

CHEMISTRY

BOOKS - MTG CHEMISTRY (ENGLISH)

CHEMICAL BONDING & MOLECULAR STRUCTURE

Mcqs

1. The electronic configuration of four atoms are given in brackets :



The element that would most readily form a diatomic molecule is

A. Q

B. M

C. R

D. L

Answer: B



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2. Two elements P and Q combine to form a compound.

If P has 2 and Q has 6 electrons in their outermost shell, what will be formula of the compound formed ?

A. PQ

B. P_2Q

C. P_2Q_3

D. PQ_2

Answer: A



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3. Number of electrons shared in the formation of nitrogen molecules is

A. Three

B. Four

C. Eight

D. Six

Answer: D



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4. The bond between two identical nonmetal atoms has a pair of electrons

A. is shifted to one of the atoms

B. is shared equally between them

C. undergoes addition reactions

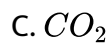
D. have same spin.

Answer: B



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5. Which one of the following violates octet rule ?



Answer: D



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6. How is covalent bond formed ?

A. transfer of electrons takes place

B. equal sharing of electrons between two atoms takes place

C. electrons are shared by one atom only

D. electrons are donated by one atom and shared by both atoms.

Answer: B



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7. The compound containing coordinate bond is

A. one electron from an atom is transferred to other

B. one electron each is lost from both the atoms

C. a pair of electrons is contributed by one atom and shared by both
the atoms

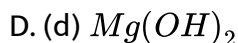
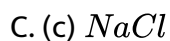
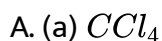
D. a pair of electrons is transferred to the other atom.

Answer: C



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8. Which of the following compounds shows ionic, covalent and coordinate bonds as well ?

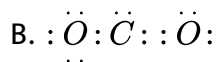


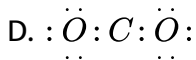
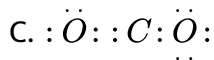
Answer: B



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9. In the correct Lewis dot structure of CO_2 , the total number of lone pairs are :





Answer: A

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10. How many and what types of bonds are present in NH_4^+ ?

A. Four covalent bonds

B. Three covalent bonds and one ionic bond

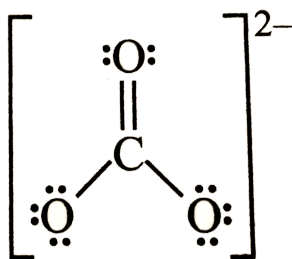
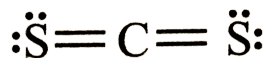
C. Four ionic bonds

D. Three covalent bonds and one coordinate bond

Answer: D

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11. What is the formal charge on carbon atom in the following two structures :



A. 0, - 2

B. 0, 0

C. +2, - 2

D. +1, - 1

Answer: B

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12. Which one of the following exceeds octet rule ?

- A. The incomplete octet of central atom
- B. An odd number of electrons on central atom
- C. Expanded octet of the central atom
- D. All of these

Answer: D

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13. Two elements X and Y combine to form a compound XY. Under what conditions the bond formed between them will be ionic ?

- A. If the difference in electronegativities of X and Y is 1.7.
- B. If the difference in electronegativities of X and Y is more than 1.7.
- C. If the difference in electronegativities of X and Y is less than 1.7.
- D. If both X and Y are highly electronegative.

Answer: B

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14. In which of the following species the bond is nondirectional ?



Answer: B

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15. Can sodium chloride conduct electricity in the solid state ? (A)Solids do not conduct electricity. (B)The ions of NaCl become mobile only in molten state and are not free to move in solid state. (C)The crystalline structure does not have ions. (D)When a bond is formed between ions they lose their charges.

- A. Solids do not conduct electricity.
- B. The ions of NaCl become mobile only in molten state and are not free to move in solid state.
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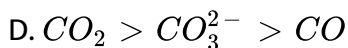
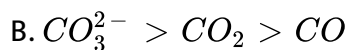
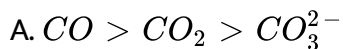
Answer: B

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16. Why carbon forms covalent compounds whereas lead forms ionic compounds ?

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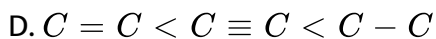
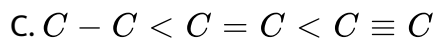
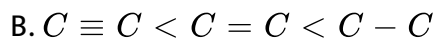
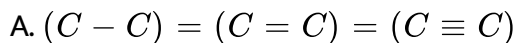
17. The correct order of decreasing $C - O$ bond length of (I) CO , (II) CO_3^{2-} (III) CO_2 is .



Answer: B

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18. Compare the Bond Lengths between Carbon Carbon single Bond, double bond and triple bond.



Answer: B

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19. Which has the strongest bond?

A. F - O

B. O - Cl

C. N - H

D. O - H

Answer: D

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20. Match the bond enthalpies given in column II with the molecules given in column I and mark the appropriate choice.

Column I

Column II

(A) Hydrogen (H_2) (i) 498.0 kJ mol⁻¹

(B) Oxygen(O_2) (ii) 946.0 kJ mol⁻¹

(C) Nitrogen(N_2) (iii) 435.8 kJ mol⁻¹

A. (A) \rightarrow (i), (B) \rightarrow (ii), (C) \rightarrow (iii)

B. (A) \rightarrow (iii), (B) \rightarrow (ii), (C) \rightarrow (i)

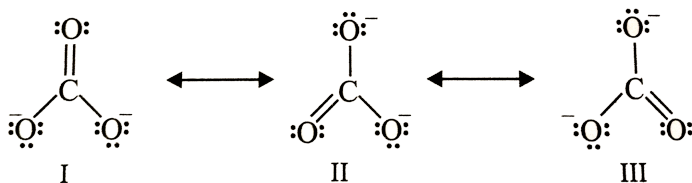
C. (A) \rightarrow (i), (B) \rightarrow (iii), (C) \rightarrow (ii)

D. (A) \rightarrow (iii), (B) \rightarrow (i), (C) \rightarrow (ii)

Answer: D

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21. The given structures I, II and III of carbonate ion represent



A. hybrid structures

B. isomeric structures

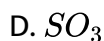
C. canonical structures

D. dipole structures.

Answer: C

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22. Which of the following molecules does not show any resonating structures?



Answer: A

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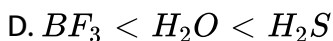
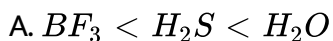
23. The canonical or resonating structures of a molecule required to describe the structure of a molecule follow which of the following rules ?

- A. The relative position of all atoms can differ.
- B. The same number of unpaired and paired electrons in all structures.
- C. The energy of each structure is different.
- D. Like charges are present on adjacent atoms.

Answer: B

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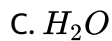
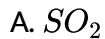
24. Arrange the following in decreasing order of dipole moment <



Answer: A

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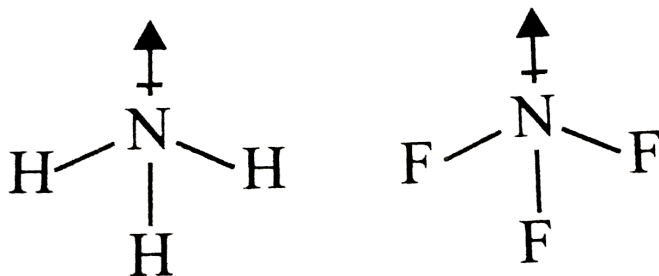
25. Which of the following is non polar species.



Answer: B

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26. Although F is more electronegative than H, the resultant dipole moment of NH_3 is much more than that of NF_3 . It can be explained as



- A. the lone pair of nitrogen opposes the dipole moment of NF_3 while it is added to the dipole moment of NH_3
- B. all the dipoles of NF_3 are in same direction
- C. all the dipoles of NH_3 are in opposite direction
- D. NH_3 has a regular geometry while NF_3 has irregular geometry which makes dipole moment of NH_3 more than NF_3 .

Answer: A



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27. Diatomic molecule has a dipole moment of $1.2D$ If its bond 1.0\AA what fraction of an electronic charge exists on each atom ? .

- A. 0.50
- B. 1.2×10^{-10}
- C. 0.25

D. 1.2

Answer: C

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28. Which of the following are arranged in the decreasing order of dipole moment ?

A. CH_3Cl , CH_3Br , CH_3F

B. CH_3Cl , CH_3F , CH_3Br

C. CH_3Br , CH_3Cl , CH_3F

D. CH_3Br , CH_3F , CH_3Cl

Answer: B

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29. The dipole moment of NF_3 is less than NH_3 because

A. $4.90 \times 10^{-30} \text{ Cm}$ and $0.80 \times 10^{-30} \text{ Cm}$

B. $0.80 \times 10^{-30} \text{ Cm}$ and $4.90 \times 10^{-30} \text{ Cm}$

C. $4.90 \times 10^{-30} \text{ Cm}$ and $4.90 \times 10^{-30} \text{ Cm}$

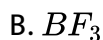
D. $0.80 \times 10^{-30} \text{ Cm}$ and $0.80 \times 10^{-30} \text{ Cm}$

Answer: A



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30. In water molecule, the two O - H bonds are oriented at an angle of 104.5° . In BF_3 , the three B - F bonds are oriented at an angle of 120° . In BeF_2 , the two Be - F bonds are oriented at an angle of 180° . Which of the following will have highest dipole moment ?



C. H_2O

D. All have zero dipole moment.

Answer: C

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31. Give the decreasing pH of aqueous solution of the following compounds :

a. $NaCl$, b. $MgCl_2$, c. $AlCl_3$, d. PCl_5

A. $NaCl_{(2)}$ lt $MgCl_{(2)}$ lt $AlCl_{(3)}$

B. $MgCl_2 < NaCl < AlCl_3$

C. $AlCl_3 < MgCl_2 < NaCl$

D. $NaCl < AlCl_3 < MgCl_2$

Answer: A

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32. According to VSEPR THEORY

- A. the shape of the molecule depends upon the bonded electron pairs
- B. pair of electrons attract each other in valence shells
- C. the pairs of electrons tend to occupy such positions that minimise repulsions
- D. the pairs of electrons tend to occupy such positions that minimise distances from each other.

Answer: C



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33. In a bonded molecule, the order of repulsion between the bonded and non-bonded electrons(lone pair) is -

A. lone pair - lone pair > bond pair - bond pair > lone pair - bond pair

B. bond pair - bond pair > lone pair - lone pair > lone pair - bond pair

C. lone pair - lone pair > lone pair - bond pair > bond pair - bond pair

D. bond pair - bond pair > lone pair - bond pair > lone pair - lone pair.

Answer: C



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34. In water molecule, the bond angle of 104.5° around oxygen is accounted due to

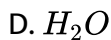
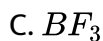
A. lp-lp repulsion is more than lp-bp repulsion.

- B. lp-bp repulsion is more than lp-lp repulsion.
- C. lp-lp repulsion is equal to lp-bp repulsion.
- D. Presence of lone pair does not affect the bond angle.

Answer: A

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35. Which of the following acts as a ligand but does not have any lone pair of electrons ?



Answer: C

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36. Few examples of the compounds formed by chemical bonding are given below . Mark the incorrect example.

A. A molecule with central atom devoid of octet - BF_3

B. A molecule with linear shape - CO_2

C. A non - polar covalent compound between two different atoms -
 CH_4

D. A molecule which is V- shaped with a bond angle 104.5° - NH_3

Answer: D



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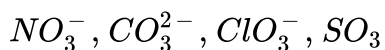
37. Which of the following statements is correct regarding the structure of PCl_5 ?

- A. Three P - Cl bonds lie in one plane and two P - Cl bonds lie above and below the equatorial plane.
- B. Five P- Cl bonds lie is the same plane.
- C. The bond angle in all P - Cl bonds is 90° .
- D. The bond length of all P - Cl bonds is same .

Answer: A

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38. Which of the following are iso-electronic as well as iso-structural ?

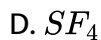
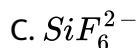
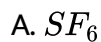


- A. All have linear shape.
- B. All have trigonal planar shape.
- C. All have tetrahedral shape.
- D. All have trigonal pyramidal shape.

Answer: B

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39. Which of the following does not show octahedral geometry ?



Answer: D

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40. The BCl_3 is a planar molecule whereas NCl_3 is pyramidal because

A. B-Cl bond is more polar than N - Cl bond

B. N-Cl bond is more covalent than B- Cl bond

C. nitrogen atom is smaller than boron atoms

D. BCl_3 has no lone pair but NCl_3 has a lone pair of electrons.

Answer: D

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41. CF_4 , SF_4 and XeF_4 contain the following electronic structure on their central atoms. Which one is correct option ?

A. 1, 2 and 3 lone pairs of electrons respectively

B. 0,1 and 2 lone pairs of electrons respectively

C. 1,1 and 1 lone pairs of electrons respectively

D. No lone pairs of electrons on any molecule

Answer: B

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42. Which of the following statements is not true ?

- A. Ionic bonds are non- directional while covalent bonds are directional.
- B. Formation of π - bond shortens the distance between the two concerned atoms.
- C. Ionic bond is possible between similar and dissimilar atoms.
- D. Linear overlapping of atomic p- orbitals leads to a sigma bond.

Answer: C



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43. Which of the following orbitals will not form sigma bond after overlapping ?

- A. s - orbital and s- orbital

B. s- orbital and p_z – orbital

C. p_z - orbital and p_z – orbital

D. p_x -orbital and p_y - orbital

Answer: D

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44. How do p_x , p_y and p_z atomic orbitals differ ?

A. Two end to end and one sidewise overlap

B. Two sidewise and one end to end overlap

C. Three sidewise overlaps

D. Three end to end overlaps

Answer: B

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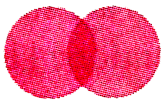
45. Oxygen molecule is

- A. one axial s-s overlap and one p-p axial overlap
- B. two p-p axial overlaps
- C. two p-p sidewise overlaps
- D. one p-p axial and one p-p sidewise overlap.

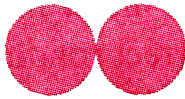
Answer: D

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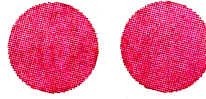
46. Which of the following is the most stable state when two atoms come closer to each other to form a molecule?



(i)



(ii)



(iii)

- A. (i), when the bond is formed , the energy is minimum.
- B. (ii) , when the atoms touch each other, the energy is zero.

C. (iii), when the atoms are isolated, the energy is minimum .

D. (ii), when the attractive forces are more than repulsive forces.

Answer: A

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47. The number of sigma (σ) and pi (π) bonds present in acetylene are ____ respectively.

A. Three sigma bonds and two pi bond

B. Three sigma bonds and one pi bond

C. One sigma bond and two pi bonds

D. Three pi bonds and three sigma bonds

Answer: C

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48. Propyne molecule contains

- A. 6 sigma and 2 pi bonds
- B. 5 sigma bonds
- C. 5 pi bonds and 1 sigma bond
- D. 2 sigma and 3 pi bonds .

Answer: A



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49. How many sigma and pi bonds are present in toluene ?

- A. 10σ and 3π bonds
- B. 12σ and 3π bonds
- C. 15σ and 3π bonds
- D. 6σ and 3π bonds

Answer: C

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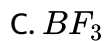
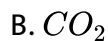
50. Which of the following statements is true about hybridisation ?

- A. The hybridised orbitals have different energies for each orbital.
- B. The number of hybrid orbitals is equal to the number of atomic orbitals that are hybridised.
- C. Hybrid orbitals form multiple bonds.
- D. The orbitals with different energies undergo hybridisation.

Answer: B

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51. In which of the following the central atom use sp^2 hybrid orbitals in its bonding

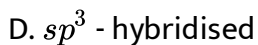
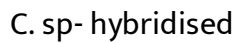
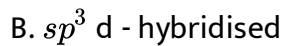
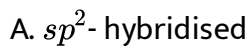


Answer: C



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52. carbon in carbon dioxide is

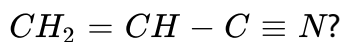


Answer: C



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53. Which type of hybridisation is shown by carbon atoms from left to right in the given compound :



A. sp^2 , sp^2 , sp

B. sp^2 , sp , sp

C. sp , sp^2 , sp

D. sp^3 , sp^2 , sp

Answer: A



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54. On hybridisation of one s and three p-orbitals, we get

A. four orbitals with tetrahedral orientation

B. three orbitals with trigonal orientation

C. two orbitals with linear orientation

D. two orbitals with perpendicular orientation.

Answer: A

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55. Among the following molecules : SO_2 , SF_4 , ClF_3 , BrF_5 , and XeF_4 , which of the following shapes does not describe any of the molecules mentioned ?

A. Bent

B. Trigonal Bipyramidal

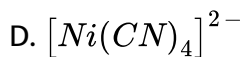
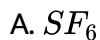
C. See-Saw

D. T-Shape

Answer: D

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56. Which of the following involves dsp^2 -hybridisation and are square planar ?

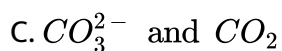
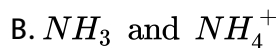
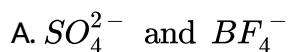


Answer: D



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57. Which of the following pairs of species are isostructural ?



D. CH_4 and BF_3

Answer: A

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58. The increasing d-character in hybridisation of Xe in XeF_2 , XeF_4 , XeF_6 is

A. sp^2 , sp^3d , sp^3d^2

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

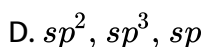
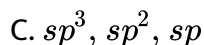
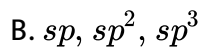
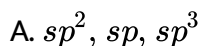
C. sp^3d^2 , sp^3d , sp^3d^3

D. sp^2 , sp^3 , sp^3d

Answer: B

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59. What is the hybrid state of carbon in ethyne, graphite and diamond ?

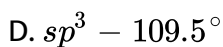
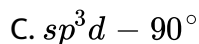
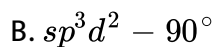
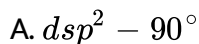


Answer: B



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60. Given below is the bond angle in various types of hybridisation. Mark the bond angle which is not correctly matched.



Answer: C

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61. Arrange in increasing order of s character

A. $sp^3 < sp^2 < sp$

B. $sp < sp^2 < sp^3$

C. $sp^2 < sp < sp^3$

D. $sp^2 < sp^3 < sp$

Answer: B

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62. Match the column I with column II and mark the appropriate choice.

Column I	Column II
(A) C_2H_2	(i) sp^3d^2 hybridisation
(B) SF_6	(ii) sp^3d^3 hybridisation
(C) SO_2	(iii) sp hybridisation
(D) IF_7	(iv) sp^2 hybridisation

A. (A) \rightarrow (i), (B) \rightarrow (iii), (C) \rightarrow (ii), (D) \rightarrow (iv)

B. (A) \rightarrow (iii), (B) \rightarrow (i), (C) \rightarrow (iv), (D) \rightarrow (ii)

C. (A) \rightarrow (ii), (B) \rightarrow (iii), (C) \rightarrow (i), (D) \rightarrow (iv)

D. (A) \rightarrow (iv), (B) \rightarrow (i), (C) \rightarrow (iii), (D) \rightarrow (ii)

Answer: B

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63. In formation of ethene, the bond formation between s and p- orbitals takes place in the following manner.

- A. sp^2 hybridised orbitals form sigma bond while the unhybridised (p_x or p_y) overlaps sidewise to form π -bond.
- B. sp^2 hybridised orbitals form π -bond while the unhybridised (p_z) overlaps to form σ -bond.
- C. sp^2 hybridised orbitals overlap with s- orbitals of H atoms while unhybridised orbitals form C - C bond.
- D. sp^2 hybridised orbitals form sigma bonds with H atoms while unhybridised orbitals form σ bonds between C atoms.

Answer: A



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64. The ground state electronic configuration of S is $3s^23p^4$. How does it form the compound SF_6 ?

A. Due to octahedral shape of S atoms

- B. Due to presence of vacant 3d- orbitals which provide 6 unpaired electrons in excited state
- C. Due to sp^3 hybridisation of S atom which provides 6 electrons to 6 F atoms
- D. Due to presence of 3 sigma and 3 pi bonds between S and F

Answer: B

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65. Which of the following statements is not true regarding molecular orbital theory?

- A. The atomic orbitals of comparable energies combine to form molecular orbitals.
- B. An atomic orbital is monocentric while a molecular orbital is polycentric.

C. Bonding molecular orbital has higher energy than antibonding molecular orbital.

D. Molecular orbitals like atomic orbitals obey Aufbau principle for filling of electrons.

Answer: C

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66. Which of the following representation of wave functions of molecular orbitals and atomic orbitals are not correct ?

A. $\Psi_{MO} = \Psi_A \pm \Psi_B$

B. $\sigma = \Psi_A + \Psi_B$

C. $\sigma^* = \Psi_A - \Psi_B$

D. $\Psi_{MO} = \Psi_A \times \Psi_B$

Answer: D

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67. $2s$ and $2p$ - atomic orbitals combine to give how many molecular orbitals ?

A. 2

B. 4

C. 8

D. 6

Answer: C

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68. The conditions for the combination of atomic orbitals to form molecular orbitals are stated below.

Mark the incorrect condition mentioned here.

- A. The combining atomic orbitals must have nearly same energy.
- B. The combining atomic orbitals must overlap to maximum extent.
- C. Combining atomic orbitals must have same symmetry about the molecular axis.
- D. Pi (π) molecular orbitals are symmetrical around the bond axis.

Answer: D

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69. The electronic configuration of carbon is $1s^2 2s^2 2p^2$.

There are 12 electrons in C_2 . The correct electronic configuration of C_2 molecule is

- A. $(\sigma 1s^2)(\sigma^* 1s^2)(\sigma 2s^2)(\sigma^* 2s^2)(\sigma 2p_z^2)(\pi 2p_x^2)$
- B. $(\sigma 1s^2)(\sigma^* 1s^2)(\sigma 2s^2)(\sigma^* 2s^2)(\pi 2p_x^2 = \pi 2p_y^2)$
- C. $(\sigma 1s^2)(\sigma^* 1s^2)(\sigma 2s^2)(\sigma^* 2s^2)(\sigma 2p_z^2)(\pi 2p_x^1 = \pi 2p_y^1)$
- D. $(\sigma 1s^2)(\sigma^* 1s^2)(\sigma 2s^2)(\sigma^* 2s^2)(\pi 2p_x^2 = \pi 2p_y^1)$

Answer: B



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70. Comprehension given below is followed by some multiple choice question, Each question has one correct options. Choose the correct option.

Molecular orbitals are formed by the overlap of atomic orbitals. Two atomic orbitals combine to form two molecular orbitals called bonding molecular orbital (BMO) 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 nitrogen increase in the order

$$\sigma 1s < \sigma^* 1s < \sigma 2s < ((\pi 2p_x) = (\pi 2p_y)) < \sigma 2p_z < (\pi^* 2p_x = \pi^* 2p_y) <$$

and For oxygen and fluorine order of energy of molecules orbitals is given below.

$$\sigma 1s < \sigma^* 1s < \sigma 2s < \sigma^* 2s < \sigma p_z < (\pi 2p_x \approx \pi 2p_y) < (\pi^* 2p_x \approx \pi^* 2p_y)$$

Different atomic orbitals of one atom combine with those atoms orbitals of the second atom which have comparable energies and proper orientation.

Further, if the overlapping is head on, the molecular orbital is called sigma, σ and if the overlap is lateral, the molecular orbital is called pi, π .

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 of the most important parameters to compare the strength of bonds.

67) Which of the following pair is expected to have the same bond order?

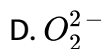


Answer: C



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71. Which of the following species have one unpaired electron each

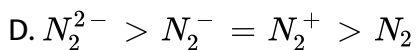
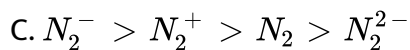
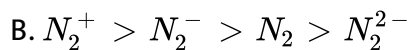
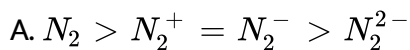


Answer: C



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72. The correct stability order for N_2 and its given ions is :



Answer: A

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73. What will be the bond order of the species with electronic configuration $1s^2 2s^2 2p^5$?

- A. One
- B. Two
- C. Three
- D. Zero

Answer: A

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74. Which of the following bond order is indication of existence of a molecule ?

- A. Zero bond order
- B. Negative bond order
- C. Positive bond order
- D. All of these.

Answer: C

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75. Which of the following pairs have identical bond order?

- A. F_2 and O_2^{2-}
- B. N_2 and CO_2
- C. O_2 and O_2^-
- D. N_2 and N_2^+

Answer: A

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76. Respective Bond Order for the following N_2 , N_2^+ , N_2^-

- A. 2.5, 2.5 and 3 respectively
- B. 2, 2.5 and 3 respectively
- C. 3, 2.5 and 3 respectively
- D. 2.5, 2.5 and 2.5 respectively.

Answer: A



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77. According to molecular orbital theory, which of the following will not be a viable molecule?

- A. H_2^+
- B. Be_2
- C. B_2

D. C_2

Answer: B

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78. Which of the following facts regarding bond order is not valid ?

- A. Bond order is given by the number of bonds between the two atoms in a molecule.
- B. With increase in bond order, bond enthalpy of the molecule decreases.
- C. Isoelectronic molecules and ions have identical bond orders.
- D. With increase in bond order, bond length decrease.

Answer: B

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79. Which of the following formulae does not show the correct relationship ?

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

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

C. $B. O. \propto \frac{1}{\text{Bond dissociation energy}}$

D. $N_b > N_a, B. O. = +ve$

Answer: C



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80. Fill in the blanks with appropriate choice.

Bond order of N_2^+ is P while that of N_2 is Q.

Bond order of O_2^+ is R while that of O_2 is S.

N - N bond distance T when N_2 changes to N_2^+ and when O_2 changes

to O_2^+ , the O - O bond distance U.

- A. P Q R S T U
 2 2.5 2.5 1 increases decreases
- B. P Q R S T U
 2.5 3 2 1.5 decreases increases
- C. P Q R S T U
 3 2 1.5 1 increases decreases
- D. P Q R S T U
 2.5 3 2.5 2 increases decreases

Answer: D

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81. Which of the following relationships is true?

- A. Bond dissociation energy of O_2 and O_2^- are same.
- B. Bond dissociation energy of O_2^+ is higher than O_2 ,
- C. Bond dissociation energy of O_2^- and O_2^{2-} are same.
- D. Bond dissociation energy of O_2^{2-} is higher than O_2^- .

Answer: B

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82. Paramagnetism is shown by the molecules which have

- A. paired electrons
- B. unpaired electrons
- C. lone pair of electrons
- D. bond order more than one.

Answer: B



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83. Which of the following species is paramagnetic in nature ?

- A. H_2
- B. Li_2
- C. B_2

D. N_2

Answer: C



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84. How many orbitals are singly occupied in O_2 molecule ?

A. 2

B. 1

C. 3

D. 4

Answer: A



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85. Oxygen molecule is paramagnetic because

A. no. of bonding electrons $>$ no. of antibonding electrons

B. no. of bonding electrons $<$ no. of antibonding electrons

C. no. of bonding electrons = no. of antibonding electrons

D. presence of unpaired electrons in molecular orbitals.

Answer: D

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86. Oxygen molecule is paramagnetic in nature . What is the paramagnetic content in terms of magnetic moment is O_2^- ? (a) 1.732 (b) 3 (c) 1.5 (d) 2.5

A. 1.732

B. 3

C. 1.5

D. 2.5

Answer: A



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87. Which one shows maximum hydrogen bonding ?

A. HF

B. H_2O

C. NH_3

D. CH_3OH

Answer: A



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88. Hydrogen bond is formed between hydrogen atoms and highly electronegative elements. It is of two types - intermolecular and intramolecular. It is a weaker bond than ionic, covalent and metallic.

bonds

Which is correct statement ? .

- A. displacement of electrons towards more electronegative atom resulting in fractional positive charge on hydrogen
- B. displacement of electrons towards hydrogen atom resulting in a polar molecule
- C. formation of a bond between hydrogen atoms of one molecule and the other
- D. existence of an attractive force which binds hydrogen atoms together.

Answer: A



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89. Which of the following statements is true of hydrogen atom ? (a) Cl and N have comparable electronegativities yet there is no H-bonding in

HCl because size of Cl is large. (b) Intermolecular H- bonding results in decrease in m.p. and b.p. (c) Ice has maximum density at $0^{\circ}C$ due to H-bonding. (d) $KHCl_2(HCl_2^-)$ exists but $KHF_2(HF_2^-)$ does not exist due to lack of H- bonding in HCl.

A. Cl and N have comparable electronegativities yet there is no H-bonding in HCl because size of Cl is large.

B. Intermolecular H- bonding results in decrease in m.p. and b.p.

C. Ice has maximum density at $0^{\circ}C$ due to H- bonding.

D. $KHCl_2(HCl_2^-)$ exists but $KHF_2(HF_2^-)$ does not exist due to lack of H- bonding in HCl.

Answer: A



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90. Strongest bond is (a) HF (b) HCl (c) HBr (d) HI

A. HF

B. HCl

C. HBr

D. HI

Answer: A



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91. Which of the following observations can be explained on the basis of hydrogen bonding ?

(i) H- F has higher boiling point than other halogen acids.

(ii) H_2O has highest boiling point among hydrides of group 16 elements.

(iii) NH_3 has lower boiling point than PH_3 .

A. (i) , (ii) and (iii)

B. (i) and (iii)

C. (ii) and (iii)

D. (i) and (ii)

Answer: D

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92. Though covalent in nature, methanol is soluble in water , why ?

- A. Methanol is transparent like water.
- B. Due to hydrogen bonding between methanol and water molecules.
- C. Due to van der Waals' forces between methanol and water.
- D. Due to covalent attraction forces.

Answer: B

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93. For same mass of water and ice, why ice floats over water? (A)solids have lesser density than liquids (B)it has open - cage like structure in which lesser molecules are packed per mL than water (C)ice is lighter than

water (D) when ice is formed water molecules come closer and start floating.

A. solids have lesser density than liquids

B. it has open - cage like structure in which lesser molecules are packed per mL than water

C. ice is lighter than water

D. when ice is formed water molecules come closer and start floating.

Answer: B



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94. Which of the following species shows intramolecular hydrogen bonding ? (A) o-Nitrophenol (B) p- Nitrophenol (C) Benzoic acid (D) Ethanol

A. o-Nitrophenol

B. p- Nitrophenol

C. Benzoic acid

D. Ethanol

Answer: A

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95. Which of the following statements is not true ? (a) Intermolecular hydrogen bonds are formed between two different molecules of compounds. (b) Intramolecular hydrogen bonds are formed between two different molecules of the same compounds. (c) Intramolecular hydrogen bonds are formed within the same molecule. (d) Hydrogen bonds have strong influence on the physical properties of a compound.

A. Intermolecular hydrogen bonds are formed between two different molecules of compounds.

B. Intramolecular hydrogen bonds are formed between two different molecules of the same compounds.

C. Intramolecular hydrogen bonds are formed within the same molecule.

D. Hydrogen bonds have strong influence on the physical properties of a compound.

Answer: B

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Higher Order Thinking Skills

1. $\text{NaCl}_{(aq)}$ gives a white precipitate with AgNO_3 solution but CCl_4 or CHCl_3 does not, because

A. NaCl is a covalent compound and forms AgCl as white ppt.

B. NaCl is an ionic compound and forms AgCl as white ppt.

C. CCl_4 and CHCl_3 are ionic compound.

D. none of these.

Answer: B



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2. The lattice energy of NaCl is 788 kJ mol^{-1} . This means that 788 kJ of energy is required

A. to separate one mole of solid NaCl into one mole of $\text{Na}_{(g)}$ and one mole of $\text{Cl}_{(g)}$ to infinite distance

B. to separate one mole of solid NaCl into one mole of $\text{Na}_{(g)}^{+}$ and one mole of $\text{Cl}_{(g)}^{-}$ to infinite distance

C. to convert one mole of solid NaCl into one mole of gaseous NaCl

D. to convert one mole of gaseous NaCl into one mole of solid NaCl.

Answer: B



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3. The dipole moment of LiH is $1.964 \times 10^{-29} Cm$ and the interatomic distance between Li and H in this molecule is 1.596 \AA . What is the per cent ionic character in LiH .

A. 75.0

B. 76.8

C. 79.8

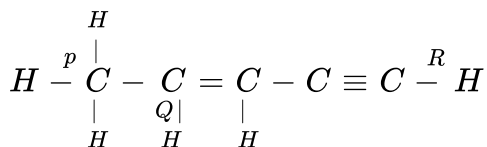
D. 100

Answer: B



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4. Which is the correct order of bond lengths P, Q and R in



A. $P > Q > R$

B. $R > Q > P$

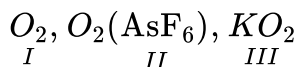
C. $Q > P > R$

D. $Q > R > P$

Answer: A

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5. Consider the following molecules



Choose the correct answer.

A. The correct decreasing bond order is $II > I > III$.

B. The correct decreasing order of bond length is $III > II > I$.

C. The bond strength of I is less than that of III.

D. Bond dissociation energy is highest in case of III.

Answer: A

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6. The relationship between the dissociation energy of N_2 and N_2^+ is

- A. dissociation energy of N_2 = dissociation energy of N_2^+
- B. dissociation energy of N_2 can either be lower or higher than the dissociation energy of N_2^+
- C. dissociation energy of $N_2 >$ dissociation energy of N_2^+
- D. dissociation energy of $N_2^+ >$ dissociation energy of N_2 .

Answer: C



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7. Molecular shape of SF_4 , CF_4 and XeF_4 are

- A. the same with 2, 0 and 1 lone pairs of electrons respectively
- B. the same with 1, 1 and 1 lone pairs of electrons respectively
- C. different with 0, 1 and 2 lone pairs of electrons respectively

D. different with 1, 0 and 2 lone pairs of electrons respectively.

Answer: D

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8. The AsF_5 molecule is trigonal bipyramidal. The orbitals used by As for hybridisation are

A. $d_{x^2-y^2}$, d_{z^2} , s , p_x , p_y

B. d_{xy} , s , p_x , p_y , p_z

C. s , p_x , p_y , p_z , d_{z^2}

D. $d_{x^2-y^2}$, s , p_x , p_y , p_z .

Answer: C

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9. Explain, why *o*-hydroxybenzaldehyde is a liquid at room temperature while *p*-hydroxybenzaldehyde is a high melting solid?

- A. H-bonding
- B. ionisation energy
- C. electron gain enthalpy
- D. lattice enthalpy.

Answer: A



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10. Ethyl alcohol (C_2H_5OH) has higher boiling point than dimethyl ether ($CH_3 - O - CH_3$) although the molecular weight of both are same .

- A. intramolecular H-bonding
- B. intermolecular H-bonding

C. dipole moment

D. lattice enthalpy.

Answer: B

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Exemplar Problems

1. Isostructural species are those which have the same shape and hybridisation. Among the given identify the isostructural pairs.

A. [NF_3 and BF_3]

B. [BF_4^- and NH_4^+]

C. [BCl_3 and $BrCl_3$]

D. [NH_3 and NO_3^-]

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 CO_2 B HI C

H_2O D SO_2

A. CO_2

B. HI

C. H_2O

D. SO_2

Answer: C



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3. The hybridisation of atomic orbitals of nitrogen in NO_2^+ , NO_3^- and NH_4^+ respectively are

A. sp , sp^3 and sp^2

B. sp , sp^2 and sp^3

C. sp^2 , sp and sp^3

D. sp^2 , sp^3 and sp

Answer: B

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4. Hydrogen bonds are formed in many compounds e.g. H_2O , HF , 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

A. $HF > H_2O > NH_3$

B. $H_2O > HF > NH_3$

C. $NH_3 > HF > H_2O$

D. $NH_3 > H_2O > HF$

Answer: B

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5. In PO_4^{3-} ion the formal charge on the oxygen atom of P-O bond is

A. +1

B. -1

C. -0.75

D. +0.75

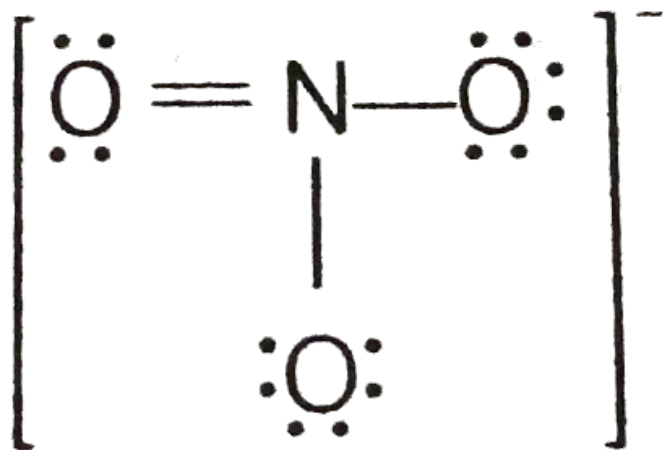
Answer: C

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6. In NO_3^- ion, the number of bond pairs and lone pairs of electrons on nitrogen atom are

Thinking process

To solve this sequence we must know the structure of NO_3^- ion i.e,



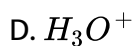
Then, count the bond pairs and lone pairs of electron on nitrogen.

- A. 2, 2
- B. 3, 1
- C. 1, 3
- D. 4, 0

Answer: D

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7. Which of the following species has tetrahedral geometry? A BH_4^- B NH_2^- C CO_3^{2-} D H_3O^+

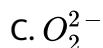


Answer: A



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8. Which molecule/ion out of the following does not contain unpaired electrons?



D. B_2

Answer: C

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9. In which of the following molecule/ion all the bonds are not equal? A

XeF_4 B BF_4^- C C_2H_4 D SiF_4

A. XeF_4

B. BF_4^-

C. C_2H_4

D. SiF_4

Answer: C

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10. In which of the following substances will hydrogen bond be strongest?

A. HCl

B. H_2O

C. HI

D. H_2S

Answer: B



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11. If the electron configuration of an element is $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 3d^2, 4s^2$, the four electrons involved in chemical bond formation will be

A. $3p^6$

B. $3p^6, 4s^2$

C. $3p^6, 3d^2$

D. $3d^2, 4s^2$

Answer: D



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12. Which of the following angle corresponds to sp^2 hybridisation ?

A. 90°

B. 120°

C. 180°

D. 109°

Answer: B



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13. Which of the following order of energies of molecular orbitals of N_2 is correct?

A. $(\pi 2p_y) < (\sigma 2p_z) < (\pi^* 2p_x) \approx (\pi^* 2p_y)$

B. $(\pi 2p_y) > (\sigma 2p_z) > (\pi^* 2p_x) \approx (\pi^* 2p_y)$

C. $(\pi 2p_y) < (\sigma 2p_z) > (\pi^* 2p_x) \approx (\pi^* 2p_y)$

D. $(\pi 2p_y) > (\sigma 2p_z) < (\pi^* 2p_x) \approx (\pi^* 2p_y)$

Answer: A



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14. Which of the following statement is not correct from the view point of molecular orbital theory?

A. Be_2 is not a stable molecule .

B. He_2 is not stable of N_2 is maximum amongst the homonuclear diatomic molecules belonging to the second period .

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 is

$$\sigma 2s < \sigma^* 2s < \sigma 2p_z < (\pi 2p_x = \pi 2p_y) < (\pi^* 2p_x = \pi^* 2p_y) < \sigma^* 2p_z$$

Answer: D

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Assertion Reason

1. Assertion : In the formation of a molecule , only the outer shell electrons take part in chemical combination and they are known as valence electrons.

Reason : Atoms achieve the stable octet when they are linked by chemical bonds .

- A. If both assertion and reason are true and reason is the correct explanation of assertion.
- B. If both assertion and reason are true but reason is not the correct explanation of assertion.
- C. If assertion is true but reason is false.
- D. If both assertion and reason are false.

Answer: B



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2. Assertion : In the formation of water molecule, both hydrogen and oxygen atoms attain octet of electrons.

Reason : Oxygen atom forms two ionic or electrovalent bonds with two hydrogen atoms.

- A. both assertion and reason are true and reason is the correct explanation of assertion.

B. both assertion and reason are true but reason is not the correct explanation of assertion.

C. assertion is true but reason is false.

D. both assertion and reason are false.

Answer: D

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3. Assertion : In Lewis structures of NF_3 and CO_3^{2-} , nitrogen and carbon occupy the central position whereas fluorine and oxygen occupy the terminal positions.

Reason : In Lewis representation, the least electronegative atom occupies the central position in the molecule/ion.

A. If both assertion and reason are true and reason is the correct explanation of assertion.

B. If both assertion and reason are true but reason is not the correct explanation of assertion.

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

Answer: A

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4. Assertion : PF_5 , SF_6 and H_2SO_4 are the examples of expanded octet molecules .

Reason : Octet rule is not applicable to the second period elements of the periodic table.

A. both assertion and reason are true and reason is the correct explanation of assertion.

B. both assertion and reason are true but reason is not the correct explanation of assertion.

C. assertion is true but reason is false.

D. both assertion and reason are false.

Answer: C



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5. Assertion : Octet rule is based upon the chemical inertness of noble gases.

Reason : Octet rule can explain the shape and relative stability of the molecule.

A. both assertion and reason are true and reason is the correct explanation of assertion.

B. both assertion and reason are true but reason is not the correct explanation of assertion.

C. assertion is true but reason is false.

D. both assertion and reason are false.

Answer: C

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6. Assertion : Sodium chloride (NaCl) is a stable ionic solid.

Reason : NaCl has high lattice enthalpy.

- A. If both assertion and reason are true and reason is the correct explanation of assertion.
- B. If both assertion and reason are true but reason is not the correct explanation of assertion.
- C. If assertion is true but reason is false.
- D. If both assertion and reason are false.

Answer: A

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7. Assertion : F_2 and O_2^{2-} have bond order 1 while N_2 , CO and NO^+ have bond order 3.

Reason : Higher the bond order, higher is the stability of the molecule.

- A. If both assertion and reason are true and reason is the correct explanation of assertion.
- B. If both assertion and reason are true but reason is not the correct explanation of assertion.
- C. If assertion is true but reason is false.
- D. If both assertion and reason are false.

Answer: B



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8. Assertion : The experimentally determined carbon to oxygen bond length in carbon dioxide is 115 pm.

Reason : The lengths of a normal carbon to oxygen double bond

($C = O$) and carbon to oxygen triple bond ($C \equiv$) are 121 pm and 110 pm respectively.

- A. If both assertion and reason are true and reason is the correct explanation of assertion.
- B. If both assertion and reason are true but reason is not the correct explanation of assertion.
- C. If assertion is true but reason is false.
- D. If both assertion and reason are false.

Answer: B

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9. Assertion : The dipole moment in case of BeF_2 is zero.

Reason : The two equal bond dipoles point in opposite directions and cancel the effect of each other.

- A. If both assertion and reason are true and reason is the correct explanation of assertion.
- B. If both assertion and reason are true but reason is not the correct explanation of assertion.
- C. If assertion is true but reason is false.
- D. If both assertion and reason are false.

Answer: A



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10. Assertion : Dipole moment of NH_3 is greater than that of NF_3 .

Reason : Nitrogen is more electronegative than fluorine.

- A. both assertion and reason are true and reason is the correct explanation of assertion.

B. both assertion and reason are true but reason is not the correct explanation of assertion.

C. assertion is true but reason is false.

D. both assertion and reason are false.

Answer: C

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11. Assertion : Among alkaline earth metals, Be predominantly forms covalent bond.

Reason : Be is smaller in size and hence has greater polarising power.

A. both assertion and reason are true and reason is the correct explanation of assertion.

B. both assertion and reason are true but reason is not the correct explanation of assertion.

C. assertion is true but reason is false.

D. both assertion and reason are false.

Answer: A

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12. Assertion : In NH_3 , N is sp^3 hybridised but bond angle is 107° .

Reason : Shape of NH_3 molecule is trigonal pyramidal.

- A. If both assertion and reason are true and reason is the correct explanation of assertion.
- B. If both assertion and reason are true but reason is not the correct explanation of assertion.
- C. If assertion is true but reason is false.
- D. If both assertion and reason are false.

Answer: B

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13. Ionic bonds are non-directional while covalent bonds are directional.

- A. If both assertion and reason are true and reason is the correct explanation of assertion.
- B. If both assertion and reason are true but reason is not the correct explanation of assertion.
- C. If assertion is true but reason is false.
- D. If both assertion and reason are false.

Answer: D

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14. Assertion : O_2 molecule is diamagnetic while C_2 molecule is paramagnetic in nature.

Reason : Bond order of O_2 molecule is 1.5 and that of C_2 molecule is 2.5 .

- A. If both assertion and reason are true and reason is the correct explanation of assertion.
- B. If both assertion and reason are true but reason is not the correct explanation of assertion.
- C. If assertion is true but reason is false.
- D. If both assertion and reason are false.

Answer: D



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15. Assertion : Boiling point of p-nitrophenol is greater than that of o-nitrophenol.

Reason : There is intramolecular hydrogen bonding in p-nitrophenol and intermolecular hydrogen bonding in o-nitrophenol.

- A. If both assertion and reason are true and reason is the correct explanation of assertion.

B. If both assertion and reason are true but reason is not the correct explanation of assertion.

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

Answer: C

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Lewis Approach Of Chemical Bonding

1. The electronic configuration of four atoms are given in brackets :



The element that would most readily form a diatomic molecule is

A. Q

B. M

C. R

D. L

Answer: B



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2. Two elements P and Q combine to form a compound.

If P has 2 and Q has 6 electrons in their outermost shell, what will be formula of the compound formed ?

A. PQ

B. P_2Q

C. P_2Q_3

D. PQ_2

Answer: A



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3. Number of electrons shared in the formation of nitrogen molecules is

A. Three

B. Four

C. Eight

D. Six

Answer: D



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4. The bond between two identical nonmetal atoms has a pair of electrons

A. is shifted to one of the atoms

B. is shared equally between them

C. undergoes addition reactions

D. have same spin.

Answer: B



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5. Which one of the following violates octet rule ?

A. NH_3

B. CH_4

C. CO_2

D. NO

Answer: D



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6. How is covalent bond formed ?

- A. transfer of electrons takes place
- B. equal sharing of electrons between two atoms takes place
- C. electrons are shared by one atom only
- D. electrons are donated by one atom and shared by both atoms.

Answer: B

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7. The compound containing coordinate bond is

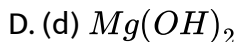
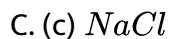
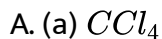
- A. one electron from an atom is transferred to other
- B. one electron each is lost from both the atoms
- C. a pair of electrons is contributed by one atom and shared by both the atoms
- D. a pair of electrons is transferred to the other atom.

Answer: C



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8. Which of the following compounds shows ionic, covalent and coordinate bonds as well ?



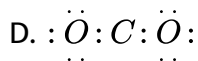
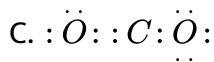
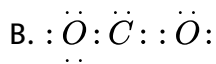
Answer: B



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9. In the correct Lewis dot structure of CO_2 , the total number of lone pairs are :





Answer: A

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10. How many and what types of bonds are present in NH_4^+ ?

A. Four covalent bonds

B. Three covalent bonds and one ionic bond

C. Four ionic bonds

D. Three covalent bonds and one coordinate bond

Answer: D

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11. Which one of the following exceeds octet rule ?

- A. The incomplete octet of central atom
- B. An odd number of electrons on central atom
- C. Expanded octet of the central atom
- D. All of these

Answer: D



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Ionic And Electrovalent Bond

1. Two elements X and Y combine to form a compound XY. Under what conditions the bond formed between them will be ionic ?

- A. If the difference in electronegativities of X and Y is 1.7.
- B. If the difference in electronegativities of X and Y is more than 1.7.

C. If the difference in electronegativities of X and Y is less than 1.7.

D. If both X and Y are highly electronegative.

Answer: B

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2. In which of the following species the bond is nondirectional ?

A. NCl_3

B. $RbCl$

C. $BeCl_2$

D. BCl_3

Answer: B

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3. Can sodium chloride conduct electricity in the solid state ? (A)Solids do not conduct electricity. (B)The ions of NaCl become mobile only in molten state and are not free to move in solid state. (C)The crystalline structure does not have ions. (D)When a bond is formed between ions they lose their charges.

A. Solids do not conduct electricity.

B. The ions of NaCl become mobile only in molten state and are not free to move in solid state.

C. The crystalline structure does not have ions.

D. When a bond is formed between ions they lose their charges.

Answer: B



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4. Why carbon forms covalent compounds whereas lead forms ionic compounds ?

A. Be

B. Mg

C. Ca

D. Sr

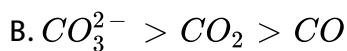
Answer: A



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Bond Parameters

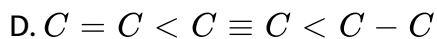
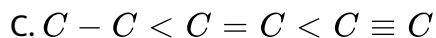
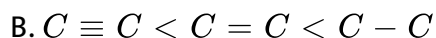
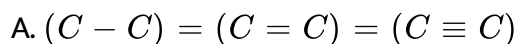
1. The correct order of decreasing $C - O$ bond length of (I) CO , (II) CO_3^{2-} (III) CO_2 is .



Answer: B

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2. Compare the Bond Lengths between Carbon Carbon single Bond, double bond and triple bond.



Answer: B

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3. Which has the strongest bond?

A. F - O

B. O - Cl

C. N - H

D. O - H

Answer: D

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4. Match the bond enthalpies given in column II with the molecules given in column I and mark the appropriate choice.

Column I

Column II

(A) Hydrogen (H_2) (i) 498.0 kJ mol⁻¹

(B) Oxygen(O_2) (ii) 946.0 kJ mol⁻¹

(C) Nitrogen(N_2) (iii) 435.8 kJ mol⁻¹

A. (A) → (i), (B) → (ii), (C) → (iii)

B. (A) → (iii), (B) → (ii), (C) → (i)

C. (A) → (i), (B) → (iii), (C) → (ii)

D. (A) \rightarrow (iii), (B) \rightarrow (i), (C) \rightarrow (ii)

Answer: D

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5. Which of the following molecules does not show any resonating structures?

A. NH_3

B. CO_3^{2-}

C. O_3

D. SO_3

Answer: A

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6. The canonical or resonating structures of a molecule required to describe the structure of a molecule follow which of the following rules ?

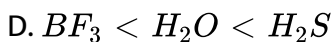
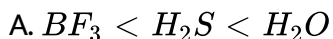
- A. The relative position of all atoms can differ.
- B. The same number of unpaired and paired electrons in all structures.
- C. The energy of each structure is different.
- D. Like charges are present on adjacent atoms.

Answer: B



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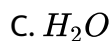
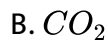
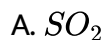
7. Arrange the following in decreasing order of dipole moment <



Answer: A

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8. Which of the following is non polar species.



Answer: B

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9. Diatomic molecule has a dipole moment of $1.2D$ If its bond 1.0\AA what fraction of an electronic charge exists on each atom ? .

A. 0.50

B. 1.2×10^{-10}

C. 0.25

D. 1.2

Answer: C



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10. Which of the following are arranged in the decreasing order of dipole moment ?

A. CH_3Cl, CH_3Br, CH_3F

B. CH_3Cl, CH_3F, CH_3Br

C. CH_3Br, CH_3Cl, CH_3F

D. CH_3Br, CH_3F, CH_3Cl

Answer: B

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11. The dipole moment of NF_3 is less than NH_3 because

A. $4.90 \times 10^{-30} Cm$ and $0.80 \times 10^{-30} Cm$

B. $0.80 \times 10^{-30} Cm$ and $4.90 \times 10^{-30} Cm$

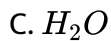
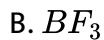
C. $4.90 \times 10^{-30} Cm$ and $4.90 \times 10^{-30} Cm$

D. $0.80 \times 10^{-30} Cm$ and $0.80 \times 10^{-30} Cm$

Answer: A

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12. In water molecule, the two O - H bonds are oriented at an angle of 104.5° . In BF_3 , the three B - F bonds are oriented at an angle of 120° . In BeF_2 , the two Be - F bonds are oriented at an angle of 180° . Which of the following will have highest dipole moment ?



D. All have zero dipole moment.

Answer: C

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13. Give the decreasing pH of aqueous solution of the following compounds :

a. $NaCl$, b. $MgCl_2$, c. $AlCl_3$, d. PCl_5

A. $NaCl$ (2) lt $MgCl_2$ (2) lt $AlCl_3$ (3)

B. $MgCl_2 < NaCl < AlCl_3$

C. $AlCl_3 < MgCl_2 < NaCl$

D. $NaCl < AlCl_3 < MgCl_2$

Answer: A

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Vsepr Theory

1. According to VSEPR THEORY

- A. the shape of the molecule depends upon the bonded electron pairs
- B. pair of electrons attract each other in valence shells
- C. the pairs of electrons tend to occupy such positions that minimise repulsions
- D. the pairs of electrons tend to occupy such positions that minimise distances from each other.

Answer: C

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2. In a bonded molecule, the order of repulsion between the bonded and non-bonded electrons (lone pair) is -

A. lone pair - lone pair > bond pair - bond pair > lone pair - bond pair

B. bond pair - bond pair > lone pair - lone pair > lone pair - bond pair

C. lone pair - lone pair > lone pair - bond pair > bond pair - bond pair

D. bond pair - bond pair > lone pair - bond pair > lone pair - lone pair.

Answer: C



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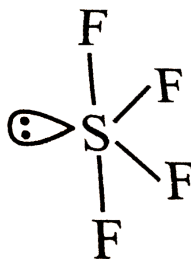
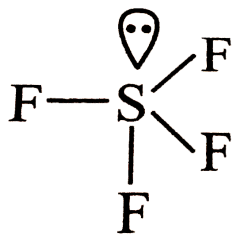
3. In water molecule, the bond angle of 104.5° around oxygen is accounted due to

- A. lp-lp repulsion is more than lp-bp repulsion.
- B. lp-bp repulsion is more than lp-lp repulsion.
- C. lp-lp repulsion is equal to lp-bp repulsion.
- D. Presence of lone pair does not affect the bond angle.

Answer: A

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4. Which of the following shapes of SF_4 is more stable and why?



A. (i) , due to 3 lp-bp repulsions at 90° .

B. (ii) , due to 2 lp-bp repulsions.

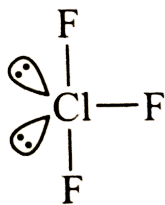
C. Both are equally stable due to 2 lp-bp repulsions.

D. Both are unstable since SF_4 has tetrahedral shape.

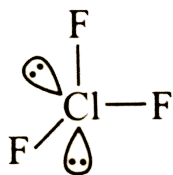
Answer: B

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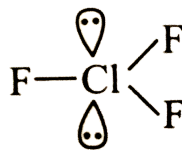
5. The most stable shape of ClF_3 is shown by



(i)



(ii)



(iii)

A. (i) only

B. (i) and (ii)

C. (ii) only

D. (iii)only

Answer: A



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6. Which of the following acts as a ligand but does not have any lone pair of electrons ?

A. NO_2

B. NH_3

C. BF_3

D. H_2O

Answer: C



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7. Few examples of the compounds formed by chemical bonding are given below . Mark the incorrect example.

A. A molecule with central atom devoid of octet - BF_3

B. A molecule with linear shape - CO_2

C. A non - polar covalent compound between two different atoms -



D. A molecule which is V- shaped with a bond angle 104.5° - NH_3

Answer: D



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8. Which of the following statements is correct regarding the structure of



A. Three P - Cl bonds lie in one plane and two P - Cl bonds lie above and below the equatorial plane.


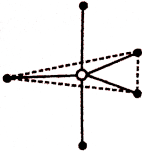
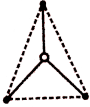
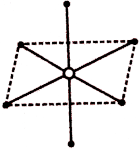
- B. Five P- Cl bonds lie is the same plane.
- C. The bond angle in all P - Cl bonds is 90° .
- D. The bond length of all P - Cl bonds is same .

Answer: A



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9. Match the molecules given in column I with their shapes given in column II and mark the appropriate choice.

Column I (Molecule)		Column II (Shape)	
(A)	SF_6	(i)	
(B)	$SiCl_4$	(ii)	
(C)	AsF_5	(iii)	
(D)	BCl_3	(iv)	

A. (A) \rightarrow (iv), (B) \rightarrow (ii), (C) \rightarrow (iii), (D) \rightarrow (i)

B. (A) \rightarrow (iv), (B) \rightarrow (i), (C) \rightarrow (ii), (D) \rightarrow (iii)

C. (A) \rightarrow (iii), (B) \rightarrow (i), (C) \rightarrow (ii), (D) \rightarrow (iv)

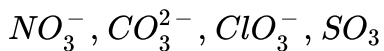
D. (A) \rightarrow (ii), (B) \rightarrow (iii), (C) \rightarrow (i), (D) \rightarrow (iv)

Answer: B



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10. Which of the following are iso-electronic as well as iso-structural ?

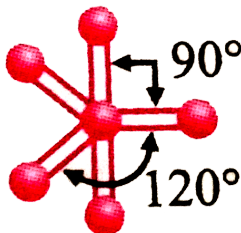
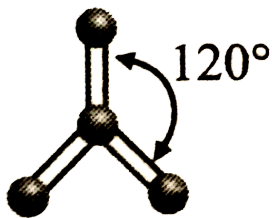


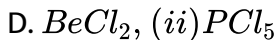
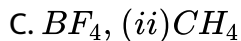
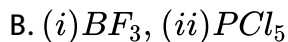
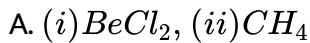
- A. All have linear shape.
- B. All have trigonal planar shape.
- C. All have tetrahedral shape.
- D. All have trigonal pyramidal shape.

Answer: B

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11. Which molecule is depicted by the given ball and stick models ?





Answer: B

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12. Given below is the table showing shapes of some molecules having lone pairs of electrons. Fill up the blanks left in it.

Molecule type	bp	lp	Shape	Example
AB_2E_2	2	<u>P</u>	Bent	H_2O
AB_3E_2	3	2	<u>Q</u>	ClF_3
AB_5E	5	<u>R</u>	<u>S</u>	BrF_5
AB_4E_2	4	2	<u>T</u>	<u>U</u>

A. 2 Square pyramidal 2 T-shaped Square planar H_2O_2

- B. 4 T-shaped 5 Square planar Square pyramidal SO_3
- C. 2 T-shaped 1 Square pyramidal Square planar XeF_4
- D. 3 Square planar 2 T-shaped Square pyramidal $BrCl_3$

Answer: C



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13. Which of the following does not show octahedral geometry ?

- A. SF_6
- B. IF_5
- C. SiF_6^{2-}
- D. SF_4

Answer: D



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14. The BCl_3 is a planar molecule whereas NCl_3 is pyramidal because

- A. B-Cl bond is more polar than N - Cl bond
- B. N-Cl bond is more covalent than B- Cl bond
- C. nitrogen atom is smaller than boron atoms
- D. BCl_3 has no lone pair but NCl_3 has a lone pair of electrons.

Answer: D



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15. CF_4 , SF_4 and XeF_4 contain the following electronic structure on their central atoms. Which one is correct option ?

- A. 1, 2 and 3 lone pairs of electrons respectively
- B. 0,1 and 2 lone pairs of electrons respectively
- C. 1,1 and 1 lone pairs of electrons respectively
- D. No lone pairs of electrons on any molecule

Answer: B

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Valence Bond Theory

1. Which of the following statements is not true ?

- A. Ionic bonds are non- directional while covalent bonds are directional.
- B. Formation of π - bond shortens the distance between the two concerned atoms.
- C. Ionic bond is possible between similar and dissimilar atoms.
- D. Linear overlapping of atomic p- orbitals leads to a sigma bond.

Answer: C

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2. Which of the following orbitals will not form sigma bond after overlapping ?

A. s - orbital and s- orbital

B. s- orbital and p_z – orbital

C. p_z - orbital and p_z – orbital

D. p_x -orbital and p_x - orbital

Answer: D



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3. How do p_x , p_y and p_z atomic orbitals differ ?

A. Two end to end and one sidewise overlap

B. Two sidewise and one end to end overlap

C. Three sidewise overlaps

D. Three end to end overlaps

Answer: B



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4. Oxygen molecule is

- A. one axial s-s overlap and one p-p axial overlap
- B. two p-p axial overlaps
- C. two p-p sidewise overlaps
- D. one p-p axial and one p-p sidewise overlap.

Answer: D



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5. The number of sigma (σ) and pi (π) bonds present in acetylene are _____ respectively.

- A. Two sigma bonds and one pi bond
- B. Three sigma bonds
- C. One sigma bond and two pi bonds
- D. Three pi bonds

Answer: C

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6. Propyne molecule contains

- A. 6 sigma and 2 pi bonds
- B. 5 sigma bonds
- C. 5 pi bonds and 1 sigma bond
- D. 2 sigma and 3 pi bonds .

Answer: A

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7. How many sigma and pi bonds are present in toluene ?

A. 10σ and 3π bonds

B. 12σ and 3π bonds

C. 15σ and 3π bonds

D. 6σ and 3π bonds

Answer: C



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Hybridisation

1. Which of the following statements is true about hybridisation ?

A. The hybridised orbitals have different energies for each orbital.

- B. The number of hybrid orbitals is equal to the number of atomic orbitals that are hybridised.
- C. Hybrid orbitals form multiple bonds.
- D. The orbitals with different energies undergo hybridisation.

Answer: B

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2. In which of the following the central atom use sp^2 hybrid orbitals in its bonding

- A. CH_4
- B. CO_2
- C. BF_3
- D. BeF_2

Answer: C

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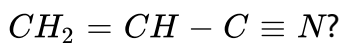
3. carbon in carbon dioxide is

- A. sp^2 - hybridised
- B. sp^3 d - hybridised
- C. sp- hybridised
- D. sp^3 - hybridised

Answer: C

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4. Which type of hybridisation is shown by carbon atoms from left to right in the given compound :



- A. sp^2 , sp^2 , sp

B. sp^2 , sp , sp

C. sp , sp^2 , sp

D. sp^3 , sp^2 , sp

Answer: A

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5. On hybridisation of one s and three p-orbitals, we get

A. four orbitals with tetrahedral orientation

B. three orbitals with trigonal orientation

C. two orbitals with linear orientation

D. two orbitals with perpendicular orientation.

Answer: A

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6. Among the following molecules : SO_2 , SF_4 , ClF_3 , BrF_5 , and XeF_4 , which of the following shapes does not describe any of the molecules mentioned ?

A. Bent

B. Trigonal Bipyramidal

C. See-Saw

D. T-Shape

Answer: D

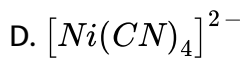


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7. Which of the following involves dsp^2 -hybridisation and are square planar ?

A. SF_6

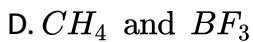
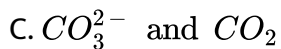
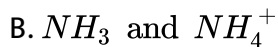
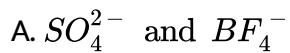
B. BrF_5



Answer: D

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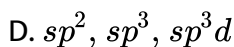
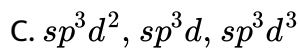
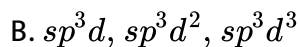
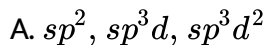
8. Which of the following pairs of species are isostructural ?



Answer: A

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9. The increasing d-character in hybridisation of Xe in XeF_2 , XeF_4 , XeF_6 is

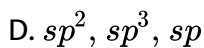
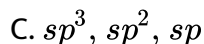
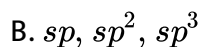
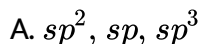


Answer: B



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10. What is the hybrid state of carbon in ethyne, graphite and diamond ?



Answer: B

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11. Given below is the bond angle in various types of hybridisation. Mark the bond angle which is not correctly matched.

A. $dsp^2 - 90^\circ$

B. $sp^3d^2 - 90^\circ$

C. $sp^3d - 90^\circ$

D. $sp^3 - 109.5^\circ$

Answer: C

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12. Arrange in increasing order of s character

A. $sp^3 < sp^2 < sp$

B. $sp < sp^2 < sp^3$

C. $sp^2 < sp < sp^3$

D. $sp^2 < sp^3 < sp$

Answer: B

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13. Match the column I with column II and mark the appropriate choice.

Column I	Column II
(A) C_2H_2	(i) sp^3d^2 hybridisation
(B) SF_6	(ii) sp^3d^3 hybridisation
(C) SO_2	(iii) sp hybridisation
(D) IF_7	(iv) sp^2 hybridisation

A. (A) \rightarrow (i), (B) \rightarrow (iii), (C) \rightarrow (ii), (D) \rightarrow (iv)

B. (A) \rightarrow (iii), (B) \rightarrow (i), (C) \rightarrow (iv), (D) \rightarrow (ii)

C. (A) \rightarrow (ii), (B) \rightarrow (iii), (C) \rightarrow (i), (D) \rightarrow (iv)

D. (A) \rightarrow (iv), (B) \rightarrow (i), (C) \rightarrow (iii), (D) \rightarrow (ii)

Answer: B



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14. In formation of ethene, the bond formation between s and p- orbitals takes place in the following manner.

- A. sp^2 hybridised orbitals form sigma bond while the unhybridised (p_x or p_y) overlaps sidewise to form π - bond.
- B. sp^2 hybridised orbitals form π - bond while the unhybridised (p_z) overlaps to form σ -bond.
- C. sp^2 hybridised orbitals overlap with s- orbitals of H atoms while unhybridised orbitals form C - C bond.
- D. sp^2 hybridised orbitals form sigma bonds with H atoms while unhybridised orbitals form σ bonds between C atoms.

Answer: A





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15. The ground state electronic configuration of S is $3s^2 3p^4$. How does it form the compound SF_6 ?

- A. Due to octahedral shape of S atoms
- B. Due to presence of vacant 3d- orbitals which provide 6 unpaired electrons in excited state
- C. Due to sp^3 hybridisation of S atom which provides 6 electrons to 6 F atoms
- D. Due to presence of 3 sigma and 3 pi bonds between S and F

Answer: B



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Molecular Orbital Theory

1. Which of the following statements is not true regarding molecular orbital theory?

A. The atomic orbitals of comparable energies combine to form molecular orbitals.

B. An atomic orbital is monocentric while a molecular orbital is polycentric.

C. Bonding molecular orbital has higher energy than antibonding molecular orbital.

D. Molecular orbitals like atomic orbitals obey Aufbau principle for filling of electrons.

Answer: C



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2. Which of the following representation of wave functions of molecular orbitals and atomic orbitals are not correct ?

A. $\Psi_{MO} = \Psi_A \pm \Psi_B$

B. $\sigma = \Psi_A + \Psi_B$

C. $\sigma^* = \Psi_A - \Psi_B$

D. $\Psi_{MO} = \Psi_A \times \Psi_B$

Answer: D



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3. 2s and 2p- atomic orbitals combine to give how many molecular orbitals ?

A. 2

B. 4

C. 8

D. 6

Answer: C

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4. The conditions for the combination of atomic orbitals to form molecular orbitals are stated below.

Mark the incorrect condition mentioned here.

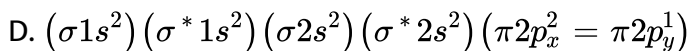
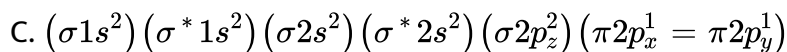
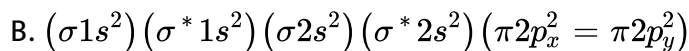
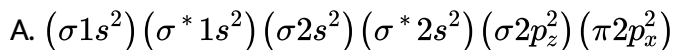
- A. The combining atomic orbitals must have nearly same energy.
- B. The combining atomic orbitals must overlap to maximum extent.
- C. Combining atomic orbitals must have same symmetry about the molecular axis.
- D. Pi (π) molecular orbitals are symmetrical around the bond axis.

Answer: D

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5. The electronic configuration of carbon is $1s^2 2s^2 2p^2$.

There are 12 electrons in C_2 . The correct electronic configuration of C_2 molecule is



Answer: B

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6. Comprehension given below is followed by some multiple choice question, Each question has one correct options. Choose the correct option.

Molecular orbitals are formed by the overlap of atomic orbitals. Two

atomic orbitals combine to form two molecular orbitals called bonding molecular orbital (BMO) 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 nitrogen increase in the order

$$\sigma 1s < \sigma^* 1s < \sigma 2s < \sigma^* 2s < (\pi 2p_x = \pi 2p_y) < \sigma 2p_z < (\pi^* 2p_x = \pi^* 2p_y) < \sigma^* 2p_z$$

and For oxygen and fluorine order of energy of molecules orbitals is given below.

$$\sigma 1s < \sigma^* 1s < \sigma 2s < \sigma^* 2s < \sigma p_z < (\pi 2p_x \approx \pi 2p_y) < (\pi^* 2p_x \approx \pi^* 2p_y) < \sigma^* 2p_z$$

Different atomic orbitals of one atom combine with those atoms orbitals of the second atom which have comparable energies and proper orientation.

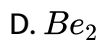
Further, if the overlapping is head on, the molecular orbital is called sigma, σ and if the overlap is lateral, the molecular orbital is called pi, π .

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 of the most important parameters to compare the strength of bonds.

67) Which of the following pair is expected to have the same bond order?



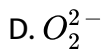
Answer: C



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7. Which of the following species have one unpaired electron each

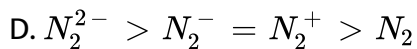
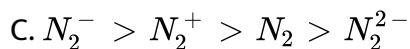
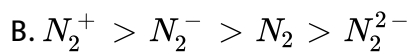
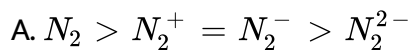




Answer: C

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8. The correct stability order for N_2 and its given ions is :



Answer: A

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9. What will be the bond order of the species with electronic configuration $1s^2 2s^2 2p^5$?

- A. One
- B. Two
- C. Three
- D. Zero

Answer: A



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10. Which of the following bond order is indication of existence of a molecule ?

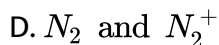
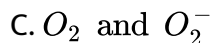
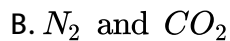
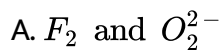
- A. Zero bond order
- B. Negative bond order
- C. Positive bond order

D. All of these.

Answer: C

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11. Which of the following pairs have identical bond order?



Answer: A

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12. Respective Bond Order for the following N_2 , N_2^+ , N_2^-

A. 2.5, 2.5 and 3 respectively

B. 2, 2.5 and 3 respectively

C. 3, 2.5 and 3 respectively

D. 2.5, 2.5 and 2.5 respectively.

Answer: A



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13. According to molecular orbital theory, which of the following will not be a viable molecule?

A. H_2^+

B. Be_2

C. B_2

D. C_2

Answer: B

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14. Which of the following facts regarding bond order is not valid ?

- A. Bond order is given by the number of bonds between the two atoms in a molecule.
- B. With increase in bond order, bond enthalpy of the molecule decreases.
- C. Isoelectronic molecules and ions have identical bond orders.
- D. With increase in bond order, bond length decrease.

Answer: B

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15. Which of the following formulae does not show the correct relationship ?

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

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

$$C. B. O. \propto \frac{1}{\text{Bond dissociation energy}}$$

$$D. N_b > N_a, B. O. = +ve$$

Answer: C

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16. Fill in the blanks with appropriate choice.

Bond order of N_2^+ is P while that of N_2 is Q.

Bond order of O_2^+ is R while that of O_2 is S.

N - N bond distance T when N_2 changes to N_2^+ and when O_2 changes to O_2^+ , the O - O bond distance U.

A.

<i>P</i>	<i>Q</i>	<i>R</i>	<i>S</i>	<i>T</i>	<i>U</i>
2	2.5	2.5	1	increases	decreases

B.

<i>P</i>	<i>Q</i>	<i>R</i>	<i>S</i>	<i>T</i>	<i>U</i>
2.5	3	2	1.5	decreases	increases

C.

<i>P</i>	<i>Q</i>	<i>R</i>	<i>S</i>	<i>T</i>	<i>U</i>
3	2	1.5	1	increases	decreases

D. P Q R S T U
2.5 3 2.5 2 increases decreases

Answer: D

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17. Which of the following relationships is true?

- A. Bond dissociation energy of O_2 and O_2^- are same.
- B. Bond dissociation energy of O_2^+ is higher than O_2 ,
- C. Bond dissociation energy of O_2^- and O_2^{2-} are same.
- D. Bond dissociation energy of O_2^{2-} is higher than O_2^- .

Answer: B

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18. Paramagnetism is shown by the molecules which have

- A. paired electrons
- B. unpaired electrons
- C. lone pair of electrons
- D. bond order more than one.

Answer: B

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Bonding In Some Homonuclear Diatomic Molecules

1. Which of the following species is paramagnetic in nature ?



Answer: C

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2. How many orbitals are singly occupied in O_2 molecule ?

A. 2

B. 1

C. 3

D. 4

Answer: A

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3. Oxygen molecule is paramagnetic because

A. no. of bonding electrons $>$ no. of antibonding electrons

B. no. of bonding electrons $<$ no. of antibonding electrons

C. no. of bonding electrons = no. of antibonding electrons

D. presence of unpaired electrons in molecular orbitals.

Answer: D

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4. Oxygen molecule is paramagnetic in nature . What is the paramagnetic content in terms of magnetic moment is O_2^- ? (a) 1.732 (b) 3 (c) 1.5 (d) 2.5

A. 1.732

B. 3

C. 1.5

D. 2.5

Answer: A

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Hydrogen Bonding

1. Which one shows maximum hydrogen bonding ?

A. HF

B. H_2O

C. NH_3

D. CH_3OH

Answer: A



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2. Hydrogen bond is formed between hydrogen atoms and highly electronegative elements. It is of two types - intermolecular and intramolecular. It is a weaker bond than ionic, covalent and metallic.

bonds

Which is correct statement ? .

- A. displacement of electrons towards more electronegative atom resulting in fractional positive charge on hydrogen
- B. displacement of electrons towards hydrogen atom resulting in a polar molecule
- C. formation of a bond between hydrogen atoms of one molecule and the other
- D. existence of an attractive force which binds hydrogen atoms together.

Answer: A



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3. Which of the following statements is true of hydrogen atom ? (a)Cl and N have comparable electronegativities yet there is no H- bonding in HCl

because size of Cl is large. (b) Intermolecular H- bonding results in decrease in m.p. and b.p. (c) Ice has maximum density at $0^{\circ}C$ due to H-bonding. (d) $KHCl_2(HCl_2^-)$ exists but $KHF_2(HF_2^-)$ does not exist due to lack of H- bonding in HCl.

A. Cl and N have comparable electronegativities yet there is no H-bonding in HCl because size of Cl is large.

B. Intermolecular H- bonding results in decrease in m.p. and b.p.

C. Ice has maximum density at $0^{\circ}C$ due to H- bonding.

D. $KHCl_2(HCl_2^-)$ exists but $KHF_2(HF_2^-)$ does not exist due to lack of H- bonding in HCl.

Answer: A



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4. Strongest bond is (a) HF (b) HCl (c) HBr (d) HI

A. HF

B. HCl

C. HBr

D. HI

Answer: A



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5. Which of the following observations can be explained on the basis of hydrogen bonding ?

(i) H- F has higher boiling point than other halogen acids.

(ii) H_2O has highest boiling point among hydrides of group 16 elements.

(iii) NH_3 has lower boiling point than PH_3 .

A. (i) , (ii) and (iii)

B. (i) and (iii)

C. (ii) and (iii)

D. (i) and (ii)

Answer: D



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6. Though covalent in nature, methanol is soluble in water , why ?

- A. Methanol is transparent like water.
- B. Due to hydrogen bonding between methanol and water molecules.
- C. Due to van der Waals' forces between methanol and water.
- D. Due to covalent attraction forces.

Answer: B



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7. For same mass of water and ice, why ice floats over water? (A)solids have lesser density than liquids (B)it has open - cage like structure in which lesser molecules are packed per mL than water (C)ice is lighter than

water (D) when ice is formed water molecules come closer and start floating.

A. solids have lesser density than liquids

B. it has open - cage like structure in which lesser molecules are packed per mL than water

C. ice is lighter than water

D. when ice is formed water molecules come closer and start floating.

Answer: B



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8. Which of the following species shows intramolecular hydrogen bonding ? (A) o-Nitrophenol (B) p- Nitrophenol (C) Benzoic acid (D) Ethanol

A. o-Nitrophenol

B. p- Nitrophenol

C. Benzoic acid

D. Ethanol

Answer: A



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9. Which of the following statements is not true ? (a) Intermolecular hydrogen bonds are formed between two different molecules of compounds. (b) Intramolecular hydrogen bonds are formed between two different molecules of the same compounds. (c) Intramolecular hydrogen bonds are formed within the same molecule. (d) Hydrogen bonds have strong influence on the physical properties of a compound.

A. Intermolecular hydrogen bonds are formed between two different molecules of compounds.

B. Intramolecular hydrogen bonds are formed between two different molecules of the same compounds.

C. Intramolecular hydrogen bonds are formed within the same molecule.

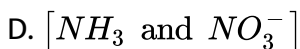
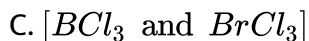
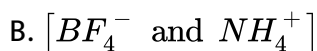
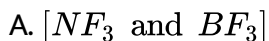
D. Hydrogen bonds have strong influence on the physical properties of a compound.

Answer: B

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Ncert Exemplar

1. Isostructural species are those which have the same shape and hybridisation. Among the given identify the isostructural pairs.



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 CO_2 B HI C

H_2O D SO_2

A. CO_2

B. HI

C. H_2O

D. SO_2

Answer: C

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3. The hybridisation of atomic orbitals of nitrogen in NO_2^+ , NO_3^- and NH_4^+ respectively are

A. sp , sp^3 and sp^2

B. sp , sp^2 and sp^3

C. sp^2 , sp and sp^3

D. sp^2 , sp^3 and sp

Answer: B



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4. Hydrogen bonds are formed in many compounds e.g. H_2O , HF, 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

A. $HF > H_2O > NH_3$



Answer: B

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5. In PO_4^{3-} ion the formal charge on the oxygen atom of P-O bond is

A. +1

B. -1

C. -0.75

D. +0.75

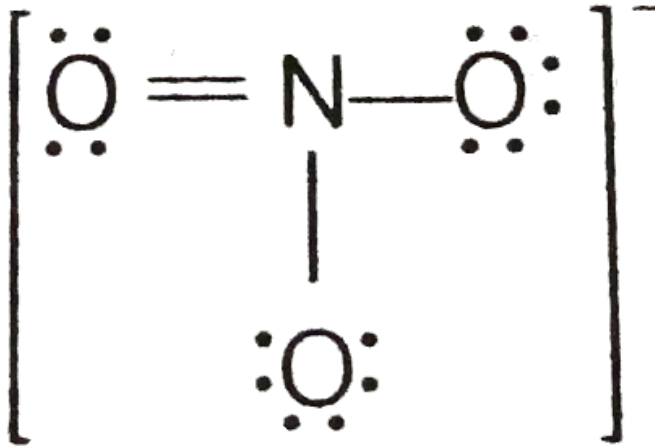
Answer: C

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6. In NO_3^- ion, the number of bond pairs and lone pairs of electrons on nitrogen atom are

Thinking process

To solve this sequence we must know the structure of NO_3^- ion i.e.,



Then, count the bond pairs and lone pairs of electron on nitrogen.

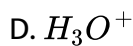
- A. 2, 2
- B. 3, 1
- C. 1, 3
- D. 4, 0

Answer: D



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7. Which of the following species has tetrahedral geometry? A BH_4^- B NH_2^- C CO_3^{2-} D H_3O^+

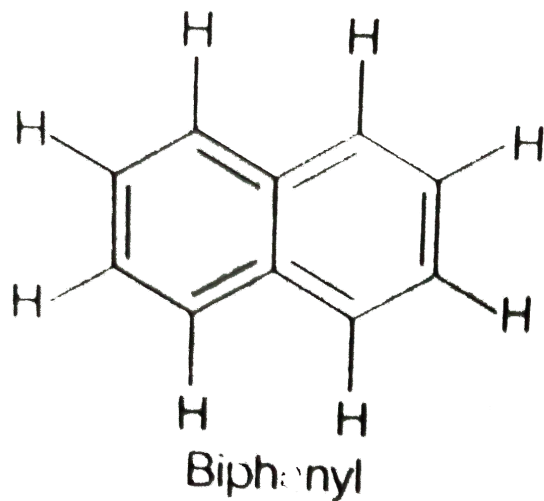


Answer: A



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8. Number of π bonds and σ bonds in the following structure is



A. 6, 19

B. 4, 20

C. 5, 19

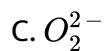
D. 5, 20

Answer: C



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9. Which molecule/ion out of the following does not contain unpaired electrons?

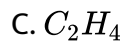
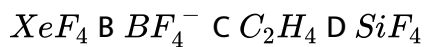


Answer: C



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10. In which of the following molecule/ion all the bonds are not equal? A



D. SiF_4

Answer: C

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11. In which of the following substances will hydrogen bond be strongest?

A. HCl

B. H_2O

C. HI

D. H_2S

Answer: B

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12. If the electron configuration of an element is $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 3d^2, 4s^2$, the four electrons involved in chemical bond formation will be

- A. $3p^6$
- B. $3p^6, 4s^2$
- C. $3p^6, 3d^2$
- D. $3d^2, 4s^2$

Answer: D



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13. Which of the following angle corresponds to sp^2 hybridisation ?

- A. 90°
- B. 120°
- C. 180°

D. 109°

Answer: B

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14. Which of the following order of energies of molecular orbitals of N_2 is correct?

A. $(\pi 2p_y) < (\sigma 2p_z) < (\pi^* 2p_x) \approx (\pi^* 2p_y)$

B. $(\pi 2p_y) > (\sigma 2p_z) > (\pi^* 2p_x) \approx (\pi^* 2p_y)$

C. $(\pi 2p_y) < (\sigma 2p_z) > (\pi^* 2p_x) \approx (\pi^* 2p_y)$

D. $(\pi 2p_y) > (\sigma 2p_z) < (\pi^* 2p_x) \approx (\pi^* 2p_y)$

Answer: A

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15. Which of the following statement is not correct from the view point of molecular orbital theory?

A. Be_2 is not a stable molecule .

B. He_2 is not stable of N_2 is maximum amongst the homonuclear diatomic molecules belonging to the second period .

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 is

$$\sigma 2s < \sigma^* 2s < \sigma 2p_z < (\pi 2p_x = \pi 2p_y) < (\pi^* 2p_x = \pi^* 2p_y) < \sigma^* 2p_z$$

Answer: D



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Assertion And Reason

1. Assertion : In the formation of a molecule , only the outer shell electrons take part in chemical combination and they are known as valence electrons.

Reason : Atoms achieve the stable octet when they are linked by chemical bonds .

- A. If both assertion and reason are true and reason is the correct explanation of assertion.
- B. If both assertion and reason are true but reason is not the correct explanation of assertion.
- C. If assertion is true but reason is false.
- D. If both assertion and reason are false.

Answer: B



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2. Assertion : In the formation of water molecule, both hydrogen and oxygen atoms attain octet of electrons.

Reason : Oxygen atom forms two ionic or electrovalent bonds with two hydrogen atoms.

A. both assertion and reason are true and reason is the correct explanation of assertion.

B. both assertion and reason are true but reason is not the correct explanation of assertion.

C. assertion is true but reason is false.

D. both assertion and reason are false.

Answer: D



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3. Assertion : In Lewis structures of NF_3 and CO_3^{2-} , nitrogen and carbon occupy the central position whereas fluorine and oxygen occupy the terminal positions.

Reason : In Lewis representation, the least electronegative atom occupies the central position in the molecule/ion.

- A. If both assertion and reason are true and reason is the correct explanation of assertion.
- B. If both assertion and reason are true but reason is not the correct explanation of assertion.
- C. If assertion is true but reason is false.
- D. If both assertion and reason are false.

Answer: A



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4. Assertion : PF_5 , SF_6 and H_2SO_4 are the examples of expanded octet molecules .

Reason : Octet rule is not applicable to the second period elements of the periodic table.

- A. both assertion and reason are true and reason is the correct explanation of assertion.
- B. both assertion and reason are true but reason is not the correct explanation of assertion.
- C. assertion is true but reason is false.
- D. both assertion and reason are false.

Answer: C



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5. Assertion : Octet rule is based upon the chemical inertness of noble gases.

Reason : Octet rule can explain the shape and relative stability of the molecule.

A. both assertion and reason are true and reason is the correct explanation of assertion.

B. both assertion and reason are true but reason is not the correct explanation of assertion.

C. assertion is true but reason is false.

D. both assertion and reason are false.

Answer: C



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6. Assertion : Sodium chloride (NaCl) is a stable ionic solid.

Reason : NaCl has high lattice enthalpy.

A. If both assertion and reason are true and reason is the correct explanation of assertion.

B. If both assertion and reason are true but reason is not the correct explanation of assertion.

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

Answer: A



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7. Assertion : F_2 and O_2^{2-} have bond order 1 while N_2 , CO and NO^+ have bond order 3.

Reason : Higher the bond order, higher is the stability of the molecule.

- A. If both assertion and reason are true and reason is the correct explanation of assertion.
- B. If both assertion and reason are true but reason is not the correct explanation of assertion.
- C. If assertion is true but reason is false.
- D. If both assertion and reason are false.

Answer: B



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8. Assertion : The experimentally determined carbon to oxygen bond length in carbon dioxide is 115 pm.

Reason : The lengths of a normal carbon to oxygen double bond ($C = O$) and carbon to oxygen triple bond ($C \equiv$) are 121 pm and 110 pm respectively.

- A. If both assertion and reason are true and reason is the correct explanation of assertion.
- B. If both assertion and reason are true but reason is not the correct explanation of assertion.
- C. If assertion is true but reason is false.
- D. If both assertion and reason are false.

Answer: B



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9. Assertion : The dipole moment in case of BeF_2 is zero.

Reason : The two equal bond dipoles point in opposite directions and cancel the effect of each other.

- A. If both assertion and reason are true and reason is the correct explanation of assertion.

B. If both assertion and reason are true but reason is not the correct explanation of assertion.

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

Answer: A

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10. Assertion : Dipole moment of NH_3 is greater than that of NF_3 .

Reason : Nitrogen is more electronegative than fluorine.

A. both assertion and reason are true and reason is the correct explanation of assertion.

B. both assertion and reason are true but reason is not the correct explanation of assertion.

C. assertion is true but reason is false.

D. both assertion and reason are false.

Answer: C

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11. Assertion : Among alkaline earth metals, Be predominantly forms covalent bond.

Reason : Be is smaller in size and hence has greater polarising power.

- A. both assertion and reason are true and reason is the correct explanation of assertion.
- B. both assertion and reason are true but reason is not the correct explanation of assertion.
- C. assertion is true but reason is false.
- D. both assertion and reason are false.

Answer: A



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12. Assertion : In NH_3 , N is sp^3 hybridised but bond angle is 107° .

Reason : Shape of NH_3 molecule is trigonal pyramidal.

- A. If both assertion and reason are true and reason is the correct explanation of assertion.
- B. If both assertion and reason are true but reason is not the correct explanation of assertion.
- C. If assertion is true but reason is false.
- D. If both assertion and reason are false.

Answer: B



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13. Ionic bonds are non-directional while covalent bonds are directional.

- A. If both assertion and reason are true and reason is the correct explanation of assertion.
- B. If both assertion and reason are true but reason is not the correct explanation of assertion.
- C. If assertion is true but reason is false.
- D. If both assertion and reason are false.

Answer: D

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14. Assertion : O_2 molecule is diamagnetic while C_2 molecule is paramagnetic in nature.

Reason : Bond order of O_2 molecule is 1.5 and that of C_2 molecule is 2.5 .

- A. If both assertion and reason are true and reason is the correct explanation of assertion.

B. If both assertion and reason are true but reason is not the correct explanation of assertion.

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

Answer: D

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15. Assertion : Boiling point of p-nitrophenol is greater than that of o-nitrophenol.

Reason : There is intramolecular hydrogen bonding in p-nitrophenol and intermolecular hydrogen bonding in o-nitrophenol.

A. If both assertion and reason are true and reason is the correct explanation of assertion.

B. If both assertion and reason are true but reason is not the correct explanation of assertion.

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

Answer: C



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