Daily Tutorial Sheet-2	JEE Main (Archive)

16.(A) The value of lattice energy depends on the charges present on the two ions and the distance between them.

17.(C) The distribution of electrons in MOs is an follows:

N_2^+ (electrons 13) $\sigma^2\sigma^{*2}2\sigma^{*2}\begin{matrix}\pi^2\\\pi^2\end{matrix}\sigma^1\begin{matrix}\pi^*\\\pi^*\end{matrix}\sigma^*$

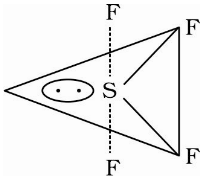
O_2 (electrons 16) $\sigma^2\sigma^{*2}\sigma^2\sigma^{*2}\sigma^2\begin{matrix}\pi^2\,\pi^{*1}\\\pi^2\,\pi^{*1}\end{matrix}\sigma^*$

O_2^{2-} (electrons 18) $\sigma^2\sigma^{*2}\sigma^2\sigma^{*2}\sigma^2\begin{matrix}\pi^2\,\pi^*\\\pi^2\,\pi^*\end{matrix}\sigma^*$

B_2 (electrons 10) $\sigma^2\sigma^{*2}\sigma^2\sigma^{*2}\begin{matrix}\pi^1\\\pi^1\end{matrix}$

Only O_2^{2-} does not contain any unpaired electron.

18.(D) In SF_4 the hybridization is sp^3d and the shape of molecule is



19.(B) The bond angle decreases on moving down the group due to decrease in bond pair-bond pair repulsion.

NH_3	PH_3	AsH_3	SbH_3	BiH_3
107°	94°	92°	91°	90°

NOTE: This can also be explained by the fact that as the size of central atom increases sp^3 hybrid orbital becomes more distinct with increasing size of central atom i.e. pure p-orbitals are utilized in M-H bonding

20.(B) Diamagnetic species have no unpaired electrons

$O_2^{2-} \Rightarrow \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma * 2s^2, \sigma 2p_x^2, \{\pi 2p_y^2 = \pi 2p_z^2, \{\pi * 2p_y^2 = \pi * 2p_z^2$

Whereas paramagnetic species has one ore more unpaired electrons as in

$O_2 \rightarrow \sigma 1s^2, \sigma * 1s^2, \sigma 2s^2, \sigma * 2s^2, \sigma 2p_x^2, \{\pi 2p_y^2 = \pi 2p_z^2, \{\pi^* 2p_y^1 = \pi^* 2p_z^1 - 2$ unpaired electrons

$O_2^+ \rightarrow \sigma 1s^2, \sigma * 1s^2, \sigma 2s^2, \sigma * 2s^2, \sigma 2p_x^2, \{\pi 2p_y^2 = \pi 2p_z^2 \{\pi^* 2p_y^1 = \pi^* 2p_z^0 - 1$ unpaired electron

$NO \rightarrow \sigma 1s^2, \sigma * 1s^2, \sigma 2s^2, \sigma * 2s^2, \sigma 2p_x^2, \{\pi 2p_y^2 = \pi 2p_z^2, \{\pi * 2p_y^1 = \pi * 2p_z^0 - 1$ unpaired electron

21.(D) Smaller the size and higher the charge more will be polarizing power of cation. Since the order of the size of cation is $K^+ > Ca^{++} > Mg^{++} > Be^{++}$. So the correct order of polarizing power is

$K^+ < Ca^{2+} < Mg^{2+} < Be^{2+}$

22.(C) (a) N_2 : bond order 3, paramagnetic

N_2^- : bond order, 2.5, paramagnetic

(b) C_2 : bond order 2, diamagnetic

C_2^+ : bond order 1.5, paramagnetic

(c) NO : bond order 2.5, paramagnetic

NO^+ : bond order 3, diamagnetic

(d) O_2 : bond order 2, paramagnetic

O_2^+ : bond order 2.5, paramagnetic

23.(C) **NOTE:** Greater the difference between electronegativity of bonded atoms, stronger will be bond. Since F is most electronegative hence $F-H......F$ is the strongest bond.

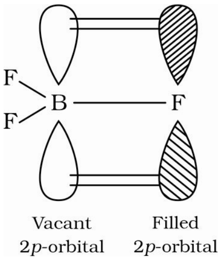
24.(A) For any species to have same bond order we can expect them to have same number of electrons. Calculating the number of electrons in various species.

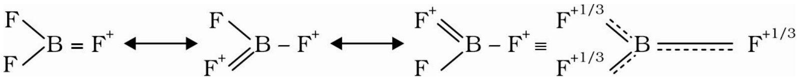
$O_2^-(8+8+1=17); CN^-(6+7+1=14)$

$NO^+(7+8-1=14); CN^+(6+7-1=12)$

We find CN^- and NO^+ both have 14 electrons so they have same bond order. Correct is (A).

25.(B) **NOTE:** The delocalized $p\pi - p\pi$ bonding between filled p-orbital of F and vacant p-orbital of B leads to shortening of $B-F$ bond length which results in higher bond dissociation energy of the $B-F$ bond.





26.(D) Bond order $= \dfrac{\text{No. of bonding electrons} - \text{No. of anti bonding electrons}}{2}$

Bond order in $O_2^+ = \dfrac{10-5}{2} = 2.5$

Bond order in $O_2^- = \dfrac{10-7}{2} = 1.5$

Bond order in $O_2^{2-} = \dfrac{10-8}{2} = 1$

Bond order in $O_2^{2+} = \dfrac{10-4}{2} = 3$

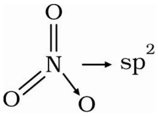
Since Bond order $\propto \dfrac{1}{\text{Bond length}}$

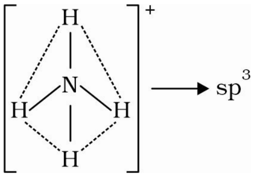
$\therefore$ Bond length is shortest in O_2^{2+}.

27.(C) The proportion of covalent character in an ionic bond is decided by polarizability of the metal cation as well as the electronegativity of both elements involved in bonding. Polarisability is further decided by the density of positive charge on the metal cation. $AlCl_3$ is considered to show maximum covalent character among the given compounds. This is because Al^{3+} bears 3 unit of positive charge and shows strong tendency to distort the electron cloud, thus the covalent character in Al-Cl bond dramatically increases.

28.(B) The formula to find the hybridization of central atom is $Z = \frac{1}{2}$[Number of valence electrons on central atom + No. of monovalent atom attached to it + negative charge if any – positive charge if any]

For $NO_3^-, Z = \frac{1}{2}\left[5+0+1-0\right] = 3$



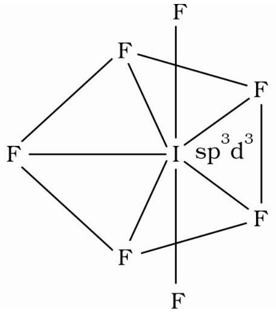


For $NO_2^+, Z = \frac{1}{2}\left[5+0+0-1\right] = 2$

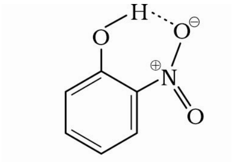
$O = \overset{+}{N} = O \rightarrow sp$

For $NH_4^+, Z = \frac{1}{2}\left[5+4+0-1\right] = 4$

29.(D) Pentagonal bipyramidal shape.



30.(B) Compounds involved in chelation become non-polar. Consequently such compounds are soluble in non-polar solvents like ether, benzene etc. and are only sparingly soluble in water whereas meta and para isomers are more soluble in water & less soluble in non-polar solvents.



intra-molecular H-bonding