

CHEMICAL BONDING

1. The element that shows greater ability to form $p\pi-p\pi$ multiple bonds, is :
(1) Si (2) Ge (3) Sn (4) C
2. The element that does NOT show catenation is:
(1) Sn (2) Ge (3) Si (4) Pb
3. The chloride that CANNOT get hydrolysed is :
(1) SiCl_4 (2) SnCl_4 (3) PbCl_4 (4) CCl_4
4. The relative stability of +1 oxidation state of group 13 elements follows the order :-
(1) $\text{Al} < \text{Ga} < \text{Tl} < \text{In}$
(2) $\text{Tl} < \text{In} < \text{Ga} < \text{Al}$
(3) $\text{Al} < \text{Ga} < \text{In} < \text{Tl}$
(4) $\text{Ga} < \text{Al} < \text{In} < \text{Tl}$
5. The hydride that is NOT electron deficient is :-
(1) B_2H_6 (2) AlH_3 (3) SiH_4 (4) GaH_3
6. The type of hybridisation and number of lone pair(s) of electrons of Xe in XeOF_4 , respectively, are :
(1) sp^3d and 1 (2) sp^3d and 2
(3) sp^3d^2 and 1 (4) sp^3d^2 and 2
7. Two pi and half sigma bonds are present in:
(1) N_2^+ (2) N_2 (3) O_2^+ (4) O_2
8. The pair that contains two P-H bonds in each of the oxoacids is :
(1) H_3PO_2 and $\text{H}_4\text{P}_2\text{O}_5$
(2) $\text{H}_4\text{P}_2\text{O}_5$ and $\text{H}_4\text{P}_2\text{O}_6$
(3) H_3PO_3 and H_3PO_2
(4) $\text{H}_4\text{P}_2\text{O}_5$ and H_3PO_3
9. According to molecular orbital theory, which of the following is true with respect to Li_2^+ and Li_2^- ?
(1) Both are unstable
(2) Li_2^+ is unstable and Li_2^- is stable
(3) Li_2^+ is stable and Li_2^- is unstable
(4) Both are stable
10. C_{60} , an allotrope of carbon contains :
(1) 20 hexagons and 12 pentagons.
(2) 12 hexagons and 20 pentagons.
(3) 18 hexagons and 14 pentagons.
(4) 16 hexagons and 16 pentagons.
11. Aluminium is usually found in +3 oxidation state. In contrast, thallium exists in +1 and +3 oxidation states. This is due to :
(1) lanthanoid contraction
(2) lattice effect
(3) diagonal relationship
(4) inert pair effect
12. Good reducing nature of H_3PO_2 attributed to the presence of:
(1) One P-OH bond (2) One P-H bond
(3) Two P-H bonds (4) Two P-OH bonds
13. In which of the following processes, the bond order has increased and paramagnetic character has changed to diamagnetic ?
(1) $\text{N}_2 \rightarrow \text{N}_2^+$ (2) $\text{NO} \rightarrow \text{NO}^+$
(3) $\text{O}_2 \rightarrow \text{O}_2^{2-}$ (4) $\text{O}_2 \rightarrow \text{O}_2^+$
14. The number of 2-centre-2-electron and 3-centre-2-electron bonds in B_2H_6 , respectively, are :
(1) 2 and 4 (2) 2 and 1
(3) 2 and 2 (4) 4 and 2
15. The C-C bond length is maximum in
(1) graphite (2) C_{70}
(3) diamond (4) C_{60}
16. The correct sequence of thermal stability of the following carbonates is
(1) $\text{BaCO}_3 < \text{CaCO}_3 < \text{SrCO}_3 < \text{MgCO}_3$
(2) $\text{MgCO}_3 < \text{CaCO}_3 < \text{SrCO}_3 < \text{BaCO}_3$
(3) $\text{BaCO}_3 < \text{SrCO}_3 < \text{CaCO}_3 < \text{MgCO}_3$
(4) $\text{MgCO}_3 < \text{SrCO}_3 < \text{CaCO}_3 < \text{BaCO}_3$
17. The correct statement among the following is
(1) $(\text{SiH}_3)_3\text{N}$ is pyramidal and more basic than $(\text{CH}_3)_3\text{N}$
(2) $(\text{SiH}_3)_3\text{N}$ is planar and more basic than $(\text{CH}_3)_3\text{N}$
(3) $(\text{SiH}_3)_3\text{N}$ is pyramidal and less basic than $(\text{CH}_3)_3\text{N}$
(4) $(\text{SiH}_3)_3\text{N}$ is planar and less basic than $(\text{CH}_3)_3\text{N}$
18. The basic structural unit of feldspar, zeolites, mica, and asbestos is :
(1) $(\text{SiO}_3)^{2-}$ (2) SiO_2
(3) $(\text{SiO}_4)^{4-}$ (4) $\begin{matrix} \text{R} \\ | \\ (\text{Si}-\text{O})_n \\ | \\ \text{R} \end{matrix}$ (R=Me)

19. The number of pentagons in C_{60} and trigons (triangles) in white phosphorus, respectively, are:
 (1) 12 and 3 (2) 20 and 4
 (3) 12 and 4 (4) 20 and 3
20. The ion that has sp^3d^2 hybridization for the central atom, is :
 (1) $[ICl_2]^-$ (2) $[IF_6]^-$
 (3) $[ICl_4]^-$ (4) $[BrF_2]^-$
21. The covalent alkaline earth metal halide ($X = Cl, Br, I$) is :
 (1) CaX_2 (2) SrX_2
 (3) BeX_2 (4) MgX_2
22. 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) C_2^{2-} (2) N_2^{2-} (3) O_2 (4) O_2^{2-}
23. The correct statement about ICl_5 and ICl_4^- is
 (1) ICl_5 is trigonal bipyramidal and ICl_4^- is tetrahedral.
 (2) ICl_5 is square pyramidal and ICl_4^- is tetrahedral.
 (3) ICl_5 is square pyramidal and ICl_4^- is square planar.
 (4) Both are isostructural.
24. The correct order of the oxidation states of nitrogen in NO, N_2O, NO_2 and N_2O_3 is :
 (1) $NO_2 < N_2O_3 < NO < N_2O$
 (2) $NO_2 < NO < N_2O_3 < N_2O$
 (3) $N_2O < N_2O_3 < NO < NO_2$
 (4) $N_2O < NO < N_2O_3 < NO_2$
25. Among the following, the molecule expected to be stabilized by anion formation is :
 C_2, O_2, NO, F_2
 (1) NO (2) C_2 (3) F_2 (4) O_2
26. The number of water molecule(s) not coordinated to copper ion directly in $CuSO_4 \cdot 5H_2O$, is :
 (1) 4 (2) 3 (3) 1 (4) 2
27. Among the following species, the diamagnetic molecule is
 (1) O_2 (2) NO
 (3) B_2 (4) CO
28. The structures of beryllium chloride in the solid state and vapour, phase, respectively, are :
 (1) chain and dimeric (2) chain and chain
 (3) dimeric and dimeric (4) dimeric and chain
29. HF has highest boiling point among hydrogen halides, because it has :
 (1) lowest dissociation enthalpy
 (2) strongest van der Waals' interactions
 (3) strongest hydrogen bonding
 (4) lowest ionic character
30. The correct statements among I to III are :
 (I) Valence bond theory cannot explain the color exhibited by transition metal complexes.
 (II) Valence bond theory can predict quantitatively the magnetic properties of transition metal complexes.
 (III) Valence bond theory cannot distinguish ligands as weak and strong field ones.
 (1) (I) and (II) only
 (2) (I), (II) and (III)
 (3) (I) and (III) only
 (4) (II) and (III) only
31. The oxoacid of sulphur that does not contain bond between sulphur atoms is :
 (1) $H_2S_4O_6$ (2) $H_2S_2O_7$
 (3) $H_2S_2O_3$ (4) $H_2S_2O_4$
32. During the change of O_2 to O_2^- , the incoming electron goes to the orbital :
 (1) $\sigma^* 2P_z$ (2) $\pi 2P_y$
 (3) $\pi^* 2P_x$ (4) $\pi 2P_x$

SOLUTION

1. Ans. (4)

Carbon atom have 2p orbitals able to form strongest $p\pi - p\pi$ bonds

2. Ans. (4)

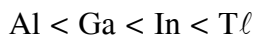
Catenation is not shown by lead.

3. Ans. (4)

CCl_4 cannot get hydrolyzed due to the absence of vacant orbital at carbon atom.

4. Ans. (3)

Due to inert pair effect as we move down the group in 13th group lower oxidation state becomes more stable.



5. Ans. (3)

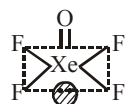
(1) B_2H_6 : Electron deficient

(2) AlH_3 : Electron deficient

(3) SiH_4 : Electron precise

(4) GaH_3 : Electron deficient

6. Ans. (3)



$sp^3d^2 \Rightarrow [5\sigma\text{-bond} + 1 \text{ l.p.}]$

7. Ans. (1)

$$N_2^{\oplus} \Rightarrow BO = 2.5 \Rightarrow \left[\pi\text{-Bond} = 2 \ \& \ \sigma\text{-Bond} = \frac{1}{2} \right]$$

$$N_2 \Rightarrow B.O. = 3.0 \Rightarrow [\pi\text{-Bond} = 2 \ \& \ \sigma\text{-Bond} = 1]$$

$$O_2^{\oplus} = B.O. \Rightarrow 2.5 \Rightarrow [\pi\text{-Bond} = 1.5 \ \& \ \sigma\text{-Bond} = 1]$$

$$O_2 \Rightarrow B.O. \Rightarrow 2 \Rightarrow [\pi\text{-Bond} \Rightarrow 1 \ \& \ \sigma\text{-Bond} = 1]$$

8. Ans. (1)

9. Ans. (4)

Both Li_2^+ and Li_2^- has 0.5 bond order and hence both are stable.

10. Ans.(1)

In C_{60} molecule there are 20 hexagons and 12 pentagons

\therefore Ans.(1)

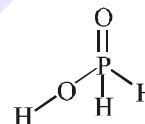
11. Ans. (4)

Inert pair effect is prominent character of p-block element.

12. Ans. (3)

H_3PO_2 is good reducing agent due to presence

of two P-H bonds.



13. Ans. (2)

Process	Change in magnetic nature	Bond Order Change
$N_2 \rightarrow N_2^+$	Dia \rightarrow para	$3 \rightarrow 2.5$
$NO \rightarrow NO^+$	Para \rightarrow Dia	$2.5 \rightarrow 3$
$O_2 \rightarrow O_2^{2-}$	Para \rightarrow Dia	$2 \rightarrow 1$
$O_2 \rightarrow O_2^+$	Para \rightarrow Para	$2 \rightarrow 2.5$

14. Ans. (4)

15. Ans.(3)

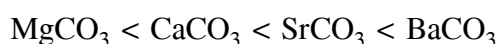
In diamond C-C bond have only σ bond character while in case of graphite and fullerene (C_{60} and C_{70}) C-C bond contain double bond character. That's why diamond having maximum C-C bond length.

16. Ans.(2)

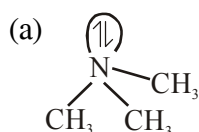
Thermal stability of Alkaline earth metals carbonates increases down the group.

because down the group polarizing power of cation decreases. So thermal stability increases.

Hence, Thermal stability order :

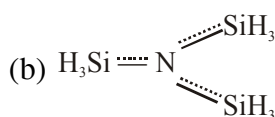


17. Ans.(4)



nitrogen is sp^3 hybrid and pyramidal

no back-bonding i.e. more basic



Nitrogen sp^2 hybrid and planar due to back bonding and less basic because lone pair is not available for donation.

18. Ans.(3)

Fledspar - $\text{KAlSi}_3\text{O}_8 - \text{NaAlSi}_3\text{O}_8 - \text{CaAl}_2\text{Si}_2\text{O}_8$

Zeolites - $\text{NaAlSi}_2\text{O}_6 \cdot \text{H}_2\text{O}$

mica - $\text{KAl}_3\text{Si}_3\text{O}_{10}(\text{OH})_2$

asbestos - $\text{Mg}_3\text{Si}_2\text{O}_5(\text{OH})_4$

These all are silicates having basic unit $(\text{SiO}_4)^{4-}$

19. Ans.(3)

Total No. of pentagons in $\text{C}_{60} = 12$

Total no. of trigons (triangles) in white phosphorus (P_4) = 4

20. Ans.(3)

Chemical species Hybridisation of central atom



21. Ans.(3)

All halides of Be are predominantly covalent in nature.

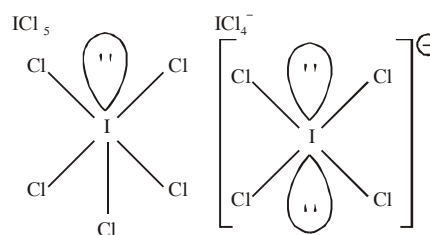
22. Ans.(1)

Chemical Species	Bond Order	Magnetic behaviour
C_2^{2-}	3	diamagnetic
N_2^{2-}	2	paramagnetic
O_2	2	paramagnetic
O_2^{2-}	1	diamagnetic

$$\text{B.O.} \propto \frac{1}{\text{bond length}}$$

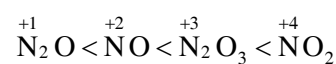
23. Ans.(3)

Chemical species	Hybridisation	Shape
ICl_5	sp^3d^2	Square pyramidal
ICl_4^-	sp^3d^2	Square planar



24. Ans.(4)

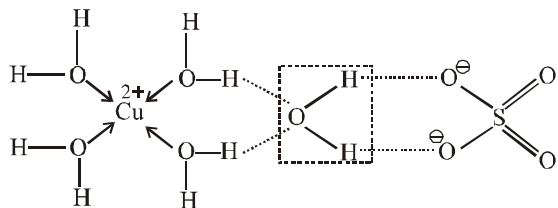
Correct order of oxidation state of nitrogen in oxides of nitrogen is following



25. Ans.(2)

In case of only C_2 , incoming electron will enter in the bonding molecular orbital which increases the bond order and stability too. Whereas rest of all takes electron in their antibonding molecular orbital which decreases bond order and stability.

26. Ans.(3)



One water molecule as shown in the diagram, is not coordinated to copper ion directly.

27. Ans.(4)

O_2, NO, B_2 are paramagnetic according to M.O.T. where as CO is diamagnetic.

28. Ans.(1)

$BeCl_2$ exist as $(BeCl_2)_n$ polymeric chain in solid form, while $BeCl_2$ exist as dimer $(BeCl_2)_2$ in vapour phase.

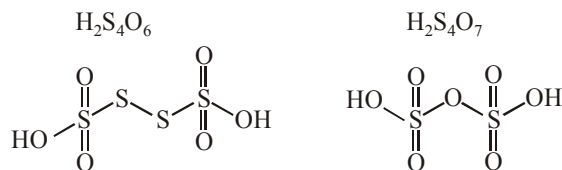
29. Ans.(3)

HF has highest boiling point among hydrogen halides because it has strongest hydrogen bonding

30. Ans.(3)

Based on NCERT, statement of limitations of VBT, I & III are correct

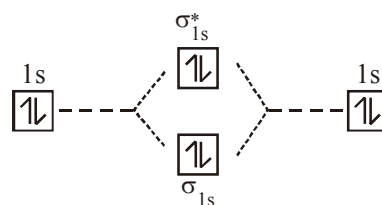
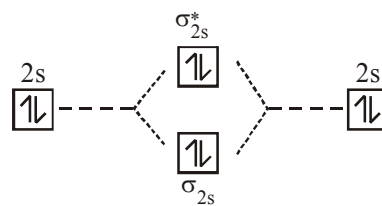
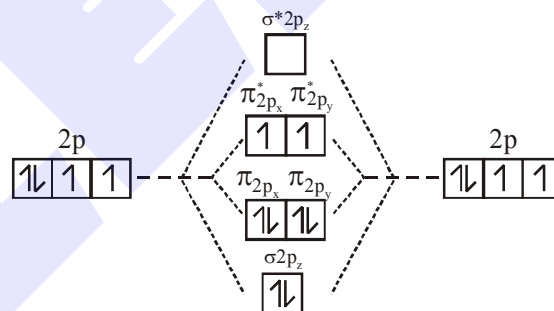
31. Ans.(2)



$H_2S_2O_7$ does not contain bond between sulphur atoms.

32. Ans.(3)

Molecular orbital diagram of O_2 is



An incoming electron will go in $\pi_{2p_x}^*$ orbital.