Chemical Bonding and Molecular Structure

1. The correct order of dipole moments for molecules NH_3, H_2S, CH_4 and HF is: **(2023)**
   (a) $CH_4 > H_2S > NH_3 > HF$
   (b) $H_2S > NH_3 > HF > CH_4$
   (c) $NH_3 > HF > CH_4 > H_2S$
   (d) $HF > NH_3 > H_2S > CH_4$

2. Which one of the following represents all isoelectronic species? **(2023)**
   (a) Na^+, Cl^-, 0^-, NO^+
   (b) N_2O, N_2O_4, NO^+, NO
   (c) Na^+, Mg^{2+}, 0^-, F^-
   (d) Ca^{2+}, Ar, K^+, Cl^-

3. Which one of the following statements is incorrect related to Molecular Orbital Theory? **(2023)**
   (a) The π^* antibonding molecular orbital has a node between the nuclei.
   (b) In the formation of bonding molecular orbital, the two electron waves of the bonding atoms reinforce each other.
   (c) Molecular orbitals obtained from $2P_x$ and $2P_y$ orbitals are symmetrical around the bond axis.
   (d) A π-bonding molecular orbital has larger electron density above and below the internuclear axis.

4. Given below are two statements:
   Statement I: Hydrated chlorides and bromides of Ca, Sr and Ba on heating undergo hydrolysis.
   Statement II: Hydrate chlorides and bromides of Be and Mg on heating undergo dehydration.
   In the light of the above statements, choose the correct answer from the options given below: **(2023)**
   (a) Statement I is correct but Statement II is false.
   (b) Statement II is incorrect but Statement II is true.
   (c) Both Statement I and Statement II are true.
   (d) Both Statement I and Statement II are false.

5. The correct order of energies of molecular orbitals of N_2 molecule, is **(2023)**
   (a) $\sigma 1s < \sigma^* 1s < \sigma 2s < \sigma^* 2s < \sigma 2p_z < (\pi 2p_x = \pi 2p_y) < (\pi^* 2p_x = \pi^* 2p_y) < \sigma^* 2p_z$
   (b) $\sigma 1s < \sigma^* 1s < \sigma 2s < \sigma^* 2s < \sigma 2p_z < \sigma^* 2p_z < (\pi 2p_x = \pi 2p_y) < (\pi^* 2p_x = \pi^* 2p_y)$
   (c) $\sigma 1s < \sigma^* 1s < \sigma 2s < \sigma^* 2s < (\pi 2p_x = \pi 2p_y) < (\pi^* 2p_x = \pi^* 2p_y) < \sigma 2p_z < \sigma^* 2p_z$
   (d) $\sigma 1s < \sigma^* 1s < \sigma 2s < \sigma^* 2s < (\pi 2p_x = \pi 2p_y) < \sigma 2p_z < (\pi^* 2p_x = \pi^* 2p_y) < \sigma^* 2p_z$

6. Talking stability as the factor, which one of the following represents correct relationship? **(2023)**
   (a) $InI_3 > InI$
   (b) $AlCl > AlCl_3$
   (c) $TlI > TlI_3$
   (d) $TlCl_3 > TlCl$

7. Intermolecular forces are forces of attraction and repulsion between interacting particles that will include:
   A. dipole-dipole forces
   B. dipole-induced dipole forces
   C. hydrogen bonding
   D. covalent bonding
   E. dispersion forces
   Choose the most appropriate answer from the options given below: **(2023)**
   (a) A, B, C, D are correct
   (b) A, B, C, E are correct
   (c) A, C, D, E are correct
   (d) B, C, D, E are correct

8. Match List I with List II:

List I (Molecules)		List II (Shape)	
A.	NH_3	i.	Square pyramidal
B.	ClF_3	ii.	Trigonal bipyramidal
C.	PCl_5	iii.	Trigonal pyramidal
D.	BrF_5	iv.	T-shape

   Choose the correct answer from the options given below: **(2022)**
   (a) A-iii, B-iv, C-i, D-ii
   (b) A-ii, B-iii, C-iv, D-i
   (c) A-iii, B-iv, C-ii, D-i

(d) A-iv, B-iii, C-i, D-ii

9. The correct order of bond angles in the following compounds/species is: **(2022)**
   (a) $CO_2 < NH_3 < H_2O < \overset{+}{N}H_4$
   (b) $H_2O < NH_3 < \overset{+}{N}H_4 < CO_2$
   (c) $H_2O < \overset{+}{N}H_4 < NH_3 < CO_2$
   (d) $H_2O < \overset{+}{N}H_4 = NH_3 < CO_2$

10. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
    Assertion (A): ICl is more reactive than I_2.
    Reason (R): I-Cl bond is weaker than l-l bond.
    In the light of the above statements, choose the most appropriate answer from the options given below: **(2022)**
    (a) Both (A) and (R) are correct and (R) is the correct explanation of (A).
    (b) Both (A) and (R) are correct but (R) is not the correct explanation of (A).
    (c) (A) is correct but (R) is not correct.
    (d) (A) is not correct but (R) is correct.

11. Amongst the following which one will have maximum 'lone pair – lone pair' electron repulsions? **(2022)**
    (a) ClF_3
    (b) IF_5
    (c) SF_4
    (d) XeF_2

12. Which amongst the following is incorrect statement? **(2022)**
    (a) The bond orders of O_2^+, O_2, O_2^- and O_2^{2-} are 2.5, 2, 1.5 and 1, respectively
    (b) C_2 molecule has four electrons in its two degenerate π molecular orbitals
    (c) H_2^+ ion has one electron
    (d) O_2^+ ion is diamagnetic

13. BF_3 is planar and electron compound. Hybridization and number of electrons around the **central atom**, respectively are : **(2021)**
    (a) sp^3 and 6
    (b) sp^2 and 6
    (c) sp^2 and 8
    (d) sp^3 and 4

14. Match List-I with List-II. **(2021)**

	List-I		List-II
A.	PCl_5	(i)	Square pyramidal
B.	SF_6	(ii)	Trigonal planar
C.	BrF_5	(iii)	Octahedral
D.	BF_3	(iv)	Trigonal bipyramidal

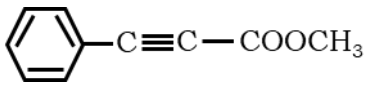
    Choose the correct answer from the options given below.
    (a) A-ii, B-iii, C-iv, D-i
    (b) A-iii, B-I, C-iv, D-ii
    (c) A-iv, B-iii, C-ii, D-i
    (d) A-iv, B-iii, C-I, D-ii

15. Which of the following molecules is non-polar in nature? **(2021)**
    (a) CH_2O
    (b) $SbCl_5$
    (c) NO_2
    (d) $POCl_3$

16. Which of the following set of molecules will have zero dipole moment? **(2020)**
    (a) Boron trifluoride, hydrogen fluoride, carbon dioxide, 1,3-dichlorobenzene
    (b) Nitrogen trifluoride, beryllium difluoride, water 1, 3-dichlorobenzzene
    (c) Boron trifluoride, beryllium difluoride, carbon dioxide, 1,4-dichlorobenzene
    (d) Ammonia, beryllium difluoride, water, 1,4-dichlorobenzene

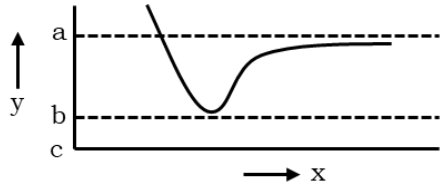
17. Identify a molecule which does not exist. **(2020)**
    (a) Li_2
    (b) C_2
    (c) O_2
    (d) He_2

18. How many (i) sp^2 hybridised carbon atoms and (ii) π bonds are present in the following compound? **(2020 Covid Re-NEET)**



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

19. The potential energy (y) curve for H_2 formation as a function of internuclear distance (x) of the H atoms is shown below.



The bond energy of H_2 is **(2020 Covid Re-NEET)**

(a) $\frac{(c-a)}{2}$

(b) $\frac{(b-a)}{2}$

(c) $(c-a)$

(d) $(b-a)$

20. Identify the wrongly matched pair. **(2020 Covid Re-NEET)**

Molecule	Shape or geometry of molecule
(a) SF_6	Octahedral
(b) $BeCl_2$	Linear
(c) NH_3	Trigonal pyramidal
(d) PCl_5	Trigonal planar

21. Which of the following diatomic molecular species has only π bonds according to Molecular Orbital Theory? **(2019)**

(a) O_2

(b) N_2

(c) C_2

(d) Be_2

22. Identify the incorrect statement related to PCl_5 from the following: **(2019)**

(a) Three equational P–Cl bonds make an angle of 120° with each other

(b) Two axial P–Cl bonds make an angle of 180° with each other

(c) Axial P–Cl bonds are longer than equatorial P–Cl bonds

(d) PCl_5 molecule is non-reactive

23. Consider the following species: **(2018)**

CN^+, CN^-, NO and CN

Which one of these will have the highest bond order?

(a) NO

(b) CN^-

(c) CN

(d) CN^+

24. Which one of the following pair of species have the same bond order? **(2017-Delhi)**

(a) N_2, O_2^-

(b) CO, NO

(c) O_2, NO^+

(d) CN^-, CO

25. The species, having bond angles of 120° is **(2017-Delhi)**

(a) BCl_3

(b) PH_3

(c) ClF_3

(d) NCl_3

26. Which one of the following ions is not tetrahedral in shape? **(2017-Gujarat)**

(a) $[NiCl_4]^{2-}$

(b) NH_4^+

(c) BF_4^-

(d) $[Cu(NH_3)_4]^{2+}$

27. Which of the following pair of species is not iso-structural? **(2017-Gujarat)**

(a) BrO_3^-, XeO_3

(b) ICl_4^-, XeF_4

(c) ClO_3^-, CO_3^{2-}

(d) IBr_2^-, XeF_2

28. Which of the following hydrides has the largest bond angle? **(2017-Gujarat)**

(a) H_2Se

(b) H_2S

(c) H_2Te

(d) H_2O

29. Which one of the following compounds shows the presence of intramolecular hydrogen bond? **(2016-II)**

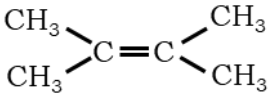
(a) Cellulose

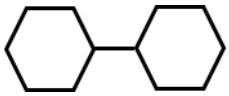
(b) Concentrated acid

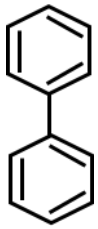
(c) H_2O_2

(d) HCN

30. In which of the following molecules, all atoms are coplanar? **(2016-II)**

(a) 

(b) 

(c) 

(d) 

31. Among the following which one is a wrong statement? **(2016-II)**

(a) SeF_4 and CH_4 have same shape

(b) I_3^+ has bent geometry

(c) PH_5 and $BiCl_5$ do not exist

(d) pπ – dπ bonds are present in SO_2

32. The hybridisations of atomic orbitals of nitrogen in NO_2^+, NO_3^- and NH_4^+ respectively are : **(2016-II)**
(a) sp, sp^3 and sp^2
(b) sp^2, sp^3 and sp
(c) sp, sp^2 and sp^3
(d) sp^2, sp and sp^3

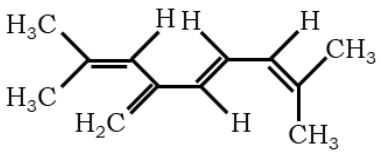
33. Which of the following pairs of ions is isoelectronic and isostructural? **(2016-II)**
(a) CO_3^{2-}, NO_3^-
(b) ClO_3^-, CO_3^{2-}
(c) SO_3^{2-}, NO_3^-
(d) ClO_3^-, SO_3^{2-}

34. Consider the molecules CH_4, NH_3 and H_2O. Which of the given statement is false? **(2016-I)**
(a) The H–C–H bond angle in CH_4 is larger than the H–N–H bond angle in NH_3
(b) 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°
(c) Then H–O–H bond angle in H_2O is larger than the H–C–H bond angle in CH_4
(d) The H–O–H bond angle in H_2O is smaller than the H–N–H bond angle in NH_3

35. Predict the correct order among the following: **(2016-I)**
(a) Lone pair – bond pair > bond pair – bond pair > lone pair – lone pair
(b) Lone pair – lone pair > lone pair – bond pair > bond pair – bond pair
(c) Lone pair – lone pair > bond pair – bond pair > lone pair – bond pair
(d) Bond pair – bond pair > lone pair – bond pair > lone pair – lone pair

36. Decreasing order of stability of O_2, O_2^-, O_2^+ and O_2^{2-} is : **(2015 RE)**
(a) $O_2^- > O_2^{2-} > O_2^+ > O_2$
(b) $O_2^+ > O_2 > O_2^- > O_2^{2-}$
(c) $O_2^{2-} > O_2^- > O_2 > O_2^+$
(d) $O_2 > O_2^+ > O_2^{2-} > O_2^-$

37. The total number of π-bond electrons in the following structure is: **(2015)**



(a) 8
(b) 12
(c) 16
(d) 4

38. Which of the following options represents the correct bond order? **(2015)**
(a) $O_2^- < O_2 < O_2^+$
(b) $O_2^- > O_2 < O_2^+$
(c) $O_2^- < O_2 > O_2^+$
(d) $O_2^- > O_2 > O_2^+$

39. The correct bond order in the following species is: **(2015)**
(a) $O_2^{2+} < O_2^- < O_2^+$
(b) $O_2^{2+} < O_2^- < O_2^+$
(c) $O_2^- < O_2^+ < O_2^{2+}$
(d) $O_2^{2+} < O_2^+ < O_2^-$

40. Which of the following pairs of ions are isoelectronic and isostructural? **(2015)**
(a) SO_3^{2-}, NO_3^-
(b) ClO_3^-, SO_3^{2-}
(c) CO_3^{2-}, SO_3^{2-}
(d) ClO_3^-, CO_3^{2-}

41. Maximum bond angle at nitrogen is present in which of the following? **(2015)**
(a) NO_2^+
(b) $2NO_3^-$
(c) NO_2
(d) NO_2^-

42. Which of the following molecules has the maximum dipole moment? **(2014)**
(a) CH_4
(b) NH_3
(c) NF_3
(d) CO_2

43. Which one of the following species has planar triangular shape? **(2014)**
(a) NO_3^-
(b) NO_2^-
(c) CO_2
(d) N_3

44. Which of the following organic compounds has same hybridization as its combustion product (CO_2)? **(2014)**
(a) Ethyne
(b) Ethene
(c) Ethanol
(d) Ethane

45. Which of the following is a polar molecule? **(2013)**
(a) BF_3
(b) SF_4

(c) SiF_4
(d) XeF_4

46. Which of the following is electron-deficient? **(2013)**

(a) $(CH_3)_2$
(b) $(SiH_3)_2$
(c) $(NH_3)_2$
(d) PH_3

47. Which of the following is paramagnetic? **(2013)**

(a) CO
(b) O_2^-
(c) CN
(d) NO^+

Answer Key

S1. Ans. (d)

S2. Ans. (d)

S3. Ans. (c)

S4. Ans. (d)

S5. Ans. (d)

S6. Ans. (c)

S7. Ans. (b)

S8. Ans. (c)

S9. Ans. (b)

S10. Ans. (a)

S11. Ans. (d)

S12. Ans. (d)

S13. Ans. (b)

S14. Ans. (d)

S15. Ans. (b)

S16. Ans. (c)

S17. Ans. (d)

S18. Ans. (b)

S19. Ans. (d)

S20. Ans. (d)

S21. Ans. (c)

S22. Ans. (d)

S23. Ans. (b)

S24. Ans. (d)

S25. Ans. (a)

S26. Ans. (d)

S27. Ans. (c)

S28. Ans. (d)

S29. Ans. (a)

S30. Ans. (c)

S31. Ans. (a)

S32. Ans. (c)

S33. Ans. (a/d)

S34. Ans. (c)

S35. Ans. (b)

S36. Ans. (b)

S37. Ans. (a)

S38. Ans. (a)

S39. Ans. (c)

S40. Ans. (b)

S41. Ans. (a)

S42. Ans. (b)

S43. Ans. (a)

S44. Ans. (a)

S45. Ans. (b)

S46. Ans. (c)

S47. Ans. (b)

Solutions

S1. Ans.(d)

$HF > NH_3 > H_2S > CH_4$ (non-polar)

S2. Ans.(d)

Total numbers electrons are same

Cr^{+2}, Ar, K^+, $Cl^- \rightarrow$ 20 electrons

S3. Ans.(c)

In the formation of BMO, the two electron waves of the bonding atoms reinforce each other due to constructive interference. Molecular orbitals obtained from $2P_x$ and $2P_y$ orbitals are 'unsymmetrical' around bond axis.

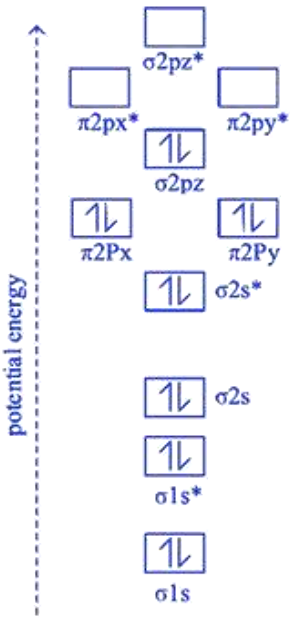
S4. Ans.(d)

Hydrated chlorides and Bromides of Ca, Sr and Ba are ionic so undergo dehydration after heating. Hydrated chlorides and Bromides of Be and Mg are covalent so undergo hydrolysis on Heating.

NH_3, $AlCl_3$, $BeCl_2$, CCl_4 PCl_5

S5. Ans.(d)

Molecular orbital (energy) diagram sequence of N_2



S6. Ans.(c)

Tl^+ & I^- > Tl^{+3} & $3I^-$

due to inert pair effect Tl^+ is more stable than Tl^{+3}.

S7. Ans.(b)

Intermolecular forces means force of attraction between two or more molecules dipole-dipole (attraction between two or more polar molecules).

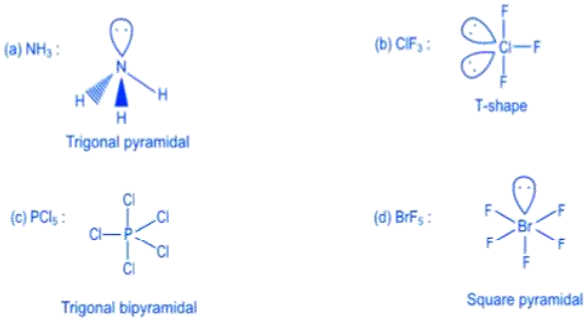
Dipole induced dipole (attraction between polar and non-polar molecules)

Hydrogen bonding (it is a special type of dipole-dipole and ion-dipole attraction)

Dispersion forces (mainly acts between non-polar molecules).

Covalent bonding (acts between atom not between molecules).

S8. Ans.(c)



A-iii, B-iv, C-ii, D-i

S9. Ans.(b)

$CO_2 \Longrightarrow sp^2$ hybridisation, bond angle = 180°

$NH_4^+ \Longrightarrow sp^3$ hybridisation, bond angle = 109° 28'

$NH_3 \Longrightarrow sp^3$ hybridisation with one lone pair on central atom, bond angle ≃ 107°

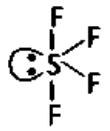
$H_2O \Longrightarrow sp^3$ hybridisation with two lone pairs on central atom, bond angle ≃ 104.5°

S10. Ans.(a)

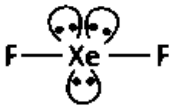
In general, interhalogen compounds are more reactive than halogens (except fluorine). This is because X-X' bond in interhalogens is weaker than X-X bond in halogens excepts F-F bond. Therefore I-Cl is more reactive than I_2 because of weaker I-Cl bond then I-I bond.

S11. Ans.(d)

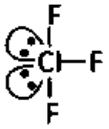
$SF_4 \rightarrow sp^3d$ + 1 lone pair



$XeF_2 \rightarrow sp^3d$ + 3 lone pair



$ClF_3 \rightarrow sp^3d$ + 2 lone pair



$IF_5 \rightarrow sp^3d^2$ + 1 lone pair

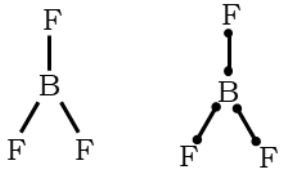
XeF_2 having maximum lone pairs, so, it has maximum 'lone pair – lone pair' electron repulsions.

S12. Ans.(d)

$\sigma 1s^2 \sigma^* 1s^2 \sigma 2s^2 \sigma^* 2s^2 \sigma 2p_z^2$ $\pi 2p_x^2$ | $\pi 2p_y^2$ $\pi^* 2p_x^1$ | $\pi 2p_y$

Due to one unpaired electron in π^*2p molecular orbital, O_2^+ is a paramagnetic ion.

S13. Ans.(b)

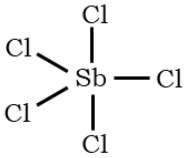


sp^2, Trigonal planar 6e– around central atom.

S14. Ans.(d)

		Hybridisa-tion	L.P.	Shape
A	PCl_5	sp^3d	0	Trigonal bipyramidal
B	SF_6	sp^3d^2	0	Octahedral
C	BrF_5	sp^3d^2	1	Square pyramidal
D	BF_3	sp^2	0	Trigonal planar

S15. Ans.(b)

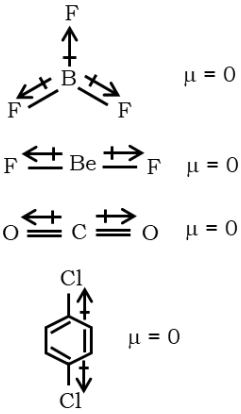


sp^3d Dipole moment (μ) = 0

Trigonal bipyramidal Non-polar

S16. Ans.(c)

The given set of molecules have dipole moment zero. Because dipoles of the bond cancel each other.



S17. Ans.(d)

For He_2 molecule

Electronic configuration is $\sigma\ 1s^2$, σ^*1s^2

$$B.O. = \frac{1}{2}(N_b - N_a)$$

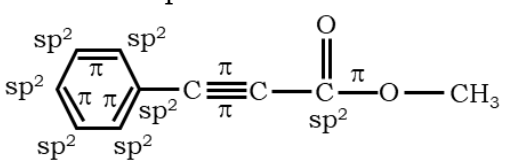
$$= \frac{1}{2}(2-2) = 0$$

The bond order comes out to be zero. This indicates that there is no bond formation between 2 He atoms and hence the He_2 molecule does not exist.

S18. Ans.(b)

(i) Number of sp^2 hybridised carbon atoms is 7

(i) Number of pi bonds is 6



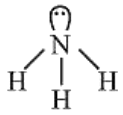
S19. Ans.(d)

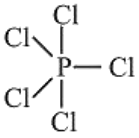
Potential energy of two H atoms at infinite distance = a

Potential energy of two H atoms at distance equal to bond length = b

So, the bond energy of H_2 = (b – a)

S20. Ans.(d)

NH_3  Trigonal pyramidal

PCl_5  Trigonal bipyramidal

SF_6  Octahedral

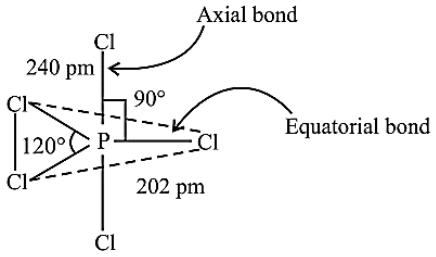
$BeCl_2$ Cl—Be—Cl Linear

S21. Ans.(c)

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

Double bond in C_2 consists of both π bonds because of the presence of four electrons in two π molecular orbital. In other molecule a double bond is made up of a sigma bond and a pi bond.

S22. Ans.(d)



(d) False

Due to longer and thus weaker axial bonds, PCl_5 is a reactive molecule.

S23. Ans.(b)

NO : , $(\sigma^*1s)^2, (\sigma 2s)^2, (\sigma^*2s)^2, (\sigma 2p_z)^2,$

$(\pi 2p_x)^2 = (\pi 2p_y)^2, (\pi^*2p_x)^1 = (\pi^*2p_y)^0$

$BO = \frac{10-5}{2} = 2.5$

CN^- : $(\sigma 1s)^2, (\sigma^*1s)^2, (\sigma 2s)^2, (\sigma^*2s)^2,$

$(\pi 2p_x)^2 = (\pi 2p_y)^2, (\sigma 2p_z)^2$

$BO = \frac{10-4}{2} = 3$

CN : $(\sigma 1s)^2, (\sigma^*1s)^2, (\sigma 2s)^2, (\sigma^*2s)^2,$

$(\pi 2p_x)^2 = (\pi 2p_y)^2, (\sigma 2p_z)^1$

$BO = \frac{9-4}{2} = 2.5$

CN^+ : $(\sigma 1s)^2, (\sigma^*1s)^2, (\sigma 2s)^2, (\sigma^*2s)^2,$

$(\pi 2p_x)^2 = (\pi 2p_y)^2$

$BO = \frac{8-4}{2} = 2$

Hence, option (b) should be the right answer.

S24. Ans.(d)

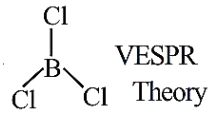
CN^- = 6 + 7 + 1 = 14

CO = 6 + 8 = 14

These two species are isoelectronic and iso structural in nature. Therefore, they have both have same bond order.

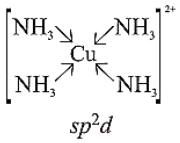
S25. Ans.(a)

BCl_3 having bond angles of 120°.



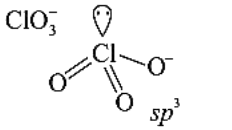
S26. Ans.(d)

$[Cu(NH_3)_4]^{2+}$ is not tetrahedral. It is a square planar complex.



sp^2d

S27. Ans.(c)



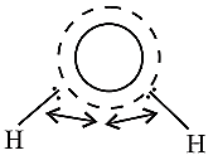
tetrahedral geometry trigonal planar pyramidal shape.

Hence, they both are not isostructural.

S28. Ans.(d)

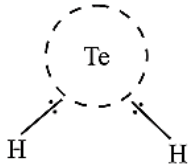
O, Se, Se, Te belong to Group 16.

On moving down the group, size of atom increases.



'O' is most electronegative and lone pairs lie close to the atom electron cloud. This causes repulsion in lone pairs of oxygen and bond pairs of hydrogen.

∴ Angle maximum due to l.p. – b.p. repulsion.



Te has maximum size: lone pair lie far away from the atom electron cloud. Lone pair – bond pair repulsion is the least.

S29. Ans.(a)

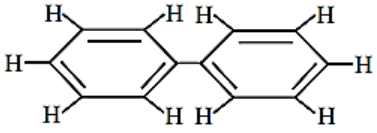
Intramolecular hydrogen bonding takes place within the same molecule i.e., between the atoms of the same molecule. Since, cellulose is a complex structure containing oxygen and hydrogen the bonding occurs between them easily.

Whereas, in HCN, H_2O_2 and concentrated acetic acid intermolecular hydrogen bonding occurs.

Eg.: $^{+}H-CN^{-}\cdots\cdots{}^{+}H-CN^{-}$

$^{-}CN-H^{+}$

S30. Ans.(c)



Coplanar are in a plane or where all C atoms are sp^2 hybridised.

S31. Ans.(a)

SeF_4 and CH_4 do not have same shape. SeF_4 is AB_4L type molecule with 4 bond pair and 1 lone pair with shape see-saw. CH_4 is AB_4 type molecule with no lone pair and tetrahedral shape.

I_3^+ have 2 lone pairs with bent/angular shape. $BiCl_5$ does not exists because of inert pair effect. SO_2 type molecule have both pπ – pπ & dπ – pπ bonds.

S32. Ans.(c)

Hybridisation state = Number of σ bond + number of lone pair

Or

Hybridisation state → from steric number rule

Hybridisation state

$$= \frac{1}{2}(\text{V.E} + \text{MA} - \text{C} + \text{a})$$

For, $NO_2^+ = \frac{1}{2}(5 + 0 - 1)$

$= 2 \rightarrow sp$

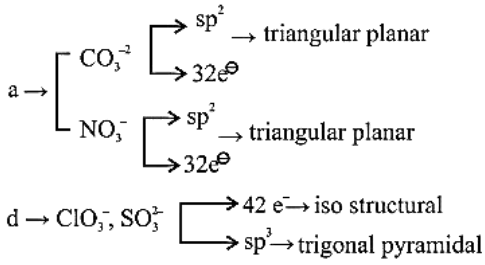
$NO_3^- = \frac{1}{2}[5 + 0 + 1]$

$= 3 \rightarrow sp^2$

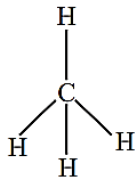
$NH_4^+ = \frac{1}{2}[5 + 4 - 1]$

$= 4 \rightarrow sp^3$

S33. Ans.(a, d)

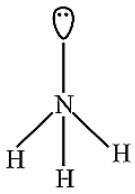


S34. Ans.(c)



CH_4 – sp^3 hybridised, tetrahedral bond angle 109°28'

NH_3 – sp^3 hybridised, bond angle – 107°



H_2O – sp^3 – bent shaped bond angle – 104°5'

So, bond angle of H_2O is less than that of NH_3 & CH_4

S35. Ans.(b)

Order of repulsing force according to VSEPR theory is lone pair – lone pair > lone pair – bond pair > bond pair – bond pair.

S36. Ans.(b)

O_2 (atomic number) = 16

Molecular orbital Diagram :

Bond order = ½ (No. of bonding orbital – no. of anti bonding orbitals)

= ½ (10 – 6) = 2

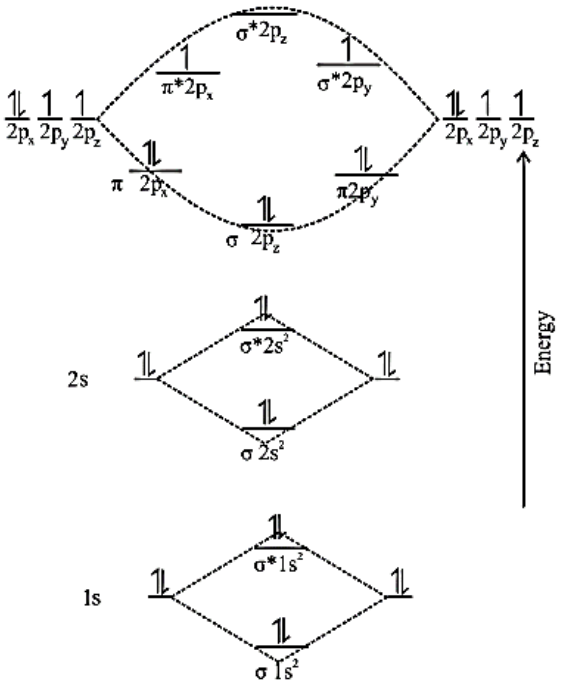
Similarly, For O_2^- = 1.5

O_2^{2-}= 1

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

∴ Order of Bond length

$= O_2^{2-} > O_2^- > O_2 > O_2^+$



S37. Ans.(a)

Each pi bond have $2e^-$ involved so 4 pi bonds = $8e^-$.

S38. Ans.(a)

Bond order : $O_2^- = 1.5 \quad O_2 = 2 \quad O_2^+ = 2.5$

$O_2^+ > O_2 > O_2^-$

S39. Ans.(c)

Indentation Bond order :

$O_2^{2+} = 3, O_2^- = 1.5, O_2^+ = 2.5$

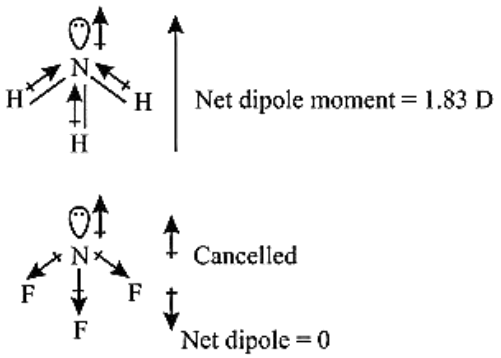
$\rightarrow O_2^{2+} > O_2^+ > O_2^-$

S40. Ans.(b)

S41. Ans.(a)

Species →	NO_3^-	NO_2	NO_2^-	NO_2^+
Hybd. →	sp^2	sp^2	sp^2	sp
Bond angle →	120°	134°	115°	180°
		↓	↓	
		B.P.– B.P. repulsion dominant	L.P. – B.P. repulsion dominant So, Bond angle ↓ So bond angle↑	

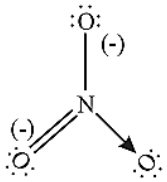
S42. Ans.(b)



= 0.23 D

S43. Ans.(a)

NO_3^- resonating structure

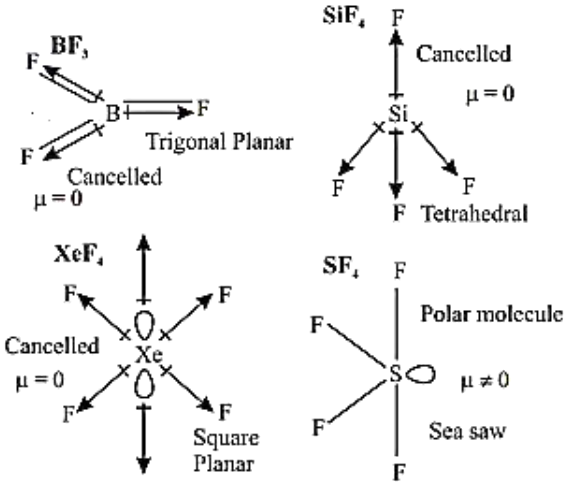


Planar structure

S44. Ans.(a)

Hybridisation of CO_2 is sp O = C = O and of ethyne C_2H_2 is sp H – C ≡ C – H

S45. Ans.(b)



S46. Ans.(c)

Among the 4 optuions $(CH_3)_2$, $(SiH_3)_2$ and PH_3 all have complete octets with $8e^-$. But BH_3 has only $6e^-$ and act as a Lewis acid.

S47. Ans.(b)

In paramagnetic species there is a presence of unpaired electrons.
Except 0_2^- all contains paired electrons.