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India's Number 1 Education App

## CHEMISTRY

## BOOKS - S DINESH \& CO CHEMISTRY (HINGLISH)

## CHEMICAL BONDING AND MOLECULAR STRUCTURE

## Example

1. Write the Lewis dot symbols of the following elements and predict their valencies :(i) Na (ii) Mg (iii) P (iv)S(v)Cl (vi) Ar.

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2. Deduce the empirical formulae and draw Lewis structures for the ionic compounds formed from the following pairs of elements

Na, O ,K, S , Na P , Mg, Br, Al, F, Ca, O, li, S
3. Write the various steps involved in the Lewis structure for nitrate $\left(\mathrm{NO}_{3}^{-}\right)$ion.

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4. Write the Lewis dot structure of $C O$ molecule .

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5. Write the formal charges on atoms in (i) and carbonate ion (ii) nitrite ion.
6. By using an expanded octen for the sulphur atom in thionyl chloride $\left(\mathrm{SOCl}_{2}\right)$, write a Lewis structure with no charge.

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7. Identify the atoms in each of the following compounds which do not obey octet rule :
$\mathrm{SO}_{2}, \mathrm{NH}_{3}, \mathrm{OF}_{2}, \mathrm{BCl}_{3}, \mathrm{PCl}_{3}$

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8. Explain the structure of $\mathrm{CO}_{3}^{2-}$ ion in terms of resonance
(b) Explain the resonance structures of $\mathrm{CO}_{2}$ molecule .

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9. Explain the structure of $\mathrm{CO}_{2}$ molecule.
10. On the basis of VSEPR theory, prefict the shapes of the following molecules ions:
(i) $\mathrm{ClF}_{3}$
(ii) $B r F_{5}$
(iii) $I F_{7}$
(iv) $\mathrm{H}_{3} \mathrm{O}^{+}$ion.

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11. The dipole moment of $L i H$ is $1.964 \times 10^{-29} C-m$ and the interatomic distance between $L i$ and $H$ in this molecule is $1.596 \AA$. What is the percentage of ionic character in $L i H$ ?

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12. Sketch the bond moments and resultant dipole moments in cis and trans forms of $\mathrm{C}_{2} \mathrm{H}_{2} \mathrm{Cl}_{2}$
13. Explain the formation of chemical bond.

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2. Write the Lewis dot symbols of the following elements:
$\mathrm{Be}, \mathrm{Na}, \mathrm{B}, \mathrm{O}, \mathrm{N}, \mathrm{Br}$.

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3. Write the Lewis dot symbole of the following atoms and ions :

S and $\mathrm{S}^{2-}$, P and $P^{3-}$, Na and $N a^{+}$, Al and $A l^{3+}, \mathrm{H}$ nad $H^{-}$

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4. Draw the Lewis structures the following molecules and ions :
$\mathrm{PH}_{3}, \mathrm{H}_{2} \mathrm{~S}, \mathrm{SiCl}_{4}, \mathrm{BeF}_{2}, \mathrm{AlI}_{3}^{2-}$, HCOOH
5. Define octet rule. Write its significance and limitations.

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6. Write the favourable factors for the formation of ionic bond.

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7. Discuss the shape of the following molecules using the $V S E P R$ model:
$B e C l_{2}, B C l_{3}, S i C l_{4}, A s F_{5}, H_{2} S, P H_{3}$

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8. Although geometries of $\mathrm{NH}_{3}$ and $\mathrm{H}_{2} \mathrm{O}$ molecules are distorted tetrahedral, bond angle in water is less than that of ammonia. Discuss.

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9. How do you express the bond strength in terms of bond order?

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10. EXPLAIN BOND PARAMETERS- BOND LENGTH,BOND ORDER AND BOND STRENGTH

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11. Explain the important aspects of resonance with respect to the $\mathrm{CO}_{3}^{2-}$ ion.
12. $\mathrm{H}_{3} \mathrm{PO}_{3}$ can be represented by structure (a) and (b) shown below. Can these two structures be taken as the canonical forms of the resonance hybrid representing $\mathrm{H}_{3} \mathrm{PO}_{3}$ ? If not, give reasons for the same.


## (a)


(b)

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13. Write the resonance structures for $\mathrm{SO}_{3}, \mathrm{NO}_{2}^{\ominus}$, and $\mathrm{NO}_{3}^{\ominus}$.

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14. Using Lewis dot symbols, show electron transfer between the following atoms to form cations and anions :
(a) Na and Cl
(b) K and S (c ) Ca and O (d) Al and N.

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15. Although both $\mathrm{CO}_{2}$ and $\mathrm{H}_{2} \mathrm{O}$ are triatomic molecules, the shape of $\mathrm{H}_{2} \mathrm{O}$ molecules in bent while that of $\mathrm{CO}_{2}$ is linear. Explain this on the basis of dipole moment.

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16. a) Discuss the significance/applications of dipole moment.
b) Represent diagrammatically the bond moments and the resultant dipole moment in $\mathrm{CO}_{2}, \mathrm{NF}_{3}$ and $\mathrm{CHCl}_{3}$

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18. Explain with the help of suitable example polar covalent bond.

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19. Arrange the bonds in order of increasing ionic character in the molecules: LiF, $\mathrm{K}_{2} \mathrm{O}, \mathrm{N}_{2}, \mathrm{SO}_{2}$ and $\mathrm{ClF}_{3}$.

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20. The skeletal structure of $\mathrm{CH}_{3} \mathrm{COOH}$ as shown below is correct but some of the bords are wrongly shown. Write the correct Lewis structures of acetic acid.

21. Apart from tetrahedral geometry, another possible geometry for $\mathrm{CH}_{4}$ is square planar with the four $H$ atoms at the corners of the square and the $C$ atom at its centre. Explain why $\mathrm{CH}_{4}$ is not square planar?

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22. Explain why $\mathrm{BeH}_{2}$ molecule has a zero dipole moment although the $B e-H$ bonds are polar?

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23. Both $N H_{3}$ and $N F_{3}$ have identical shapes and same state of hybridisation. Both N-H and N-F bonds have almost the same electronegativity difference. But still, the two molecules have different dipole moment values. How will you account for it ?
24. What is meant by hybridisation of atomic orbitals? Describe the shape of $s p, s p^{2}, s p^{3}$ hybrid orbitals.

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25. Describe the change in hybridisation (if any) of the $A l$ atom in the following:
$A l C l_{3}+C l^{\ominus} \rightarrow A l C l l_{4}^{\ominus}$

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26. Is there any change in hybridisation of the $B$ and $N$ atom as a result of the following reaction?
$\mathrm{BF}_{3}+\mathrm{NH}_{3} \rightarrow \mathrm{~F}_{3} \mathrm{~B} . \mathrm{NH}_{3}$

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27. Draw diagrams showing the formation of a double bond and a triple bond between carbon atoms in $C_{2} H_{4}$ and $C_{2} H_{2}$ molecules.

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28. what is the total number of sigma and pi bonds in the following molecules?

$$
\text { a. } C_{2} H_{2} \text {, b. } C_{2} H_{4}
$$

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29. Considering X -axis as the internucler axis, which out of the following atomic orbitals will from a sigma bond ?
(a) $1 s$ and $1 s$
(b) $1 s$ and $2 p_{x}$
(c) $2 p_{y}$ and $2 p_{y}$
(d) $1 s$ and $2 s$.

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30. Which hybrid orbitals are used by the carbon atoms in the following molecules?
(a) $\mathrm{H}_{3} \mathrm{C}-\mathrm{CH}_{3}$
(b) $\mathrm{H}_{3} \mathrm{C}-\mathrm{CH}=\mathrm{CH}_{3}$
(c) $\mathrm{CH}_{3}-\mathrm{CHO}$

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31. What do you understand by bond pairs and lone pairs of electrons?

Illustrate by giving one example of each type.

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32. Distinguish between a sigma and a pi bond.

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33. Explain the formation of $\mathrm{H}_{2}$ molecule on the basis of valance bond theory.
34. Write the important conditions required for the linear combination of atomic orbitals to form molecular orbitals.

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35. Use molecular orbital theory to explain why the $B e_{2}$ molecules do not exist?

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36. Compare the relative stability of the following species and indicate their magnetic properties:
$O_{2}, O_{2}^{\oplus}, O_{2}^{\ominus}$ (superoxide), $O_{2}^{-2}$ (peroxoide).

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37. Write the singificance of plus and inus signs in representing the opitals.

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38. Describe the hybridisation in case of $P C l_{2}$. Why are the axial bonds longer as compared to equatorial bonds ?

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39. Define hydrogen bond. Is it weaker or stronger than the van der Waals forces?

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40. What is meant by the term bond order ? Calculate the bond order ?

Calculate the bond order of : $\mathrm{N}_{2}, \mathrm{O}_{2}, \mathrm{O}_{2}^{-}$and $\mathrm{O}_{2}^{2-}$
41. Interpret the non-linear shape of $H_{2} S$ molecule and non-planar shape of $\mathrm{PCl}_{3}$ using valence shell electron pair repulsion (VSEPR) theory. (Atomic number : $H=1, P=15, S=16, C l=17$ )

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42. Using molecular orbital theory, compare the bond energy and magnetic character of $O_{2}^{+}$and $O_{2}^{-}$species.

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43. Explain the shape of $\mathrm{Br} \mathrm{F}_{5}$

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44. Structures of molecules of two compounds are given:
(a) Which of the two compounds will have intermolecular hydrogen bonding and which compound is expected to show intramolecular hydrogen bonding.
(b) The melting point of a compound depends on, among other things, the extent of hydrogen bonding. On this basis explain which of these two compounds will show higher melting point.
(c ) Solubility of compounds in water depends on power of formed hydrogen bonds with water. Which of these compounds will from hydrogen bond will water easily and be more soluble in it ?


(I)
(II)
45. Why does type of overlap given in the following figure not result in bnd formation?


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46. Explain why $P C l_{5}$ is trigonal bipyramidal whereas $I F_{5}$ is square pyramidal ?

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47. In both water and dimethyl ether $\left(\mathrm{CH}_{3}-\ddot{O}-\mathrm{CH}_{3}\right)$, oxygen atom is central atom, and has the same hybridisation, yet they have different
bond angles. Which one has greater bond angle ? Give reason.


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48. The energy of $\sigma 2 p_{z}$, molecular orbital is greater than $\pi 2 p_{x}$ and $\pi 2 p_{y}$ molecular orbitals in nitrogen molecule. Write the complete sequence of energy levels in the increasing order of energy in the molecule. Compare the relative stability and the magnetic behaviour of the following species.
$N_{2}, N_{2}^{+}, N_{2}^{-}, N_{2}^{2+}$

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49. Give the change in bond order in the following ionisation process?
i. $O_{2} \rightarrow O_{2}^{\oplus}+e^{-}$, ii. $N_{2} \rightarrow N_{2}^{\oplus}+e^{-}$
50. Give reasons for the following :
(i) Covalent bonds are directional while ionic bonds are non-directional.
(ii) Water molecule has bent structure whereas carbon dioxide molecule is linear.
(iii) Etyne molecule is linear.

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51. What is an ionic bond ? With two suitable examples, explain the diference between an ionic and a covalent bond ?

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52. Explain why $\mathrm{CO}_{3}^{2-}$ ion cannot be represented by a single Lewis structure. How can it be best represented ?
53. Predict the hybridisation of each carbon in the molecule of organic compound given below. Also indicate the total number of sigma and pi bonds in this molecule.

$\mathrm{HC} \equiv \mathrm{C}-\mathrm{C}-\mathrm{CH}_{2}-\mathrm{C}$
OH

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54. Group the following as linear and non-linear molecules:
$\mathrm{H}_{2} \mathrm{O}, \mathrm{HOCl}, \mathrm{BeCl}_{2}, \mathrm{Cl}_{2} \mathrm{O}$

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55. Elements $X, Y$ and $Z$ have 4,5 and 7 valence electrons respectively, (i) Write the molecular formula of the compounds formed by these elements
individually with hydrogen (ii) which of these compounds will have the highest dipolw moment ?

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56. Draw the resonatin structure of
(i) Ozone molecule (ii) Nitrate ion

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57. Presict the shapes of the following molecules on the basis of hybridisation.
$\mathrm{BCl}_{3}, \mathrm{CH}_{4}, \mathrm{CO}_{2}, \mathrm{NH}_{3}$

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58. All the $\mathrm{C}-\mathrm{O}$ bonds in carbonate in $\left(\mathrm{CO}_{3}^{2-}\right)$ are equal in length.

Explain.
59. What is meant by the term vaerange bond enthalpy? Why is there difference in bond enthalpy of O-H bond in ethanol $\left(\mathrm{C}_{2} \mathrm{H}_{5} \mathrm{OH}\right)$ and water $\left(\mathrm{H}_{2} \mathrm{O}\right)$ ?

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60. (I) Discuss the significance/applications of dipole moment.
(ii) Represent diagrammatically the bond moments and the resultant dipole moment in $\mathrm{CO}_{2}, \mathrm{NF}_{3}$.

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61. Use the molecular orbital energy level diagram to show that $N_{2}$ would br expected to have a triple bond, $F_{2}$ a single bond $N e_{2}$ no bond.
62. Briefly describe the valence bond theory of covalent bond formation by taking an example of hydrogen. How can you interpret energy changes taking place in the formation of dihydrogen?

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63. Describe hybridisation in the case of $P C l_{5}$ and $S F_{6}$ The axial bonds are longer as compared to equatorial bonds in $P C l_{5}$ whereas in $S F_{6}$ both axial bonds and equatorial bonds and have the same bond length. Explain.

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64. Discuss the concept of hybridisation. What are its different types in a carbon atom ?

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65. What is the type of hybridisation of carbon atoms marked with star.
(a) $\stackrel{*}{C} H_{2}=C H-*{ }^{\|} \mathrm{C}-\mathrm{O}-\mathrm{H}$
(b) $\mathrm{CH}_{3}-\stackrel{*}{\mathrm{C}} \mathrm{H}_{2}-\mathrm{OH}$
(c) $\mathrm{CH}_{3}$
(d) $\stackrel{*}{\mathrm{C}} \mathrm{H}_{3}-\mathrm{CH}=\mathrm{CH}-\mathrm{CH}_{3}$
(e) $\mathrm{CH}_{3}-\stackrel{*}{\mathrm{C}} \equiv \mathrm{CH}$

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66. A molecule of $\mathrm{H}_{2}$ exist while that of the $\mathrm{He}_{2}$ does not. Explain.

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67. NaCl and $\mathrm{AgNO}_{3}$ are ionic solids and they readily dissodciate to from ions in solution. $\mathrm{Ag}^{+}$ions combine with $\mathrm{Cl}^{-}$ions to give white precipitate of AgCl . But $C C l_{4}$ is covaolent compound and does not give $\mathrm{Cl}^{-}$ions in solution. Therefore, no reaction is possible between $\mathrm{CCl}_{4}$ and $\mathrm{AgNO}_{3}$.

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68. $\mathrm{BeF}_{2}$ and $\mathrm{H}_{2} \mathrm{O}$ are both tri-atomic molecules but have different shapes. Discuss.

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69. Bond angle in $\mathrm{NH}_{3}$ is molre than in $\mathrm{PH}_{3}$. Explain.

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70. Why is HCl predominantly covalent in the gaseous state but is ionic in squeous solution?

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71. Can a non-polar molecule have polar covalent bonds?

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72. (a) Explain sigma and pi bonds with suitable examples,
(b) A pi bond cannot be formed in the absence of sigma bond. Discuss.

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73. $\mathrm{PCl}_{5}$ exists but $\mathrm{NCl}_{5}$ does not because

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74. o- nitrophenol is steam volatile while $p$-nitrophenol is not. Discuss.

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75. $K H F_{2}$ exists while $K H C l_{2}$ does not. Explain.

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76. Yor are given the electronic configuration of five neural atoms -A,B,C,D and E .
$A-1 s^{2} 2 s^{2} 2 p^{6} 3 s^{2}, B-1 s^{2} 2 s^{2} 2 p_{2} 3 s^{1}, C-1 s^{1} 2 s^{2} 2 p_{1}, D-1 s^{2} 2 s^{2} 2 p^{5}, E 1 s^{2}$.
formula for the substances containing (i) $A$ and $D$ (ii) $B$ and $D$ (iv) onle $E$.

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77. Boiling point of ethane is more than that of methane. Assign reason.

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78. Which comopound from each of the following pairs ismore covalent and why ?
(a) CuO or CuS
(b) AgCl or AgI
(c) $\mathrm{PbCl}_{2}$ or $\mathrm{PbCl}_{4}$
(d) $\mathrm{BeCl}_{2}$ or $\mathrm{MgCl}_{2}$

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79. The bond angles in $\mathrm{NH}_{4}^{+}$and $\mathrm{CH}_{4}$ are same but $\mathrm{NH}_{3}$ has different bond angle. Why ?

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80. Predict which out of the following species are planar.
(i) $\mathrm{NH}_{4}^{+}(i i) \mathrm{CH}_{3}^{+}(i i) \mathrm{SF}_{4}(i v) \mathrm{OF}_{2}(v) \mathrm{H}_{2} \mathrm{O}$

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81. Why is $\mathrm{MgCl}_{2}$ molecule linear whereas the molecules of $\mathrm{SnCl}_{2}$ chloride has angulare shape?

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82. The hybridisatio of oxygen in both water and diethyl ether molecules is the same but they differ in their bond angles. Explain.
83. Both Na and H occur in group 1 of the periodic table ,yet melting point of HCl is $-114^{\circ} \mathrm{C}$. Why ?

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84. With the help of molecular orbital theory, draw the molecular orbital energy level diagram for $N_{2}$ molecule. Also calculate the bond order and predict the magnetic behaviour.

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## Additional Important Quastions

1. Write the Lewis dot symbols of the following ions :
$\mathrm{Li}^{+}, \mathrm{Cl}^{-}, \mathrm{O}^{2-}, \mathrm{Mg}^{2-}$ and $\mathrm{N}^{3-}$
2. Write the Lewis dot structures of (a) $\mathrm{CCl}_{4}$ (b) $\mathrm{PH}_{3}$ ( c) $B C l_{3}$. Is the octet roule obeyed in these structures?

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3. Explain how valence bond theory accounts for
(i) a carbon-carbn double bond ( $\mathrm{C}=\mathrm{C}$ )
(ii) a carbon -carbon triple bond ( $\mathrm{C}=\mathrm{C}$ )

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4. Dary Lewis structures for $\mathrm{H}_{2} \mathrm{CO}_{3}, S F_{6}, P F_{7}$ and $\mathrm{CS}_{2}$. Is the octet rule obeyd in these cases ?

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## 5. ELECTRONEGATIVITY \& ELECTRON GAIN ENTHALPY

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6. Arrange the following in order of increasing ionic character :

## $\mathrm{C}-\mathrm{H}, \mathrm{F}-\mathrm{H}, \mathrm{Br}-\mathrm{H}, \mathrm{Na}-\mathrm{I}, \mathrm{K}-\mathrm{F}$ and $\mathrm{Li}-\mathrm{Cl}$

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7. Which of the following has larger bond angle in the following pairs ?
(a) $\mathrm{NH}_{3}, \mathrm{PH}_{3}(b) \mathrm{BeF}_{2}, \mathrm{BF}_{3}(c) \mathrm{H}_{2} \mathrm{O}, \mathrm{CO}_{2}(d) \mathrm{H}_{2} \mathrm{O}, \mathrm{H}_{2} \mathrm{~S}(e) \mathrm{CCl}_{4}, \mathrm{C}_{2} \mathrm{H}_{2}$

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8. Out of intermolecular and intramolecular hydrogen bonding which has an infulence on the characteristics of substances ?
9. Discuss the shape of $\mathrm{CO}_{2}$ molecule on the basis of hybridisation.

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10. Out of the following resonating strictures for $\mathrm{CO}_{2}$ molecule, which are important for describing the bonding in the molecule and why ?
$\because \ddot{O}=\underset{(I)}{C}=\ddot{O}:$
$\stackrel{+}{O}=\underset{(I I)}{C}-\ddot{O}:$
$\ddot{O}^{-}=\underset{(I I I)}{C}-\stackrel{+}{O} \quad \ddot{O}^{-}-\underset{(I V)}{C}$

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11. Why is that in the $S F_{4}$ molecule, the lone pair of electrons occupies an equatorial position in the overall trigonal pyramidal arrangement in preferencr to an axial position ?

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12. Differentiate between $V B$ theory and Lewis concept.

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13. Find out the number of sigma and pi bonds in the following molecules.

$$
\text { (a) } \mathrm{C}_{2} \mathrm{H}_{5} \mathrm{Cl}(b) \mathrm{CH}_{2} \mathrm{Cl}_{2}(c) \mathrm{CH}_{3}-\mathrm{CH}=\mathrm{CH}-\mathrm{C} \equiv \mathrm{C}-\mathrm{H}
$$

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14. Calculate the formula charge on each atom in a : O-S $=O$ :

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15. How many sigma and pi bonds are present in the molecules of toluene and naphthalene ?
16. What is the hybridisatio carbon atoms numbered as 1,2 and 4 in the following molecule?

$$
H_{2} \stackrel{5}{C}=\stackrel{4}{C}=H \stackrel{3}{C}-H_{2} \stackrel{2}{C}-\stackrel{\|}{C^{1}}-H
$$

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17. What is meant by the term bond order ? Calculate the bond order ?

Calculate the bond order of : $\mathrm{N}_{2}, \mathrm{O}_{2}, \mathrm{O}_{2}^{-}$and $\mathrm{O}_{2}^{2-}$

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18. The sdipole miment of hydrogen halides decreases form HF to HI . Explain this trend.

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19. Which out of $\mathrm{N}_{2}$ and $\mathrm{H}_{2} \mathrm{O}$ is polar and why ?

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20. Calculate the electronegativity value of chlorine on Mulliken's scale, given that $I P=13.0 \mathrm{eV}$ and $E A=4.0 \mathrm{eV}$.

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21. $\mathrm{H}_{2} \mathrm{O}$ molecule is a triatomic molecule but its geometry is not linear.

Why ?

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22. (a) Which of the following species has greater polarising power?
(i) $\mathrm{Fe}^{3+}$ or $\mathrm{Fe}^{2+}(i i) \mathrm{Cu}^{2+}$ or $\mathrm{Na}^{+}(i i i) \mathrm{Mg}^{2+}$ or $\mathrm{Al}^{3+}$.
(b) Which of the following species is most susceptible to polarisation ?
(i) $\mathrm{Br}^{-}$or $I^{-}(i i) \mathrm{O}^{2-}$ or $\mathrm{S}^{2-}(i i i) \mathrm{N}^{3-}$ or $\mathrm{O}^{2-}$
23. Why is lithium iodide more covalent than lithium fluoride?

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24. Out of $C S_{2}$ and $O C S$ which have higher dipole moment and why?

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25. Draw the Lewis structure of HCN .

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26. The presence of polar bonds in a polyatomic molecule suggests that the molecule has non-zero dipole moment.
27. Write two resonance structure of $\mathrm{N}_{2} \mathrm{O}$ that satisfy the octet rule.

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28. Out of but-1-yne or but-1-ene which has higher dipole moment?

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29. Using $V S E P R$ theory draw the shape of $P C I_{5}$ and $B r F_{5}$ ?.

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30. How does the bond length vary in dicarbon species
$C_{2}, C_{2}^{-}, C_{2}^{2-}$

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31. (a) How does bond energy vary from $N_{2}^{+}$and $N_{2}^{-}$and why ?
(b) On the basis of the molecular orbital theory, what is the similarly between :
(i) $F_{2}, O_{2}^{2-}$
(ii) $\mathrm{CO}, \mathrm{N}_{2}, \mathrm{NO}^{+}$.
(c) Like CO why its analong SiO is not so stable ?

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32. Why is mobilty of $H^{+}$ions in ice greater as compared to liquid water ?

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33. According to Octed Rule, each atom gains or loses electrons to complete its outermost shell. As a result, molecules are formed. Each contributing element has 8 electrons in the outermost shell, but there are some limitations to this rule in which central atom of some molecules has more han 8 electrons. Some molecules like NO and $\mathrm{NO}_{2}$ don't satisfy
octet rule as they have add electrons in them.

On the basis of above paragraph, answer the following :
(i) Writer the Lewis structurre of $N_{2}$ molecule.
(ii) How the structure of $S F_{6}$ cannot be explained on the basis of octet rule ?

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34. L.C.A.O. principle is involved in the formation of molecular orbitals according to molecular obtital theory. The energy of bonding molecular orbital is less than that of the combining atomic orbitals while that of the anitibonding bonding melecular orbital is more. The B.O.

$$
={ }^{1 / 2}\left[N_{b}-N_{a}\right]
$$

Answer the following questions on the basis of the above paragraph :
(i) What is bonding molecular orbital ?
(ii) Calculate B.O. of $\mathrm{He}_{2}$ molecule.

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35. Arrange $\mathrm{H}_{2} \mathrm{O}, \mathrm{NH}_{3}$ and $\mathrm{CH}_{4}$ molecules in decreasing order of bond angle.

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36. Explain $s p^{2}$ hybridisation by taking example of ethylene.

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37. In ionic solids, the oppositely charged ions are closely packed in space and have strong electrostatic forces of attraction. These compound have high melting and boiling points and are poor conductors of electricity in the solid state.
(i) Why are ionic solids poor conductros of electricity ?
(ii) What happens to electrical conductivity when these are dissolved in water?
38. The study of dipole moment of a molecule is useful to explain the shape of a molecule and also to predict a number of other properties of the molecule. The net dipole moment of a polyatomic is the resultant of the different bond dipole moments present in that molecule.

Answer the following questions on the basis of above paragraph :
(i) What is dipole moment ?
(ii) Out of $\mathrm{CO}_{2}$ and $\mathrm{H}_{2} \mathrm{O}$, which molecule is polar in nature any why ?

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39. Draw the structure and state polar and non-polar nature of (a) $C h_{4}$
(b) $\mathrm{So}_{4}$ (c) $\mathrm{CHCl}_{3}$.

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40. Drawn the molecular orbital diagram and write the bond order, magnetic properties of $N_{2}$ molecule and $N_{2}{ }^{\oplus}$ ion ?
41. How do you differentiatie between sigma and pi bonds?

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## H O T S Conceptual Questions

1. Atom $A, B$ and $C$ occur in the same period and have one, six and seven valence electron respectively.
(a) Will the bonds between B and C be predominantly ionic or covalent?
(b) Will the bond between $A$ and $B$ be predominantly ionic or covalent ?
(c) Write he electronic structure of the compound between $B$ and $C$

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2. Interpret non-linear shape of $\mathrm{H}_{2} \mathrm{~S}$ and non-planar shape of $\mathrm{PCl}_{3}$ on the basis of VSEPR theory.
3. In a polar solvent, $\mathrm{PCl}_{5}$ undergoes an ionization reaction as :

$$
2 P C l_{5} \Leftrightarrow P C l_{4}^{+}+P C l_{6}^{-}
$$

What are the geometrical shapes of the species involved in the equilibrium mixture?

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4. 

In
the
equation,
$A+2 \mathrm{~B}+\mathrm{H}_{2} \mathrm{O} \rightarrow \mathrm{C}+2 \mathrm{D}\left(\mathrm{A}=\mathrm{HNO}_{2}, \mathrm{~B}=\mathrm{H}_{2} \mathrm{SO}_{3}, \mathrm{C}=\mathrm{NH}_{2} \mathrm{OH}\right)$ identify D. Draw the structures of $A, B, C$ and $D$.

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5. In which of the following pairs, the two species are iso-structural ?
(a) $\mathrm{SO}_{4}^{2-}$ and $\mathrm{NO}_{3}^{-}$
(b) $B F_{3}$ and $N F_{3}$
(c) $\mathrm{BrO}_{3}^{-}$and $\mathrm{XeO}_{3}$
(d) $\mathrm{SF}_{4}$ and $\mathrm{XeF}_{4}$
6. Answer the following :
(a) $\mathrm{CCl}_{4}$ is non-polar but $\mathrm{CH}_{3} \mathrm{Cl}$ is polar.
(b) $\mathrm{SiF}_{4}$ is non-polar although Si-F bonds are polar.
(c) A hetero-diatomic molecule is always polar.

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7. Explain why is o-hydroxybenzaldehyde a liquis at room temperaturre while p-hydroxybenzaldehyde is a high melting solid.

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8. (a) $\mathrm{H}_{2}^{+}$and $\mathrm{H}_{2}^{-}$ions have same bond order but $\mathrm{H}_{2}^{-}$ion is more stable. Explain.
(b) $N_{2}$ has a greater bond dissociation enthalpy than $N_{2}^{+}$ion hals more bond dissociation enthalpy than $O_{2}$. Why?
(c) Can we have ahomonuclear diatomic molecule with all its ground state molecular orbitals full of electrons?
(d) When a magnet is dipped in a jar of liquid oxygen, some oxygen clings to it. Assign reason :

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9. State with reasons :
(i) Which is more acidic : anhydrous HCl or aqueous HCl ?
(ii) Which is more polar : $\mathrm{CO}_{2}$ or $\mathrm{N}_{2} \mathrm{O}$ ?
(iii) Which is more soluble in water : enhyl alcohol or dimethyl ether ?

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10. Assign reason for the following :
(i) Ammonis is soluble in water while phosphine is not
(ii) $B_{2}$ is paramagnetic while $C_{2}$ is not.
11. Drw all the possible resonating structures for azide ion ( $N_{3}^{-}$ion). Which our of these are actually feasible?

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## Value Based Questions

1. $\mathrm{H}_{2} \mathrm{O}$ is a covalent molecule and the two $\mathrm{O}-\mathrm{H}$ bonds are of polar nature.

The $\mathrm{H}_{2} \mathrm{O}$ molecules are involved in intermolecular hydrogen bonding both in water and ice which differ in their relative densities.
(i) What type of structure does ice possess ?
(ii) Out of ice and water, which is heavier ?
(iii) At what temperature,does water have maximum density ?
(iv) What is the value associated with this characteristic of water ?

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2. In ionic solids, the oppositelycharged ions are closely packed in space and have strong electrostatic forces of attraction. These compounds have high melting and boiling points and are also proop conductors of electricity in the solid state.
(i) Why are ionic solids poor conductors of electricity ?
(ii) What happens to electrical conductivity when these are dissoved in water?
(iii) What is the value associated with it ?

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## Prombems For Practice

1. Write the Lewis symbols of (i) C (ii) Cl (iii) $O^{2-}$ (iv) $\mathrm{N}^{3-}$

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2. Give two cations and two anions which have the electronic structure of Ne.

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3. Choose the elements which from monovalent ions:
(i) Li (ii) Ca (iii) F (iv) Al (v) P (vi) K

## - Watch Video Solution

4. Can sodium chloride conduct eletricity in the solid state ?

## - Watch Video Solution

5. An element A has the configuration $1 s^{2} 2 s^{2} / 2 p^{6} 3 s^{1}$ and the elemen B has the configuration $1 s^{2} 2 s^{2} 2 p^{4}$ Give the formula of the compound formed.
6. Out of NaCl and MgO which has higher lattice energy ?

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7. Which will from more stable ionic bond (i) Na and (ii) Ca and Cl ?

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8. Predict the shapes of the followihng molecules using VSEPR theory
(i) $B c C l_{2}$ (ii) $S c C l_{4}$ (iii) $A s F_{5}$ (iv) $H_{2} S$ (v) $H g B r_{2}$ (vi) $P H_{3}$ (vii) $G e F_{2}$

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9. Arrenge $\mathrm{NH}_{3}, \mathrm{H}_{2} \mathrm{O}$ and $\mathrm{CH}_{4}$ in increasing bond angles.
10. Assign the correct bond angles to each of the following molecules.

Molecules : $\mathrm{H}_{2} \mathrm{O}, \mathrm{BeF}_{2}, \mathrm{CH}_{4}, \mathrm{NH}_{3}, \mathrm{BCl}_{3}, \mathrm{SF}_{6}$. Bond angles : $90^{\circ}, 107^{\circ}, 109^{\circ}-28,104.5^{\circ}, 120^{\circ}, 180^{\circ}$

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11. Do $\mathrm{NH}_{3}$ and $B F_{3}$ have same shape ?

## - Watch Video Solution

12. What is the expected geometry of $A F_{5}$ molecule ?

## - Watch Video Solution

13. The molecule of $S O_{2}$ has dipole moment. Is the molecule linear or bent?
14. Predict the dipole moment of :
(i) a molecule of the type $A X_{4}$ having dquare planar geometry a molecule of type $A X_{5}$ having trogonal biprmidal geometry
(iii) a molecule of the type $A X_{6}$ having octahedral geometry.

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15. Which uot of the following pairs has dipole moment ?
(i) $\mathrm{BF}_{3}$ and $\mathrm{NCl}_{3}$ (ii) $\mathrm{H}_{2} \mathrm{O}$ and $\mathrm{BF}_{3}$ (iii) $\mathrm{CO}_{2}$ and $\mathrm{H}_{2} \mathrm{~S}$

## ( Watch Video Solution

16. Can a non-polar molecule have polar covalent bonds?

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17. Which of the following molecules behave as electrical dipoles ?
(i) $\mathrm{Cl}_{4}$ (ii) $\mathrm{CHCl}_{3}$ (iii) $\mathrm{BF}_{3}$ (iv) $\mathrm{H}_{2} \mathrm{O}$ (v) $\mathrm{BeF}_{2}$ (vi) $\mathrm{NH}_{3}$

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18. Out of and $\pi$ bonds, which is strong ?

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19. Can a $\sigma$ bond be formed in the absence of $\pi$ bond ?

## - Watch Video Solution

20. Can orbitals present in the 2 p sub-sheel hybridise alone ?

## - Watch Video Solution

21. What types of hybridisation are associated with central atom when the atoms attached to it from (1) Equilateral triangle (ii) Linear structure (iii) Regular tetrahedron ?

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22. Write the state of hybridisation of boron in $B F_{3}$

## - Watch Video Solution

23. How many $\sigma$ and $\pi$ bonds are present in the molecule of ethene ?

## - Watch Video Solution

24. Mention the state of hybridisation of all the carbon atoms in he molecule $\mathrm{CH}_{2}=\mathrm{CH}-\mathrm{CH}=\mathrm{CH}_{2}$
25. Assuming z-axis to be intermolecular axis, designate the molecule orbitals from the following combination.
(i) $2 p x+2 p x$ (ii) $2 p z+2 p z$ (iii) $2 p y-2 p y$

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26. Which of the follwing combinations are not permisible ?
(i) 2 pz and 2 pz (ii) 2 s and 2 py (iii) 1 s and 2 s (iv) 2 px and 2 px

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27. Which combination will lead to $\pi$-molecular orbitals?
(i) $2 p x-2 p x$ (ii) $2 p z+2 p z$ (iii) $2 s+2 p z$ (iv) $2 p y+2 p y$

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28. Can 1 s and 2 s atomic orbitals from molecular orbitals

## - Watch Video Solution

29. In the molecular orbital configuration of $N_{2}$ which orbital has lower energy: $\sigma_{2 p z}$ or $\pi_{2 p x}$ ?

## - Watch Video Solution

30. What is the bond order of $\mathrm{H}_{2}^{-}$ion ?

## - Watch Video Solution

31. Arrenge $O_{2}, O_{2}^{-}, O_{2}^{2-}, O_{2}^{+}$in increasing order of bond energy.

## - Watch Video Solution

32. What will happen to the bond order if the electron is added ot bonding molecular orbital ?

## - Watch Video Solution

33. Why does a molecule of $N e_{2}$ fail to exist ?

## - Watch Video Solution

34. Predict the stability of a molecule if $N_{a}>N_{b}$.

## - Watch Video Solution

35. What type of magnetic behaviour is shown by a molecule containing unpaired electrons?

## - Watch Video Solution

36. Name a molecule for which bond order is 3.

## - Watch Video Solution

37. Out of $O_{2}$ and $O_{2}^{-}$ion which has smaller bond order ?

## - Watch Video Solution

38. Do $H_{2}^{+}$and $H_{2}^{-}$ions have same or different bond orders?

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## Multiple Choice Questions Mcqs

1. The crystal lattice of electro covalent compounds is composed of
A. atoms
B. molecules
C. oppositeoly charged ions
D. both molecules and ions.

## Answer: C

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2. The electronegativity of cesium is 0.7 and that of flourine is 4.0 The bond formed between the two is:
A. covalent
B. electrovalent
C. co-ordinate
D. metallic.

## Answer: B

3. A covalent bond is formed between
A. similar atoms
B. dissimilar atoms
C. similar or dissimilar atoms
D. silimar molecules

## Answer: C

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4. Multiple bond can exist in :
A. $\mathrm{CH}_{4}$ molecule
B. $\mathrm{NH}_{3}$ molecule
C. $\mathrm{Cl}_{2}$ molecule
D. $N_{2}$ molecule

## Answer: D

## D Watch Video Solution

5. The formula of a compound is $A_{2} B_{5}$. The number of electrons in the outermst shells of $A$ and $B$ respectively are:
A. 6 and 3
B. 5 and 6
C. 5 and 2
D. 2 and 3.

## Answer: C

## D Watch Video Solution

6. Which of the following has pyramidal structure?
A. $\mathrm{NH}_{3}$
B. $B F_{3}$
C. $\mathrm{CCl}_{4}$
D. $\mathrm{H}_{2} \mathrm{O}$.

## Answer: A

## - Watch Video Solution

7. According to is M.O. theory, which is the correct increasing sequence of B.o. in $N_{2}, N_{2}^{-}$and $N_{2}^{2-}$ ?
A. $N_{2}^{2-}<N_{2}^{-}<N_{2}$
B. $N_{2}<N_{2}^{2-}<N_{2}^{-}$
C. $N_{2}^{-}<N_{2}^{2-}<N_{2}$
D. $N_{2}^{-}<N_{2}<N_{2}^{2-}$

## Answer: C

8. In which of the following pairs, the two spices are iso-structural?
A. $\mathrm{So}_{3}^{2-}$ and $\mathrm{NO}_{3}^{-}$
B. $B F_{3}$ and $N F_{3}$
C. $\mathrm{BrO}_{3}^{-}$and $\mathrm{XeO}_{3}$
D. $S F_{4}$ and $X e F_{4}$.

## Answer: D

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9. The maximum possible number of hydrogen bonds a water molecule can form is
A. 1
B. 2
C. 3
D. 4

## Answer: D

## - Watch Video Solution

10. Which of the following is a non-linear molecule ?
A. $\mathrm{CO}_{2}$
B. $\mathrm{C}_{2} \mathrm{H}_{2}$
C. HCN
D. $\mathrm{H}_{2} \mathrm{O}$.

## Answer: D

11. The molecule that has a linear staructure is :
A. $\mathrm{CO}_{2}$
B. $\mathrm{NO}_{2}$
C. $\mathrm{SO}_{2}$
D. $\mathrm{SiO}_{2}$

Answer: A

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12. Correct B.O. of $O_{2}$ is :
A. 1
B. 2
C. 2.5
D. 3

## Answer: B

## - Watch Video Solution

## Ionic Bond

1. Write the Lewis symbols of Mg and Al .

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2. Which electrons take part in the bond formation?

## - Watch Video Solution

3. Give the empirical formaulae for the ionic compounds formed between $\mathrm{K}, \mathrm{O}$ and $\mathrm{Na}, \mathrm{p}$.
4. Is ionic bond directional ?

## - View Text Solution

5. Which type of elements take part in the bond formation?

## Watch Video Solution

6. Which will from stronger ionic bond ?
(i) Na and F (ii) m Na and Cl .

## - Watch Video Solution

7. Can ionic bond be formed between similar atoms ?

## - Watch Video Solution

8. The electrovalency of the element is equal to the

## - Watch Video Solution

9. Out of NaCl and MgO which has higher lattice energy ?

## - Watch Video Solution

10. Deaw Lwis structure of $N^{3-}$ ion.

## - Watch Video Solution

11. Explain the formation of ionic bond in Ca and Cl atoms.

## - Watch Video Solution

12. Can sodium chloride conduct eletricity in the solid state ?

## (D) Watch Video Solution

13. Which type of element are likely to from anions ? Explain.

## - View Text Solution

14. Ionic compounds donot exist as single molecules, Explain

## - Watch Video Solution

15. An element A has the configuration $1 s^{2} 2 s^{2} / 2 p^{6} 3 s^{1}$ and the elemen B has the configuration $1 s^{2} 2 s^{2} 2 p^{4}$ Give the formula of the compound formed. $1 s^{2} 2 s^{2} 2 p^{6} 3 s^{1}$ while the configuration of B is $1 s^{2} 2 s^{2} 2 p^{5}$. What type of bond is likely to be formed between them?

## - Watch Video Solution

16. Define lattice energy. How is lattice energy influenced by (i) charge on the ions (ii) size of the ions?

## - Watch Video Solution

17. Elements with low ionization energies generally form cations. Explain.

## - Watch Video Solution

18. Explain the formation of ionic bond with two examples.

## - Watch Video Solution

19. Write the favourable factors for the formation of ionic bond.

## - Watch Video Solution

20. Assign reasons for the following :
(i) lonic bond is non-following:
(ii) lonic bond is non-directional
(iii) lonic compounds have high melting points.

## ( Watch Video Solution

## Covalent And Co Ordinate Bonds

1. How is covalent bond formed?

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2. What is a double bond ?

## - Watch Video Solution

3. Draw electron dot structures of (i) $\mathrm{NH}_{3}$ (ii) $\mathrm{PCl}_{5}$ (iii) $\mathrm{C}_{2} \mathrm{H}_{2}$.

## - Watch Video Solution

4. What is meant by bond pair of electrons?

## - Watch Video Solution

5. What does VSEPR stand for ?

## - Watch Video Solution

6. Do $\mathrm{NH}_{3}$ and $\mathrm{BF}_{3}$ have same shape ?

## - Watch Video Solution

7. Define covalent bond according to orbital concept.
8. Enilist the favourable conditions for orbital overlap.

## - View Text Solution

9. Why is $\alpha$-bond stronger than $\pi$-bond ?

## - View Text Solution

10. Difine electronegativily.

## - Watch Video Solution

11. Has electroegativity of of an element specific units ?
12. HF is polar while $F_{2}$ is non-polar. Explain.

## - Watch Video Solution

13. How many sigma bonds and pi bonds are present in a benzene molecules?.

## - Watch Video Solution

14. Which out of the following molecules have covalent bonds
(i) $\mathrm{CaCl}_{2}(i i) \mathrm{NH}_{3}(i i i) n M g O(i v) \mathrm{PCl}_{5}$ ?

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15. What are $S I$ units of dipole moment?
16. Which type of elements take part in the bond formation ?

## - Watch Video Solution

17. Why do covalent molecules have definite geometries?

## - Watch Video Solution

18. Give the shapes associated with the following molecules
(i) $A B_{3}(i i) A b_{4}(i i i) A B_{5}$.

## - Watch Video Solution

19. Presence of a lone pair of electrons distrots the geometry of a covalent molecule.Explain.

## - Watch Video Solution

20. Bond angle in $\mathrm{NH}_{3}$ is more than in $\mathrm{H}_{2} \mathrm{O}$. Discuss

## - Watch Video Solution

21. Define hybridisation. Explain $s p^{2}$ hybridisation with suitable example.

## - Watch Video Solution

22. Draw the resonating structures fo $\mathrm{CO}_{2}$ molecule.

## - Watch Video Solution

23. Arrange $\mathrm{H}_{2} \mathrm{O}, \mathrm{NH}_{3}$ and $\mathrm{CH}_{4}$ molecules in decreasing order of bond angle.

## - Watch Video Solution

24. How will you differentiate between covalent and coordinate bonds?

## D Watch Video Solution

25. Which of the following has larger bond angle in each pair ?
(i) $\mathrm{CO}_{2}, \mathrm{BF}_{3}(i i) \mathrm{NH}_{3}, \mathrm{CH}_{4}(i i i) \mathrm{H}_{2} \mathrm{O}, \mathrm{H}_{2} \mathrm{~S}(i v) S F_{4}, \mathrm{C}_{2} \mathrm{H}_{2}$.

## - Watch Video Solution

26. Indicate whether the following statement is true or false. Justify your answer :

## D View Text Solution

27. Sodium metal vapprises on heating and the vapours have diatomic molecules of sodium $\left(N a_{2}\right)$. what type of bonding is present in these moleceles ?
28. Which of the following has maximum bond angle ?
$\mathrm{H}_{2} \mathrm{O}, \mathrm{NH}_{3}, \mathrm{CO}_{2}, \mathrm{CH}_{4}$
Give suitable explanation for your answer.

## - Watch Video Solution

29. Why do covalent molecules have definite geometries ?

## - Watch Video Solution

30. (a) What is depoole moment ?
(b) What are the units of dipole moment ?
(i) Dipole moment values help in prediciting the shapes of covalent molecules. Explain.
31. (a) Explain sigma and pi bonds with suitable examples,
(b) A pi bond cannot be formed in the absence of sigma bond. Discuss.

## - Watch Video Solution

32. Define hybridisation. What are the characteristics of hybridisation ?

## - View Text Solution

33. Discuss the orital stuctures of the following molecules on the basis of hybridisation.
(i) $\mathrm{NH}_{3}(i i) \mathrm{C}_{2} \mathrm{H}_{2}(i i i) \mathrm{CO}_{2}$.

## - Watch Video Solution

34. What is the major difference between valence bond molecular orbital theories?
35. Which types of orbitals stabilise a molecule ?

## - View Text Solution

36. What is bond stabilising energy ?

## - View Text Solution

37. State three conditions which govern the combination of atomic arbitals to from molecular orbitals.

## - View Text Solution

38. What is the principle of L.C.A.O. Discuss the formation of bonding and antibonsing molecular orbital in the basis of this principle.
39. A bonding molecular orbital has lesser energy than the corresponding antibonding molecular orbital. Justify

## - Watch Video Solution

40. On the basic of the bond order, predivt which of the following species is the most stable.
(i) $\mathrm{O}_{2}^{-}(i i) \mathrm{O}_{2}(i i i) N e_{2}^{+}$

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41. Explain the diamagnetic behaviour of $F_{2}$ molecule on the basis of molecular orbital theory.

## - Watch Video Solution

42. Write the molecular orbital electronic configuration of peroxide and super oxide ions. Which out of these has higher bond order and why ?

## - Watch Video Solution

43. Write the molecular orbital condiguration $O_{2}, \mathrm{O}_{2}^{-}$and $o_{2}^{2-}$ Arrange them in increasing order of
(i) Bond order (ii) Bond dissociation energy

## - Watch Video Solution

44. With the help of molecular orbital theory predict which of the following species are diamagnetic ?

$$
\mathrm{H}_{2}^{+}, \mathrm{O}_{2} \mathrm{O}_{2}^{2+}
$$

## - Watch Video Solution

45. Explain why $N_{2}$ has a greater bond dissociation energy than $N_{2}^{+}$ while $O_{2}$ has lesser bond dissociation energy than $O_{2}^{+}$.

## - Watch Video Solution

46. Which of the two peroxide ion or superoxide ion has larger bond length?

## - Watch Video Solution

47. What is bond order? Discuss its significance.

## - Watch Video Solution

48. Out of bonding and antibonding M.O, which is filled first and why?

## - Watch Video Solution

49. Define bond order. How is it related to the stability of a molecule ?

## - Watch Video Solution

50. How is bond order related to bond length and bond dissociation energy of a molecule ?

## - Watch Video Solution

51. Write the electronic jconfiguration of $\mathrm{H}_{2}^{+}$ion. Calculate the bond order.

## - Watch Video Solution

52. Which out of $O_{2}^{-}$and $O_{2}^{2-}$ has higher bond order and why ?

## - Watch Video Solution

53. Can a stable molecule have zero bond order? Justify your answer.

## - Watch Video Solution

54. How will you differentiate between bonding and anti bonding molecular orbitals ?

## - Watch Video Solution

55. What are bonding and antibonding molecular arbitals ? Define bond order and give is significance.

## - Watch Video Solution

56. How will your differentiate between atomic and molecular orbitals?

## - Watch Video Solution

57. Which out of two $O_{2}^{2+}$ and $O_{2}^{2+}$ has higher bond order and why ?

## - Watch Video Solution

58. How is bonding molecular orbital of hydrogen different from the antibonding molecular orbital ?

## - Watch Video Solution

59. How is bond length related to the stability of a molecule?

## - Watch Video Solution

60. Which type of atomic orbitals can overlap to from molecular orbitals ?

## - Watch Video Solution

61. Which our of $O_{2}^{+}$and $O_{2}^{-}$is more stable on the basis of bond order calculations?

## - Watch Video Solution

62. What are bonding and antibonding molecular arbitals ? Define bond order and give is significance.

## - Watch Video Solution

63. Write the $M O$ electron distribution of $O_{2}$.Specify its bond order and magnetic property.

## - Watch Video Solution

64. Draw the energy level diagram of $H_{2}^{+}$ion and discuss its stability in terms of bond order.
65. How does the bond length very in dicarbon species
$C_{2}, C_{2}^{-}, C_{2}^{2-}$

## - Watch Video Solution

66. Calculate the bond order of $O_{2}^{-}$and $O_{2}^{2-}$ ions on the basis of M.O. theory and explain their magnetic properties.

## - Watch Video Solution

67. Describe mathamatically the formation of molecular orbitals in nomonuclear diamtomc hydrogen molecule by LCAO method.

## - View Text Solution

68. Compare the relative stabilities of $O_{2}$ and $O_{2}^{2-}$ an indicate their magnetic behavious.

## - Watch Video Solution

69. (a) What is linear combination of atomic orbitals ?
(b) llustrate bonding and antibonding moleular orbitals based on homonuclear dihydrogen molecule.

## - View Text Solution

70. (a) Which of these have higher bond dissociation energy and why ?
(i) $\mathrm{N}_{2}^{+}($ii $) \mathrm{O}_{2}^{+}$
(b) What kinds of molecular forced exist between the species in the following pairs of particles and why ?
(i) He and $\mathrm{N}_{2}(i i) \mathrm{Cl}_{2}$ and $\mathrm{NO}_{3}^{-}(\mathrm{iii}) \mathrm{NH}_{3}$ and CO .
71. Compare the relative stiabilities of $O_{2}^{2-}$ and $N_{2}^{2-}$ and comment on their magnetic (paramagnetic) behaviour.

## - Watch Video Solution

72. Draw the energy diaagram of $O_{2}$ molecule. Find bond order and siscuss its magnetic character.

## - Watch Video Solution

## Hydrogen Bonding

1. What is hydrogen bonding ? Lllustrate with an example.

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2. Which types of elements take part in hydrogen bonding ?
3. Intermolecular bonding influences the properties of substances while inter molecular does not. Comment on the statement.

## - Watch Video Solution

4. On the basis of hydrogen bonding explain the following :
(i) $\mathrm{H}_{2} \mathrm{O}$ is a liquid at room temperature while $\mathrm{H}_{2} \mathrm{~S}$ is a gas
(ii) Boiling pint of $\mathrm{NH}_{3}$ is more than that of $\mathrm{PH}_{3}$

## - Watch Video Solution

5. Ice seems to be denser than water but it floats over it. Explain.

## - Watch Video Solution

6. Show hydrogen bonding in the molecules of o-nitrophenol and pnitrophenol.

## - Watch Video Solution

7. N and Cl have same electronegativily. Whereas hydrogen bonding is present in the molecules of $\mathrm{NH}_{3}$, it is absent at the sometime in HCl molecules. Explain.

## - Watch Video Solution

8. Water has maximum density and minimum volume at $4^{\circ} \mathrm{C}$. Explain.

## - View Text Solution

9. Does hydrogen bond involved the overlapping in atomic orbital ?
10. How is hydrogen bond formed ? Give hydrogen bonding in (i) $\mathrm{H}_{2} \mathrm{O}($ ii) HF molecules.

## - Watch Video Solution

## Multiple Choice Questions Bank Mcqb

1. The payramidal geometry is associated with :
A. $\mathrm{CH}_{4}$
B. $\mathrm{NH}_{3}$
C. $\mathrm{H}_{2} \mathrm{O}$
D. $\mathrm{CO}_{2}$

## Answer: B

2. Among $\mathrm{LiCI}, B e C I_{2}$ and $C C I_{4}$ the covalent bond character varies as .
A. $\mathrm{LiCl}>\mathrm{BeCl}_{2}<\mathrm{BCl}_{3}>\mathrm{CCl}_{4}$
B. $\mathrm{LiCl}>\mathrm{BeCl}_{2}<\mathrm{BCl}_{3}<\mathrm{CCl}_{4}$
C. $\mathrm{LiCl}<\mathrm{BeCl}_{2}<\mathrm{BCl}_{3}<\mathrm{CCl}_{4}$
D. $\mathrm{LiCl}>\mathrm{BeCl}_{2},>\mathrm{BCl}_{3}>\mathrm{CCl}_{4}$

## Answer: C

## - Watch Video Solution

3. The bond length the species $O_{2}, O_{2}^{+}$and $O_{2}^{-}$are in the order of
A. $O_{2}^{+}>O_{2}>O_{2}^{-}$
B. $\mathrm{O}_{2}^{+}>\mathrm{O}_{2}^{-}>\mathrm{O}_{2}$
C. $O_{2}>O_{2}^{+}>O_{2}^{-}$
D. $O_{2}^{-}>O_{2}>O_{2}^{+}$

## Answer: D

## D Watch Video Solution

4. Which one of them is the weakest?
A. lonic bond
B. Covalent bond
C. Metallic bond
D. van der Wall's forces

## Answer: D

## D Watch Video Solution

5. $\mathrm{NH}_{3}$ and $B F_{3}$ from adduct readily because they from
A. Ionic bond
B. Covalent bond
C. Co-ordinate bond
D. Hydrogen bond

## Answer: C

## - Watch Video Solution

6. The angle between the covalent bonds is maximum in :
A. $\mathrm{CH}_{4}$
B. $B F_{3}$
C. $P F_{3}$
D. $\mathrm{NH}_{3}$

## Answer: B

7. The bond angle around atom which uses $s p^{2}$ hybridisation is :
A. $120^{\circ}$
B. $180^{\circ}$
C. $107^{\circ}$
D. $109^{\circ} 28$

## Answer: A

## - Watch Video Solution

8. In the resonating structures of of benzene, the number of $\sigma$ and $\pi$ bonds are:
A. $3 \pi$ and $12 \sigma$
B. $3 \sigma$ and $12 \pi$
C. $6 \pi$ and $6 \sigma$
D. $12 \pi$ and $12 \sigma$

## Answer: A

## - Watch Video Solution

9. How many $\sigma$ and $\pi$ bonds are present in tetra cyanoethylene?
A. Nine $\sigma$ and nine $\pi$
B. Five $\pi$ and nine $\sigma$
C. Nine $\sigma$ and seven $\pi$
D. Eight $\sigma$ and eight $\pi$

## Answer: A

## - Watch Video Solution

10. Which of the following substancs has dipole moment more than zero
A. Water
B. Methane
C. Carbon dioxide
D. Nitrogen

## Answer: A

## - Watch Video Solution

11. The ion which is iso-electronic with CO is:
A. $C N^{-}$
B. $\mathrm{O}_{2}^{-}$
C. $N_{2}^{+}$
D. $\mathrm{O}_{2}^{+}$

## Answer: A

12. Which of the following pair contains iso-structural species?
A. $\mathrm{CH}_{3}^{-}$and $\mathrm{CH}_{3}^{+}$
B. $\mathrm{NH}_{4}^{+}$and $\mathrm{NH}_{3}$
C. $\mathrm{SO}_{4}^{2-}$ and $\mathrm{BF}_{4}^{-}$
D. $\mathrm{NH}_{2}^{-}$and $\mathrm{BeF}_{2}$

## Answer: C

## - Watch Video Solution

13. Select the molecules which has only one pi bond
A. $C H \equiv C H$
B. $\mathrm{CH}_{2}=\mathrm{CHCHO}$
C. $\mathrm{CH}_{3}=\mathrm{CH}=\mathrm{CH}_{2}$
D. $\mathrm{CH}_{3} \mathrm{C} \equiv \mathrm{CCOOH}$

## Answer: C

## - Watch Video Solution

14. The electronic configuration of metal M is $1 s^{2} 2 s^{2} 2 p^{6} 3 s^{1}$. The formula of its oxide will be :
A. MO
B. $M_{2} O$
C. $\mathrm{M}_{2} \mathrm{O}_{3}$
D. $\mathrm{MO}_{3}$

## Answer: B

## - Watch Video Solution

15. The hybridisation of carbon in diamond, graphite and acetylene are respectively
A. $s p^{3}, s p, s p^{2}$
B. $s p^{3}, s p^{2}, s p$
C. $s p, s p^{2}, s p^{3}$
D. $s p^{2}, s p^{3}, s p$

## Answer: B

## - Watch Video Solution

16. In which of the following paird, the two molecules have identical bond orders:
A. $N_{2}, O_{2}^{+}$
B. $\mathrm{N}_{2}, \mathrm{O}_{2}^{-}$
C. $N_{2}^{-}, O_{2}$
D. $N_{2}^{2-}, N_{2}$.

## Answer: A

## - Watch Video Solution

17. Which of the following hydrides has the least boilling point ?
A. $H_{2} S$
B. $\mathrm{H}_{2} \mathrm{O}$
C. $\mathrm{H}_{2} \mathrm{Se}$
D. $\mathrm{H}_{2} \mathrm{Te}$

## Answer: A

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18. The best method to separate a mixture of ortho and para nitrophenol (1:1) is :
A. Steam sidtillation
B. Crystallisation
C. Vaporisation
D. Spectroscopy

## Answer: A

## - Watch Video Solution

19. Which of the following at ordinary temperature and pressure exists as linear polymer due to extensive hydeogen bonding ?
A. $\mathrm{H}_{2} \mathrm{O}$
B. HCl
C. HF
D. $\mathrm{NH}_{3}$

## Answer: C

## - Watch Video Solution

20. Which is a square planar molecule ?
A. $X e F_{6}$
B. $\mathrm{XeF}_{4}$
C. $\mathrm{XeOF}_{4}$
D. $\mathrm{XeOF}_{2} \mathrm{~F}_{4}$

## Answer: B

## - Watch Video Solution

21. The structure of $\mathrm{CH}_{2}=\mathrm{C}=\mathrm{CH}_{2}$ is:
A. linear
B. planar
C. non-planar
D. has several resonating structures

## Answer: A

## D Watch Video Solution

22. Which of the following pairs are iso-structural ?
A. $X e F_{2}, l F_{2}^{-}$
B. $\mathrm{NH}_{3}, B F_{3}$
C. $\mathrm{CO}_{3}^{2-}, \mathrm{SO}_{3}^{2-}$
D. $P C l_{5}, l C l_{5}$

## Answer: A

23. The $H-O-H$ bond angle in water is
A. $105^{\circ}$
B. $102^{\circ}$
C. $180^{\circ}$
D. $90^{\circ}$

## Answer: A

## - Watch Video Solution

24. When two ice cubes are pressed over each other, they unite to form one cube. Which of the following forces is responsible to hold them together?
A. lonic interaction
B. Covalent attraction
C. van der Waals' forces
D. Hydrogen bond formation.

## Answer: D

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25. In $\mathrm{NO}_{3}^{-}$ion, the number of bond pair and lone pair of electrons on nitrogen atom are:
A. 2,2
B. 3,1
C. 1,3
D. 4,0

## Answer: D

26. The number of $\sigma-$ and $\pi$ bonds present in pent-4en-1-yne is :
A. 10,3
B. 3,10
C. 4,9
D. 9,4 .

## Answer: A

## Watch Video Solution

27. In which of the following molecules, the central atom has one lone pair and three bond pairs of electrons,
A. $H_{2} S$
B. $\mathrm{AlCl}_{3}$
C. $\mathrm{NH}_{3}$
D. $B F_{3}$.

## Answer: C

## - Watch Video Solution

28. If a molecule $M X_{3}$ has zero dipole moment, the state hybridisation of $M$ is :
A. $s p^{3} d$
B. sp.
C. $s p^{3} p^{2}$
D. $s p^{2}$

## Answer: D

## - Watch Video Solution

29. Which molecule has trigonal planar geometry ?
A. $B F_{3}$
B. $\mathrm{NH}_{3}$
C. $\mathrm{PCl}_{3}$
D. $I F_{3}$.

## Answer: A

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30. Which of the following species has a linear shape?
A. $\mathrm{SO}_{2}$
B. $\mathrm{NO}_{2}^{+}$
C. $O_{3}$
D. $\mathrm{NO}_{2}^{-}$.

## Answer: B

31. In which of the following pairs, the two species are isostructural :
A. $\mathrm{SO}_{4}^{2-}$ and $\mathrm{NO}_{3}^{-}$
B. $B F_{3}$ and $N F_{3}$
C. $\mathrm{BrO}_{3}^{-}$and $\mathrm{XeO}_{3}$
D. $\mathrm{SF}_{4}$ and $\mathrm{XeF}_{4}$

## Answer: C

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32. Four diatomic species are listed in different sequence .Which of these represent the correct order of their increasing bond order?
A. $\mathrm{C}_{2}^{2-}<\mathrm{He}_{2}^{+}<\mathrm{NO}<\mathrm{O}_{2}^{-}$
B. $\mathrm{He}_{2}^{+}<\mathrm{O}_{2}^{-}<\mathrm{NO}<\mathrm{C}_{2}^{2-}$
C. $\mathrm{O}_{2}^{-}<\mathrm{NO}<\mathrm{C}_{2}^{2-}<\mathrm{He}_{2}^{+}$
D. $\mathrm{NO}<\mathrm{C}_{2}^{2-}<\mathrm{O}_{2}^{-}<\mathrm{He}_{2}^{+}$

## Answer: B

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33. In which one of the following species, the central atom has the tuype of hybdridiztion which is not the same as that present in other three?
A. $S F_{4}$
B. $I_{3}^{-}$
C. $\mathrm{SbCl}_{5}^{2-}$
D. $\mathrm{PCl}_{5}$

## Answer: C

34. Hydridisation of the central atom in $\mathrm{Br} F_{5}$ molecule is :
A. $s p^{3}$
B. $d s p^{2}$
C. $s p^{3} d^{2}$
D. $d^{2} s p^{2}$

## Answer: C

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35. In which of the following pairs of molecules centreal atom is $s p^{2}$ hybrisised?
A. $\mathrm{NO}_{2}^{-}$and $\mathrm{NH}_{3}$
B. $\mathrm{BF}_{3}$ and $\mathrm{NH}_{2}^{-}$
C. $\mathrm{HN}_{2}^{-}$and $\mathrm{H}_{2} \mathrm{O}$
D. $\mathrm{BF}_{3}$ and $\mathrm{NH}_{2}^{-}$

## - Watch Video Solution

36. Which of the following pairs is isostractural (i.e having the same shape and hybridization ?
A. $\left[B C l_{3}\right.$ and $\left.B r C l_{3}\right]$
B. $\left[\mathrm{NH}_{3}\right.$ and $\left.\mathrm{NO}_{3}^{-}\right]$
C. $\left[N F_{3}\right.$ and $\left.B F_{3}\right]$
D. $\left[B F_{4}^{-}\right.$and $\left.N H_{4}^{+}\right]$

## Answer: D

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37. Bond order of 1.5 is shown by:
A. $O_{2}^{+}$
B. $\mathrm{O}_{2}^{-}$
C. $O_{2}^{2-}$
D. $O_{2}$.

## Answer: B

## - Watch Video Solution

38. Which of the following species contains three bond pair and one lone pair around the central atom ?
A. $\mathrm{H}_{2} \mathrm{O}$
B. $B F_{3}$
C. $\mathrm{NH}_{2}^{-}$
D. $\mathrm{PCl}_{3}$.
39. The pair of specied having the same bond order is:
A. $O_{2}^{-}, B_{2}$
B. $\mathrm{O}_{2}^{+}, \mathrm{NO}^{+}$
C. $\mathrm{NO}^{+}, \mathrm{CO}$,
D. $\mathrm{NO}_{2}, \mathrm{O}_{2}$.

## Answer: A

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40. During change of $O_{2}$ to $O_{2}^{2-}$ ion, the electrons add on which of the following orbitals ?
A. $\pi^{*}$ orbital
B. $\pi$ orbital
C. $\sigma^{*}$ orbital
D. $\sigma$ orbital.

## Answer: A

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41. Which one of the following molecules contains no $\pi$ - bond ?
A. $\mathrm{NO}_{2}$
B. $\mathrm{CO}_{2}$
C. $\mathrm{H}_{2} \mathrm{O}$
D. $\mathrm{SO}_{2}$.

## Answer: C

42. $X e F_{2}$ is iso-structural with :
A. $\mathrm{BaCl}_{2}$
B. $\mathrm{TeF}_{2}$
C. $\mathrm{lCl}_{2}^{-}$
D. $\mathrm{SbCl}_{3}$.

## Answer: C

## - Watch Video Solution

43. Dipole-induced dipole interaction are present in which of the following pairs
A. $\mathrm{SiF}_{4}$ and He atoms
B. $\mathrm{H}_{2} \mathrm{O}$ and alcohol
C. $C l_{2}$ and $C C l_{4}$
D. HCl and He atoms.

## Answer: B

## - Watch Video Solution

44. Which of the following is paramagnetic?
A. $\mathrm{NO}^{+}$
B. CO
C. $O_{2}^{-}$
D. $C N^{-}$

## Answer: C

45. Which of the following species has plane tringular shape?
A. $N_{3}^{-}$
B. $\mathrm{NO}_{3}^{-}$
C. $\mathrm{NO}_{2}^{-}$
D. $\mathrm{CO}_{2}$.

## Answer: B

## - Watch Video Solution

46. Which one of the following is paramagnetic in nature ?
A. NO
B. $\mathrm{NO}^{+}$
C. $\mathrm{NO}^{-}$
D. $N_{2}$

## Answer: A

47. Which of the following pairs of ions are isoelectronic and also isostructural ?
A. $\mathrm{SO}_{3}^{2-}, \mathrm{NO}_{3}^{-}$
B. $\mathrm{ClO}_{3}^{-}, \mathrm{SO}_{3}^{2-}$
C. $\mathrm{CO}_{3}^{2-}, \mathrm{SO}_{3}^{2-}$
D. $\mathrm{ClO}_{3}^{-}, \mathrm{CO}_{3}^{2-}$

## Answer: B

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48. The correct bond order in the following species is:
A. $O_{2}^{+}<O_{2}^{-}<O_{2}^{2+}$
B. $O_{2}^{-}<O_{2}^{+}<O_{2}^{2+}$
C. $O_{2}^{2+}<O_{2}^{+}<O_{2}^{2-}$
D. $O_{2}^{2+}<O_{2}^{-}<O_{2}^{2+}$

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49. The total number of $\pi$-bond electrons in the following structure is

A. 12
B. 16
C. 4
D. 8

Answer: D
50. Which of the following species contains equal number of pi and pi bonds?
A. $\mathrm{CH}_{2}(\mathrm{CN})_{2}$
B. $\mathrm{HCO}_{3}^{-}$
C. $\mathrm{XeO}_{4}$
D. $(C N)_{2}$

## Answer: C

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51. Decreasing order of stability of $O_{2}, O_{2}^{-}, O_{2}^{+}$and $O_{2}^{2-}$ is
A. $O_{2}^{2-}>O_{2}^{-}>O_{2}>O_{2}^{+}$
B. $O_{2}>O_{2}^{2-}>O_{2}^{2-}>O_{2}^{2-}$
C. $\mathrm{O}_{2}^{-}>\mathrm{O}_{2}^{2-}>\mathrm{O}_{2}^{+}>\mathrm{O}_{2}$
D. $O_{2}^{+}>O_{2}>O_{2}^{-}>O_{2}^{2-}$

## Answer: D

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52. Which of the following sets of molecules contains the same number of lone pairs of electrons in the central atom?
A. $S O_{2}, C l F_{3}, B r F_{3}$
B. $S F_{4}, N H_{3}, O_{3}$
C. $\mathrm{ClF}_{3}, \mathrm{XeF}_{2}, \mathrm{H}_{2} \mathrm{O}$
D. $\mathrm{H}_{2} \mathrm{O}, S F_{2}, \mathrm{NH}_{3}$

## Answer: B

## D Watch Video Solution

53. Which one of the following does not match with respect to the shape of the molecule?
A. $\mathrm{NH}_{3}$ - Trigonal pyramidal
B. $S F_{4}$ - Tetrahedral
C. $\mathrm{H}_{2} \mathrm{~S}$ - Bent
D. $C l F_{3}$-T-shape

## Answer: B

## - Watch Video Solution

54. Find the pair that has the same bond order with diamagnetic and paramagnetic properties respectively.
A. $F_{2}$ and $O_{2}$
B. $N_{2}$ and $O_{2}^{2-}$
C. $L i_{2}$ and $B_{2}$
D. $B_{2}$ and $O_{2}$

## Answer: C

55. In which one of the following compounds does the central atom obey the octet rule ?
A. $\mathrm{XeF}_{4}$
B. $\mathrm{XeOF}_{2}$
C. $S C l l_{2}$
D. $\mathrm{AlCl}_{3}$

## Answer: C

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56. Consider the molecules $\mathrm{CH}_{4}, \mathrm{NH}_{3}$ and $\mathrm{H}_{2} \mathrm{O}$ which of the given statement is false ?
A. The $\mathrm{H}-\mathrm{O}-\mathrm{H}$ bond angle in $\mathrm{H}_{2} \mathrm{O}$ is smaller than the $\mathrm{H}-\mathrm{N}-\mathrm{H}$ bond angle in $\mathrm{NH}_{3}$
B. The $\mathrm{H}-\mathrm{C}-\mathrm{H}$ bond angle in $\mathrm{CH}_{4}$ is larger than the $\mathrm{H}-\mathrm{N}-\mathrm{H}$ bond angle in $\mathrm{NH}_{3}$.
C. The H-C-H bond angle in $\mathrm{CH}_{4}$, the H-N-H bond angle in $\mathrm{NH}_{3}$ and the H-O-H bond angle in $\mathrm{H}_{2} \mathrm{O}$ are all greater than $90^{\circ}$.
D. The $\mathrm{H}-\mathrm{O}-\mathrm{H}$ bond angle in $\mathrm{H}_{2} \mathrm{O}$ is larger than the $\mathrm{H}-\mathrm{C}-\mathrm{H}$ bond angle in $\mathrm{CH}_{4}$.

## Answer: D

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57. Predict the correct order omong the following:
A. bond pair - bond pair $>$ lone pair - bond - pair $>$ lone pair-lone pair
B. lone pair - bond pair > bond pair - bond pair > bone pair - lone pair
C. pone pair - lone pair > lone pair - bond pair $>$ bond pair - bond pair
D. lone pair - lone pair > bond pair - bond pair > lone pair- bond pair.

## Answer: C

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58. The hybridisatipon of atomic orbitals of nitrogen in $\mathrm{NO}_{2}^{+}, \mathrm{NO}_{3}^{-}$and $\mathrm{NH}_{4}^{+}$respectively are
A. $s p, s p^{3}$ and $s p^{3}$
B. $s p^{2}, s p^{3}$ and $s p$
C. $s p, s p^{2}$ and $s p^{3}$
D. $s p^{2}, s p$ and $s p^{3}$

## Answer: C

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59. The species with fractional bond order is :
A. $O_{2}^{+}$
B. $O_{2}^{2+}$
C. CO
D. $H e_{2}$

Answer: A

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1. A molecule is square planar with no lone pair. What type of hybridisation is associated with it?
A. $s p^{3} d$
B. $s p^{3} d^{2}$
C. $d s p^{3}$
D. $d s p^{2}$

## Answer: D

2. Octrahedral shape is associated with
A. $P F_{5}$
B. $S F_{4}$
C. $\mathrm{TeF}_{6}$
D. $\mathrm{ClF}_{3}$.

## Answer: C

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3. Which of the following is linear ?
A. $\mathrm{C}_{2} \mathrm{H}_{2}$
B. $\mathrm{CH}_{4}$
C. $\mathrm{H}_{2} \mathrm{O}$
D. $\mathrm{NH}_{3}$.

## Answer: A

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4. The central atom assume $s p^{3}$ hybridisation in:
A. $\mathrm{PCl}_{3}$
B. $\mathrm{SO}_{3}$
C. $B F_{3}$
D. $\mathrm{NO}_{3}^{-}$.

## Answer: A

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5. Which of the following has net dipole moment ?
A. $\mathrm{CCl}_{4}$
B. $B F_{3}$
C. $\mathrm{NH}_{3}$
D. $\mathrm{CO}_{2}$.

## Answer: C

6. Which of the following hydrogen halide is most volatile.
A. HF
B. HCl
C. HBr
D. HI .

## Answer: B

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7. The structure of $l \mathrm{Cl}_{2}^{-}$is:
A. trigonal
B. trigonal bipyramidal
C. octahedral
D. square planar.

## Answer: B

## D Watch Video Solution

8. The molecules with maximum percentage ionic character is :
A. HI
B. HBr
C. HCl
D. HF.

## Answer: D

9. Ammonia has abnormally high boliling point because it has
A. Alkaline nature
B. Distored shape
C. $s p^{3}$ hybridisation
D. Hydrogen bonding.

## Answer: D

## D Watch Video Solution

10. The shape of $\mathrm{ClO}_{3}^{-}$ion according to VSEPR theory is:
A. Triangle planar
B. Pyramidal
C. Tetrahedral
D. square planar.

## Answer: B

11. According to Fazan rule, the covalent bond is favoured by :
A. Large cation and small anion
B. Large cation and large anion
C. Small cation and small anion
D. Small cation and large anion:

## Answer: D

## D Watch Video Solution

12. The shape of $S F_{3} C l_{3}$ molecule is:
A. trgonal bi-pyramidal
B. cubic
C. octahedral
D. thetrahedral.

## Answer: C

## D Watch Video Solution

13. A molecule of fluorine is formed by:
A. the axial p-p orbital overlap
B. the sidewise p-p orbital overlap
C. the axial s-s orbital overlap.
D. the axial s-p orbital overlap.

## Answer: A

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14. Which is the correct arrangement of the molecules basexd on dipole moments ?
A. $B F_{3}>\mathrm{NF}_{3}>\mathrm{NH}_{3}$
B. $\mathrm{NF}_{3}>\mathrm{BF}_{3}>\mathrm{NH}_{3}$
C. $\mathrm{NH}_{3}>\mathrm{BF}_{3}>\mathrm{NF}_{3}$
D. $\mathrm{NH}_{3}>\mathrm{NF}_{3}>\mathrm{BF}_{3}$

## Answer: D

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15. Covalent compounds have olw m.p. because :
A. Covalent molecules are held by weak van der Waals forces
B. Covalent bond is less exothermic
C. Covalent bond is weeker than ionic bond
D. Covalent molecules have definite shapes.

## Answer: A

16. Which of the following is a correct set with respect to molecule, hybridization, and shape?
A. $B e C l_{2}: s p^{2}$ linear
B. $B e C l_{2}: s p^{2}$, triangular planar
C. $B C l_{3}: s p^{2}$, triangular planar
D. $B C l_{3}: s p^{3}$ tetrahedral.

## Answer: C

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17. The pair of species having identical shapes for molecules of both species is?.
A. $B F_{3}, P C l_{3}$
B. $P F_{5}, l F_{5}$
C. $\mathrm{CCl}_{4}, S F_{4}$
D. $\mathrm{XeF}_{2}, \mathrm{CO}_{2}$

## Answer: D

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18. The correct order of decreasing bond angles in $\mathrm{H}_{2} \mathrm{~S}, \mathrm{NH}_{3}, \mathrm{BF}_{3}$ and $\mathrm{SiH}_{4}$ is
A. $\mathrm{H}_{2} \mathrm{~S}<\mathrm{SiH}_{4}<\mathrm{NH}_{3}<\mathrm{BF}_{3}$
B. $\mathrm{NH}_{3}<\mathrm{H}_{2} \mathrm{~S}<\mathrm{SiH}_{4}<B F_{3}$
C. $\mathrm{H}_{2} \mathrm{~S}<\mathrm{NH}_{3}<\mathrm{SiH}_{4}<\mathrm{BF}_{3}$
D. $\mathrm{H}_{2} \mathrm{~S}<\mathrm{NH}_{3}<\mathrm{BF}_{3}<\mathrm{SiH}_{4}$.

## Answer: C

19. In acetylene molecule, the carbon atoms are linked by:
A. one sigma bond and two pi bonds
B. two sigma bonds and one pi bond
C. Three sigma bonds
D. Three pi bonds.

## Answer: A

## - Watch Video Solution

20. As $P F_{5}$ molecule is $s p^{3} \mathrm{~d}$ hybridised and is trigonal bipyramidal (TbP) shape Which d-orbital is involved in $s p^{3} \mathrm{~d}$ hyridisation.
A. $d_{\left(x^{2}-y^{2}\right)}$
B. $d_{x y}$
C. $d_{z 2}$
D. $d_{z x}$

## Answer: C

## D Watch Video Solution

21. Which one of the following sepcies is diamagnetic in nature ?
A. $H e_{2}^{+}$
B. $\mathrm{H}_{2}$
C. $\mathrm{H}_{2}^{+}$
D. $\mathrm{H}_{2}^{-}$

## Answer: B

22. Which of the following molecules/ins does not contain unpaired electrons?
A. $O_{2}^{2-}$
B. $B_{2}$
C. $\mathrm{N}_{2}^{+}$
D. $O_{2}$.

## Answer: A

## - Watch Video Solution

23. In which of the following, hydrogen bond is the strongest ?
A. O-H......F
B. O-H..... H
C. F-H.....F
D. O-H......O.

## Answer: C

24. The charge/size ratio of a cation determines its polarizing power. Which one of the following sequences represents the increasing order of the polarizing power of the cationic species, $\mathrm{K}^{+}, \mathrm{Ca}^{2+}, \mathrm{Mg}^{2+}, \mathrm{Ba}^{2+}$ ?
A. $\mathrm{Ca}^{2+}<, \mathrm{Ca}^{2+}<\mathrm{Be}^{2+}<\mathrm{K}^{+}$
B. $\mathrm{Mg}^{2+}<, \mathrm{Be}^{2+}<\mathrm{K}^{+}<\mathrm{Ca}^{2+}$
C. $\mathrm{Be}^{2+}<, \mathrm{K}^{+}<\mathrm{Ca}^{+}<\mathrm{Mg}^{2+}$
D. $\mathrm{K}^{+}<, \mathrm{Ca}^{2+}<\mathrm{Mg}^{2+}<\mathrm{Be}^{2+}$

## Answer: D

## - Watch Video Solution

25. In which of the following ionixation processes, the bond order has increased and the magnetic behaviour has changed ?
A. $N_{2} \rightarrow N_{2}^{+}$
B. $C_{2} \rightarrow C_{2}^{+}$
C. $\mathrm{NO} \rightarrow \mathrm{NO}^{+}$
D. $O_{2} \rightarrow O_{2}$.

## Answer: C

## - Watch Video Solution

26. Which of the following statements is false ?
A. $H_{2}$ molecule has one sigma bond
B. HCl molecule has one sigma bond
C. Water molecule has two sigma bonds and two lone pairs.
D. Acetylene molecule has three pi bonds and thre sigma bonds.

## Answer:

27. $N_{2}$ and $O_{2}$ are converted into monocations, $N_{2}^{+}$and $O_{2}^{+}$ respectively. Which of the following is wrong?
A. In $N_{2}^{+}$, the $\mathrm{N}-\mathrm{N}$ bond is weakened
B. In $O_{2}^{+}$, the bond order increases
C. In $O_{2}^{+}$, paramagnetism decreases
D. $\mathrm{N}_{2}^{+}$becomes diamagnetic

## Answer: D

## - Watch Video Solution

28. A neutral molecule $X F_{3}$ has a zero diple moment. The element X is most likely :
A. chlorine
B. boron
C. nitrogen
D. carbon

## Answer: B

## - Watch Video Solution

29. The molecule having smallest bond angle is
A. $A s C l_{3}$
B. $S b C l_{3}$
C. $P C l_{3}$
D. $\mathrm{NCl}_{3}$.

## Answer: B

## - Watch Video Solution

30. Stability of the species $L i_{2}, L i_{2}^{-}$and $L i_{2}^{+}$increases in the order of
A. $L i_{2}^{-}<L i_{2}<L i_{2}^{+}$
B. $L i_{2}<L i_{2}^{+}<L i_{2}^{-}$
C. $L i_{2}^{-}<L i_{2}^{+}<L i_{2}$
D. $L i_{2}<L i_{2}<L i_{2}^{+}$

## Answer: C

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31. In the of the following pairs of molecules /ions both the species are not likely to exist?
A. $H_{2}^{-}, H e_{2}^{2+}$
B. $H_{2}^{+}, \mathrm{He}_{2}^{2-}$
C. $H_{2}^{-}, H e_{2}^{2-}$
D. $H_{2}^{2+}, H e_{2}$
32. Which of the following is diamagnetic ?
A. $H_{2}^{+}$
B. $\mathrm{He}_{2}^{+}$
C. $O_{2}$
D. $N_{2}$.

## Answer: D

## - Watch Video Solution

33. Number of antibonding electrons in $\mathrm{O}_{2}^{-}$molecular ion is:
A. 8
B. 6
C. 7
D. 4

## Answer: C

## - Watch Video Solution

34. The pair of compounds having identical shapes for their molecules is:
A. $\mathrm{CH}_{4}, S F_{4}$
B. $\mathrm{BCl}_{3}, \mathrm{ClF}_{3}$
C. $\mathrm{XeF}_{2}, \mathrm{ZnCl}_{2}$
D. $\mathrm{SO}_{2}, \mathrm{CO}_{2}$

## Answer: C

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35. Which of the following properties is not shown by $N O$ ?
A. its bond order is 2.5
B. Its is diamagnetic in the gaseous state
C. It is a netural oxide
D. Its combines with oxygen to from nitrogen dioxide.

## Answer: B

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36. In the formation of $\pi$-bond, the atomic orbitals overlap in such a way that
A. their axis remain parallel to each other and perpendicular to the internuclear axis
B. their axis remain parallel to each other and parallel to the internuclear axis
C. their axis remain perpendicular to each other and parallel to the internuclear axis
D. their axis remain perpendicular to each other and perpendicular to the internuclear axis.

## Answer: A

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37. The attractive force which holdes various constituents togrther in different chemical species is called
A. valence bond
B. chemical bond
C. atomic bond
D. electrovalent bond.
38. Which of the following stability order is correct ?
A. $O_{2}^{2-}>O_{2}^{-}>O_{2}>O_{2}^{+}$
B. $O_{2}^{+}>O_{2}>O_{2}^{-}>O_{2}^{2-}$
C. $O_{2}^{+}>O_{2}>O_{2}^{-}>O_{2}^{2-}$
D. $O_{2}>O_{2}^{+}>O_{2}>O_{2}^{-}$

## Answer: B

## - Watch Video Solution

39. The number of lone pairs of electrons on central atom of $\mathrm{H}_{2} \mathrm{O}, \mathrm{SnCl}_{2}, \mathrm{PCl}_{3}$ and $\mathrm{XeF}_{2}$ respectively are:
A. $2,1,1,3$
B. 2, 2, 1, 3
C. $3,1,1,2$
D. $2,1,2,3$

## Answer: A

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40. Which of the following changes in the respectively bond $N_{2}$ and $F_{2}$ molecules ?
A. decrease by 0.5 in both
B. increase by 0.5 in both
C. increase by 0.5 in the former and decrease by 0.5 in the later
D. decrease by 0.5 in the frmer and increase by 0.5 in the later

## Answer: D

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41. The species in which the N -atom is in a state of sp hybridisation is
A. $\mathrm{NO}_{2}^{+}$
B. $\mathrm{NO}_{2}^{-}$
C. $\mathrm{NO}_{3}^{-}$
D. $\mathrm{NO}_{2}$.

## Answer: A

42. Which of the following have least dipole moment?
A. $\mathrm{H}_{2} \mathrm{O}$
B. $B e F_{2}$
C. $\mathrm{NH}_{3}$
D. $B F_{3}$.

## - Watch Video Solution

43. The increassing order of bond order of $O_{2}, O_{2}^{+}, O_{2}^{-}$and $\mathrm{O}_{-}(2)^{\wedge}(-)^{\wedge}$ is :
A. $O_{2}^{+}, O_{2}, O_{2}^{-}, O_{2}^{--}$
B. $O_{2}^{--}, O_{2}^{-}, O_{2}^{+}, O_{2}$
C. $O_{2}, O_{2}^{+}, O_{2}^{-}, O_{2}^{--}$
D. $O_{2}^{2-}, O_{2}^{-}, O_{2}, O_{2}^{+}$

## Answer: D

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44. HCl gas is covalent and NaCl is an ionic compound. This is because
A. sodium is highly electropositive
B. hydrogen is a non-metal
C. HCl is a gas
D. electronegativity difference between H and Cl is less then 2.1

## Answer: D

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45. Out of $\mathrm{SO}_{2}, \mathrm{BeCl}_{2}, \mathrm{O}_{3}, \mathrm{H}_{2} \mathrm{O}$ and $\mathrm{HgCl}_{2}$, the linear species are:
A. $\mathrm{SO}_{2}$ and $O_{3}$
B. $\mathrm{SO}_{2}$ and $\mathrm{H}_{2} \mathrm{O}$
C. $\mathrm{BeCl}_{2}$ and $\mathrm{HgCl}_{2}$
D. $\mathrm{O}_{3}$ and $\mathrm{H}_{2} \mathrm{O}$

## Answer: C

46. Hybridisation and shape of $B r F_{5}$ is :
A. $s p^{3} d$ (Trigonal bipyramidal)
B. $s p^{3} d^{2}$ (Octahedral)
C. $d s p^{2}$ (Square planar)
D. $s p^{3} d^{2}$ (Square pyramidal)

## Answer: D

## - Watch Video Solution

## Jee Joint Entrange Examination Advanced Comprehension Linked Mcqs

1. L.C.A.O. Principle is involved in the formationof the molecular orbitals according ot molecular orbital theory. The energy of the bonding molecular orbital is less than that of thecombining atomic orbitals while that of the antibonding molecular orbitals while that of the order (B. O. $)=\frac{1}{2}\left(N_{b}-N_{a}\right)$ helps in predicting (i) formation of
molecules/molecular ions, bond dossociation energy, stability and bond length. Only the molecules or ions with positive B.O. can be formed. These will be diamagnetic if all molecular orbitals are dilled and paramagnetic if one of more are half filled. The atomic prbitals at the time of overlap must have the same symmetry as well.

Which of the followijng combinatinos is not allowed (assume $z$ axis as the internuclear azis) ?
A. 2 s and 2 s
B. $2 p_{x}$ and $2 p_{x}$
C. 2 s and $2 p_{z}$
D. $2 p_{y}$ and $2 p_{y}$

## Answer: D

## - View Text Solution

2. L.C.A.O. Principle is involved in the formationof the molecular orbitals according ot molecular orbital theory. The energy of the bonding
molecular orbital is less than that of thecombining atomic orbitals while that of the antibonding molecular orbitals while that of the order (B. O.) $=\frac{1}{2}\left(N_{b}-N_{a}\right)$ helps in predicting (i) formation of molecules/molecular ions, bond dossociation energy, stability and bond length. Only the molecules or ions with positive B.O. can be formed. These will be diamagnetic if all molecular orbitals are dilled and paramagnetic if one of more are half filled. The atomic prbitals at the time of overlap must have the same symmetry as well.

Bond arder is :
A. directly related to bond length
B. inversely related to bond length
C. incersely related to bond strength
D. never fractional.

## Answer: B

3. L.C.A.O. Principle is involved in the formationof the molecular orbitals according ot molecular orbital theory. The energy of the bonding molecular orbital is less than that of thecombining atomic orbitals while that of the antibonding molecular orbitals while that of the order (B.O. ) $=\frac{1}{2}\left(N_{b}-N_{a}\right)$ helps in predicting (i) formation of molecules/molecular ions, bond dossociation energy, stability and bond length. Only the molecules or ions with positive B.O. can be formed. These will be diamagnetic if all molecular orbitals are dilled and paramagnetic if one of more are half filled. The atomic prbitals at the time of overlap must have the same symmetry as well.

In the formation of $N_{2}^{+}$from $N_{2}$, the electron is removed from a
A. $\sigma$ orbital
B. $\pi$ orbital
C. $\sigma *$-orbital
D. $\pi *$-prbital.

## Answer: A

4. L.C.A.O. Principle is involved in the formationof the molecular orbitals according ot molecular orbital theory. The energy of the bonding molecular orbital is less than that of thecombining atomic orbitals while that of the antibonding molecular orbitals while that of the order (B. O. $)=\frac{1}{2}\left(N_{b}-N_{a}\right)$ helps in predicting (i) formation of molecules/molecular ions, bond dossociation energy, stability and bond length. Only the molecules or ions with positive B.O. can be formed. These will be diamagnetic if all molecular orbitals are dilled and paramagnetic if one of more are half filled. The atomic prbitals at the time of overlap must have the same symmetry as well.

The bond order (B.O.) in $B_{2}$ molecule is:
A. 0
B. 1
C. 2
D. 3

## Answer: B

## D Watch Video Solution

5. L.C.A.O. Principle is involved in the formationof the molecular orbitals according ot molecular orbital theory. The energy of the bonding molecular orbital is less than that of thecombining atomic orbitals while that of the antibonding molecular orbitals while that of the order (B.O.) $=\frac{1}{2}\left(N_{b}-N_{a}\right)$ helps in predicting (i) formation of molecules/molecular ions, bond dossociation energy, stability and bond length. Only the molecules or ions with positive B.O. can be formed. These will be diamagnetic if all molecular orbitals are dilled and paramagnetic if one of more are half filled. The atomic prbitals at the time of overlap must have the same symmetry as well.

In the homonuclear molecule3 which of the following sets of M.O. orbitals are degenerate ?
A. $\sigma_{1 s}$ and $\sigma_{1 s}^{*}$
B. $\pi_{2 p x}$ and $\pi_{2 p y}$
C. $\pi_{2 p x}$ and $\sigma_{2 p z}$
D. $\sigma_{2 p z}$ and $\pi_{2 p x}^{*}$

## Answer: B

## - View Text Solution

6. The concept of hybridisation has been introduced to explain the shapes of molecules. It involves the intermixing of two or more atomic orbitals belonging to same atom but in or more atomic orbitals beloging to sasme atom but in different sub-shells so as to intermix and redistibute energies to from equivalent orbitals called hybrid orbitals.Depending upon toh enumber and nature of the orbitals involved, the hybridisation may be divided into sp (linear), $s p^{2}$ (trigonal), $s p^{3}$ (tetrahedral), $s p^{3} d$ (trigonal bipyramidal), $s p^{3} d^{3}$ (octahedral) and $s p^{3} d^{3}$ (pentagonal bipyramidal) types. it may be noted that the orbitals of isolated atoms never hybridise and they do so at the time of bond formation.

A hybrid orbital from s-and p-orbitals can contribute to
A. $\sigma$-bond only
B. $\pi$-bond only
C. either $\sigma$ or $\pi$-bond
D. cannot be predicted.

## Answer: A

## D View Text Solution

7. The concept of hybridisation has been introduced to explain the shapes of molecules. It involves the intermixing of two or more atomic orbitals belonging to same atom but in or more atomic orbitals beloging to sasme atom but in different sub-shells so as to intermix and redistibute energies to from equivalent orbitals called hybrid orbitals.Depending upon toh enumber and nature of the orbitals involved, the hybridisation may be divided into sp (linear), $s p^{2}$ (trigonal), $s p^{3}$ (tetrahedral), $s p^{3} d$ (trigonal bipyramidal), $s p^{3} d^{3}$ (octahedral) and $s p^{3} d^{3}$ (pentagonal bipyramidal) types. it may be noted that the orbitals of isolated atoms
never hybridise and they do so at the time of bond formation.
Which carbon is maximum electronegative ?
A. $s p^{3}$-hybridise carbon
B. sp-hybridised carbon
C. $s p^{2}$-hybridised carbon
D. the electron attracting power of carbon is always the same irrespective of its hybrid state.

## Answer: B

## - Watch Video Solution

8. The concept of hybridisation has been introduced to explain the shapes of molecules. It involves the intermixing of two or more atomic orbitals belonging to same atom but in or more atomic orbitals beloging to sasme atom but in different sub-shells so as to intermix and redistibute energies to from equivalent orbitals called hybrid orbitals.Depending upon toh enumber and nature of the orbitals
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The hybrid state of carbon in $\mathrm{C}_{2} \mathrm{H}_{2}$ is same as that of carbon in:
A. $C_{2} H_{6}$
B. $\mathrm{CO}_{2}$
C. Benzene
D. C (diamond).

## Answer: B

## - Watch Video Solution

9. The concept of hybridisation has been introduced to explain the shapes of molecules. It involves the intermixing of two or more atomic orbitals belonging to same atom but in or more atomic orbitals beloging
to sasme atom but in different sub-shells so as to intermix and redistibute energies to from equivalent orbitals called hybrid orbitals.Depending upon toh enumber and nature of the orbitals involved, the hybridisation may be divided into $s p$ (linear), $s p^{2}$ (trigonal), $s p^{3}$ (tetrahedral), $s p^{3} d$ (trigonal bipyramidal), $s p^{3} d^{3}$ (octahedral) and $s p^{3} d^{3}$ (pentagonal bipyramidal) types. it may be noted that the orbitals of isolated atoms never hybridise and they do so at the time of bond formation.

The hybridisation of phostphorus in $\mathrm{PCOl}_{3}$ is the same as:
A. P in $P C l_{3}$
B. S in $S F_{4}$
C. Cl in $\mathrm{ClF}_{3}$
D. B in $B C l_{3}$.

## Answer: A

## - Watch Video Solution

10. The concept of hybridisation has been introduced to explain the shapes of molecules. It involves the intermixing of two or more atomic orbitals belonging to same atom but in or more atomic orbitals beloging to sasme atom but in different sub-shells so as to intermix and redistibute energies to from equivalent orbitals called hybrid orbitals.Depending upon toh enumber and nature of the orbitals involved, the hybridisation may be divided into sp (linear), $s p^{2}$ (trigonal), $s p^{3}$ (tetrahedral), $s p^{3} d$ (trigonal bipyramidal), $s p^{3} d^{3}$ (octahedral) and $s p^{3} d^{3}$ (pentagonal bipyramidal) types. it may be noted that the orbitals of isolated atoms never hybridise and they do so at the time of bond formation.

The d-orbital involved in $d s p^{2}$ hybridisation is:
A. $d_{x y}$
B. $d_{2 z}$
C. $d_{x^{2}-y^{2}}$
D. $d_{x z}$

## Answer: C

## - Watch Video Solution

11. Whenever, anion and cation approach each other, the valence shell of the anion is pulled towards the uncleus of the anion is pulled towards the nucles of the cation and as a result, the shape of the anion gets cation is known as polarization of polarizing an amion by a cation is known as polarrization. The ability or capacity of a cation of polarizethe anion towards litsef, is known as its polarizing power. Similiarty. the ability or capacity of an anion to get polarized by the cation, is known as its polarizability. As a result of polarisation, the two ions tend to come closer and the ionic character of the ionic ond acquired partial covalent character. The magnitude of polarization depends upon a number of factors whihc were suggested by Fazan and are termed as Fazan rules.
which of the halides, there is maximum polarization ?
A. $A l F_{3}$
B. $A l C l_{3}$
C. $A l B r_{3}$
D. $\mathrm{AlI}_{3}$.

## Answer: D

## - Watch Video Solution

12. Whenever, anion and cation approach each other, the valence shell of the anion is pulled towards the uncleus of the anion is pulled towards the nucles of the cation and as a result, the shape of the anion gets cation is known as polarization of polarizing an amion by a cation is known as polarrization. The ability or capacity of a cation of polarizethe anion towards litsef, is known as its polarizing power. Similiarty. the ability or capacity of an anion to get polarized by the cation, is known as its polarizability. As a result of polarisation, the two ions tend to come closer and the ionic character of the ionic ond acquired partial covalent character. The magnitude of polarization depends upon a number of factors whihc were suggested by Fazan and are termed as Fazan rules.

Which is most covalent in nature?
A. NaCl
B. $M g C l_{2}$
C. $A L C l_{3}$
D. $\mathrm{CaCl}_{2}$.

## Answer: C

## - Watch Video Solution

13. Whenever, anion and cation approach each other, the valence shell of the anion is pulled towards the uncleus of the anion is pulled towards the nucles of the cation and as a result, the shape of the anion gets cation is known as polarization of polarizing an amion by a cation is known as polarrization. The ability or capacity of a cation of polarizethe anion towards litsef, is known as its polarizing power. Similiarty. the ability or capacity of an anion to get polarized by the cation, is known as its polarizability. As a result of polarisation, the two ions tend to come closer and the ionic character of the ionic ond acquired partial covalent
character. The magnitude of polarization depends upon a number of factors whihc were suggested by Fazan and are termed as Fazan rules. Non-aqueous solvent like eather is added to the mixture of LiCl, NaCl . Which will be extracted by ether ?
A. NaCl
B. LiCl
C. KCl
D. None.

## Answer: B

## - Watch Video Solution

14. Whenever, anion and cation approach each other, the valence shell of the anion is pulled towards the uncleus of the anion is pulled towards the nucles of the cation and as a result, the shape of the anion gets cation is known as polarization of polarizing an amion by a cation is known as polarrization. The ability or capacity of a cation of polarizethe
anion towards litsef, is known as its polarizing power. Similiarty. the ability or capacity of an anion to get polarized by the cation, is known as its polarizability. As a result of polarisation, the two ions tend to come closer and the ionic character of the ionic ond acquired partial covalent character. The magnitude of polarization depends upon a number of factors whihc were suggested by Fazan and are termed as Fazan rules.

Which has the minimum melting point ?
A. $\mathrm{CaF}_{2}$
B. $\mathrm{CaCl}_{2}$
C. $\mathrm{CaBr}_{2}$
D. $\mathrm{Cal}_{2}$.

## Answer: D

## - Watch Video Solution

15. Which one among the following does not have the hydrogen bond?
A. Phenol
B. Liquid $\mathrm{NH}_{3}$
C. Water
D. HCl

## Answer: D

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16. The bond between two identical non-metal atoms has a pair of electrons:
A. unequally shared between the two.
B. transferred fully fro one atom to the other
C. with identical spins
D. equally shared between tham.
17. Hybridisationof sulphur in $S o_{2}$ is:
A. $s p$
B. $s p^{2}$
C. $s p^{3}$
D. $d s p^{2}$

## Answer: B

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18. The melecule that has linear structure is:
A. $\mathrm{CO}_{2}$
B. $\mathrm{NO}_{2}$
C. $\mathrm{SO}_{2}$
D. $\mathrm{SiO}_{2}$.

## Answer: A

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19. The type of hybrid orbitals used by the chlorine atom in $\mathrm{CIO}_{2^{-}}$is
A. $s p^{3}$
B. $s p^{2}$
C. $s p$
D. none of these

## Answer: A

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20. The maximum possible number of hydrogen bonds a water molecule can form is
A. 2
B. 4
C. 3
D. 1

## Answer: B

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21. The number and type of bonds between two carbon atoms in $\mathrm{CaC}_{2}$ are:
A. one sigma $(\sigma)$ one pi $(\pi)$ bond
B. one sigma ( $\sigma$ ) and two pi ( $\pi$ ) bonds.
C. one sigma ( $\sigma$ ) and one half pi $(\pi)$ bonds
D. one sigma $(\sigma)$ bond.

## Answer: C

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22. The cyanide ion $C N$ and $N_{2}$ are isoelectronic, but in contrast to $C N^{-}, N_{2}$ is chemically inert, because of
A. low bond energy
B. absence of bond polairty
C. unsymmetical electron distribution
D. Presence of more number of electron is bonding orbitals.

## Answer: B

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23. The geometry of $\mathrm{H}_{2} \mathrm{~S}$ and its dipole moment are :
A. angular and non-zero
B. angular and zero
C. linear and non-zero
D. linear and zero.

## Answer: A

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24. The hybridization of atomic orbitals of nitrogen is $\mathrm{NO}_{2}^{+}, \mathrm{NO}_{3}^{-}$, and $\mathrm{NH}_{4}^{+}$respectively are
A. $s p, s p^{3}$, and $s p^{2}$ respectively
B. $s p, s p^{2}$, and $s p^{3}$ respectively
C. $s p^{2}, s p$, and $s p^{3}$ rspectively
D. $s p^{2}, s p^{3}$, and $s p$ respectively

## Answer: B

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25. The common features among the species $\mathrm{CN}^{-}, \mathrm{CO}$ and $\mathrm{NO}^{+}$are :
A. bond order three and isoelectronic
B. bond order three and weak field ligands
C. bond order tow and $\pi$-acceptors
D. isoelectronic and weak field ligands.

## Answer: A

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26. Identify the least stable among the following
A. $L i^{-}$
B. $B e^{-}$
C. $B^{-}$
D. $C^{-}$

## Answer: B

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27. Which of the following are iso-electronic as well as is structural ? $\mathrm{NO}_{3}^{-}, \mathrm{CO}_{3}^{2-}, \mathrm{ClO}_{3}^{-}, \mathrm{SO}_{3}$
A. $\mathrm{NO}_{3}^{-}, \mathrm{CO}_{2}^{2-}$
B. $\mathrm{SO}_{3}, \mathrm{NO}_{3}^{-}$
C. $\mathrm{ClO}_{3}^{-}, \mathrm{CO}_{3}^{2-}$
D. $\mathrm{CO}_{3}^{2-}, \mathrm{SO}_{3}$

## Answer: A

28. According to $M O$ theory,
A. $O_{2}^{+}$is paramagnetic and b.o. is ggreater than that of $O_{2}$
B. $O_{2}^{+}$is paramagnetic and b.o. is less than that of $O_{2}$
C. $O_{2}^{+}$is diamagnetic and b.o. is less than that of $O_{2}$
D. $O_{2}^{+}$is diamagnetic and b.o. is more than that of $O_{2}$.

## Answer: A

## - Watch Video Solution

29. The bond angle in $H_{2} \mathrm{Sis} 92^{\circ}$. It suggest that :
A. hybridised state of S atom is $s p^{2}$
B. bond pair-bond pair repulsions are more due to large size of $S$ atom
C. Ione pair-lone pair repulsions are greater than bonds pair-bond pair
D. Bonds are more or les purely $\pi$-bonds.

## Answer: C

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30. The species having bond order different from that in $C O$ is
A. $\mathrm{NO}^{-}$
B. $\mathrm{NO}^{+}$
C. $C N^{-}$
D. $N_{2}$.

## Answer: A

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31. The bond energy (in kcal $\mathrm{mol}^{-1}$ ) of a $C-c$ single bond is approximately
A. $347 \mathrm{KJ} \mathrm{mol}^{-1}$
B. $500 \mathrm{KJ} \mathrm{mol}^{-1}$
C. $200 \mathrm{KJ} \mathrm{mol}^{-1}$
D. $950 \mathrm{KJ} \mathrm{mol}^{-1}$

## Answer: A

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32. In allene $\left(C_{3} H_{4}\right)$, the type (s) of the carbon atom (s) is (are) :
A. $s p$ and $s p^{3}$
B. $s p$ and $s p^{2}$
C. only $s p^{2}$
D. $s p^{2}$ and $s p^{3}$.

## Answer: B

## - Watch Video Solution

33. The shapes of $\mathrm{XeO}_{2} F_{2}$ molecule is
A. trigonal bipyramidal
B. square planar
C. tetrahedral
D. see-saw.

## Answer: D

## D Watch Video Solution

34. Assuming $2 s-2 p$ mixing is $N O T$ operative, the paramagnetic species among the following is .
A. $B e_{2}$
B. $B_{2}$
C. $C_{2}$
D. $N_{2}$

## Answer: C

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## Straight Objective Type Mcqs Single Correct Option

1. Carbon tetrachloride has no net dipole moment because of
A. its planar structure
B. its regular tetrahedral geometry
C. similar sizes of carbon and chlirine atoms
D. similar electron affinities of carbon an chlorine.

## Answer: B

## D Watch Video Solution

## Multiple Choice Answer Type Mcqs

1. $\mathrm{CO}_{2}$ is iso-structural with :
A. $\mathrm{HgCl}_{2}$
B. $\mathrm{C}_{2} \mathrm{H}_{2}$
C. $\mathrm{SnCl}_{2}$
D. $\mathrm{NO}_{2}$.

Answer: A: B

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2. Which of the following have identicla bond order ?
A. $C N^{-}$
B. $O_{2}^{-}$
C. $\mathrm{NO}^{+}$
D. $C N^{+}$.

## Answer: A:C

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3. Iso-structural species among the folwong are
$(l) \mathrm{CH}_{3}^{+}(\mathrm{ll}) \mathrm{H}_{3} \mathrm{O}^{+}(\mathrm{lll}) \mathrm{NH}_{3}(\mathrm{IV}) \mathrm{CH}_{3}^{-}$
A. I and II
B. III and IV
C. I and III
D. II,III and IV
4. The compound(s) with two lone pairs of electron on the central atom is (are)
A. $B r F_{5}$
B. $\mathrm{ClF}_{3}$
C. $\mathrm{XeF}_{4}$
D. $S F_{4}$.

## Answer: B::C

## - Watch Video Solution

5. According to molecular arbital theory,
A. $C_{2}^{2+}$ is expected to be diamagnetic
B. $O_{2}^{2+}$ os expected to have a bond length than $O_{2}$
C. $N_{2}^{2+}$ and $N_{2}^{-}$have the same bond order.
D. $\mathrm{He}_{2}^{+}$has the same energy as two isolated He atoms.

## Answer: A: C

## - Watch Video Solution

## Reason Type Questions

1. Statement 1:All molecules with polar bonds may not have dipole moments

Statement 2 : Dipole moment is a vectot quantity and bond dipoles may cancel out.
A. Statemetn-1 is true, Statrment-2 is also true, Statement -2 is the correct explanation of statement-1
B. Statement -1 is true, Statement 2 is also true, Statement- 2 is not the correct ezplanation of Statement-1
C. Statement-1 is true, Statement-2 is false.
D. Statement-1 is false, Statement-2 is true.

## Answer: a

## - Watch Video Solution

2. Statement 1: $H_{2}$ molecule is more stable than $H_{2}-H E$ molecule Statement 2: The antibonding electeon in $H_{2}-H e$ molecule destabilies. It.
A. Statemetn-1 is true, Statrment-2 is also true, Statement -2 is the correct explanation of statement-2
B. Statement -1 is true , Statement 2 is also true, Statement-2 is not the correct ezplanation of Statement-2
C. Statement- 1 is true, Statement-2 is false.
D. Statement- 1 is false, Statement- 2 is true.

## Answer: a

## - View Text Solution

3. Statement 1: $\mathrm{N}_{2}$ and $\mathrm{NO}^{+}$are both dia-magnetic.

Statement 2: $\mathrm{NO}^{+}$is isoelectronic with $\mathrm{N}_{2}$
A. Statemetn-1 is true, Statrment-2 is also true, Statement -2 is the correct explanation of statement-3
B. Statement -1 is true , Statement 2 is also true, Statement-2 is not the correct ezplanation of Statement-3
C. Statement- 1 is true, Statement-2 is false.
D. Statement- 1 is false, Statement- 2 is true.

Answer: b

## D Watch Video Solution

4. Statement 1: $P F_{5}$ molecule is little less stable as compared to $S F_{6}$ molecule.

Statement :2 In $P F_{5}$ molecule is little less stable as compared to $S F_{6}$ molecule.
A. Statemetn-1 is true, Statrment-2 is also true, Statement -2 is the correct explanation of statement-4
B. Statement -1 is true, Statement 2 is also true, Statement- 2 is not the correct ezplanation of Statement-4
C. Statement-1 is true, Statement-2 is false.
D. Statement-1 is false, Statement-2 is true.

## Answer: a

## - View Text Solution

5. Statement 1: The addition of electron in antibonding M.O. decreases bond order.

Statement 2: Antibonding electrons tend ot bring the atoms close together.
A. Statemetn-1 is true, Statrment-2 is also true, Statement -2 is the correct explanation of statement-5
B. Statement -1 is true , Statement 2 is also true, Statement-2 is not the correct ezplanation of Statement-5
C. Statement-1 is true, Statement-2 is false.
D. Statement-1 is false, Statement-2 is true.

## Answer: c

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6. Statement 1: When a magnet is dipped in liquid oxygen, some of it sticks to the magnet.

Statemetn 2: Oxygen is paramgnetic in nature.
A. Statemetn-1 is true, Statrment-2 is also true, Statement -2 is the correct explanation of statement-6
B. Statement -1 is true, Statement 2 is also true, Statement-2 is not the correct ezplanation of Statement-6
C. Statement-1 is true, Statement-2 is false.
D. Statement-1 is false, Statement-2 is true.

## Answer: a

## - Watch Video Solution

7. Statement 1 : Bond order in a stable molecule can be fractional.

Statemetn 2: The value of bond order depends upon the number of electrons in bonding and antibonding molecular orbitals.
A. Statemetn- 1 is true, Statrment- 2 is also true, Statement -2 is the correct explanation of statement-7
B. Statement -1 is true , Statement 2 is also true, Statement- 2 is not the correct ezplanation of Statement-7
C. Statement-1 is true, Statement-2 is false.
D. Statement-1 is false, Statement-2 is true.

## Answer: a

## D Watch Video Solution

8. Statement 1: $S F_{6}$ molecular has octahedral geometry

Statement 2: Sulphur atom in $S F_{6}$ molecule is in $s p^{3} d$ hybridisation state.
A. Statemetn-1 is true, Statrment-2 is also true, Statement -2 is the correct explanation of statement-8
B. Statement -1 is true, Statement 2 is also true, Statement- 2 is not the correct ezplanation of Statement-8
C. Statement-1 is true, Statement-2 is false.
D. Statement- 1 is false, Statement- 2 is true.

## Answer: c

## - Watch Video Solution

9. Assertion : All F - S - F angle in $S F_{4}$ are greater than $90^{\circ}$ but less than $180^{\circ}$.

Reason :The lone pair -bond pair repulsion is weaker than bond pair bond pair repulsion
A. Statemetn- 1 is true, Statrment- 2 is also true, Statement -2 is the correct explanation of statement-9
B. Statement -1 is true , Statement 2 is also true, Statement- 2 is not the correct ezplanation of Statement-9
C. Statement-1 is true, Statement-2 is false.
D. Statement-1 is false, Statement-2 is true.

## Answer: c

## D Watch Video Solution

10. Statement 1: Molecular nitrogen is less reactive than molecular oxygen Statement 2: The bond length of $N_{2}$ is less as compared to that of $O_{2}$.
A. Statemetn-1 is true, Statrment-2 is also true, Statement -2 is the correct explanation of statement-10
B. Statement -1 is true , Statement 2 is also true, Statement-2 is not the correct ezplanation of Statement-10
C. Statement- 1 is true, Statement-2 is false.
D. Statement-1 is false, Statement-2 is true.

## Answer: a

## - Watch Video Solution

11. Assertion: Boron always froms covalent bond.

Reason: The small size of $B^{3+}$ favours formation of covalent bond.
A. Statemetn-1 is true, Statrment-2 is also true, Statement -2 is the correct explanation of statement-11
B. Statement -1 is true, Statement 2 is also true, Statement- 2 is not the correct ezplanation of Statement-11
C. Statement- 1 is true, Statement-2 is false.
D. Statement-1 is false, Statement-2 is true.

## Answer: a

## - Watch Video Solution

12. Assertion(A) - In case the central atom in a molecule is surrounded only by shared pairs of electrons, the molecule has a regular geometry.

Reason $(R)$-The shared pair of electrons repel each other with equal force so all bonds are equidistant from each other.
A. Statemetn-1 is true, Statrment-2 is also true, Statement -2 is the correct explanation of statement-12
B. Statement -1 is true , Statement 2 is also true, Statement- 2 is not the correct ezplanation of Statement-12
C. Statement-1 is true, Statement-2 is false.
D. Statement-1 is false, Statement-2 is true.

## Answer: a

## - Watch Video Solution

13. Statement 1: There are ten valence electrons on the sulphur atom in $S F_{4}$ molecule.

Statement 2: The structure of $S F_{4}$ molecule is distorted trigonal bipyramidal.
A. Statemetn-1 is true, Statrment-2 is also true, Statement -2 is the
B. Statement -1 is true , Statement 2 is also true, Statement- 2 is not the correct ezplanation of Statement-13
C. Statement-1 is true, Statement-2 is false.
D. Statement- 1 is false, Statement- 2 is true.

## Answer: b

## - Watch Video Solution

14. Statement 1: $B F_{3}$ moleculeis planar while $N F_{3}$ is pyramidal.

Statement 2: N atom is smalar in size as compared ot B atom.
A. Statement-1 is true, Statement-2 is also true, Statement -2 is the correct explanation of statement-1
B. Statement -1 is true, Statement 2 is also true, Statement-2 is not the correct explanation of Statement-1
C. Statement-1 is true, Statement-2 is false.
D. Statement- 1 is false, Statement- 2 is true.

## Answer: b

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15. Statement 1: o-nitrophenol has higher boilling point than p nitrophenol.

Statement 2: Intermolecular hydrogen bonding is present in pnitrophenol and intrmolecular hydrogen bonding in o-nitrophenol.
A. Statemetn-1 is true, Statrment-2 is also true, Statement -2 is the correct explanation of statement-15
B. Statement -1 is true, Statement 2 is also true, Statement- 2 is not the correct ezplanation of Statement-15
C. Statement-1 is true, Statement-2 is false.
D. Statement-1 is false, Statement-2 is true.

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16. Statement 1: The B.O. of $F_{2}$ molecule is 1.

Statement 2: In $F_{2}$ molecule, the number of electrons in the antibonding
M.O. is two less than in bonding M.O.
A. Statemetn-1 is true, Statrment-2 is also true, Statement -2 is the correct explanation of statement-16
B. Statement -1 is true, Statement 2 is also true, Statement- 2 is not the correct ezplanation of Statement-16
C. Statement- 1 is true, Statement- 2 is false.
D. Statement- 1 is false, Statement- 2 is true.

## Answer: a

1. Match the statement ( $\mathrm{A}, \mathrm{B}, \mathrm{C}, \mathrm{D}$ ) in column I with the statement ( $\mathrm{p}, \mathrm{q}, \mathrm{r}, \mathrm{s}$ ) in column II. The answers are to be properly bobbled.

Column I
(A) $\mathrm{NH}_{3}$
(B) $\mathrm{BeF}_{2}$
(C) $\mathrm{H}_{2} \mathrm{O}$
(D) $\mathrm{CO}_{2}$
$p$
$q$

(D)

(p) Linear
(q) Polar
(r) $\mu=0 D$
(s) Angular

|  | $p$ | $q$ | $r$ | $s$ |
| :---: | :---: | :---: | :---: | :---: |
| (A) 0 | 0 | 0 | 0 |  |
| (B) 0 | 0 | 0 | 0 |  |
| (C) 0 | 0 | 0 | 0 | 0 |
| $(D)$ | 0 | 0 | 0 | 0 |

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2. 

Column I
(A) $\mathrm{CH}_{4}$
(B) $\mathrm{C}_{2} \mathrm{H}_{4}$
(C) $\mathrm{C}_{6} \mathrm{H}_{6}$
(D) $\mathrm{CO}_{2}$


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Column !
(A) $\mathrm{O}_{2}$
(B) $\mathrm{N}_{2}$
(C) $\mathrm{H}_{2}$
(D) $\mathrm{O}_{2}^{2}$
(A) $\quad \begin{array}{r}p \\ \end{array}$
(B) $\bigcirc$
(C) 0 0

$r$
 $S$
(p) Bond order $=2$
(q) Diamagnetic
(r) Bond order $=3$
(s) Paramagnetic

## Column II

(D) $\bigcirc$


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4. 

## Column I

(A) Linear shape
(B) $s p$-hybridisation
(C) $s p^{3} d$-hybridisation
(D) Angular
$p \quad q \quad r \quad s$
(A) $\bigcirc$
(B) $\bigcirc$
(C)
(D)

$\square$

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5.

Column I
(A) $\mathrm{O}_{2}{ }^{2}$
(B) CO
(C) $\mathrm{NO}^{+}$
(D) $\mathrm{He}_{2}{ }^{+}$

## Column II

(p) isoelectronic with $\mathrm{N}_{2}$
(q) Fractional bond order
(r) Paramagnetic
(s) Diamagnetic

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6. 

Column I
(A) $\mathrm{SO}_{3}{ }^{2}$
(B) HNC
(C) $\mathrm{SiF}_{4}$
(D) $\mathrm{NO}_{3}$

## Column II

(p) Central atom nas no lone pair
(q) All atoms of the species have lone pairs
(r) It has a co-ordinate bond
(s) It has $\pi, \pi$ as weil as co-ordinate bonds


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## Multiple Choice Questions Type 1

1. Isostructural species are those which have the same shape and hybridisation. Among the given identify the isostructural pairs.
A. $\left[N F_{3}\right.$ and $\left.B F_{3}\right]$
B. $\left[B F_{4}^{-}\right.$and $\left.N H_{4}^{+}\right]$
C. $\left[B C l_{3}\right.$ and $\left.B r C l_{3}\right]$
D. $\left[\mathrm{NH}_{3}\right.$ and $\left.\mathrm{NO}_{3}^{-}\right]$

## Answer: B

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2. Polarity in a molecule and hence the dipole moment depends primarily on electronegativity of the constituent atoms and shape of a molecule.

Which of the following has the highest dipole moment?
A. $\mathrm{CO}_{2}$
B. Hl
C. $\mathrm{H}_{2} \mathrm{O}$
D. $\mathrm{SO}_{2}$

## Answer: C

3. The types of hybrid orbitals of nitrogen in $\mathrm{NO}_{2}^{+}, \mathrm{NO}_{3}^{+}$and $\mathrm{NH}_{4}^{+}$ respectively are expented to be :
A. $s p, s p^{2}$ and $s p^{2}$
B. $s p, s p^{2}$ and $s p^{3}$
C. $s p^{2}, s p$ and $s p^{3}$
D. $s p^{2}, s p^{3}$ and $s p$

## Answer: B

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4. Hydrogen bonds are formed in many compounds e.g. $\mathrm{H}_{2} \mathrm{O}, \mathrm{HF}, \mathrm{NH}_{3}$. The boiling point of such compounds depends to a extent on the strength of hydrogen bond and the number of hydrogen bonds. The correct decreasing order of the boiling points above compounds is

$$
\text { A. } \mathrm{HF}>\mathrm{H}_{2} \mathrm{O}>\mathrm{NH}_{3}
$$

B. $\mathrm{N}_{2} \mathrm{O}>\mathrm{HF}>\mathrm{NH}_{3}$
C. $\mathrm{NH}_{3}>\mathrm{HF}>\mathrm{H}_{2} \mathrm{O}$
D. $\mathrm{NH}_{3}>\mathrm{H}_{2} \mathrm{O}>\mathrm{HF}$

## Answer: B

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5. In $\mathrm{PO}_{4}^{3-}$ ion the formal charge on the oxygen atom of $\mathrm{P}-\mathrm{O}$ bond is
A. +1
B. -1
C. -0.75
D. +0.75

## Answer: B

6. In $\mathrm{NO}_{3}^{-}$ion, the number of bond pair and lone pair of electrons on nitrogen atom are:
A. 2,2
B. 3,1
C. 1, 3
D. 4,0

## Answer: D

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7. Which of the following species does not have tetraahedral geometry ?
A. $\mathrm{BH}_{4}^{-}$
B. $\mathrm{NH}_{2}^{-}$
C. $\mathrm{CO}_{3}^{2-}$
D. $\mathrm{H}_{3} \mathrm{O}^{+}$

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8. Number of $\pi$ bonds and $\sigma$ bonds in the following structure is


Biph: nyl
A. 6,19
B. 4,20
C. 5,19
D. 5,20
9. Which molecule/ion out of the following does not contain unpaired electrons?
A. $N_{2}^{+}$
B. $O_{2}$
C. $O_{2}^{2-}$
D. $B_{2}$

## Answer: C

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10. In which of the following substances will hydrogen bond be strongest ?
A. $\mathrm{XeF}_{4}$
B. $B F_{4}^{-}$
C. $\mathrm{C}_{2} \mathrm{H}_{4}$
D. $\mathrm{SiF}_{4}$

## Answer: C

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11. In which of the following substances will hydrogen bond be strongest?
A. HCl
B. $\mathrm{H}_{2} \mathrm{O}$
C. HI
D. $H_{2} S$

## Answer: B

12. If the electronic configuration of an element is $1 s^{2} 2 s^{2} 2 p^{2} 3 s^{2} 3 p^{6} 3 d^{2} 4 s^{2}$ , four electrons involved in chemical bond formation will be $\hat{a} \epsilon_{\mid}|\hat{} \notin| \hat{a} \epsilon_{1}^{1}$.
A. $3 p^{6}$
B. $3 p^{6}, 4 s^{2}$
C. $3 p^{6}, 3 d^{2}$
D. $3 d^{2}, 4 s^{2}$

## Answer: D

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13. Which of the folowing angles corresponds to $s p^{2}$ hybridisation ?
A. $90^{\circ}$
B. $120^{\circ}$
C. $180^{\circ}$
D. $109^{\circ}$

## Answer: B

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14. Stable from of A may be represented by the formula :
A. A
B. $A_{2}$
C. $A_{3}$
D. $A_{4}$

## Answer: A

15. Stable from of C may be represented by the formula :
A. C
B. $C_{2}$
C. $C_{3}$
D. $C_{4}$

## Answer: B

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16. The molecular formula of the compound formed from B and C will be :
A. $B C$
B. $B_{2} C$
C. $B C_{2}$
D. $B C_{3}$

## Answer: D

17. The bond between $B$ and $C$ will be
A. Ionic
B. Colvalent
C. Hydrogen
D. Coordinate

## Answer: B

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18. Which of the following orderof energies of molecular orbitals of $N_{2}$ is correct?
A. $\sigma_{2 s}^{*}<\pi_{2 p y}=\pi_{2 p y}<\sigma_{2 p z}$
B. $\sigma_{2 s}^{*}<\pi_{2 p x}<\pi_{2 p y}<\sigma_{2 p z}$
C. $\sigma_{2 s}^{*}<\pi_{2 p z}<\pi_{2 p x}<\sigma_{2 p y}$
D. $P_{2 p x}<P_{2 p y}<s_{2 s}^{*}<s_{2 p z}$

## Answer: A

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19. Which of the following statement is not correct from the view point of molecular orbital theory?
A. $B e_{2}$ is not a stable molecule.
B. $H e_{2}$ is not stable but $H e_{2}^{+}$is expected to exist.
C. Bond strength of $N_{2}$ is maximum amongst the homonuclear diatomic molecules belonging to the second period.
D. The order of energies of molecular orbitals in $N_{2}$ molecule of

$$
\sigma_{2 s}<\sigma_{2 s}^{*}<\left(\pi_{2 p x}=\pi_{2 p x}\right)<\left(\pi_{2 p x}^{*}-\pi_{2 p x}^{*}\right)
$$

## Answer: D

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20. Which of the following options represents the correct bond order?

Thinking process

To calcualte bond order, write the molecular orbital configuration of particular species and afterwards using the formula.
Bond order $=\frac{1}{2}$ [Number of bonding $\left(N_{6}\right)$ - Number of anti-bonding electrons $\left(N_{a}\right)$ ]
A. $O_{2}^{-}>O_{2}>O_{2}^{+}$
B. $O_{2}^{-}<O_{2}<O_{2}^{+}$
C. $O_{2}^{-}>O_{2}<O_{2}^{+}$
D. $O_{2}^{-}<O_{2}>O_{2}^{+}$

## Answer: B

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21. The electronic configuration of the outer most shell of the most electronegative element is :
A. $2 s^{2} 2 p^{5}$
B. $3 s^{2} 3 p^{5}$
C. $4 s^{2} 4 p^{5}$
D. $5 s^{2} 5 p^{5}$

## Answer: A

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22. Amongst the following elements (whose electronic configuration an given below) the one having highest ionization energy is
A. $[N e] 3 s^{2} 3 p^{1}$
B. $[N e] 3 s^{2} 3 p^{3}$
C. $[N e] 3 s^{2} 3 p^{2}$
D. $[A r] 3 d^{10} 4 s^{2} 4 p^{3}$
23. Which of the following attain the linear structure?
A. $\mathrm{BeCl}_{2}$
B. $\mathrm{NCO}^{+}$
C. $\mathrm{NO}_{2}$
D. $C S_{2}$

## Answer: A::D

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24. CO is isoelectronic with
A. $\mathrm{NO}^{+}$
B. $N_{2}$
C. $\mathrm{SnCl}_{2}$
D. $\mathrm{NO}_{2}^{-}$.

## Answer: A: B

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25. Which of the following species have the same shape?
A. $\mathrm{CO}_{2}$
B. $\mathrm{CCl}_{4}$
C. $O_{3}$
D. $\mathrm{NO}_{2}^{-}$

## Answer: C::D

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26. Which of the following statements are correct about $\mathrm{CO}_{3}^{2-}$ ?
A. The hybridisation of central atom is $s p^{3}$.
B. Its resonance structure has one $\mathrm{C}-\mathrm{O}$ single bond and two $\mathrm{C}=\mathrm{O}$ double bonds.
C. The average formal charge on each oxygen atom is 0.67 units.
D. All C-O bond lengths are equal.

## Answer: C::D

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27. Dimagnetic species are those which contain no unpaired electrons.

Which among the followig are diamagnetic ?
A. $N_{2}$
B. $N_{2}^{2-}$
C. $O_{2}$
D. $O_{2}^{2-}$

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28. Species having same bond order are
A. $N_{2}$
B. $N_{2}^{-}$
C. $F_{2}{ }^{+}$
D. $O_{2}^{-}$

## Answer: C::D

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29. Which of the following statements are not correct?
A. NaCl being an ionic compound is a good conductor of electricity in the solid state.
B. In canonical structures, there is a difference in the arrangement of atoms.
C. Hybrid oritals form stronger bonds than pure orbitals.
D. VSEPR Theory can explain the square planar geometry of $X w F_{4}$.

## Answer: A: B

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## Multiple Choice Questions Type li

1. Which of the following have identical bond order ?
A. $C N^{-}$
B. $\mathrm{NO}^{+}$
C. $O_{2}^{-}$
D. $\mathrm{O}_{2}^{2-}$

## Answer: A::B

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## lii Matching Type Questions

1. Match the species in Column 1 with the type of hybrid orbitals in

Column II.
Column I Column II
(a) $S F_{4}$
(i) $s p^{3} d^{2}$
(b) $l F_{5}$
(ii) $d^{2} s p^{3}$
(c) $\mathrm{NO}_{2}^{+} \quad$ (iii) $s p^{3} d$
(d) $\mathrm{NH}_{4}^{+} \quad(i v) s p^{3}$
(v) $s p$

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2. Match the species in Column I with the geometry/shape in Column II.

|  | Column I | Column II |  |
| :--- | :--- | :--- | :--- |
| A. | $\mathrm{H}_{3} \mathrm{O}^{+}$ | 1. | Linear |
| B. | $\mathrm{HC} \equiv \mathrm{CH}$ | 2. | Angular |
| C. | $\mathrm{ClO}_{2}^{-}$ | 3. | Tetrahedral |
| D. | $\mathrm{NH}_{4}^{+}$ | 4. | Trigonal bipyramidal |
|  |  | 5. | Pyramidal |

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3. Match the species in Column I with the bond order in Column II.

| Column I |  | Column II |  |
| :--- | :--- | :--- | :--- |
| A. | NO | 1. | 1.5 |
| B. | CO | 2. | 2.0 |
| C | $\mathrm{O}_{2}^{-}$ | 3. | 2.5 |
| D. | $\mathrm{O}_{2}$ | 4. | $\mathbf{3 . 0}$ |

4. Match the items given in Column 1 with examples give in Column II.

## Column I Column II

(a)Hydrogen bond (i)C
(b)Resonance
(ii) LiF
(c) Ionic solid (iii) $\mathrm{H}_{2}$
(d) Covalent solid (iv) HF
(v) $O_{3}$

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5. Match the shape of molecules in Column 1 with the type of hybridisation in Column II.
Column I
Column II
(a)Tetrahedral
(i) $s p^{2}$
(b)Trigonal
(ii) $s p$
(c)Linear
(iii) $s p^{3}$
(d)Trigonal bipyramidal $(i v) s p^{3} d$

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## Iv Assertion Reason Type Questions

1. Assertion (A): Sodium chloride formed by the action of chlorine gas on sodium metal is a stable compound.

Reason: ( R ) This is because sodium and chloride ions acquire octet in sodium chloride formation.
A. A and R both are correct, and $R$ is the correct explanation of $A$.
B. A and R both are correct, but $R$ is not correct explanation of $A$.
C. $A$ is true but $R$ is false.
D. A and $R$ bot are false.

## Answer: A

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2. Assertion (A): Though the central atom of both $\mathrm{NH}_{3}$ and $\mathrm{H}_{2} \mathrm{O}$ molecules are $s p^{3}$ hybridised, yet $\mathrm{H}-\mathrm{N}-\mathrm{H}$ bond angle is greater thant that of $\mathrm{H}-\mathrm{O}-\mathrm{H}$.

Reason $(R)$ : This is because nitrogen atom has one lone pair and oxygen atom has two lone pairs.
A. A and R both are correct and R is the correct explanation of A .
B. A and R both are correct but R is not the correct explanation of A .
C. $A$ is true but $R$ is false.
D. A and $R$ bot are false.

## Answer: A

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3. Assertion (A): Among the two O-H bonds in $\mathrm{H}_{2} \mathrm{O}$ molecule, the energy required to break the first $\mathrm{O}-\mathrm{H}$ bond and the other $\mathrm{O}-\mathrm{H}$ bond is the same. Reason (R) This is because the electronic environment around oxygen is the same even after brekage of one $\mathrm{O}-\mathrm{H}$ bond.
A. A and R both are correct and R is the correct explanation of A .
B. A and R both are correct but R is not the correct explanation of $A$.
C. $A$ is true but $R$ is false.
D. A and $R$ bot are false.

## Answer: D

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## Comprehension

1. Molecular orbitals are formed by the overlap of atomic orbitals. Two atomic orbitals combine atom from two molecular orbitals called vonding molecular orbital (BOM) and anti bonding molecular orbital (ABMO). Energy of anti bonding orbital is raised above the parent atomic orbitals that have combined and the energy of the bonding orbital is lowered than the parent atomic orbitals. Energies of various molecular orbitals for elements hydrogen to nitrogne increase in the order :
$\sigma_{1 s}<\sigma_{1 s}^{*}<\sigma_{2 s}<\sigma_{2 s}^{*}<\left(\pi_{2 p y} \approx \pi_{2 p y}\right)<\sigma_{2 p y}<\left(\pi_{2 p y}^{*} \approx \pi_{2 p y}^{*}\right)<\sigma_{2 p z}^{*}$ and for ozygen and fluorine order of energy of molecular orbitals id given
below:
$\sigma_{1 s}<\sigma_{1 s}^{*}<\sigma_{2 s}<\sigma_{2 s}^{*}<\sigma_{2 p z}<\left(\pi_{2 p x}^{*} \approx \pi_{2 p y}^{*}\right) \sigma_{2 p z}^{*}$
Different atomic orbitals of one atom combine wiht the atomic orbitals of the second atom whihc have comparable energies and proper orientation. Further, if the overlapping is head on, the molecular orbital is called 'Sigma' $(\sigma)$ and if the overlap is atreal, the molecular orbital is called 'pi', $(\pi)$. The molecular orbitals are filled with electrons according to the same rules as followed for filling of atomic orbitals. However, the order for filling is not the same for all molecules or their ions, Bond order is one the most ipmrtaint parameters to compare the strength of bonds.

Which of the following statements is correct ?
A. In the formation of dioxygen atoms, 10 molecular orbitals will be formed.
B. All the molecular orbitals in the dioxygen will be completely filled.
C. Total number of bonding molecular orbitals will not be same as total number of anti bonding orbitals in dioxygen
D. Number of filed bonding orbitals will be same as number of filled antibonding orbitals.

## Answer: a

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2. Molecular orbitals are formed by the overlap of atomic orbitals. Two atomic orbitals combine atom from two molecular orbitals called vonding molecular orbital (BOM) and anti bonding molecular orbital (ABMO). Energy of anti bonding orbital is raised above the parent atomic orbitals that have combined and the energy of the bonding orbital is lowered than the parent atomic orbitals. Energies of various molecular orbitals for elements hydrogen to nitrogne increase in the order :
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Different atomic orbitals of one atom combine wiht the atomic orbitals of
the second atom whihc have comparable energies and proper orientation. Further, if the overlapping is head on, the molecular orbital is called 'Sigma' $(\sigma)$ and if the overlap is atreal, the molecular orbital is called 'pi', ( $\pi$ ). The molecular orbitals are filled with electrons according to the same rules as followed for filling of atomic orbitals. However, the order for filling is not the same for all molecules or their ions, Bond order is one the most ipmrtaint parameters to compare the strength of bonds.

Which of the following molecular orbital has maximum number of nodal planes?
A. $\sigma_{1 s}^{*}$
B. $\sigma_{2 p z}^{*}$
C. $\pi_{2 p x}$
D. $\pi_{2 p y}^{*}$

## Answer: d

3. Molecular orbitals are formed by the overlap of atomic orbitals. Two atomic orbitals combine atom from two molecular orbitals called vonding molecular orbital (BOM) and anti bonding molecular orbital (ABMO).

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is one the most ipmrtaint parameters to compare the strength of bonds.

Which of the following pair is expected to have the same bond order ?
A. $O_{2}, N_{2}$
B. $O_{2}^{+}, N_{2}^{-}$
C. $O_{2}^{-}, N_{2}^{+}$
D. $O_{2}^{-}, N_{2}^{-}$

## Answer: b

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4. Molecular orbitals are formed by the overlap of atomic orbitals. Two atomic orbitals combine atom from two molecular orbitals called vonding molecular orbital (BOM) and anti bonding molecular orbital (ABMO). Energy of anti bonding orbital is raised above the parent atomic orbitals that have combined and the energy of the bonding orbital is lowered than the parent atomic orbitals. Energies of various molecular orbitals for elements hydrogen to nitrogne increase in the order :
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Different atomic orbitals of one atom combine wiht the atomic orbitals of the second atom whihc have comparable energies and proper orientation. Further, if the overlapping is head on, the molecular orbital is called 'Sigma' $(\sigma)$ and if the overlap is atreal, the molecular orbital is called 'pi', $(\pi)$. The molecular orbitals are filled with electrons according to the same rules as followed for filling of atomic orbitals. However, the order for filling is not the same for all molecules or their ions, Bond order is one the most ipmrtaint parameters to compare the strength of bonds. In which of the following molecules $\sigma_{2 p z}$ molecular orbital is filled after $\pi_{2 p x}$ and $\pi_{2 p y}$ molecular orbitals ?
A. $O_{2}$
B. $N e_{2}$
C. $N_{2}$
D. $F_{2}$

Answer: c

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