CHEMISTRY

BOOKS - IIT-JEE PREVIOUS YEAR (CHEMISTRY)

CHEMICAL BONDING

Jee Main And Advanced

1. The intermolecular interaction that is dependent on the inverse cube of distance between the molecules is

A. ion-ion interaction

B. ion-dipole interaction

C. London force

D. hydrogen bond

Answer: B

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2. The nodal plane is the pi -bond of ethene is located in :

A. the molecular plane

B. a plane parallel to the molecular plane

C. a plane perpendicular to the molecular plane which bisects the carbon-carbon σ-bond at right angle

D. a plane perpendicular to the molecular plane which contains the carbon-carbon σ-bond

Answer: a

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3. Amongst H_2O, H_2S, H_2Se and H_2Te, the one with the highest boiling point is :

A. H_2O because of hydrogen bonding

B. H_2Te because of higher molecular weight

C. H_2Se because of lower molecular weight

D.

Answer: a

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4. Arrange the following compounds in order of increasing dipole moment .

Toluene (I) m-dichlorobenzene (II)

o-dichlorobenzene (III) . P-dichlorobenzene (IV) .

A. $I < IV < II < III$

B. $IV < I < II < III$

C. $IV < I < III < II$

D. $IV < II < I < III$

Answer: b

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5. The number and type of bonds between two carbon atoms in CaC_2 are:

A. one sigma(σ) and one pi (π) bonds

B. one sigma (σ) and two pi (π) bonds

C. one sigma (σ) and one half pi (π) bonds

D. one sigma (σ) bonds

Answer: b

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6. The molecule which has zero dipole moment is

A. CH_2Cl_2

B. BF_3

C. NF_3

D. ClO_2

Answer: b

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7. Element X is strongly electropositive and element Y is strongly electronegative. Both are univalent. The compound formed would be

A. X^+Y^-

B. X^-Y^+

C. $X - Y$

D. $X \rightarrow Y$

Answer: a

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8. Which of the following compound is covalent?

A. H_2

B. CaO

C. KCl

D. Na_2S

Answer: a

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9. The total number of electrons that take part in forming the bond in N_2 is .

A. 2

B. 4

C. 6

D. 10

Answer: c

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10. The compound which contains both ionic and covalent bonds is

A. CH_4

B. H_2

C. KCN

D. KCl

Answer: c

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11. Dipole moment is shown by

A. 1,4- dichlorobenzene

B. cis-1,2-dichloroethene

C. trans-1,2-dichloroetene

D. trans-1,2-dichoro-2-pentene

Answer: b,d

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12. Statement I $LiCl$ is predomionantly a covalent compound.

Statement II Electronegatvity difference between Li and Cl is too small

A. Statement I is true: Statement II is true, Statement II is the correct explanation of Statement I.

B. Statement I is true, Statement II is true, Statement II is not the correct explanation of Statement I.

C. Statement I is true, Statement II is false.

D. Statement I is false, Statement II is true.

Answer: c

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13. There are ..... π bonds in a nitrogen molecule

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14. All molecules with polar bonds have dipole moment.

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15. Linear overlapping of two atomic p- orbitals leads to a sigma bond.

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16. Arrange the following ions in order of their decreasing ionic radii.

$Li^{\oplus}, K^{\oplus}, Mg^{2+}, Al^{3+}$

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17. Between Na^{+} and Ag^{+} which is stronger Lewis acid and why?

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18. In the reaction $I^- + I_2 \rightarrow I_3$, which is the Lewis acid?

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19. Explain the difference in the nature of bonding in LIF and LiI

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20. The dipole moment of KCI is $3.36 \times 10^{-29} Cm$ The interatomic distance between $K^{\oplus}$ and CI^{Θ} in this unit of KCI is $2.3 \times 10^{-10} m$ Calculate the percentage ionic character of KCI .

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21. Give reasons in two or three sentences only for the following "The species $[CuCl_4]^{2-}$ exists, while $[CuI_4]^{2-}$ does not" .

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22. State four major physical properties that can be used to distinguish between covalent and ionic compounds. Mention the distinguishing features in each case.

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23. The group having isoelectronic species is

A. O^{2-}, F^{-}, Mg^{2+}

B. O^{-}, F^{-}, Na, Mg^{+}

C. $O^{2-}, F^{-}, Na, Mg^{2+}$

D. $O^{-}, F^{-}, Na^{+}, Mg^{2+}$

Answer: a

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24. The correct statement for the molecule, CsI_3 is

A. it is a covalent molecule

B. it contains Cs^+ and I_3^- ions

C. it contains Cs^{3+} and I^- ions

D. it contains Cs^+, I^- and lattice I_2 molecule

Answer: b

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25. The species having pyramidal shape is

A. SO_2

B. BrF_3

C. SiO_3^{2-}

D. OSF_2

Answer: d

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26. Assuming that Hund's rule is violated the bond order and magnetic nature of the diatomic molecle B_2 is

A. 1 and diamagnetic

B. 0 and diamagnetic

C. 1 and paramagnetic

D. 0 and paramagnetic

Answer: a

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27. The species having bond order different from that in CO is

A. NO^-

B. NO^+

C. CN^-

D. N_2

Answer: a

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28. Among the following , the paramagnetic compound is :

A. Na_2O_2

B. O_3

C. N_2O

D. KO_2

Answer: d

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29. Which species has the maximum number of lone pair of electrons on the central atom ?

A. ClO_3^-

B. XeF_4

C. SF_4

D. I_3^-

Answer: d

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30. Number of the pairs (s) in $XeOF_4$ is/are

A. 0

B. 1

C. 2

D. 3

Answer: b

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31. Which of the following are isolectronic and iso-structural ?

NO_3^{Θ} ,CO_3^{2-}, ClO_3^{Θ} ,SO_3 .

A. NO_3^- , CO_3^{2-}

B. SO_3, NO_3^-

C. ClO_3^- , CO_3^{2-}

D. CO_3^{2-} , SO_3

Answer: a

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32. Among the following, the molecule with the highest dipole moment is :

A. CH_3Cl

B. CH_2Cl_2

C. $CHCl_3$

D. $\mathbb{C}l_4$

Answer: a

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33. Which of the following molecular species has unpaired electrons(s) ? .

A. N_2

B. F_2

C. O_2^-

D. O_2^{2-}

Answer: c

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34. Specify the co-ordination geometry around and hybridisation of N and B complex of NH_3 and BF_3,

A. N: tetrahedral, sp^3, B: tetrahedral, sp^3

B. N: pyraidal, sp^3, B: pyramidal, sp^3

C. N: pyramidal, sp^3, B: planar, sp^2

D. N: pyramidal, sp^3, B: tetrahedral, sp^3

Answer: a

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35. The correct order of hybridisation of the central atom in the following species NH_3, $[PtCl_4]^{2-}$, PCl_5 and BCl_3 is :

A. dsp^2, dsp^3, sp^2 and sp^3

B. sp^3, dsp^2, sp^3d and sp^2

C. dsp^2, sp^2, sp^3 and dsp^3

D. dsp^2, sp^3, sp^2 and dsp^3

Answer: b

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36. The common features among the species CN^-, CO and NO^+ are :

A. bond order three and isoelectronic

B. bond order three and weak field ligands

C. bond order two and acceptors

D. isoelectronic and weak field ligands

Answer: a

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37. The hybridization of atomic orbitals of nitrogen is NO_2^+, NO_3^-, and NH_4^+ respectively are

A. sp, sp^3 and sp^2 respectively

B. sp, sp^2 and sp^3 respectively

C. sp^2, sp and sp^3 respectively

D. sp^2, sp^3 and sp respectively

Answer: b

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38. In the compound

$CH_2 = CH - CH_2 - CH_2 - C \equiv CH$ the $C_2 - C_3$ bond is of

A. $sp - sp^2$

B. sp^3, sp^3

C. $sp - sp^3$

D. $sp^2 - sp^3$

Answer: d

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39. The geometry of H_2S and its dipole moment are :

A. angular and non-zero

B. angular and zero

C. linear and non-zer0

D. linear and zero

Answer: a

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40. The geometry and the type of hybrid orbitals present about the central atom in BF_3 is :

A. linear, sp

B. trigonal planar, sp^2

C. tetrahedral sp^3

D. pyramidal sp^3

Answer: b

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41. Which of the following compounds has sp^2-hybridisation?

A. CO_2

B. SO_2

C. N_2O

D. CO

Answer: b

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42. Among $KO_2, ALO_2^{\Theta}, BaO_2$ and NO_2^+, unpaired electrons is present in .

A. NO_2^+ and BaO_2

B. KO_2 and AlO_2^-

C. only KO_2

D. only BaO_2

Answer: c

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43. The cyanide ion CN and N_2 are isoelectronic, but in contrast to CN^-, N_2 is chemically inert, because of

A. low bond energy

B. absence of bond polarity

C. unsymmetrical electron distribution

D. presence of more number of electron in bonding orbitals

Answer: b

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44. Among the following species, identify the isostuctural pairs

$NF_3. NO_3^-, BF_3, H_3O, HN_3$

A. $[NF_3, NO_3^-]$ and $[BF_3, H_3O^+]$

B. $[NF_3, N_3H]$ and $[NO_3^-, BF_3]$

C. $[NF_3, H_3O^+]$ and $[NO_3^-, BF_3]$

D. $[NF_3, H_3O^+]$ and $[N_3H, BF_3]$

Answer: c

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45. Which one of the following molecules is planar?

A. NF_3

B. NCl_3

C. PH_3

D. BF_3

Answer: d

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46. 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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47. The type of hybrid orbitals used by the chlorine atom in ClO_2^- is

A. sp^3

B. sp^2

C. sp

D. None of these

Answer: a

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48. The species which has pyramidal shape is

A. PCl_3

B. SO_3

C. CO_3^{2-}

D. NO_3^-

Answer: a

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49. Which of the following is paramagnetic?

A. O_2^-

B. CN^-

C. CO

D. NO^+

Answer: a

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50. The $CI-C-CI$ angle in $1,1,2,2,$ tetrachloroethone and tetrachloromethane respectively will be about:

A. 120° and 109.5°

B. 90° and 109.5°

C. 109° and 90°

D. 109.5° and 120°

Answer: a

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51. The melecule that has linear structure is:

A. CO_2

B. NO_2

C. SO_2

D. SiO_2

Answer: a

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52. The species in which the cantral atom uses sp^2 hybrid orbital in its bonding is:

A. PH_3

B. NH_3

C. CH_3^+

D. SbH_3

Answer: c

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53. Which of the following will have zero dipole moment?

A. 1,1-dichloroethylene

B. cis -1,2-dichloroethylene

C. trans-1,2,-dichloroethylene

D. none of the above

Answer: c

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54. The hybridisation of sulphur in sulphur dioxide is

A. sp

B. sp^3

C. sp^2

D. dsp^2

Answer: C

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55. The bond between two identical non-metal atoms has a pair of electrons:

A. unequally shared between the two

B. transferred fully from one atom to another

C. with identical spins

D. equally shared between them

Answer: d

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56. One hybridization of one s and one p orbital we get

A. two mutually perpendicular orbitals

B. two orbitals at 180°

C. four orbitals directed tetrahderally

D. three orbitals in a plane

Answer: b

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57. Carbon tetrachloride has no net dipole moment because of

A. its planar structure

B. its regular tetrahedral structure

C. similar sizes of carbon ad chlorine atoms

D. similar electron affinities of carbon and chlorine

Answer: b

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58. The ion that is isoelectronic with CO is

A. CN^-

B. O_2^+

C. O_2^-

D. N_2^+

Answer: a

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59. Among the following, the linear molecule is

A. CO_2

B. NO_2

C. SO_2

D. ClO_2

Answer: a

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60. If molecule MX_3 has zero dipole moment, the sigma bonding orbitals used by M (atomic number < 21) are

A. pure p

B. sp-hybridised

C. sp^2-hybridised

D. `sp^(3)-hybridised

Answer: c

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61. The molecule (s) that will have dipole moment is/are:

A. 2,2-dimethyl propane

B. trans -2-pentene

C. cis-3-hexene

D. 2,2,3,3-tetrametyl butane

Answer: b,c

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62. Which of the following has //have identical bond order ?

A. CN^-

B. O_2^-

C. NO^+

D. CN^+

Answer: a,c

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63. The linear struture is assumed by :

A. $SnCl_2$

B. CS_2

C. NO_2^+

D. NCO^-

Answer: b,c,d

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64. CO_2 is isostructural with

A. $HgCl_2$

B. C_2H_2

C. $SnCl_2$

D. NO_2

Answer: a,b

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65. Match the orbital overlap figures shown in Column I with the description given in Column II and select the correct answer using the

codes given below the Columns.

Column I		Column II	
A.		1.	*p-d* π antibonding
B.		2.	*d-d* σ bonding
C.		3.	*p-d*π bonding
D.		4.	*d-d* σ antibonding

A. $\begin{matrix} A & B & C & D \\ 4 & 3 & 2 & 1 \end{matrix}$

B. $\begin{matrix} A & B & C & D \\ 1 & 2 & 3 & 4 \end{matrix}$

C. $\begin{matrix} A & B & C & D \\ 2 & 3 & 1 & 4 \end{matrix}$

D. $\begin{matrix} A & B & C & D \\ 4 & 1 & 2 & 3 \end{matrix}$

Answer: $A \rightarrow 2; B \rightarrow 3; C \rightarrow 1; D \rightarrow 4$

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66. Among N_2O, SO_2, I_3^+ and I_3^-, the linear species are .....and.....

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67. When N_2 goes to N_2^+, the $N-N$ bond distance ....., and when O_2 goes to O_2^+ the $O-O$ bond distance.....

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68. The two types of bonds present in B_2H_6 are covalent and _____.

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69. The kind of delocalisation involving sigma bond orbitals is called.....

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70. The valence atomic orbital on C in silver acetidc is ..... hybridised.

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71. The shape of CH_3^+ is .....

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72. ..... hybrid orbitals of nitrogen atom are involved in the formation of ammonium ion.

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73. Pair of molecules which forms strongest intermolecular hydrogen bonds is ..... (SiH_4 and SiF_4, acetone and $CHCl_3$, formic acid and acetic acid)

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74. The angle between two covalent bonds is maximum in ..... (CH_4, H_2O, CO_2)

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75. The dipole moment of CH_3F is greater than that of CH_3Cl.

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76. H_2O molecule is linear

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77. The presence of polar bonds in a polyatomic molecule suggests that the molecule has non-zero dipole moment.

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78. sp^3 hybrid orbitalos have equal s and p character.

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79. In benzene, carbon uses all the three p- orbitals for hybridisation.

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80. $SnCl_2$ is a non-linear molecule.

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81. Among the triatomic molecules/ions $BeCl_2, N_3^-, N_2O, NO_2^+, O_3, SCl_2, lCl_2^-, l_3^-$ and XeF_2, the total number of linear molecules (s)/ion(s) where the hybridisation of the central atom does not have contribution from the d- orbitals (s) is [atomic number of $S = 16, Cl = 17, I = 53$ and $Xe = 54$]

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82. A list of species having the formula of XZ_4 is given below $XeF_4, SF_4, SiF_4, BF_4^-, BrF_4^-, [Cu(NH_3)4]^{2+}, [FeCl_4]^{2-}, [CoCl_4]^{2-}$ and $[PtCl_4]^{2-}$

Defining shape on the basis of the locatiion of X and Z atoms, the total number of species having a square planar shape is

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83. The total number of lone-pair of electrons in melamine is

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84. Based on VSEPR theory, the number of 90° $F-Br-F$ angles in BrF_5 is

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85. Predict whether the following molecules are isostructural or not. Justify your answer.

(i) NMe_3 (ii) $N(SiMe_3)_3$

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86. On the basis of ground state electronic configuration, arrange the following molecules in increasing $O-O$ bond length order. $KO_2, O_2, O_2[AsF_6]$

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87. Draw the shape of XeF_4 and OSF_4 according to VSEPR theory. Show the lone pair of electrons on the central atom.

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88. Using VSEPR theory, draw the shape of PCL_5 and BrF_4.

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89. Draw the molecular structures of XeF_2, XeF_4 and XeO_2F_2, indicating the location of lone pair(s) of electrons.

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90. Interpret the non-linear shape of H_2S molecule and non-planar shape of PCl_3 using valence shell electron pair repulsion (VSEPR)

theory.

(Atomic number : $H = 1, P = 15, S = 16, Cl = 17$)

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91. Using the VSEPR theory, identify the type of hybridisation and draw the structure of OF_2.What are the oxidation states of O and F?

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92. Which of the following species is not paramagnetic?

A. NO

B. CO

C. O_2

D. B_2

Answer: B

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93. Assuming $2s - 2p$ mixing is not operative, the paramagnetic species among the following is

A. Be_2

B. B_2

C. C_2

D. N_2

Answer: c

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94. Stability of the species Li_2, Li_2^- and Li_2^+ increases in the order of

A. $Li_2 < Li_2^+ < Li_2^-$

B. $Li_2^- < Li_2^+ < Li_2$

C. $Li_2 < Li_2^- < Li_2^+$

D. $Li_2^- < Li_2 < Li_2^+$

Answer: b

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95. In the of the following pairs of molecules /ions both the species are not likely to exist?

A. H_2^+, He_2^{2-}

B. H_2^-, He_2^{2-}

C. H_2^{2+}, He_2

D. H_2^-, He_2^{2+}

Answer: c

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96. Hyperconjugation involves overlap of which of the following orbitals?

A. $\sigma - \sigma$

B. $\sigma - p$

C. $p - p$

D. $\pi - \pi$

Answer: b

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97. According to MO theory,

A. O_2^+ is paramagnetic and bond order greater than O_2

B. O_2^+ is paramagnetic and order less than O_2

C. O_2^+ is diamagnetic and bond order is less than O_2

D. O_2^+ is diamagnetic and bond order is more than O_2

Answer: a

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98. Molecular shape of SF_4, CF_4 and XeF_4 are

A. the same, with 2, 0 and 1 lone pair of electrons respectively

B. the same, with 1,1 and 1 lone pair of electrons respectively

C. different, with 0,1 and 2 lone pair of electrons respectively

D. different with 1,0 and 3 lone pair of electrons respectively

Answer: c

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99. In compounds of type ECl_3 where $E = B, P, As, Bi$. The angles $Cl - E - Cl$ for different E are in the order :

A. $B > P = As = Bi$

B. $B > P > As > Bi$

C. $B < P = As = Bi$

D. $B < P < As < Bi$

Answer: b

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100. The correct order of increasig $C - O$ bond length of CO, CO_3^{2-}, CO_2 is

A. $CO_3^{2-} < CO_2 < CO$

B. $CO_2 < CO_3^{2-} < CO$

C. $CO < CO_3^{2-} < CO_2$

D. $CO < CO_2 < CO_3^{2-}$

Answer: d

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101. Which contains both polar and non-polar bonds?

A. NH_4Cl

B. HCN

C. H_2O_2

D. CH_4

Answer: c

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102. Which one among the following does not have the hydrogen bond?

A. Phenol

B. Liquid NH_3

C. Water

D. HCl

Answer: d

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103. According to molecular orbital theory, which of the following statements is (are) correct?

A. C_2^{2-} is expected to be diamagnetic

B. O_2^{2+} is expected to have a longer bond length than O_2

C. N_2^+ and N_2^- have the same bond order

D. He_2^+ has the same energy as two isolated He atoms

Answer: a,c

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104. Hydrogen bonding plays a central role in which of the following phenomena?

A. Ice floats in water

B. Higher Lewis basicity of primary amines than tertiary amines in aqueous solutions

C. Formic acid is more acidic than acetic acid

D. Dimenrisation of acetic acid in benzene

Answer: a,b,d

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105. Which one of the following molecules is expected to exhibit diamagnetic behaviour?

(i) N_2 (ii) O_2

(iii) S_2 (iv) C_2

A. C_2

B. N_2

C. O_2

D. S_2

Answer: a,b

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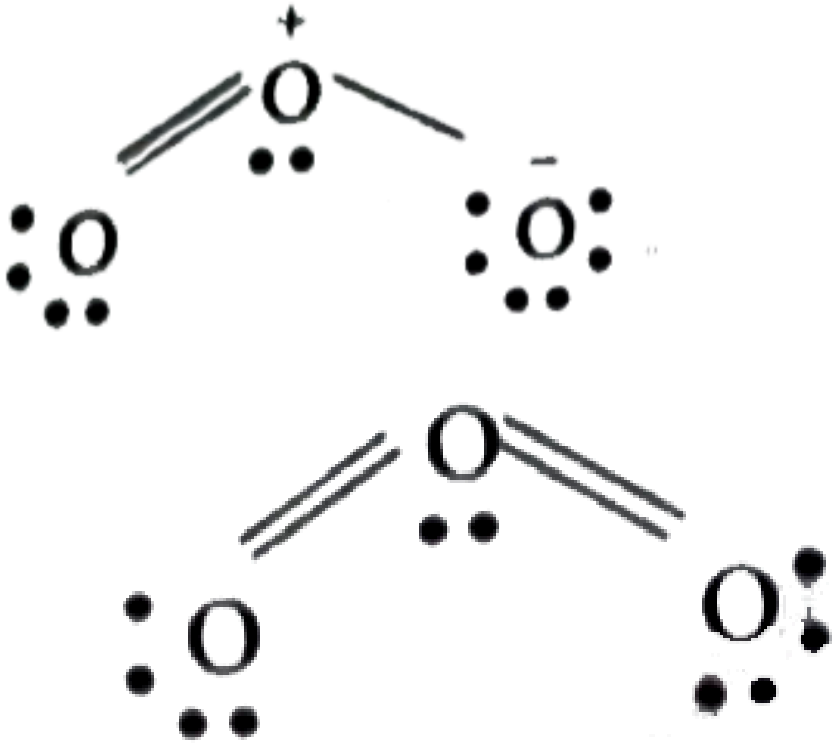
106. Statement I The electronic structure of O_3 is



Statement II

structure is not allowed because octet around O cannot be expanded.

A. Statement I is true: Statement II is true, Statement II is the correct explanation of Statement I.

B. Statement I is true, Statement II is true, Statement II is not the correct explanation of Statement I.

C. Statement I is true, Statement II is false.

D. Statement I is false, Statement II is true.

Answer: a

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107. Among H_2, He_2^+, Li_2, Be_2, B_2, C_2, N_2, O_2^- and F_2, the number of diamagnetic species is

(Atomic numbers: $H = 1, He = 2, Li = 3, Be = 4, B = 5, C = 6, N = 7, O = 8, F = 9$)

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108. Write the MO electron distribution of O_2.Specify its bond order and magnetic property.

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109. Arrange the following as stated.

"Increasing strength of hydrogen bonding $(X - H - X)$

O, S, F, Cl, N

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Match The Columns

1. Match each of the diatomic molecules in Column I with its property

properties in Column II

	Column I		ColumnII
A.	B_2	p.	Paramagnetic
B	N_2	q.	Undergoes oxidation
C.	O_2^-	r.	Undergoes reduction
D.	O_2	s.	Bond order ≥ 2
		t.	Mixing of 's' and 'p' orbitals

A. $\begin{matrix} A & B & C & D \\ q,r,s & q,r,s,t & q,r,t & p,q,t \end{matrix}$

B. $\begin{matrix} A & B & C & D \\ p,q,r,t & q,r,s,t & p,q,r,t & p,r,s,t \end{matrix}$

C. $\begin{matrix} A & B & C & D \\ q,r,s,t & p,q,r & r,s,t & p,q,r,t \end{matrix}$

D. $\begin{matrix} A & B & C & D \\ q,r,s & q,r,s,t & q,r,t & p,q,t \end{matrix}$

Answer: `Atop,q,r,t;Btoq,r,s,t;Ctop,q,r,t;Dtop,r,s,t

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Integer Type

1. The sum of the number of lone pairs of electrons on each central atom in the following species is

$[TeBr_6]^{2-}$, $[BrF_2]^+$, SNF_3 and $[XeF_3]^-$

(Atomic numbers : $N = 7, F = 9, S = 16, Br = 35, Te = 52, Xe - 54$)

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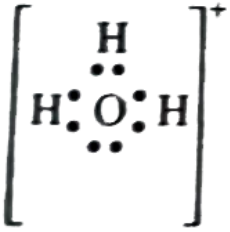
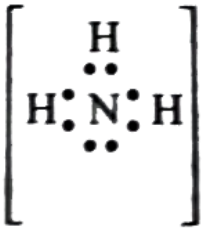
Subjective Type

1. Write the Lewis dot structural formula for each of the following. Give also, the formula of a neutral molecule, which has the same geometry and the same arrangement of the boding electrons as in each of the following. An example is given below in the case of H_3O^+ and NH_3.





(i) O_2^{2-} (ii) CO_3^{2-}

(iii) CN^- (iv) NCS^-

A. O_2^{2-}

B. CO_3^{2-}

C. CN^-

D. NCS^-

Answer: NA

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Match The Column

1. Match the reactions in Column I with nature of the reactions/type of the products in Column II

	Column I		Column II
A.	$O_2^- \longrightarrow O_2 + O_2^{2-}$	1.	Redox reaction
B.	$CrO_4^{2-} + H^+ \longrightarrow$	2.	One of the products has trigonal planar structure
C.	$MnO_4^- + NO_2^- + H^+ \longrightarrow$	3.	Dimeric bridged tetrahedral metal ion
D.	$NO_3^- + H_2SO_4 + Fe^{2+} \longrightarrow$	4.	Disproportionation

A. $\begin{matrix} A & B & C & D \\ 2 & 1,4 & 3 & 4 \end{matrix}$

B. $\begin{matrix} A & B & C & D \\ 1,4 & 3 & 1,2 & 1 \end{matrix}$

C. $\begin{matrix} A & B & C & D \\ 2 & 3 & 1 & 4 \end{matrix}$

D. $\begin{matrix} A & B & C & D \\ 3 & 4 & 2,3 & 1 \end{matrix}$

Answer: $A \rightarrow 1, 4; B \rightarrow 3; C \rightarrow 1, 2; D \rightarrow 1$

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