10}}$

66. % ionic character = $\frac{1.6\times10^{-30}}{1.6\times10^{-19}\times10^{-10}}\times100$

67. $\mu=\delta\times l \ \ (or) \ \ q\times d$

68. $q=\frac{\mu}{d}=\frac{1.8}{2\times10^{-8}}=\frac{1.8\times10^{18}\,esu.cm}{2\times10^{-8}\,cm}=0.9\times10^{-10}\,esu$

The fraction of electronic charge that exists on each atom = $\frac{0.9\times10^{-10}}{4.8\times10^{-10}}$

69. $\mu_{H_2S}=2\times\mu_{S-H}\times\cos\left(\frac{\theta}{2}\right)$

$0.95=2.x.\cos\left(\frac{96}{2}\right)$

70. Bond order = $\frac{total\ \ no.\ of\ \ bonds}{total\ \ no.\ of\ \ resonating\ \ structures}$

$=\frac{7}{4}=1.75$