CHEMICAL BONDING

1) In Graphite, carbon atoms are

1) sp^3 hybridised 2) sp^2 hybridised 3) sp hybridised 4) non hybridized

Sol.: (2)

In graphite, carbon atoms are sp^2 hybridised.

2) Linear molecule among the following is

1) H_2O 2) NH_3 3) BF_3 4) CO_2

Sol.: (4)

O =C=O linear shape

3) The boiling point of water is unexpectedly high because

1) Water forms a bent molecule 2) It is covalent compound

3) It has a high dielectric constant

4) There is association of molecule due to hydrogen bonding

Sol.: (4)

There is association of molecules due to hydrogen bonding.

4) In which compound is the bonding largely covalent?

1) NaH 2) CsH 3) BeH_2 4) BaH_2

Sol.: (3)

This is due to diagonal relationship with aluminium

5) Which set contain no ionic no ionic species

1) NH_4Cl, OF_2, H_2S 2) CO_2, CCl_4, Cl_2 3) BF_3, AlF_3, TIF_3 4) I_2, CaO, CH_3Cl

Sol.: (2)

CO_2, CCl_4, Cl_2 are covalent compound.

6) (Molecule type) (Number of lone pair e^- on central atom A)

i) AB_2 p) zero

ii) AB_3 q) one

iii) AB_4 r) two

s) three

Set of condition when AB_2, AB_3, AB_4 type neutral molecules have non zero dipole moment:

1) (i)=q,r 2) ii)=q,r 3) iii)=q 4) All of these

Sol.: (4)

For AB_2 in bent shape:

sp^2 when one lone pair two σ- bond

sp^3 when two lone pair two σ- bond

For AB_3 pyramidal shape:

sp^3 when one lone pair three σ- bond

sp^3 d when two lone pair three σ- bond

For AB_4 distorted tetrahedral:

sp^3d when one lone pair four σ- bond

7) The incorrect order of bond angle:

1) $CO_2 > CO_3^{2-} > CF_2Cl_2$ 2) $NO_2^+ > NO_3^- > NO_2^-$

3)$XeF_2 > XeF_4 > XeO_4$ 4)$PH_3 > AsH_3 > SbH_3$

Sol.: (3)

$XeF_2 > XeF_4 < XeO_4$

(180°) (90°) (109°)

8) Select the incorrect order for given properties

1) LiH>NaH>KH>RbH (Thermal stability)

2) $CdCO_3 > CaCO_3 > K_2CO_3$ Covalent character

3) $BeCO_3 > MgCO_3 > CaCO_3$ (Ease of oxide formation on heating at same temperature)

4) $BeF_2 > MgF_2 > CaF_2 > SrF_2$(solubility in water)

Sol.: (4)

Solubility of alkali earth metal fluorides are :

$BeF_2 > BaF_2 > SrF_2 > CaF_2 > MgF_2$

9) Which of the following options represent the change in the bond angle in given reaction :

$BF_3 \rightarrow BF_4^-$

1) 120° 2) 109°28’ 3) 10°72’ 4) 60°

Sol.: (3)

$BF_3 \rightarrow BF_4^-$

120° 109°28’

10) In which of the following pairs both the molecules are non existing ?

1) SF_4, OF_4 2) OF_4, OF_6 3) SF_4, SF_6 4) OF_2, OF_4

Sol.: (2)

OF_4, OF_6 are non-existing because oxygen does not have vacant orbitals in its valency shell.

11) In which of the given change bond angle at central at atom is not change ?

1) $AlCl_3 \rightarrow AlCl_4^-$ 2) $CH_4 \rightarrow CH_3^+$ 3) $CH_3^- \rightarrow CH_4$ 4) $CH_4 \rightarrow CF_4$

Sol.: (4)

$CH_4 \rightarrow CF_4$

(B.A = 109°28') (B.A = 109°28')

12) The central atom assumes sp^3 – hybridisation in

1) PCl_3 2) SO_3 3) NO_3^- 4) BF_3

Sol.:(1)

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

$PCl_3: H = \frac{1}{2}[5 + 3 - 0 + 0] = 4sp^3$

$SO_3 = sp^2; BF_3 = sp^2 \&\ NO_3^- = sp^2$

13) T-shape is exhibited by the molecule.

1) CIF_3 2) $CHCl_3$ 3) PCl_5 4) CCl_4

Sol.: (1)

CIF_3 T-shaped

14) In allene (C_3H_4) the type/s of hybridization of carbon atom is/are

1) only sp^2 2) sp & sp^3 3) sp^2 and sp^3 4) sp & sp^2

Sol. : (4)

$H_2C = C = CH_2$

sp^2 sp sp^2

15) Which of the following has a linear shape ?

1) O_3 2) NO_2^+ 3) SO_2 4) NO_2^-

Sol.:(2)

O_3, $NO_2^-\ and\ SO_2\ \Rightarrow Angular\ shape$

$While\ NO_2^+ \Rightarrow linear\ shape\ (sp\ hybridisation)$

16) Which of the following is not isostructural with $SiCl_4$?

1)PO_4^{3-} 2) SCL_4 3) SO_4^{-2} 4) NH_4^+

Sol.: (2)

$SiCl_4 \Rightarrow$tetrahedral shape

$SCl_4 \Rightarrow$see – saw shape (sp^3d)

17) Which of the following has maximum number of lone pairs on central atom?

1) I_3^- 2) XeF_4 3) SF_4 4) ClO_3^-

Sol.: (1)

$ClO_3^- \Rightarrow one\ LP$

$XeO_4 \Rightarrow 2\ LP$

$SF_4 \Rightarrow 1\ LP$

$I_3^- \Rightarrow 3\ LP$

18) According to molecular orbital theory which of the following statement about the magnetic character and bond order is correct regarding O_2^+

1) Diamagnetic and bond order > O_2 2) Diamagnetic and bond order < O_2

3) Paramagnetic and bond order >O_2 4) Paramagnetic and bond order <O_2

Sol.:(3)

$O_2^+ : K\ K\ \sigma 2s^2\ \ \sigma * 2s^2\ \ \sigma 2p_z^2\ \pi_2 p_x^2\ \ \pi_2 p_y^2\ \pi * 2p_x^1$

$B.O = \frac{8-3}{2} = 2.5$

19) Which of the following molecular species has unpaired electrons?

1) N_2 2) F_2 3) O_2^- 4) O_2^{2-}

Sol.: (3)

$O_2^-: K\ K\ \ \sigma 2s^2\ \ \sigma * 2s^2 \sigma 2p_z^2\ \pi 2p_x^2\ \pi 2p_y^2\ \pi * 2p_x^1\ \ \pi * 2p_y^1$

20) Which of the following pairs of molecules will have permanent dipole moments for both members?

1) SiF_4 and NO_2 2) NO_2 and CO_2 3) SiF_4 and CO_2 4) NO_2 and O_3

Sol. : (4)

Both NO_2 and O_3 are angular in shape.

21) Which of the following pairs of species have the same bond order?

1) NO^+& CN^- 2) O_2^- & CN^- 3) CN^-& CN^+ 4) CN^-& NO^+

Sol.:(4)

CN- and NO^+ are isoelectronic

i.e 14 electrons each

22) The energy required to break one mole of Cl– Cl bonds in Cl_2 is 2 and 2 kj / mol. The longest wave length of light capable of breaking a single Cl – Cl bond is:

1) 594 nm 2) 700 nm 3) 640 nm 4) 494 nm

Sol.: (4)

$\lambda = \frac{hc}{E} x N_o = \frac{6.6x10^{-34}x3x10^8x6.02x10^{23}}{242x10^3} = 0.494x10^{-6} = 494x10^{-9} = 494\ nm$

23) In which of the following pairs, the species are not iso structural?

1) PCl_4^+ & $SiCl_4$ 2) PF_5 and Br_5 3) CO_3^{-2} and NO_3^- 4) AlF_6^{3-} & SF_6

Sol.: (2)

PF_5=Trigonal by pyramidal

BrF_5=Square pyramidal

24) The geometry of the molecule with 25% s-character in hybrid orbital is:

1) Linear 2) Octahedral 3) tetrahedral 4) plane triangular

Sol.:(3)

25% s = character in tetrahedral geometry (sp^3)

25) A section of the periodic table is given below with elements A, B and X, Y in two groups. Which of the bonds given below is the least polar?

A X

B Y

1) AX 2) AY 3) BX 4) BY

Sol.:(2)

Electronegativity decreases down a group but increases across a period but remains almost same along a diagonal. Therefore, atoms A and Y have little difference in their electro negativities and hence AY bond is least polar.

26) Molecular shapes of SF_4, CF_4 and XeF_4 are

1) Same with 2, 0 and 1 lone pairs of electrons respectively

2) Same with 1, 1 and 1 lone pairs of electrons respectively

3) Different with 1, 0, and 2 lone pairs of electrons respectively

4) Different with 1, 1, and 1 lone pairs of electrons respectively

Sol.:(3)

SF_4(sp^3d, trigonal bipyramidal with one equatorial position occupied by 1 lone pair)

CF_4 (sp^3, tetrahedral, no lone pair),

XeF_4 (sp^3d^2, square planar, two lone pairs)

27) The energy of σ_{2s} is greater than σ_{1s}^* orbital because

1) σ_{2s} orbital is bigger than σ_{1s} orbital

2) σ_{2s} is a bonding orbital where σ_{1s}^* is an antibonding orbital

3) σ_{2s} orbital has greater value of n than σ_{1s}^* orbital

4) σ_{2s}orbital is formed only after σ_{1s}

Sol.:(3)

The energy of MO increase as the value of the principal quantum number (n) increases.

28) Which of the following is an isoster of N_2?

1) CO_2 2) CO 3) N_2O 4) O_2

Sol.:(2)

Isosters are molecules containing same number of atoms and electrons. N_2 contains 2 atoms and 14 electrons and so does CO.

29) Which one of the following is most stable?

1)H_2^+ 2) H^+ 3) H^- 4) H_2^-

Sol.: (3)

H^- is most stable because it has noble gas configuration of He.

30) Among the following, which compound will show the highest lattice enthalpy?

1) KF 2) NaF 3) CsF 4) RbF

Sol.:(2)

For compounds containing ions of same charge, lattice energy increases as the size the ions decreases. Thus, NaF has highest lattice energy.

31) In which of the following molecules / ions are all the bonds not equal?

1) XeF_4 2) BF_4^- 3) SF_4 4) SiF_4

Sol.:(3)

XeF_4 is square planar while BF_4^- and SiF_4 are tetrahedral, therefore, all M – F bonds are equal in these molecules / ions. However, in SF_4, there is sp^3d – hybridization having two axial and two equatorial S -F bonds. Thus, all the bonds in SF_4 are not equal.

32) Which of the following is least ionic?

1) KCl 2) AgCl 3) $BaCl_2$ 4) $CoCl_2$

Sol.:(2)

Out of KCl, AgCl, $BaCl_2$, and $CoCl_2$, only Ag^+ has pseudo inert gas configuration while while K^+ and Ba^{2+} have inert gas configuration and CO^{+2} has neither of the two. Since, a cation with pseudo inert gas configuration is more polarizing than those with inert gas configuration (Fajan rule) therefore, AgCl has maximum covalent or least ionic character.

33) Four elements A, B, C and D from a series of compound having the formulae AB, B_2, CB_3, DB_2 and DB_3. If the jumbled up atomic numbers of A, B, C and D are 13, 19, 26 and 35, then the ordered atomic numbers of A, B, C and D will be respectively.

1) 13, 19, 26, 35 2) 19, 35, 26, 13 3) 26, 35, 13, 19 4) 19, 35, 13, 26

Sol.: (4)

$13(Al) = 1s^2 2s^2 2p^6 3s^2 3p_{x_6}^1\ (can\ lose\ 1\ e)$

$19(K) = 1s^2 2s^2 sp^6 3s^2 3p^6 4s^1 (can\ lose\ 1\ e)$

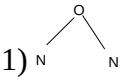
$26(Fe) = 1s^2 2s^2 2p^6 3s^2 3p^6 3d^6 4s^2 (can\ lose\ 2\ or\ 3\ e)$

$35(Br) = 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^{10}\ 4s^2\ 4p_x^2\ 4p_y^2\ 4p_1^1$ (can gain/share 1 e)

Compound formed will be KBr, Br_2, $AlBr_3$, $FeBr_2$ and $FeBr_3$,

K=A=19, Br=B=35, Al=C=13, Fe=D=26

34) N_2O is isoelectronic with CO_2 and N_3^-, Which is the structure of N_2O?

1)  2) N – O – N 3)  4) N – N – O

Sol.: (4)

Both the species CO_2 and N_3^- are linear. Therefore, N_2O must be linear. Further, the two N atoms must be bonded together as that in N_3^-. Hence, the actual structure from the knowledge of valencies would be $N \equiv \overset{+}{N} - O^-$.

35) The ONO bond angle is maximum in

1) NO_3^- 2)NO_2^- 3) NO_2 4)NO_2^+

Sol.:(4)

$N^+ O_2$ has linear geometry bond angle 180°.

36) Among the following the paramagnetic compound is

1) Na_2O_2 2) O_3 3) N_2O 4) KO_2

Sol.: (4)

KO_2 contains O_2^- ion which is paramagnetic.

37) Which of the following diatomic molecule would be stabilized by the removing of an electron?

1) C_2 2) CN 3) N_2 4) O_2

Sol.:(4)

In O_2, there are two electrons in antibonding orbitals. Removal of one electron from the O_2 molecule gives O_2^+ in which the number of antibonding electrons is one less and hence B.O. increases. Thus, removal of one electron from O_2 stabilizes the molecule.

38) For the species NO, NO^+, NO^{2+} and NO^-, the correct order of bond lengths is

1) $NO^+ < NO = NO^{2+} < NO^-$ 2) $NO^{2+} < NO^+ < NO^- < NO$

3) $NO < NO^- < NO^+ < NO^{2+}$ 4) $NO < NO^- = NO^+ < NO^{2+}$

Sol.:(1)

The electronic configurations and the bond orders of these species are as follows:

(NO has 7+8=15 electrons)

$NO: KK\sigma_{2s}^2\ \sigma_{2pz}^{*2}\ \pi_{2px}^2\ \pi_{2py}^2\ \pi_{2px}^{*1}$, Bond order=1/2 (8-3)=2.5

$NO^+: One\ electron\ removed\ from\ \pi_{2p_x}^*$, Bond order=1/2 (8-2)=3

NO^{2+}: *One electron removed from* $\pi^*_{2p_x}$ and one electron is removed from π_{2p_y}

Bond order = ½ (7-2)=2.5

NO^-: *One electron is added to* $\pi^*_{2p_x}$ *of NO, Bond order* $= \frac{1}{2} * (8-4) = 2$

Thus NO^+ has highest bond order and, therefore the shortest bond length. The correct order of bond lengths will be $NO^+ < NO = NO^{2+} < NO^-$.

39) 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 2) U 3) 2U 4) 4U

Sol.: ((4)

Lattice energy = $\frac{q_1 q_2}{r^2}$. Where q_1 and q_2 are charges on ions and r is the distance between them. Since, interionic distances in CaO and NaCl are similar, (larger cation has smaller anion and vice versa) therefore, r is almost the same. Therefore, lattice has smaller anion and viceversa) therefore, r is almost the same. Therefore lattice energy depends only on charge. Since the magnitude of charge on Na and Cl^- ions is unity and that on Ca^{2+} and O^{2-} ions is 2 each, therefore , the lattice energy of CaO is four times the lattice energy of NaCl, i.e. 4U

40) Which of the following pairs of species has the same bond order?

1) $\overset{+}{N}$O and C$\overset{-}{N}$ 2) C$\overset{-}{N}$ and $\overset{+}{N}O_2$ 3) C$\overset{-}{N}$ and O_2 4) O_2^- and C$\overset{-}{N}$

Sol.: (1)

Number of electrons in $\overset{+}{N}O$ and CN^- are 14 and B.O is 3.

41) In CO_2 the number of electrons in 2 anti bonding orbital is

1) zero 2) one 3) two 4) three

Sol.: (1)

CO contains 14 electrons

$\sigma 1s^2\ \sigma^x\ 1s^2\ \sigma\ 2s^2\ \sigma 2p_2^2\ \pi 2px^2\ \pi 2py^2\ \sigma^x 2pz^2$

42) Which one of the following conversions involves changes in both hybridization and shape?

1) $CH_4 \rightarrow C_2H_6$ 2) $NH_3 \rightarrow \overset{+}{N}H_4$ 3) $BF_3 \rightarrow BF_4^-$ 4) $H_2O \rightarrow H_3\overset{+}{O}$

Sol.:(3)

In BF_3 sp^2 hybridisation and trigonal planar geometry. Where as in BF_4^- sp^3 hybridisation and tetrahedral geometry.

43) N_2O is isoelectronic with CO_2, which is the structure of N_2O?

1) Bent 2) Linear 3) Trigonal planar 4) non planar

Sol.:(2)

Isoelectronic molecules should have identical geometry.

44) The dipole moment is the highest for

1) trans – 2 butane
2) 1, 3 – dimethyl benzene
3) acetophenone
4) ethane

Sol.: (3)

Remaining molecules are symmetrical

45) Which of the following has dπ – pπ bonding?

1) NO_3^- 2) SO_3^{2-} 3) BO_3^{3-} 4) CO_3^{2-}

Sol.:(2)

Sulphur contain vacant 3d orbitals where as in N, B and C are no vacant d orbitals

46) Specify the coordination geometry around hybridization of N and B atoms in a 1:1 mixture of BF_3 and NH_3.

1) N:tetrahedral, sp^3; B:tetrahedral, sp^3
2) N: pyramidal, sp^3; B:tetrahedral , sp^3
3) N:pyramidal, sp^3 ; B: pyramidal, sp^3
4) N: pyramidal, sp^3 ; B:planar, sp^2

Sol.:(1)

During the coordinate bond formation a pair of electrons is donated from NH_3 to BF_3. Since both N and B are involved in 4 bond formation, hybridisation is sp^3 and geometry is tetrahedral.

47) The dipole moment of LiH is found to be $2x10^{-29}$ Cm. If the inter atomic distance in LiH is 1.6 A°, then the percent of ionic character of Li-H bond is nearly.

1) 80% 2) 60% 3) 50% d) 40%

Sol.:(1)

$\mu_{ionic} = 1.6x10^{-10}mx1.602x10^{-19}C = 2.5632x10^{-29}Cm$

$Percent\ of\ ionic\ character = \frac{\mu_{observed}}{\mu_{ionic}}x100 = \frac{2x10^{-29}}{2.5x10^{-29}}x100 = 80\%$

48) Consider H_2CO_3 and CO_3^{2-} ion. Which of the following is correct?

1) There is no resonance in H_2CO_3

2) Resonance stabilization energy of $CO_3^{2-}\ is\ more\ than\ in\ H_2CO_3$

3) Resonance stabilisation energy of H_2CO_3 is more than CO_3^{2-}

4) There is no resonance in CO_3^{2-}

Sol.:(2)

Resonance structure of CO_3^{2-} are identical and hence it is more stable.

49) What is true about PF_5?

1) The molecule does not exist
2) P – F bonds are coordinate covalent
3) All P – F bonds are not equal
4) Molecule has pentagonal planar geometry

Sol.: (3)

PF_5 has trigonal pyramidal geometry. It contains 3 equatorial bonds and 2 axial bonds.

50) The C – H bond distance is the longest in

1) C_2H_2 2) C_2H_4 3) $C_2H_4Br_2$ 4) C_6H_6

Sol.:(3)

In $C_2H_4Br_2$, C - is sp^3 hybridised, as % of s character decreases bond length increases.