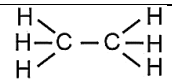
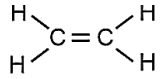
Solutions

S1. Ans.(b)

A	Ethane 	one (C – C) σ bond
B	Ethene 	one (C – C) σ and one (C – C) π bond
C	C_2	two (C – C) π bonds
D	Ethyne H – C ≡ C – H	two (C – C) π bonds and one (C – C) σ bond

S2. Ans.(d)

$NH_3 \Longrightarrow sp^3$ hybridised with 1 lone pair.

Structure will be Trigonal Pyramidal.

$BrF_5 \Longrightarrow sp^3d^2$ hybridised with 1 lone pair.

Structure will be Square Pyramidal.

$XeF_4 \Longrightarrow sp^3d^2$ with two lone pairs.

Structure will be Square Planar.

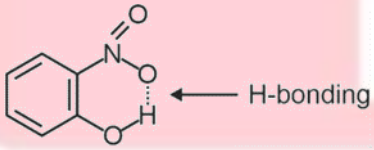
$SF_6 \Longrightarrow sp^3d^2$ with no lone pair.

Structure will be Octahedral.

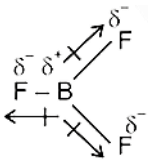
A-I, B-IV, C-II, D-III

S3. Ans.(d)

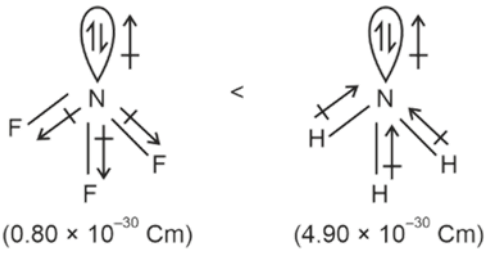
In o-nitrophenol intramolecular H-bonding is present.

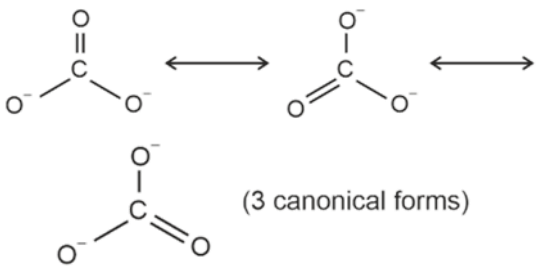


S4. Ans.(c)

(1) BF_3 i.e., 

Dipole moment = 0

(2) 

(3) 

(4) In ozone; there are two resonating structures.

S5. Ans.(d)

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

S6. Ans.(d)

Total numbers electrons are same

Ca^{+2}, Ar, K^+, Cl^- → 20 electrons

S7. 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.

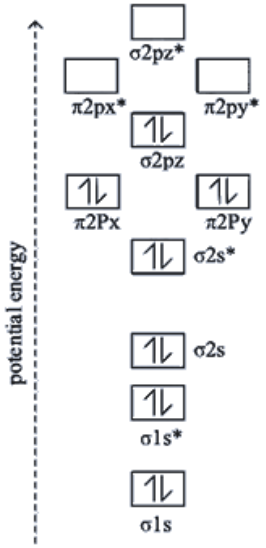
S8. Ans.(d)

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

S9. Ans.(d)

Molecular orbital (energy) diagram sequence of N_2



S10. Ans.(c)

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

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

S11. 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).

S12. Ans.(c)

(a) NH_3: Trigonal pyramidal

(b) ClF_3: T – shape

(c) PCl_5: Trigonal *bi*pyramidal

(d) BrF_5: Square pyramidal

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

S13. Ans.(b)

CO_2 ⟹ sp^2 hybridisation, bond angle = 180°

NH_4^+ ⟹ sp^3 hybridisation, bond angle = 109° 28'

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

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

S14. 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 than I-I bond.

S15. 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

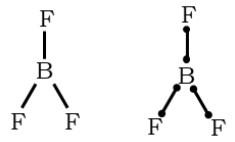
XeF_2 having maximum lone pairs, so, it has maximum 'lone pair – lone pair' electron repulsions.

S16. Ans.(d)

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

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

S17. Ans.(b)

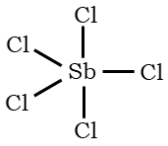


sp^2, Trigonal planar 6e– around central atom.

S18. Ans.(d)

		Hybridi-sation	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

S19. Ans.(b)

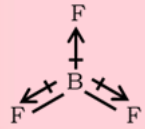


sp^3d Dipole moment (μ) = 0

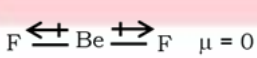
Trigonal bipyramidal Non-polar

S20. Ans.(c)

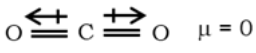
The given set of molecules have dipole moment zero. Because dipoles of the bond cancel each other.



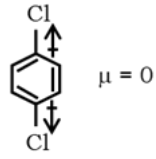
μ = 0



μ = 0



μ = 0



μ = 0

S21. Ans.(d)

For He_2 molecule

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

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

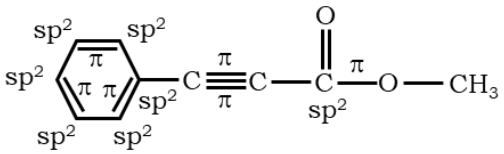
$= \frac{1}{2}(2-2) = 0$

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.

S22. Ans.(b)

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

(i) Number of pi bonds is 6



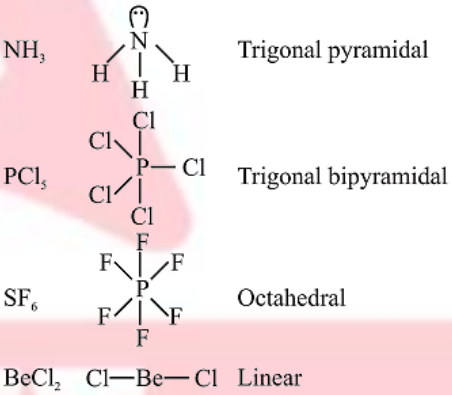
S23. Ans.(d)

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)

S24. Ans.(d)

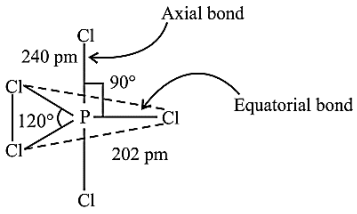


S25. Ans.(c)

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

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.

S26. Ans.(d)



(d) False

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

S27. 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.

S28. Ans.(a)

$\overset{\ominus}{O} - C \equiv \overset{\oplus}{O}$ is less stable than O = C = C, as charge separation occur in it.

S29. Ans.(d)

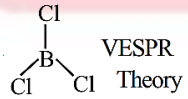
CN^- = 6 + 7 + 1 = 14

CO = 6 + 8 = 14

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

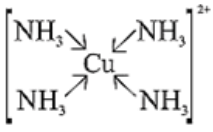
S30. Ans.(a)

BCl_3 having bond angles of 120°.



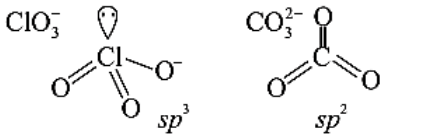
S31. Ans.(d)

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



sp^2d

S32. Ans.(c)



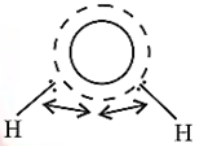
tetrahedral geometry pyramidal shape. trigonal planar

Hence, they both are not isostructural.

S33. Ans.(d)

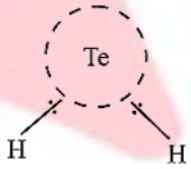
O, Se, Se, Te belong to Group 16.

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.



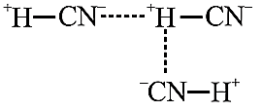
Te has maximum size: lone pair lie far away from the atom electron cloud. Lone pair – bond pair repulsion is the least.

S34. Ans.(a)

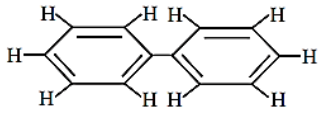
Intramolecular hydrogen bonding takes place within the same molecule i.e., between the atoms of the same molecule. Since, cellulose is a complex structure containing oxygen and hydrogen the bonding occurs between them easily.

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

Eg.:



S35. Ans.(c)



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

S36. 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 $p\pi - p\pi$ & $d\pi - p\pi$ bonds.

S37. Ans.(c)

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

Or

Hybridisation state → from steric number rule

Hybridisation state

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

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

$= 2 \rightarrow sp$

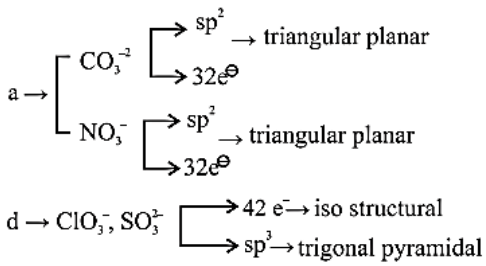
$NO_3^- = \frac{1}{2}[5 + 0 + 1]$

$= 3 \rightarrow sp^2$

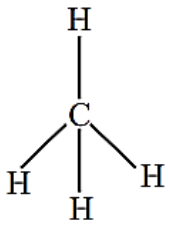
$NH_4^+ = \frac{1}{2}[5 + 4 - 1]$

$= 4 \rightarrow sp^3$

S38. Ans.(a, d)

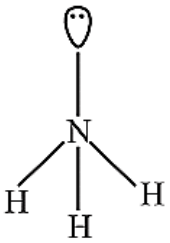


S39. Ans.(c)



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

S40. Ans.(b)

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

S41. 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

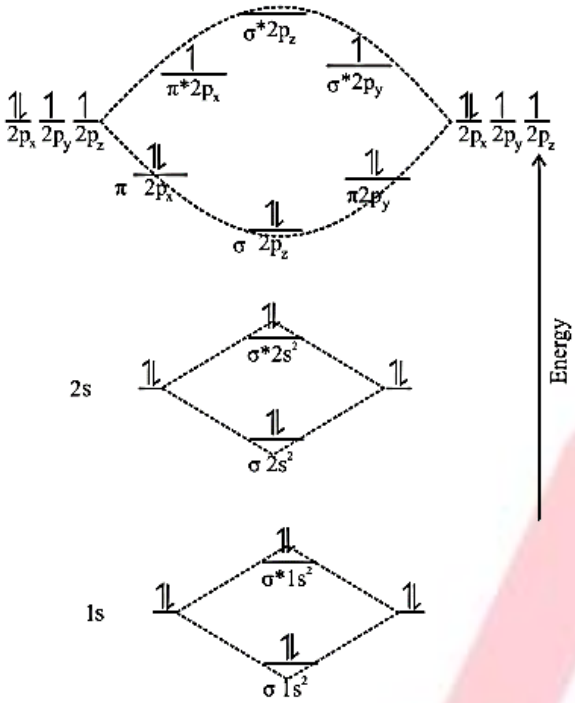
Similarly, For O_2^- = 1.5

O_2^{2-} = 1

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

∴ Order of Bond length

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



S42. Ans.(a)

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

S43. Ans.(a)

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

$O_2^+ > O_2 > O_2^-$

S44. Ans.(c)

Indentation Bond order :

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

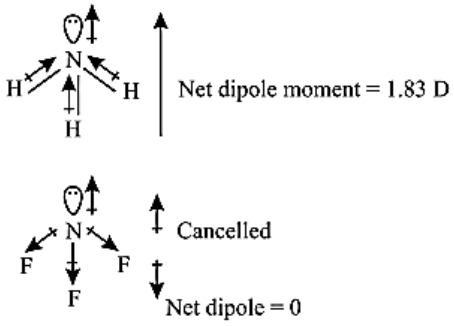
$\rightarrow O_2^{2+} > O_2^+ > O_2^-$

S45. Ans.(b)

S46. 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↑	

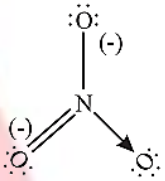
S47. Ans.(b)



= 0.23 D

S48. Ans.(a)

NO_3^- resonating structure

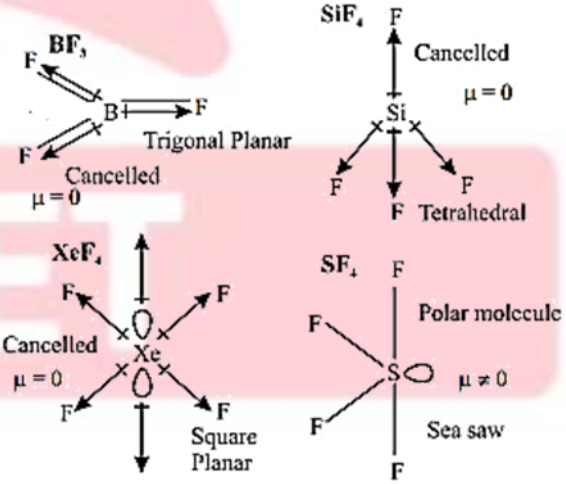


Planar structure

S49. Ans.(a)

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

S50. Ans.(b)



S51. 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.

S52. Ans.(b)

In paramagnetic species there is a presence of unpaired electrons.

Except O_2^- all contains paired electrons.