CHEMISTRY

BOOKS - BRILLIANT PUBLICATION

CHEMICAL BONDING

Question Level I Homework

1. Which of the following molecule/ion violates octect rule ?

A. BF_4^-

B. NCl_3

C. PCl_4^+

D. SF_4

Answer:

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2. In an ionic compound A^+X^- the degree of covalent bonding is greatest when

A. A^+ and X^- are small

B. A^+ and X^- are approximately of the same size

C. A^+ is small and X^- is large

D. A^+ is large and X^- is small

Answer:

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3. The melting points of sodium halides decrease in the order

A. $NaF > NaCl > NaBr > Nal$

B. $Nal > NaBr > NaCl > NaF$

C. $NaF > NaCl > NaI > NaBr$

D. $NaBr > NaF > NaCl > NaI$

Answer:

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4. Which pair is not correct order of lattice energy ?

A. $AlN > MgO$

B. $CaO > BaO$

C. $MgCO_3 > CaCo$

D. $KCl > MgO$

Answer:

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5. Which is the correct statement ? (1) A σ bond has no free rotation around its axis. (2) p orbitals always have only side wise overlap (3) s orbitals cannot form π bonds. (4) There can be more than one σ bond between two atoms.

A. A σ bond has no free rotation around its axis

B. p orbitals always have only sldewise overlap

C. orbitals cannot form π bonds

D. There can be more than one σ bond between two atoms

Answer:

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6. Assume that the internuclear axis is z-axis . What type of bonds can be formed by P_x orbitals ?

A. π bond

B. σ bond

C. δ bond

D. no bond will be formed

Answer:

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7. The hybridisation of central iodine atoms in lF_5, l_3^- and l_3^+ are

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

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

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

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

Answer:

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8. Choose the molecules in which hybridisation occurs in ground state

(I) BCl_3

(II) NH_3

(III) PCl_3

(IV) BeF_2 [a] I,II,IV [b] I,II,III [c] II,III [d] III,IV

A. I,II,IV

B. I,II,III

C. II,III

D. III,IV

Answer:

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9. Which of the following is a planar molecule/ion ?

A. $XeOF_4$

B. XeO_4

C. XeO_2F_2

D. CO_3^{2-}

Answer:

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10. Molecular shapes 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:

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11. The geometrical shape of BrF_5 is similar of that of

A. PCl_5

B. XeF_4

C. PCl_4^+

D. $XeOF_4$

Answer:

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12. In ICl_4^- the shape is square planar.The number of lone pair-bond pair repuision at 90° are

A. 8

B. 6

C. 12

D. 4

Answer:

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13. The bent or V shape of a molecule can be resulted from the hybridisation

A. sp^3

B. sp^2

C. both 1 and 2

D. sp^3d

Answer:

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14. The highest amount of s character is observed in

A. N-H bond of NH_3

B. N-H bond of NH_4^+

C. N-H bond in $H_2N - NH_2$

D. N-H bond HN=NH

Answer:

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15. Which statement is true about the most stable Lewis structure of CS_2 ?

A. There are no lone pairs in the molecule

B. All the bonds are double bonds

C. The central atom does not have octect of electrons

D. Sulphur is the central atom

Answer:

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16. Which of the following has the smallest bond angle?

A. H_2O

B. H_2S

C. NH_3

D. SO_2

Answer:

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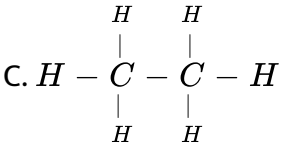
17. Which has the maximum bond energy of C-H bond ?

A. $HC \equiv C - H$

B. $H_2C = CH_2$

C. 

D. CH_3 free radical

Answer:

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18. Which of the following molecules has polar bonds but zero dipole moment ?

A. O_2

B. $CHCl_3$

C. CCl_4

D. O_3

Answer:

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19. If a molecule MX_3 has zero dipole moment, the σ bonding oritals used by Mere

A. pure P

B. sp hybridised

C. sp^2 hybridised

D. sp^3 hybridised

Answer:

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20. Resonance structures can be written for

A. O_3

B. NH_3

C. CH_4

D. H_2O

Answer:

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21. A molecule has 3 reasonating structures with energles E_1, E_2 and E_3 in the order $E_3 < E_2 < E_1$. The experimental energy of the moelcule is E_0. Its resonance energy is

A. $(E_1 + E_2 + E_3) - E_0$

B. $E_0 - E_3$

C. $E_0 - E_1$

D. $E_0 - E_2$

Answer:

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22. The common features of the specles N_2^{2-}, O_2 and NO^- are

A. bond order 3 and isoelectronic

B. bond order 2 and isoelectronic

C. bond order 3 but not isoelectronic

D. bond order 2 but not isoelectronic

Answer:

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23. Which of the following molecule/ion exhibits s-p mixing of orbitals ?

A. B_2

B. C_2^{2-}

C. O_2^+

D. both 1 and 2

Answer:

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24. Which of the following is paramagnetic ?

A. NO^-

B. O_2^{2-}

C. CN^-

D. CO

Answer:

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25. Which of the following has non integral bond order ?

A. O_2^+

B. O_2^-

C. NO

D. all of these

Answer:

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26. Which of the following statements is incorrect ? (1) Decreasing order of stability of O_2, O_2-, O_2+ is $O_2+ > O_2 > O_2-$. (2) He_2 molecule does not exist as the bonding and antibonding effects cancel each other. (3) $C_2, O_2^2-,$ and Li_2 are diamagnetic. (4) In F_2 molecule the energy of $\sigma_{2_{p_z}}$ is greater than that of $\pi_{2p_x},$ and $\pi_{2_{p_y}}$

A. $O_2^+ > O_2 > O_2^-$ decreasing order of bond energy

B. He_2 molecule does not exist as the bonding and antibonding efects cancel each other

C. C_2, O_2^{2-} and Li_2 are diamagnetic

D. In F_2 molecule, the energy of $\sigma_{2_{p_s}}$ is greater than that of $\pi_{2p},$ and $\pi_{2_{p_y}}$

Answer:

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27. The decreasing order of boiling points among the following compounds is

A. $SbH_3 > NH_3 > AsH_3 > PH_3$

B. $SbH_3 > AsH_3 > NH_3 > PH_3$

C. $NH_3 > SbH_3 > AsH_3 > PH_3$

D. $PH_3 > NH_3 > SbH_3 > AsH_3$

Answer:

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28. Which of the following properties is not due to hydrogen bond ? (1) High boiling point of water (2) High viscosity of glycerol (3) Solubility of

sugar in water (4) Polar nature of HF molecule

A. high boiling point of water

B. high viscosity of glycerol

C. solubility of suger in water

D. polar nature of HF molecule

Answer:

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29. Which of the following molecule is polar and has the central atom with sp^2 hybridisation ?

A. SiF_4

B. BF_3

C. $HClO_4$

D. H_2CO_3

Answer:

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30. Formula of the oxide of a metal M is MO. The formula of its phosphate is

A. M_2PO_4

B. MPO_4

C. $M_2(PO_4)_5$

D. $M_3(PO_4)_2$

Answer:

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Question Level LI

1. Which of the following species are hypervalent ?

(I) ClO_4^-

(II) BF_3

(III) SO_4^{2-}

(IV) CO_3^{2-}

A. I,II and IIII

B. I and III

C. III and IV

D. I and II

Answer:

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2. Pick out the most covalent compound among the following

A. NaCl

B. $PbCl_2$

C. $SnCl_4$

D. $SnCl_2$

Answer:

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3. Give the correct order of initials T or F for the given statements. Use T for true statement and F for false statement:

S1: AgI is less water soluble than AgF due to more polarisation of I^- compared to F^-

S:2 Melting point of $BaCl_2$ is higher than that of $BeCl_2$ due to higher ionic nature of $BaCl_2$

S3: Order of lattice energy $-NaF < MgO < AlN < SiC$: TTT, TTF, TFT, FTT,

A. TTT

B. TTF

C. TFT

D. FTT

Answer:

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4. Choose the correct order of thermal stability among the following compounds

A. $BaCO_3 < SrCO_3 < CaCO_3 < MgCO_3$

B. $MgCO_3 < CaCO_3 < SrCO_3 < BaCO_3$

C. $CaCO_3 < SrCO_3 < BaCO_3 < MgCO_3$

D. $BaCO_3 < MgCO_3 < CaCO_3 < SrCO_3$

Answer:

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5. The electronegativities of a atoms D,E,F and G are as follows: D=3.8, E=3.3,F=2.8and G=1.3 If the atoms form molecules DE, DG,EG and DF, the increasing order of covalent character in them is

A. $DG < EG < DF < DE$

B. $DF < DG < DE < EG$

C. $DG < DF < EG < ED$

D. $DE < EG < DG < DF$

Answer:

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6. Formal charges on the three oxygen atoms in ozone molecule are

A. $0, 0 + 1$

B. $0, \ +1 - 1$

C. $-1, \ +1 - 2$

D. $0, 0, +2$

Answer:

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7. On decreasing the internuclear distance below the optimum distance (where potential energy is minimum) there is steep increase in potential energy of a molecule due to

A. increase in force of attraction between electrons and nuclei

B. increase in stability of the bonded atoms

C. equal probability of finding bonding electrons near to either of the nuclei

D. increase in net repulsions in the molecule

Answer:

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8. Allyl cyanide has

A. 9σ bonds and 4π bonds

B. 9σbonds 3π bonds and one lone pair of electrons

C. 8σ bonds and 5π bonds

D. 8σ bonds and 4π bonds

Answer:

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9. A π bond is formed by the overlap of P_x orbitals of two atoms. The atoms can approach along

A. X-axis

B. Y-axis

C. Z-axis

D. Y or Z axes

Answer:

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10. The order of increasing s character (in percentage) in the hybrid orbitals of the following molecules/ions is

I CO_3^{2-}

II XeF_4

III l_3^-

IV NCl_3

(V) $BeCl_2$

A. $l < ll < lll < lV < V$

B. $V < lV > lll < ll < l$

C. $ll < lll < lV < l < V$

D. $lV < l < lll < ll < V$

Answer:

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11. Which of the following represents the given mode of hybridisation of carbon atoms sp^2, sp^2, sp from left to right ?

A. $H_2C = C = C = CH_2$

B. $HC \equiv C - C \equiv CH$

C. $H_2C = CH - CH = CH_2$

D. $H_2C = CH - C \equiv CH$

Answer:

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12. Specify the hybridisation of the central atom in the following species respectively N_3^-, $NOCl$, N_2O

A. sp, sp^2, sp

B. $sp, spsp^3$

C. sp^2, sp, sp^2

D. sp^2, sp^2, sp

Answer:

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13. In which of the following molecules, the central atom uses unhybridised atomic orbitals of bonding ?

A. NH_3

B. H_2O

C. SbH_3

D. BF_3

Answer:

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14. Choose the correct code of characteristics for the given order of hybrid orbitals of the same atom $sp < sp^2 < sp^3$

i. Electronegativity

ii. Bond angles between same hybrid orbitals

iii. Size

iv. Energy

A. I,iii and iv

B. iii,and iv

C. ii and iv

D. I,ii and iii

Answer:

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15. Which of the following is the correct set with respect to molecule, hybridisation and shape ?

A. $BeCl_2$, sp^2 linear

B. $BeCl_2$, sp^2, bent

C. BCl_3, sp^2, trigonal planar

D. BCl_3, sp^3, trigonal pyramidal

Answer:

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16. Which of the following xenon compound has the same number of lone pairs on the central atom as in l_3^- ?

A. XeO_4

B. XeF_4

C. XeF_2

D. XeO_3

Answer:

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17. Choose the pair of compounds which have different hybridisation but same molecular geometry ?

A. Bf_3, BrF_3

B. $lCl_2^-, BeCl_2$

C. BCl_3, PCl_3

D. PCl_3, NCl_3

Answer:

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18. A molecule XY_2 contains 2σ bonds.2π. bonds and one lone pair of electrons in the valence shell of X. The arrangement of bond pairs and lone pairs is

A. Square pyramidal

B. linear

C. trigonal planar

D. trigonal bipyramidal

Answer:

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19. What is the shape of the anion formed when iodine is dissolved in potassium iodide ?

A. linear

B. angular

C. trigonal planar

D. see saw

Answer:

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20. Which of the following statements regarding the structure of $SOCl_2$ is not correct ?

A. Sulphur is in sp^3 hybridisation and $SOCl_2$ has trigonal pyramidal shape

B. The O-S bond has a $p\pi - d\pi$ bond

C. It contains one lone pair of electrons in sp^3 hybride orbital of sulphur

D. Sulphur is in sp^3 hybrid state and $SOCl_2$ is tetrahedral in shape

Answer:

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21. The orbitals used in the hybridisatino of AsF_5 are

A. $dx^2 - y^2, s, Px, Py, Pz$

B. dxy, s, Px, Py, Pz

C. s, Px, Py, Pz, dz^2

D. $s, Px, Py, Pz, dx^2 - y^2$

Answer:

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22. Which among the following molecules cannot produce chlorine on heating ?

A. PCl_5

B. PBr_2Cl_3

C. PF_3Cl_2

D. PBr_3Cl_2

Answer:

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23. The correct order of increasing bond lengths of the following bonds is

$C-H, C-O, C-C, C=C$

A. $C-H < C-O < C-C < C=C$

B. $C-H < C=C < C-O < C-C$

C. $C-C < C=C < C-O < C-H$

D. $C-O < C-H < C-C < C=C$

Answer:

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24. bond angle is maximum in?

A. NH_3

B. NH_4^-

C. PCl_3

D. SCl_2

Answer:

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25. The bond having highest bond energy is

A. $C = O$

B. $C = C$

C. $C = S$

D. $P = N$

Answer:

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26. Which of the following has the highest dipole moment ?

A. BF_3

B. NH_3

C. NF_3

D. CH_4

Answer:

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27. Which of the followng is a polar molecule

A. 1,4-dichlorobenzene

B. cis-1,2-dichloro ethene

C. trans 1,2-dichloro ethene

D. Benzene

Answer:

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28. A diatomic molecule has dipole moment 1.2 D and its bond length is $1A^{\circ}$ the percentage of electronic charge on each atom will be

A. $10\ \%$

B. $35\ \%$

C. $25\ \%$

D. $50\ \%$

Answer:

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29. Which of the following is not true about resonance?

A. The resonance structures are hypothetical

B. The number of unpaired electrons in various resonating structures of a molecule should be the same

C. Hybrid structure is more energetic than any one of the resonating structures

D. Hybrid structure is more stable than anyone of the resonating structures

Answer:

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30. Which of the following canonical structures cannot represent resonance forms of N_2O molecule ?

(I) : $\dot{\dot{N}} = N = \dot{\dot{O}}$:

(II) : $N \equiv N - \dot{\dot{O}}$:

(III) : $\dot{\dot{N}} - N \equiv O$:

(IV) : $\dot{\dot{N}} = O = \dot{\dot{N}}$: (A) I and II (B) II, III and IV (C) IV (D) III and IV

A. I and III

B. II, III and IV

C. IV and V

D. III and IV

Answer:

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31. The species haing no $p\pi - p\pi$ bond but has bond order equal to that of O_2^- is

A. ClO_3^-

B. PO_4^{3-}

C. SO_4^{2-}

D. XeO_3

Answer:

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32. Pick out the incorrect statemnet ?

A. N_2 has higher dissociation energy than N_2^+

B. O_2 has lower dissociation energy than O_2^+

C. Bond length in N_2^+ is less than that in N_2

D. Bond length in NO^+ is less than that in NO

Answer:

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33. Two π and half sigma bonds are present in

A. N_2^+

B. N_2

C. O_2^+

D. O_2

Answer:

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34. In which of the following processes, the bond order has increased and paramagnetic character has changed to diamagnetic ?

A. $N_2 \rightarrow N_2^+$

B. $NO \rightarrow NO^+$

C. $O_2 \rightarrow O_2^{2-}$

D. $O_2 \rightarrow O_2^+$

Answer:

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

A. Be_2

B. B_2

C. C_2

D. N_2

Answer:

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36. Which of the following statements is/are correct on the basis of hydrogen bond ? (1) KHF2 exists but KHCl2 does not. (2) Boiling point

order of hydrogen halides is HF>HI>HBr>HCl (3) CCl3 CH (OH) 2 and o-nitrophenol show intermolecular hydrogen bond (4) All are correct

A. KHF_2 exists but $KHCl_2$ does not

B. Boiling point order of hydrogen halides is $HF > Hl > HBr > HCl$

C. $CCl_3CH(OH)_2$ and o-nitrophenol show intermolecular hydrogen bond

D. All are correct

Answer:

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37. Which of the following statements is/are correct ?

A. OF_4 molecule and F_3^- ion do not exist

B. C-C bond length in $FH_2C - CH_2F$ is longer than in $F_2HC - CHF_2$

C. Among $O_2, O_2^+, O_2^-, O_2^{2-}$ the stability is in the order $O_2^+ > O_2 > O_2^- > O_2^{2-}$

D. All are correct

Answer:

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38. Assertion: H_2 molecule is more stable than $He - H$molecule.

Reason: The antibonding electron in $He - H$ molecule decreases the bond order and thereby stability

A. If both asssertion 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:

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39. Assertion: CCl_4 molecule is not hydrolysed by water

Reason Carbon atom is sp3 hybridised in CCl_4

A. If both asssertion 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:

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40. Assertion : Statement -1 : The direction of dipolemoment in CO molecule is from oxygen to carbon

Reason : Statement - 2 : The contribution of co-ordinate π bond is more compared to electronegativity factor in the overall polarity of the molecule. (1) Statement-1 is true , statement -2 is true and statement-2 is the correct explanation for statement - 1. (2) Statement-1 is true, statement -2 is not the correct explanation for statement -1 . (3) Statement -1 is true, statement 2- is false (4) Statement -1 is false , statement-2 is true

A. If both asssertion 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:

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41. Assertion : Both PCl_5 and BrF_5 molecules have identical shape.

Reason : P in PCl_5 and Br in BrF_5 are in same hybridisation.

A. If both asssertion 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:

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42. Assertion: Density of ice is less than that of water.

Reason: In ice H_2O molecules are more closely packed than in water.

A. If both asssertion 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:

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Question

1. The dipole moment of water is 1.84D and dipole moment of O-H bond is 1.5D. Calculate the H-O-H bond angle in water.

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2. The percentage ionic character of a bond A-B is 86.41% and the bond length is 162.3 pm. What is the dipole moment of the molecule?

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3. The dipole moment of HF molecule is 1.91D and the bond distance is 0.92 Å. What is the fractional charge on H and F in the HF bond? (Electronic charge = 4.8×10^{-10} e.s.u.).

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4. Calculate the lattice energy of sodium chloride crystal from the following data: Born exponent, n=8, Madelung constant for NaCl=1.748, Ionic radius of $Na^{+} = 0.95\text{Å}$, Ionic radius of $Cl^{-} = 1.81\text{Å}$.

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5. Calculate the percentage ionic character of Si-H bond in SiH_4 assuming Pauling electronegativity values of Si and H to be 1.8 and 2.1 respectively.

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6. The electronegativities of H and F are 2.1 and 4.0 respectively. What is the percentage ionic character of HF bond on the basis of Hanny Smith equation?

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Level I

1. $MgSO_4$ is soluble while $BaSO_4$ is insoluble in H_2O. This is because

A. lattice energy of $BaSO_4$ is greater than $MgSO_4$

B. $BaSO_4$ is more covalent than $MgSO_4$

C. hydration energy of Mg^{2+} is greater than Ba^{2+}

D. lattice energy of $MgSO_4$ is greater than $BaSO_4$

Answer: C

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2. Which pair is not correct order of lattice energy ?

A. $KCl > MgO$

B. $AlN > MgO$

C. $BeCO_3 > MgCO_3$

D. $BeCO_3 = MgCO_3$

Answer: A

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3. Select incorrect statement.

A. Double bond is shorter than a single bond

B. σ-bond is weaker than a π-bond

C. Double bond is stronger than a single bond

D. Covalent bond is stronger than a hydrogen bond

Answer: B

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4. Which of the following statements regarding Hg^{2+} (ionic radius 116 pm) and Ca^{2+} (ionic radius 114 pm) is correct?

A. Hg^{2+} ion has more polarizing effect on anion as compared to Ca^{2+} ion

B. Hg^{2+} ion has less polarizing effect on an anion as compared to Ca^{2+} ion

C. Both Hg^{2+} ion and Ca^{2+} have equal polarizing effect on an anion.

D. Both Hg^{2+} ion and Ca^{2+} have no polarizing effect on an anion

Answer: A

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5. The increasing order of covalency in silver halides is

A. $AgF < AgCl < AgBr$

B. $AgF < AgBr < AgF$

C. $AgCl < AgBr < AgF$

D. $AgCl < AgF < AgBr$

Answer: A

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6. Which of the following pairs of species are not isostructural?

A. XeF_4, PF_4^+

B. CH_4 and NH_4^+

C. XeF_4, I_3^-

D. XeF_5^+, IF_5

Answer: A

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7. Which of the following facts regarding Fajan's rules is not correct?

A. A small positive ion favours covalency

B. A large negative ions favours covalency

C. Large charge on either ion, or on both ions, favours covalency

D. Covalency is favoured if the polarizing ion has a noble gas configuration in preference to pseudo inert gas configuration

Answer: D

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8. Which of the following statements regarding I_(3)^(-) is not correct?

A. The central I atom has five lone pairs of electrons

B. The lone pairs occupy equatorial positions

C. The bond angle I-I-I is 180°

D. There two I atoms around central I atom occupy equatorial positions

Answer: D

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9. Which of the following statements is correct?

A. CO_2 has linear whereas SO_2 has nonlinear structures

B. CO_2 has nonlinear whereas SO_2 has linear strucutres

C. Both SO_2 and CO_2 has linear structures

D. Both SO_2 and CO_2 has non-linear structures

Answer: A

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10. The number of pairs of electrons around I in IF_3, IF_5 and IF_7, respectively, are

A. 5, 6 and 7

B. 5, 7 and 6

C. 7, 5 and 6

D. 7, 6 and 5

Answer: A

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11. Which of the following species has linear structure?

A. NCO^-

B. NO_2^-

C. SO_2

D. OF_2

Answer: A

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12. The energy of $\sigma 2s$ is greater than $\sigma^* 1s$ Is orbital because

A. $\sigma 2s$ is bigger than σ^* 1s MO

B. $\sigma 2s$ is bonding whereas σ^* 1s is an ABMO

C. $\sigma 2s$ orbital has a greater value of n than σ^* 1s MO

D. $\sigma 2s$ orbital is formed only after σ^* 1s

Answer: C

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13. The hybridization of chlorine orbitals in the compound ClF_3 is

A. sp^3

B. sp^2d

C. sp^3d

D. sp^3d^2

Answer: C

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14. Which of the following ions does not involve sp^3 hybridization?

A. ClO_2^-

B. ICl_2^-

C. PO_4^{3-}

D. ClO_4^-

Answer: B

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15. The hybridization of Xe in $XeOF_4$ is

A. sp^3

B. sp^3d^2

C. sp^2d^3

D. pd^4

Answer: B

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16. Which of the following statements is not correct?

A. Hybridization involves the mixing of atomic orbitals of the same atom

B. Hybridization of orbitals results into the formation of equivalent orbitals in all respect

C. Hybridization may involve combination of s, p and d orbitals of same energy level

D. Hybridization of orbitals predicts the molecular geometry of the molecule and not vice-versa

Answer: D

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17. The number of bonding and antibonding electrons in O_2^{2-} ion, respectively are

A. 6, 8

B. 10, 8

C. 6, 10

D. 10, 4

Answer: B

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18. Which of the following pairs of species has identical value of bond order?

A. NO^+, N_2

B. CO, N_2^-

C. CN^-, O_2^+

D. N_2, O_2^+

Answer: A

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19. Which of the following is expected to be diamagnetic? H_2^+, B_2, C_2, N_2^+

A. H_2^+

B. B_2

C. C_2

D. N_2^+

Answer: C

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20. Which one of the following species is expected to have bond order $1/2$?

A. O_2^-

B. N_2^+

C. F_2^-

D. F_2^+

Answer: C

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21. Which one of the following species will have maximum bond dissociation energy?

A. C_2

B. C_2^+

C. C_2^-

D. C_2^{2-}

Answer: D

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22. Which of the following statements regarding carbon monoxide is correct?

A. A triple bond exists between C and O

B. O atom carries negative charge and C carries positive charge

C. Dipole moment of CO is low as compared to its calculated value from the charge and bond distance

D. Bond order of CO is 3

Answer: B

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23. In which one of the following compounds does hydrogen bonding occur?

A. Ammonia

B. Hydrogen iodide

C. Lithium hydride

D. Silane

Answer: A

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24. A covalent bond is most likely to be formed between two elements which

A. have similar electronegativities

B. have low ionization energies

C. have low melting points

D. form ions with small charges

Answer: A

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25. Which of the following orbitals of a diatomic molecule AB oriented along x-axis will not have positive overlap? 2s(A) and 2s(B), 2s(A) and $2p_x$ (B), $2p_x$(A) and $2p_z$(B), $2p_x$(A) and $2p_x$(B)

A. 2s(A) and 2s(B)

B. 2s(A) and $2p_x$ (A)

C. $2p_x$(A) and $2p_x$(B)

D. 2s(A) and $2p_x$(B)

Answer: D

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26. The dipole moment of hydrogen chloride (bond distance: 127pm) is 1.03 D. The per cent ionic character of its bond is about : 15, 17, 19, 21

A. 15

B. 17

C. 19

D. 21

Answer: B

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27. Which of the following unit conversion of dipole moment is correct? : 1 D=3.3356 Cm, 1 D= 3.3356×10^{-30} Cm, 1 Cm = 3.3356 D, 1 Cm= 3.3356×10^{-30} D

A. 1 D=3.3356 Cm

B. 1 D= 3.3356×10^{-30} Cm

C. 1 Cm = 3.3356 D

D. 1 Cm= 3.3356×10^{-30} D

Answer: B

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28. The geometry of CN groups around Ni in $\left[Ni(CN)_4\right]^{2-}$ is : tetrahedron, square planar, trigonal bipyramid, octahedron

A. tetrahedron

B. square planar

C. trigonal bipyramid

D. octahedron

Answer: B

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29. The sp^3d^2 hybridization of central atom of a molecule would lead to: square planar geometry, tirgonal bipyramidal geometry, tetrahedral geometry, octahedral geometry

A. square planar geometry

B. tirgonal bipyramidal geometry

C. tetrahedral geometry

D. octahedral geometry

Answer: D

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30. The bond angle in PH_3 is expected to be : $90^\circ, 105^\circ, 109^\circ, 120^\circ$

A. 90°

B. 105°

C. 109°

D. 120°

Answer: C

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31. The bond order of CO and NO is : 3 and 2, 3 and 2.5, 3 and 1.3, 3 and 3.5

A. 3 and 2

B. 3 and 2.5

C. 3 and 1.3

D. 3 and 3.5

Answer: B

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32. Which of the following statements regarding valence bond method is not true?

A. In the valence-bond method, the molecule is considered to be the collection of atoms and then interactions between different atoms are considered

B. For a molecule to be stable, the electrostatic attractions must predominate over the electrostatic repulsions

C. The potential energy of a diatomic molecule is less than the sum of corresponding energies of free atoms

D. The net force of attraction acting on the atoms in a molecule is greater than that of repulsion

Answer: D

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33. Which of the following molecules is paramagnetic? C_2, N_2, O_2, F_2

A. C_2

B. N_2

C. O_2

D. F_2

Answer: C

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34. The bond order of O_2 molecule is : 1, 2, 2.5, 3

A. 1

B. 2

C. 2.5

D. 3

Answer: B

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

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

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

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

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

Answer: A

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36. Which of the following orders regarding the bond order is correct? :

$O_2^- > O_2 > O_2^+, O_2^- < O_2 < O_2^+, O_2^- > O_2 < O_2^+, O_2^- < O_2 > O_2^+$

A. $O_2^- > O_2 > O_2^+$

B. $O_2^- < O_2 < O_2^+$

C. $O_2^- > O_2 < O_2^+$

D. $O_2^- < O_2 > O_2^+$

Answer: B

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37. Which of the following species has the shortest bond length? N_2^+, N_2, N_2^-, N_2^{2-}

A. N_2^+

B. N_2

C. N_2^-

D. N_2^{2-}

Answer: B

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38. Which of the following is the most ionic? : P_4O_{10}, MnO, CrO_3, Mn_2O_7

A. P_4O_{10}

B. MnO

C. CrO_3

D. Mn_2O_7

Answer: B

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39. $AlCl_3$ is covalent while AlF_3 is ionic. This can be justified on the basic of : The valence bond theory, Fajan's rules, The molecular orbital theory, Hydration energy

A. The valence bond theory

B. Fajan's rules

C. The molecular orbital theory

D. Hydration energy

Answer: B

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40. In PO_4^{3-}, P-O bond order is : 1.25, 2, -0.75, -3

A. 1.25

B. 2

C. -0.75

D. -3

Answer: A

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41. In which of the following species the bonds are non-directional? : $NCl_3, RbCl, BeCl_2, BCl_3$

A. NCl_3

B. RbCl

C. $\mathrm{B\ e\ C}\ l_2$

D. BCl_3

Answer: B

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42. There is no S - S bond in : $S_2O_6^{2-}, S_4O_6^{2-}, S_2O_3^{2-}, S_2O_7^{2-}$

A. $S_2O_6^{2-}$

B. $S_4O_6^{2-}$

C. $S_2O_3^{2-}$

D. $S_2O_7^{2-}$

Answer: D

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43. Among the following the electron-deficient compound is

A. CCl_4

B. PCl_5

C. OF_2

D. BCl_3

Answer: D

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44. The nodal plane in the π-bond of ethene is located in: The molecular plane, A plane parallel to the molecular plane, A plane perpendicular to the molecular plane which bisects the (C-C) σ -bond at a right angle, A

plane perpendicular to the molecular plane which contains the (C-C) σ -bond

A. The molecular plane

B. A plane parallel to the molecular plane

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

D. A plane perpendicular to the molecular plane which contains the (C-C) σ-bond

Answer: A

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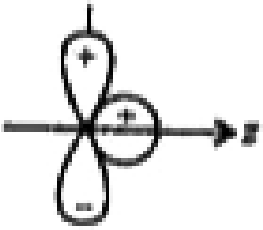
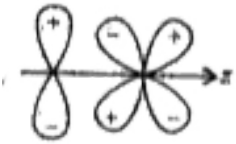
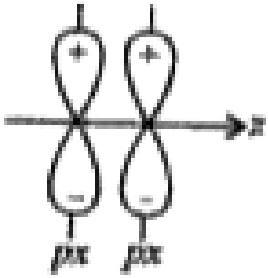
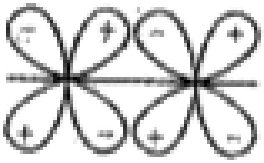
45. Which of the following is a positive overlap which leads to bonding?

A. 

B. 

C. 

D. 

Answer: C

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46. The correct order of dipole moment is

A. $CH_4 < NF_3 < NH_3 < H_2O$

B. $NF_3 < CH_4 < NH_3 < H_2O$

C. $NH_3 < NF_3 < CH_4 < H_2O$

D. $H_2O < NH_3 < NF_3 < CH_4$

Answer: A

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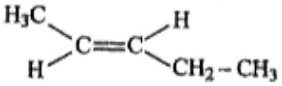
47. Which of the following hydrocarbons has the lowest dipole moment?

A. 

B. $H_3C - C \equiv C - CH$

C. $H_3C - CH = C = CH_2$

D. $H_3C - CH_2 - C \equiv CH$

Answer: B

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48. The compound in which carbon uses sp^3 hybrid orbitals for bond formation is : $HCOOH, (H_2N)_2CO, (CH_3)_3COH, CH_3CHO,$

A. HCOOH

B. $(H_2N)_2CO$

C. $(CH_3)_3COH$

D. CH_3CHO

Answer: C

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49. SF_2, SF_4 and SF_6 have the hybridisation at sulphur atom respectively as:

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

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

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

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

Answer: C

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50. Which of the following compounds has the least tendency to form H-bonds?

A. HF

B. HCl

C. H_2O

D. NH_3

Answer: B

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51. The bond angles of NH_3, $NH_4^{\oplus}$ and $\overset{\ominus}{N}H_2$ are in the order:

A. $NH_2^{\ominus} > NH_3 > \overset{\oplus}{N}H_4$

B. $NH_4^{\oplus} > NH_3 > \overset{\ominus}{N}H_2$

C. $NH_3 > \overset{\ominus}{N}H_2 > \overset{\oplus}{N}H_4$

D. $NH_3 > \overset{\oplus}{N}H_4 > \overset{\ominus}{N}H_2$

Answer: B

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52. Resonance structures can be written for

A. O_3

B. NH_3

C. CH_4

D. H_2O

Answer: A

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53. The bond length of $C \equiv O$ bond in CO is 1.20 Å and in CO_2 it is 1.34 Å.

Then C=Obond length in CO_3^{2-} will be

A. 0.95 Å

B. 1.36 Å

C. 1.29 Å

D. 1.25 Å

Answer: C

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54. Which of the following is not diamagnetic?

A. O_2^{2-}

B. Li_2

C. $N_2^{\oplus}$

D. ICl_4^-

Answer: C

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55. Which of the following molecules would be expected to be square planar?

1. NH_3 2. XeF_4 3. SF_4 4. ICl_4^- : only 1, 2 and 3 are correct, only 2 and 3 are correct, only 3 and 4 are correct, only 2 and 4 are correct

A. only 1, 2 and 3 are correct

B. only 2 and 3 are correct

C. only 3 and 4 are correct

D. only 2 and 4 are correct

Answer: D

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56. All the following species have all their bond lengths identical except

A. AsF_3

B. AsF_4^-

C. AsF_4^+

D. AsF_6^-

Answer: B

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57. According to the molecular orbital model, the highest occupied molecular obrital of O_2 is

A. $\sigma 2s$

B. $\pi 2p$

C. $\pi^* 2p$

D. $\sigma^* 2p$

Answer: C

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58. Which kind of attractive forces are likely to be holding particles together in a substance that melts at 681°C and that conducts electricity when molten but not when solid?

A. Ionic bonding

B. Metallic bonding

C. Network covalent bonding

D. Covalent molecular bonding

Answer: A

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59. In which of the following pairs , the two species are not isostructural ?

PCl_4^+ and $SiCl_4$, PF_5 and BrF_5, AlF_6^{3-} and SF_6, CO_3^{2-} and NO_3^-

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

B. PCl_4^+ and $SiCl_4$

C. PF_5 and BrF_5

D. AlF_6^{3-} and SF_6

Answer: C

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60. Which of the following species exhibits the diamagnetic behaviour?

A. NO

B. O_2^{2-}

C. O_2^+

D. O_2

Answer: B

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61. $MgSO_4$ is soluble while $BaSO_4$ is insoluble in H_2O. This is because

A. lattice energy of $BaSO_4$ is greater than $MgSO_4$

B. $BaSO_4$ is more covalent than $MgSO_4$

C. hydration energy of Mg^{2+} is greater than Ba^{2+}

D. lattice energy of $MgSO_4$ is greater than $BaSO_4$

Answer: C

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62. Which pair is not correct order of lattice energy ?

A. $KCl > MgO$

B. $AlN > MgO$

C. $BeCO_3 > MgCO_3$

D. $BeCO_3 = MgCO_3$

Answer: A

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63. Select incorrect statement.

A. Double bond is shorter than a single bond

B. σ - bond is weaker than a π-bond

C. Double bond is stronger than a single bond

D. Covalent bond is stronger than a hydrogen bond

Answer: B

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64. Which of the following statements regarding Hg^{2+} (ionic radius 116 pm) and Ca^{2+} (ionic radius 114 pm) is correct?

A. Hg^{2+} ion has more polarizing effect on anion as compared to Ca^{2+} ion

B. Hg^{2+} ion has less polarizing effect on an anion as compared to Ca^{2+} ion

C. Both Hg^{2+} ion and Ca^{2+} have equal polarizing effect on an anion.

D. Both Hg^{2+} ion and Ca^{2+} have no polarizing effect on an anion

Answer: A

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65. The increasing order of covalency in silver halides is

A. $AgF < AgCl < AgBr$

B. $AgF < AgBr < AgF$

C. $AgCl < AgBr < AgF$

D. $AgCl < AgF < AgBr$

Answer: A

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66. Which of the following pairs of species are not isostructural?

A. XeF_4, PF_4^+

B. CH_4 and NH_4^+

C. XeF_2, I_3^-

D. XeF_5^+, IF_5

Answer: A

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67. Select incorrect statement.

A. A small positive ion favours covalency

B. A large negative ions favours covalency

C. Large charge on either ion, or on both ions, favours covalency

D. Covalency is favoured if the polarizing ion has a noble gas configuration in preference to pseudo inert gas configuration

Answer: D

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68. Which of the following statements regarding I_(3)^(-) is not correct?

A. The central I atom has five lone pairs of electrons

B. The lone pairs occupy equatorial positions

C. The bond angle I-I-I is 180°

D. There two I atoms around central I atom occupy equatorial positions

Answer: D

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69. Which of the following statements is correct?

A. CO_2 has linear whereas SO_2 has nonlinear structures

B. CO_2 has nonlinear whereas SO_2 has linear structures

C. Both SO_2 and CO_2 has linear structures

D. Both SO_2 and CO_2 has non-linear structures

Answer: A

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70. The number of pairs of electrons around I in IF_3, IF_5 and IF_7, respectively, are

A. 5, 6 and 7

B. 5, 7 and 6

C. 7,5 and 6

D. 7,6 and 5

Answer: A

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71. Which of the following species has linear structure?

A. NCO^-

B. NO_2^-

C. SO_2

D. OF_2

Answer: A

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72. The energy of $\sigma 2s$ is greater than $\sigma^* 1s$ Is orbital because

A. $\sigma 2s$ is bigger than $\sigma^* s$ MO

B. $\sigma 2s$ is bonding whereas $\sigma^* 1s$ is an ABMO

C. $\sigma 2s$ orbital has a greater value of n than $\sigma^* 1s$MO

D. $\sigma 2s$ orbital is formed only after $\sigma^* 1s$

Answer: C

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73. The hybridization of chlorine orbitals in the compound ClF_3 is

A. sp^3

B. sp^2d

C. sp^3d

D. sp^3d^2

Answer: C

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74. Which of the following ions does not involve sp^3 hybridization?

A. ClO_2^-

B. ICl_2^-

C. PO_4^{3-}

D. ClO_4^-

Answer: B

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75. The hybridization of Xe in $XeOF_4$ is

A. sp^3

B. sp^3d^2

C. sp^2d^3

D. pd^4

Answer: B

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76. Which of the following statements is not correct?

A. Hybridization involves the mixing of atomic orbitals of the same atom

B. Hybridization of orbitals results into the formation of equivalent orbitals in all respect

C. Hybridization may involve combination of s,p and d' orbitals of same energy level

D. Hybridization of orbitals predicts the molecular geometry of the molecule and not vice-versa

Answer: D

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77. The number of bonding and antibonding electrons in O_2^{2-} ion, respectively are

A. 6,8

B. 10,8

C. 6,10

D. 10,4

Answer: B

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78. Which of the following pairs of species has identical value of bond order?

A. NO^+, N_2

B. CO, N_2^-

C. CN^-, O_2^+

D. N_2, O_2^+

Answer: A

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79. Which of the following is expected to be diamagnetic? H_2^+, B_2, C_2, N_2^+

A. H_2^+

B. B_2

C. C_2

D. N_2^+

Answer: C

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80. Which one of the following species is expected to have bond order $1/2$?

A. O_2^-

B. N_2^+

C. F_2^-

D. F_2^+

Answer: C

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81. Which one of the following species will have maximum bond dissociation energy?

A. C_2

B. C_2^+

C. C_2^-

D. C_2^{2-}

Answer: D

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82. Which of the following statements regarding carbon monoxide is correct?

A. A triple bond exists between C and O

B. O atom carries negative charge and C carries positive charge

C. Dipole moment of CO is low as compared to its calculated value from the charge and bond distance

D. Bond order of CO is 3

Answer: B

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83. In which one of the following compounds does hydrogen bonding occur?

A. Ammonia

B. Hydrogen iodide

C. Lithium hydride

D. Silane

Answer: A

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84. A covalent bond is most likely to be formed between two elements which

A. have similar electronegativities

B. have low ionization energies

C. have low melting points

D. form ions with small charges

Answer: A

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85. Which of the following orbitals of a diatomic molecule AB oriented along x-axis will not have positive overlap? 2s(A) and 2s(B), 2s(A) and $2p_x$ (B), $2p_x$(A) and $2p_z$(B), $2p_x$(A) and $2p_x$(B)

A. 2s(A) and 2s(B)

B. 2s(A) and 2p(A)

C. 2p(A) and 2p(B)

D. 2s(A) and 2p(B)

Answer: D

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86. The dipole moment of hydrogen chloride (bond distance: 127pm) is 1.03 D. The per cent ionic character of its bond is about : 15, 17, 19, 21

A. 15

B. 17

C. 19

D. 21

Answer: B

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87. Which of the following unit conversion of dipole moment is correct? :

1 D=3.3356 Cm, 1 D= 3.3356×10^{-30} Cm, 1 Cm = 3.3356 D, 1 Cm= 3.3356×10^{-30} D

A. 1 D=3.3356 Cm

B. $1D = 3.3356 \times 10^{-30} Cm$

C. 1 Cm=3.3356 D

D. $1Cm = 3.3356 \times 10^{-30}$ D

Answer: B

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88. The geometry of CN groups around Ni in $\left[Ni(CN)_4\right]^{2-}$ is : tetrahedron, square planar, trigonal bipyramid, octahedron

A. tetrahedron

B. square planar

C. trigonal bipyramid

D. octahedron

Answer: B

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89. The sp^3d^2 hybridization of central atom of a molecule would lead to: square planar geometry, tirgonal bipyramidal geometry, tetrahedral geometry, octahedral geometry

A. square planar geometry

B. tirgonal bipyramidal geometry

C. tetrahedral geometry

D. octahedral geometry

Answer: D

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90. The bond angle in PH_3 is expected to be : $90^\circ, 105^\circ, 109^\circ, 120^\circ$

A. 90°

B. 105°

C. 109°

D. 120°

Answer: C

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91. The bond order of CO and NO is : 3 and 2, 3 and 2.5, 3 and 1.3, 3 and 3.5

A. 3 and 2

B. 3 and 2.5

C. 3 and 1.3

D. 3 and 3.5

Answer: B

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92. Which of the following statements regarding valence bond method is not true?

A. In the valence-bond method, the molecule is considered to be the collection of atoms and then interactions between different atoms are considered

B. For a molecule to be stable, the electrostatic attractions must predominate over the electrostatic repulsions

C. The potential energy of a diatomic molecule is less than the sum of corresponding energies of free atoms

D. The net force of attraction acting on the atoms in a molecule is greater than that of repulsion

Answer: D

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93. Which of the following molecules is paramagnetic? C_2, N_2, O_2, F_2

A. C_2

B. N_2

C. O_2

D. F_2

Answer: C

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94. The bond order of O_2 molecule is : 1, 2, 2.5, 3

A. 1

B. 2

C. 2.5

D. 3

Answer: B

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

A.

$$E(\pi 2p_x) = E\left(\pi 2p_y\right) < E(\sigma 2p) < E(\pi^* 2p_x) = E(\pi^* 2p_x) = E\left(\pi^* 2p\right.$$

B. $E(\pi 2p_x) = E\left(\pi 2p_y\right) > E(\sigma 2p) > E(\pi^* 2p_x) = E\left(\pi^* 2p_y\right)$

C. $E(\pi 2p_x) = E\left(\pi 2p_y\right) < E(\sigma 2p) > E(\pi^* 2p_x) = E\left(\pi^* 2p_y\right)$

D. $E(\pi 2p_x) = E\left(\pi 2p_y\right) > E(\sigma 2p) < E(\pi^* 2p_x) = E\left(\pi^* 2p_y\right)$

Answer: A

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96. Which of the following orders regarding the bond order is correct? :

$O_2^- > O_2 > O_2^+, O_2^- < O_2 < O_2^+, O_2^- > O_2 < O_2^+, O_2^- < O_2 > O_2^+$

A. $O_2^{-} > O_2 > O_2^+$

B. $O_2^{-} < O_2 < O_2^+$

C. $O_2^{-} > O_2 < O_2^+$

D. $O_2^{-} < O_2 > O_2^+$

Answer: B

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97. Which of the following species has the shortest bond length? N_2^+, N_2, N_2^-, N_2^{2-}

A. N_2^+

B. N_2

C. N_2^-

D. N_2^{2-}

Answer: B

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98. Which of the following is the most ionic? : P_4O_{10}, MnO, CrO_3, Mn_2O_7

A. P_4O_{10}

B. MnO

C. CrO_3

D. Mn_2O_7

Answer: B

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99. $AlCl_3$ is covalent while AlF_3 is ionic. This can be justified on the basic of : The valence bond theory, Fajan's rules, The molecular orbital theory, Hydration energy

A. The valence bond theory

B. Fajan's rules

C. The molecular orbital theory

D. Hydration energy

Answer: B

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100. In PO_4^{3-}, P-O bond order is : 1.25, 2, -0.75, -3

A. 1.25

B. 2

C. -0.75

D. -3

Answer: A

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101. In which of the following species the bonds are non-directional? :

$NCl_3, RbCl, BeCl_2, BCl_3$

A. NCl_3

B. $RbCl$

C. $BeCl_2$

D. BCl_3

Answer: B

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102. There is no S - S bond in : $S_2O_6^{2-}$, $S_4O_6^{2-}$, $S_2O_3^{2-}$, $S_2O_7^{2-}$

A. $S_2O_6^{2-}$

B. $S_4O_6^{2-}$

C. $S_2O_3^{2-}$

D. $S_2O_7^{2-}$

Answer: D

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103. Among the following the electron-deficient compound is

A. CCl_4

B. PCl_5

C. OF_2

D. BCl_3

Answer: D

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104. The nodal plane in the π-bond of ethene is located in: The molecular plane, A plane parallel to the molecular plane, A plane perpendicular to the molecular plane which bisects the (C-C) σ -bond at a right angle, A plane perpendicular to the molecular plane which contains the (C-C) σ -bond

A. The molecular plane

B. A plane parallel to the molecular plane

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

D. A plane perpendicular to the molecular plane which contains the (C-C) σ -bond

Answer: A

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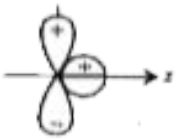
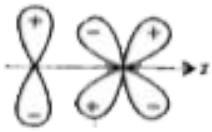
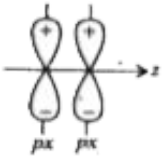
105. Which of the following is a positive overlap which leads to bonding?

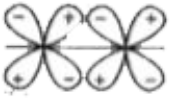
A. 

B. 

C.



D.



Answer: C

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106. The correct order of dipole moment is

A. $CH_4 < NF_3 < NH_3 < H_2O$

B. $NF_3 < CH_4 < NH_3 < H_2O$

C. $NH_3 < NF_3 < CH_4 < H_2O$

D. $H_2O < NH_3 < NF_3 < CH_4$

Answer: A

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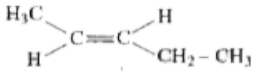
107. Which of the following hydrocarbons has the lowest dipole moment?

A. 

B. $H_3C - C = C - CH_3$

C. $H_3C - CH = C = CH_2$

D. $H_3C - CH_2 - C \equiv CH$

Answer: B

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108. The compound in which carbon uses sp^3 hybrid orbitals for bond formation is : $HCOOH, (H_2N)_2CO, (CH_3)_3COH$, $CH_3CHO,$

A. HCOOH

B. $(H_2N)_2CO$

C. $(CH_3)_3COH$

D. CH_3CHO

Answer: C

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109. SF_2, SF_4 and SF_6 have the hybridisation at sulphur atom respectively as:

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

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

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

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

Answer: C

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110. Which of the following compounds has the least tendency to form H-bonds?

A. HF

B. HCl

C. H_2O

D. NH_3

Answer: B

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111. The bond angles of NH_3, $NH_4^{\oplus}$ and $\overset{\ominus}{N}H_2$ are in the order:

A. $NH_2^- > NH_3 > NH_4^+$

B. $NH_4^+ > NH_3 > NH_2^-$

C. $NH_3 > NH_2^- > NH_4^+$

D. $NH_3 > NH_4^+ > NH_2^-$

Answer: B

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112. Resonance structures can be written for

A. O_3

B. NH_3

C. CH_4

D. H_2O

Answer: A

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113. The bond length of $C \equiv O$ bond in CO is 1.20 Å and in CO_2 it is 1.34 Å. Then C=Obond length in CO_3^{2-} will be

A. 1.50 Å

B. 1.34 Å

C. 1.29 Å

D. 0.95 Å

Answer: C

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114. Which of the following is not diamagnetic?

A. O_2^{2-}

B. Li_2

C. N_2^+

D. C_2

Answer: C

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115. Which of the following molecules would be expected to be square planar?

1. NH_3 2. XeF_4 3. SF_4 4. ICl_4^- : only 1, 2 and 3 are correct, only 2 and 3 are correct, only 3 and 4 are correct, only 2 and 4 are correct

A. only 1, 2 and 3 are correct

B. only 2 and 3 are correct

C. only 3 and 4 are correct

D. only 2 and 4 are correct

Answer: D

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116. All the following species have all their bond lengths identical except

A. AsF_3

B. AsF_4^-

C. AsF_4^+

D. AsF_6^-

Answer: B

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117. According to the molecular orbital model, the highest occupied molecular obrital of O_2 is

A. $\sigma 2s$

B. $\pi 2p$

C. $\pi^* 2p$

D. $\sigma^* 2p$

Answer: C

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118. Which kind of attractive forces are likely to be holding particles together in a substance that melts at 681° C and that conducts electricity when molten but not when solid?

A. Ionic bonding

B. Metallic bonding

C. Network covalent bonding

D. Covalent molecular bonding

Answer: A

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119. In which of the following pairs , the two species are not isostructural ? PCl_4^+ and $SiCl_4$, PF_5 and BrF_5, AlF_6^{3-} and SF_6, CO_3^{2-} and NO_3^-

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

B. PCl_4^+ and $SiCl_4$

C. PF_5 and BrF_5

D. AlF_6^{2-} and SF_6

Answer: C

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120. Which of the following species exhibits the diamagnetic behaviour?

A. NO

B. O_2^{2-}

C. O_2^+

D. O_2

Answer: B

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Level Ii

1. Polarising action of Cd^{2+} on anions is stronger than that of Ca^{2+} because

A. the charges of the ions are same

B. their radii are nearly the same

C. the Ca^{2+} ion has a noble-gas electron configuration, and the Cd^{2+} ion, an 18-electron configuration of its outer shell

D. all of the above are correct

Answer: C

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2. PCl_5 has a shape of trigonal bipyramid whereas IF_5 has the shape of a square pyramid. It is due to

A. presence of unshared electron pair on I which is oriented so as to minimise repulsion while P in PCl_5 has no unshared pair

B. octet of P is complete while that of I is incomplete

C. P and I are of different groups

D. F and Cl have different extent of repulsion

Answer: A

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3. Amolecule of the type AX_5 has square pyramidal geometry. Hence, number of lone pairs on A is

A. 4

B. 3

C. 2

D. 1

Answer: D

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4. Hybridisation of the nitrogen atom and electron geometry around nitrogen atom in pyridine is

sp^3, pyramidal, sp^2, trigonal planar, sp^2, linear, sp^3, tetrahedral

A. sp^3, pyramidal

B. sp^2, trigonal planar

C. sp^2, linear

D. sp^3, tetrahedral

Answer: B

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5. H_2O molecule is dipolar, whereas BeF_2 is non polar. It is because

A. the electronegativity of F is greater than that of O

B. H_2O involves hydrogen bonding whereas BeF_2 is a discrete molecule

C. H_2O is linear and BeF_2 is angular

D. H_2O is angular and BeF_2 is linear

Answer: D

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6. Which of the following compounds contains the maximum number of lone pairs at the central atom in its best Lewis structure?

A. XeO_3

B. ClO_2^-

C. $SOCl_2$

D. IO_4^-

Answer: B

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7. Which of the following molecules contains the maximum S-O bond length? : $SO_2, SO_3, SO_4^{2-}, SO_3^{2-}$

A. SO_2

B. SO_3

C. SO_4^{2-}

D. SO_3^{2-}

Answer: D

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8. What are the formal charges of the atoms in the nitrite ion in the order of nitrogen, oxygen 1 and oxygen 2?

$\overset{1}{O} = N - \overset{2}{O}$: 0, 0, -1 ; 0, +1, -1 ; -1, 0, -1 ; -1, 0, 0

A. 0, 0, -1

B. 0, -1, -1

C. -1, 0, -1

D. -1, 0, 0

Answer: A

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9. Molecule AB has a bond length of 1.67 Å and a dipole moment of 0.38 D. The fractional charge on each atom (absolute magnitude) is : ($e_0 = 4.082 \times 10^{-10}$ esu)

A. 0

B. 0.05

C. 0.5

D. 1

Answer: B

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10. Which of the following is arranged in order of increasing dipole moment?

A. $BCl_3 < NH_3 < H_2O < SO_2$

B. $BCl_3 < NH_3 < SO_2 < H_2O$

C. $NH_3 < SO_2 < H_2O < BCl_3$

D. $H_2O < SO_2 < NH_3 < BCl_3$

Answer: B

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

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

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

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

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

Answer: A

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12. The bond order in NO is 2.5 whereas that in NO^+ is 3. Which of the following statements is true for these two species?

A. Bond length in NO^+ is greater than in NO

B. Bond length is unipredictable

C. Bond length in NO^+ is equal to that in NO

D. Bond length in NO is greater than in NO^+

Answer: D

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13. Which of the following molecules has the greatest number of lone pairs of electrons around the central atom? : IF_7, XeF_2, BrF_3, NF_3

A. IF_7

B. XeF_2

C. BrF_3

D. NF_3

Answer: B

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14. The hybridization of N atoms in NO_3^-, NO_2^+ and NH_4^+ are respectively:

A. sp^2, sp, sp^3

B. sp, sp^3, sp^2

C. sp^2, sp^3, sp

D. sp, sp^2, sp^3

Answer: A

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15. The number and type of bonds in C_2^{2-} ion in CaC_2 are:

A. One σ bond and one π-bond

B. One σ bond and two π-bonds

C. Two σ bonds and two π-bonds

D. Two σ bonds and one π-bond

Answer: B

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16. Shapes of certain interhalogen compounds are stated below. Which one of them is not correctly stated? : IF_7 : pentagonal bipyramid, BrF_5: trigonal bipyramid, BrF_3: planar T-shaped, ICl_3 : planar dimeric

A. IF_7 : pentagonal bipyramid

B. BrF_5: trigonal bipyramid

C. BrF_3: planar T-shaped

D. ICl_3 : planar dimeric

Answer: B

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17. In which of the following chemical change, the hybridization of the central atom of the polyatomic molecule is not changing?

A. $ICl_3 + Cl^- \rightarrow ICl_4^-$

B. $BF_3 + F^- \rightarrow BF_4^-$

C. $PCl_3 + Cl_2 \rightarrow PCl_5$

D. $S_2O_3^{2-} + I^- \rightarrow I_2 + S_4O_6^{2-}$

Answer: D

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18. In which of the following ionization processes, the bond order has increased and the magnetic behaviour has changed? : $N_2 \rightarrow N_2^+$, $C_2 \rightarrow C_2^+, NO \rightarrow NO^+, O_2 \rightarrow O_2^+$

A. $N_2 \rightarrow N_2^+$

B. $C_2 \rightarrow C_2^+$

C. $NO \rightarrow NO^+$

D. $O_2 \rightarrow O_2^+$

Answer: C

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19. The bond dissociation energy of B-F in BF_3 is 646 kJ mol^{-1}, whereas that of C-F in CF_4 is 515 kJ mol^{-1}. The correct reason for higher B-F bond dissociation energy as compared to that of C-F is the : smaller size of B atom as compared to that of C atom.; stronger σ bond between B and F in BF_3 as compared to that between C and F in CF_4; significant $p\pi - p\pi$

interactions between B and F in BF_3, whereas there is no possibility of such interaction between C and F in CF_4; lower degree of $p\pi - p\pi$ interactions between B and F in BF_3 than that between C and F in CF_4

A. smaller size of B atom as compared to that of C atom.

B. stronger σ bond between B and F in BF_3 as compared to that between C and F in CF_4

C. significant $p\pi - p\pi$ interactions between B and F in BF_3, whereas there is no possibility of such interaction between C and F in CF_4

D. lower degree of $p\pi - p\pi$ interactions between B and F in BF_3 than that between C and F in CF_4

Answer: C

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20. Among the following the paramagnetic compound is

A. Na_2O_2

B. O_3

C. N_2O

D. KO_2

Answer: D

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21. The bond energy (in kJ mol^{-1}) of C-C single bond is, approximately,

A. 238

B. 293

C. 347

D. 439

Answer: C

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22. Assuming that Hund's rule is violated, the bond order and magnetic nature of the diatomic molecule B_2 is : 1 and diamagnetic, 0 and diamagnetic, 1 and paramagnetic, O and paramagnetic.

A. 1 and diamagnetic

B. 0 and diamagnetic

C. 1 and paramagnetic

D. O and paramagnetic.

Answer: A

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23. According MO theory, : O_2^+ is paramagnetic and bond order greater than O_2., O_2^+ is paramagnetic and bond order less than O_2., O_2^+ is diamagnetic and bond order less than O_2., O_2^+ is diamagnetic and bond order more than O_2.

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

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

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

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

Answer: A

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

A. NO^-

B. NO^+

C. CN^-

D. N_2

Answer: A

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25. The charge/size ratio of a cation determines its polarizing power. Which one of the following sequences represents the increasing order of the polarizing power of the cationic species, K^+, Ca^{2+}, Mg^{2+} and Be^{2+}?

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

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

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

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

Answer: D

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26. In which of the following pairs , the two species are not isostructural ?

PCl_4^+ and $SiCl_4$, PF_5 and BrF_5, AlF_6^{3-} and SF_6, CO_3^{2-} and NO_3^-

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

B. PCl_4^+ and $SiCl_4$

C. PF_5 and BrF_5

D. AlF_6^{3-} and SF_6

Answer: C

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27. Which of the following isnot correct regarding C_2 molecule? : C_2 molecule has been found to exist in vapour phase, It has a total 12 electrons, out of which 8 electrons occupy bonding orbitals while 4 electrons occupy antibonding orbitals., The molecule is paramagnetic., C_2 molecule contains double bond and both are π bonds

A. C_2 molecule has been found to exist in vapour phase.

B. It has a total 12 electrons, out of which 8 electrons occupy bonding orbitals while 4 electrons occupy antibonding orbitals.

C. The molecule is paramagnetic.

D. C_2 molecule contains double bond and both are π bonds.

Answer: C

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28. Hybridization, shape and number of π bonds in $XeOF_2$ molecule are, respectively,

A. sp^3, pyramidal, 1

B. sp^3d, trigonal bipyramidal, 2

C. sp^3d, T-shaped, 1

D. sp^3d, square pyramidal, 1

Answer: C

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29. Which of the following pairs of atoms combine to give non directional bond? : C, O ; O, O ; Na, Cl ; Na, K

A. C, O

B. O, O

C. Na, Cl

D. Na, K

Answer: C

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30. Which one of the following molecules has the largest dipole moment? (Electro-negativity values of elements concerned are: B=2.0, Cl=3.0, F=4.0, H=2.1, N=3.0, O=3.5, P=2.1, S=2.5)

A. BF_3

B. NH_3

C. PCl_3

D. SO_3

Answer: B

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31. Which of the following molecules form no intermolecular hydrogen bonds? : $CH_3CH_2OH, HF, CH_3COCH_3, CH_3COOH$

A. CH_3CH_2OH

B. HF

C. CH_3COCH_3

D. CH_3COOH

Answer: C

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32. In hydrocarbon C_3H_m, C-C-C bond angle is 120°. The value of 'm' must be

A. 4

B. 6

C. 8

D. 0

Answer: B

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33. Which of the following statements are correct?

1) The N atoms are close together in N_2 than in N_2^{2-}

2) It would be easier to separate the atoms in N_2^{2-} than in N_2

3) There is a triple bond between the nitrogen atoms in N_2.

4) There is a single bond between the nitrogen atoms in N_2^{2-}.

A. 1, 2 and 3

B. 1 and 3

C. 2 and 4

D. 4 only

Answer: A

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34. Which species contain sigma covalent, pi(π)-covalent, coordinate covalent as well as ionic bonds?

A. H_2SO_4

B. NH_4NO_3

C. NaOCl

D. K_2CrO_4

Answer: B

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35. The boiling points of F_2, Cl_2, Br_2 and I_2 increase in that order. This is best attributed to difference in : covalent bond strengths, dipole forces, london dispersion forces, colligative forces

A. covalent bond strengths

B. dipole forces

C. london dispersion forces

D. colligative forces

Answer: C

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36. All of the following lists include at least one ionic compound except

A. NO_2, $NaNO_2$, KNO_3

B. CF_4, CaF_2, HF

C. $NaCl, MgCl_2, OCl_2$

D. H_2S, SO_2, SF_6

Answer: D

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37. When forming covalent bonds which atom can have more than eight valence electrons?

A. H

B. N

C. F

D. Cl

Answer: D

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38. The geometries of the molecules BF_3 and NF_3 are trigonal planar and trigonal pyramidal, respectively. Which statement best accounts for the difference? : N is more electronegative than B, BF_3 is ionic, NF_3 is covalent, B utilise sp^2 hybridization, while N does not, N is sp^3 hybridised and has non-bonding pair of valence electrons, while B does not

A. N is more electronegative than B

B. BF_3 is ionic, NF_3 is covalent

C. B utilise sp^2 hybridization, while N does not

D. N is sp^3 hybridised and has non-bonding pair of valence electrons, while B does not

Answer: D

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39. All of the following molecules have their atoms lying in the same plane except

A. NH_3

B. BF_3

C. BeF_2

D. XeF_4

Answer: A

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40. CO_2 is a gas at room temperature while SiO_2 is a high melting solid. The best explanation of this difference is that : Si has more electrons than C , The atoms in CO_2 are bonded by covalent bonds while SO_2 is an ionic compound, van der Waals' forces are stronger in SiO_2, CO_2 consists of discrete molecules while SiO_2 has network structure

A. Si has more electrons than C

B. The atoms in CO_2 are bonded by covalent bonds while SO_2 is an ionic compound

C. van der Waals' forces are stronger in SiO_2

D. CO_2 consists of discrete molecules while SiO_2 has network structure

Answer: D

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41. The nitrite ion NO_2^- may be respresented by two major resonance forms, the lengths of the N-O bonds in this ion are expected to be

A. the same as the length of N-O double bonds

B. the same as the length of N-O triple bond

C. between the lengths of N-O single and N-O double bonds

D. between N-O double and N-O triple bonds

Answer: C

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42. Among the following species, identify the isostructural pairs : $NF_3, NO_3^{\ominus}, BF_3, H_3\overset{\oplus}{O}, N_3H.$: $\left[NF_3, NO_3^{\ominus}\right]$ and $\left[BF_3, H_3\overset{\oplus}{O}\right]$; $[NF_3, N_3H]$ and $\left[NO_3^{\ominus}, BF_3\right]$; $\left[NF_3, H_3\overset{\oplus}{O}\right]$ and $\left[NO_3^{\ominus}, BF_3\right]$;

A. $\left[NF_3, NO_3^{\ominus}\right]$ and $\left[BF_3, H_3\overset{\oplus}{O}\right]$

B. $[NF_3, N_3H]$ and $\left[NO_3^{\ominus}, BF_3\right]$

C. $\left[NF_3, H_3\overset{\oplus}{O}\right]$ and $\left[NO_3^{\ominus}, BF_3\right]$

D. $\left[NF_3, H_3\overset{\oplus}{O}\right]$ and $[N_3H, BF_3]$

Answer: C

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43. Arrange the following compounds in the order of increasing dipole moment : toluene (I), m-dichlorobenezene (II), o-dichlorobenezene (III), p-dichlorobenezene (IV).

A. $I < IV < II < III$

B. $IV < I < II < III$

C. $IV < I < III < II$

D. $IV < II < I < III$

Answer: B

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44. The cyanide ions $CN^{\ominus}$ and N_2 are isoelectronic, but in contrast to $CN^{\ominus}$, N_2 is chemically inert because of

A. Low bond energy

B. Absence of bond polarity

C. Unsymmetrical electron distribution

D. Presence of more number of electrons in bonding orbitals

Answer: B

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45. The correct order of hybridisation of the central atom in the following species: 'NH_3, [PtCl_4]^(2-)PCl_5' and 'BCl_3' is

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

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

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

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

Answer: B

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46. The common features among the species $CN^{\ominus}$, CO and $NO^{\oplus}$ are : Bond order three and isoelectronic, Bond order three and weak field ligands, Bond order two and π -acceptors, Isoelectronic and weak field ligands

A. Bond order three and isoelectronic

B. Bond order three and weak field ligands

C. Bond order two and π-acceptors

D. Isoelectronic and weak field ligands

Answer: A

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47. The percentage of 'p character in the orbitals forming P-P bonds in 'P4' is'

A. 25

B. 33

C. 50

D. 75

Answer: D

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48. For which of the following molecules, $\mu \neq 0$?

A. a) and b)

B. only c)

C. c) and d)

D. Only a)

Answer: C

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49. The ionic radii of isoelectronic species 'N^(3-), O^(2-)' and 'F^-' in 'A^0' are in the order

A. 1.36, 1.40 and 1.71

B. 1.36, 1.71 and 1.40

C. 1.71, 1.40 and 1.36

D. 1.71, 1.36 and 1.40

Answer: C

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

A. X^+Y^-

B. X^-Y^+

C. $X-Y$

D. $X \rightarrow Y$

Answer: A

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51. Polarising action of Cd^{2+} on anions is stronger than that of Ca^{2+} because

A. the charges of the ions are same

B. their radii are nearly the same

C. the Ca^{2+} ion has a noble-gas electron configuration, and theCd^{2+} ion, an 18-electron configuration of its outer shell

D. all of the above are correct

Answer: C

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52. PCl_5 has a shape of trigonal bipyramid whereas IF_5 has the shape of a square pyramid. It is due to

A. presence of unshared electron pair on I which is oriented so as to minimise repulsion while P in PCl_5 , has no unshared pair

B. octet of P is complete while that of I is incomplete

C. P and I are of different groups

D. F and Cl have different extent of repulsion

Answer: A

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53. Amolecule of the type AX_5 has square pyramidal geometry. Hence, number of lone pairs on A is

A. 4

B. 3

C. 2

D. 1

Answer: D

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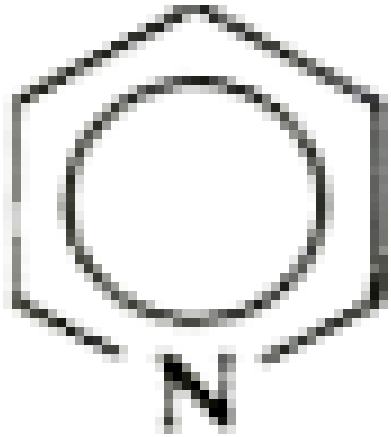
54. Hybridization of the nitrogen atom and electron geometry around nitrogen atom in pyridine is



A. sp^3 , pyramidal

B. sp^2 , trigonal planar

C. sp^2, linear

D. sp^3, tetrahedral

Answer: B

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55. H_2O molecule is dipolar, whereas BeF_2 is non polar. It is because

A. the electronegativity of F is greater than that of O

B. H_2O involves hydrogen bonding whereas BeF_2 is a discrete molecule

C. H_2O is linear and BeF_2 is angular

D. H_2O is angular and BeF_2 is linear

Answer: D

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56. Which of the following compounds contains the maximum number of lone pairs at the central atom in its best Lewis structure?

A. XeO_3

B. ClO_2^-

C. $SOCl_2$

D. IO_4^-

Answer: B

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57. Which of the following molecules contains the maximum S-O bond length? : $SO_2, SO_3, SO_4^{2-}, SO_3^{2-}$

A. SO_2

B. SO_3

C. SO_4^{2-}

D. SO_3^{2-}

Answer: D

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58. What are the formal charges of the atoms in the nitrite ion in the order of nitrogen, oxygen 1 and oxygen 2?

$\overset{1}{O} = N - \overset{2}{O}$: 0, 0, -1 ; 0, +1, -1 ; -1, 0, -1 ; -1, 0, 0

A. 0, 0,-1

B. 0,-1,-1

C. -1,0,-1

D. -1,0,0

Answer: A

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59. Molecule AB has a bond length of 1.67 Å and a dipole moment of 0.38 D. The fractional charge on each atom (absolute magnitude) is : ($e_0 = 4.082 \times 10^{-10}$ esu)

A. 0

B. 0.05

C. 0.5

D. 1

Answer: B

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60. Which of the following is arranged in order of increasing dipole moment?

A. $BCl_3 < NH_3 < H_2O < SO_2$

B. $BCl_3 < NH_3 < SO_2 < H_2O$

C. $NH_3 < SO_2 < H_2O < BCl_3$

D. $H_2O < SO_2 < NH_3 < BCl_3$

Answer: B

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

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

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

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

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

Answer: A

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62. The bond order in NO is 2.5 whereas that in NO^+ is 3. Which of the following statements is true for these two species?

A. Bond length in NO^+ is greater than in NO

B. Bond length is unpredictable

C. Bond length in NO^+ is equal to that in NO

D. Bond length in NO is greater than in NO^+

Answer: D

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63. Which of the following molecules has the greatest number of lone pairs of electrons around the central atom? : IF_7, XeF_2, BrF_3, NF_3

A. IF_7

B. XeF_2

C. BrF_3

D. NF_3

Answer: B

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64. The hybridization of N atoms in NO_3^-, NO_2^+ and NH_4^+ are respectively:

A. sp^2, sp, sp^3

B. sp, sp^3, sp^2

C. sp^2, sp^3, sp

D. sp, sp^2, sp^3

Answer: A

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65. The number and type of bonds in C_2^{2-} ion in CaC_2 are:

A. One σ bond and one π- bond

B. One σbond and two π-bonds

C. Two σ bonds and two π-bonds

D. Two σbonds and one π-bond

Answer: B

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66. Shapes of certain interhalogen compounds are stated below. Which one of them is not correctly stated? : IF_7 : pentagonal bipyramid, BrF_5: trigonal bipyramid, BrF_3: planar T-shaped, ICl_3 : planar dimeric

A. IF_7 , pentagonal bipyramid

B. BrF_5 : trigonal bipyramid

C. BrF_3 : planar T-shaped

D. Icl_3 : planar dimeric

Answer: B

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67. In which of the following chemical change, the hybridization of the central atom of the polyatomic molecule is not changing?

A. $ICl_3 + Cl^- \rightarrow Icl_4^-$

B. $BF_3 + F^- \rightarrow BF_4^-$

C. $PCl_5 + Cl_2 \rightarrow PCl_5$

D. $S_2O_3^- + I^- \rightarrow I_2 + S_4O_6^{2-}$

Answer: D

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68. In which of the following ionization processes, the bond order has increased and the magnetic behaviour has changed? : $N_2 \rightarrow N_2^+$, $C_2 \rightarrow C_2^+, NO \rightarrow NO^+, O_2 \rightarrow O_2^+$

A. $N_2 \rightarrow N_2^+$

B. $C_2 \rightarrow C_2^+$

C. $NO \rightarrow NO^{+}$

D. $O_2 \rightarrow O_2^{+}$

Answer: C

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69. The bond dissociation energy of B-F in BF_3 is 646 kJ mol^{-1}, whereas that of C-F in CF_4 is 515 kJ mol^{-1}. The correct reason for higher B-F bond dissociation energy as compared to that of C-F is the : smaller size of B atom as compared to that of C atom.; stronger σ bond between B and F in BF_3 as compared to that between C and F in CF_4; significant $p\pi - p\pi$ interactions between B and F in BF_3, whereas there is no possibility of such interaction between C and F in CF_4; lower degree of $p\pi - p\pi$ interactions between B and F in BF_3 than that between C and F in CF_4

A. smaller size of B atom as compared to that of C atom

B. stronger σ bond between Band F in BF_3 as compared to that between C and F in CF_4.

C. significant $p\pi - p\pi$ interactions between B and F in BF_3 , whereas there is no possibility of such interaction between C and F in CF_4

D. lower degree of $p\pi - p\pi$ interactions between B and F in BF_3 than that between C and F in CF_4

Answer: C

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70. Among the following the paramagnetic compound is

A. Na_2O_2

B. O_3

C. N_2O

D. KO_2

Answer: D

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71. The bond energy (in kJ mol^{-1}) of C-C single bond is, approximately,

A. 238

B. 293

C. 347

D. 439

Answer: C

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72. Assuming that Hund's rule is violated, the bond order and magnetic nature of the diatomic molecule B_2 is : 1 and diamagnetic, 0 and diamagnetic, 1 and paramagnetic, O and paramagnetic.

A. 1 and diamagnetic

B. 0 and diamagnetic

C. 1 and paramagnetic

D. 0 and paramagnetic

Answer: A

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73. According MO theory, : O_2^+ is paramagnetic and bond order greater than O_2., O_2^+ is paramagnetic and bond order less than O_2., O_2^+ is diamagnetic and bond order less than O_2., O_2^+ is diamagnetic and bond order more than O_2.

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

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

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

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

Answer: A

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

A. NO^-

B. NO^+

C. CN^-

D. N_2

Answer: A

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75. The charge/size ratio of a cation determines its polarizing power. Which one of the following sequences represents the increasing order of the polarizing power of the cationic species, K^+, Ca^{2+}, Mg^{2+} and Be^{2+}?

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

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

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

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

Answer: D

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76. In which of the following pairs , the two species are not isostructural ?

PCl_4^+ and $SiCl_4$, PF_5 and BrF_5, AlF_6^{3-} and SF_6, CO_3^{2-} and NO_3^-

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

B. PCl_4^+ and $SiCl_4$

C. PF_5 and BrF_5

D. AlF_6^{2-} and SF_6

Answer: C

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77. Which of the following isnot correct regarding C_2 molecule? : C_2 molecule has been found to exist in vapour phase, It has a total 12 electrons, out of which 8 electrons occupy bonding orbitals while 4 electrons occupy antibonding orbitals., The molecule is paramagnetic., C_2 molecule contains double bond and both are π bonds

A. C_2 molecule has been found to exist in vapour phase.

B. It has a total 12 electrons, out of which 8 electrons occupy bonding orbitals while 4 electrons occupy antibonding orbitals.

C. The molecule is paramagnetic.

D. C_2 molecule contains double bond and both are a bonds.

Answer: C

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78. Hybridization, shape and number of π bonds in $XeOF_2$ molecule are, respectively,

A. sp^3 , pyramidal,1

B. sp^3d, trigonäl bipyramidal, 2

C. sp^3d , T-shaped, 1

D. sp^3, d , square pyramidal, 1

Answer: C

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79. Which of the following pairs of atoms combine to give non directional bond? : C, O ; O, O ; Na, Cl ; Na, K

A. C, O

B. O,O

C. Na,Cl

D. Na,F

Answer: C

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80. Which one of the following molecules has the largest dipole moment? (Electro-negativity values of elements concerned are: B=2.0, Cl=3.0, F=4.0, H=2.1, N=3.0, O=3.5, P=2.1, S=2.5)

A. BF_3

B. NH_3

C. PCl_3

D. SO_3

Answer: B

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81. Which of the following molecules form no intermolecular hydrogen bonds? : $CH_3CH_2OH, HF, CH_3COCH_3, CH_3COOH$

A. CH_3CH_2OH

B. HF

C. CH_3COCH_3

D. CH_3COOH

Answer: C

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82. In hydrocarbon C_3H_m, C-C-C bond angle is 120°. The value of 'm' must be

A. 4

B. 6

C. 8

D. 0

Answer: B

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83. Which of the following statements are correct?

1) The N atoms are close together in N_2 than in N_2^{2-}

2) It would be easier to separate the atoms in N_2^{2-} than in N_2

3) There is a triple bond between the nitrogen atoms in N_2.

4) There is a single bond between the nitrogen atoms in N_2^{2-}.

A. 1, 2 and 3

B. 1 and 3

C. 2 and 4

D. 4 only

Answer: A

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84. Which species contain sigma covalent, pi(π)-covalent, coordinate covalent as well as ionic bonds?

A. H_2SO_4

B. NH_4NO_3

C. $NaOCl$

D. K_2CrO_4

Answer: B

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85. The boiling points of F_2, Cl_2, Br_2 and I_2 increase in that order. This is best attributed to difference in : covalent bond strengths, dipole forces, london dispersion forces, colligative forces

A. covalent bond strengths

B. dipole forces

C. london dispersion forces

D. colligative forces

Answer: C

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86. All of the following lists include at least one ionic compound except

A. $NO_2, NaNO_2, KNO_3$

B. CF_4, CaF_2, HF

C. $NaCl, MgCl_2, Ocl_2$

D. H_2S, SO_2, SF_6

Answer: D

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87. When forming covalent bonds which atom can have more than eight valence electrons?

A. H

B. N

C. F

D. Cl

Answer: D

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88. The geometries of the molecules BF_3 and NF_3 are trigonal planar and trigonal pyramidal, respectively. Which statement best accounts for the difference? : N is more electronegative than B, BF_3 is ionic, NF_3 is covalent, B utilise sp^2 hybridization, while N does not, N is sp^3 hybridised and has non-bonding pair of valence electrons, while B does not

A. N is more electronegative than B

B. BF_3 is ionic, NF_3 is covalent

C. B utilise sp^2 hybridization, while N does not

D. N is sp^3 hybridised and has non-bonding pair of valence electrons, while B does not

Answer: D

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89. All of the following molecules have their atoms lying in the same plane except

A. NH_3

B. BF_3

C. BeF_2

D. XeF_4

Answer: A

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90. CO_2 is a gas at room temperature while SiO_2 is a high melting solid. The best explanation of this difference is that : Si has more electrons than C , The atoms in CO_2 are bonded by covalent bonds while SO_2 is an ionic compound, van der Waals' forces are stronger in SiO_2, CO_2 consists of discrete molecules while SiO_2 has network structure

A. Si has more electrons than C

B. The atoms in CO_2 are bonded by covalent bonds while SO_2 is an ionic compound

C. van der Waals' forces are stronger in SiO_2

D. CO_2 consists of discrete molecules while SiO_2 has network structure

Answer: D

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91. The nitrite ion NO_2^- may be respresented by two major resonance forms, the lengths of the N-O bonds in this ion are expected to be

A. the same as the length of N-O double bonds

B. the same as the length of N-O triple bond

C. between the lengths of N-O single and N-O double bonds

D. between N-O double and N-O triple bonds

Answer: C

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92. Among the following species, identify the isostructural pairs : $NF_3, NO_3^{\ominus}, BF_3, H_3\overset{\oplus}{O}, N_3H.$: $\left[NF_3, NO_3^{\ominus}\right]$ and $\left[BF_3, H_3\overset{\oplus}{O}\right]$; $[NF_3, N_3H]$ and $\left[NO_3^{\ominus}, BF_3\right]$; $\left[NF_3, H_3\overset{\oplus}{O}\right]$ and $\left[NO_3^{\ominus}, BF_3\right]$;

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

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

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

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

Answer: C

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93. Arrange the following compounds in the order of increasing dipole moment : toluene (I), m-dichlorobenezene (II), o-dichlorobenezene (III), p-dichlorobenezene (IV).

A. I lt IV lt II lt III

B. IV lt I lt II lt III

C. IV lt I lt III lt II

D. IV lt II lt I lt III

Answer: B

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94. The cyanide ions $CN^{\ominus}$ and N_2 are isoelectronic, but in contrast to $CN^{\ominus}$, N_2 is chemically inert because of

A. Low bond energy

B. Absence of bond polarity

C. Unsymmetrical electron distribution

D. Presence of more number of electrons in bonding orbitals

Answer: B

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95. The correct order of hybridisation of the central atom in the following species: 'NH_3, [PtCl_4]^(2-)PCl_5' and 'BCl_3' is

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

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

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

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

Answer: B

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96. The common features among the species $CN^{\ominus}$, CO and $NO^{\oplus}$ are : Bond order three and isoelectronic, Bond order three and weak field ligands, Bond order two and π -acceptors, Isoelectronic and weak field ligands

A. Bond order three and isoelectronic

B. Bond order three and weak field ligands

C. Bond order two and π-acceptors

D. Isoelectronic and weak field ligands

Answer: A

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97. The percentage of 'p character in the orbitals forming P-P bonds in 'P4' is'

A. 25

B. 33

C. 50

D. 75

Answer: D

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98. For which of the following molecules, $\mu \neq 0$?

A. a and b

B. only c

C. c and d

D. only a

Answer: C

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99. The ionic radii (in Å) of N^{3-}, O^{2-} and F^{-} are respectively.

A. 1.36, 1.40 and 1.71

B. 1.36, 1.71 and 1.40

C. 1.71, 1.40 and 1.36

D. 1.71, 1.36 and 1.40

Answer: C

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

A. X^+Y^-

B. $X^{-Y}\hat{}\ +$

C. $X - Y$

D. $X \rightarrow Y$

Answer: A

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Level Ii Assertion Reason Type

1. In the following question, an Assertion (A) is followed by a corresponding Reason (R). Use the following keys to choose the appropriate answer.

Assertion : In case of $(CH_3)_3N$ geometry is pyramidal, but in case of $(SiH_3)_3N$ it is planar.

Reason : The maximum covalency of Si is six but that of C is four. : If both (A) and (R) are correct and (R) is the correct explanation of (A)., If both (A) and (R) are correct, but (R) is not the correct explanation of (A)., If (A) is correct, but (R) is incorrect., If both (A) and (R) are incorrect.

A. If both (A) and (R) are correct and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If both (A) and (R) are incorrect.

Answer: B

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2. In the following question, an Assertion (A) is followed by a corresponding Reason (R). Use the following keys to choose the appropriate answer.

Assertion : NCl_3 reacts with water but NF_3 is inert towards hydrolysis.

Reason : Nitrogen does not possess vacant d-orbitals. : If both (A) and (R) are correct and (R) is the correct explanation of (A)., If both (A) and (R) are correct, but (R) is not the correct explanation of (A)., If (A) is correct, but (R) is incorrect., If both (A) and (R) are incorrect.

A. If both (A) and (R) are correct and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If both (A) and (R) are incorrect.

Answer: B

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3. In the following question, an Assertion (A) is followed by a corresponding Reason (R). Use the following keys to choose the appropriate answer.

Assertion : The atoms in a covalent molecule are said to share electrons, yet some covalent molecules are polar.

Reason : In polar covalent molecule, the shared electrons concentrate more near one of the atoms.

A. If both (A) and (R) are correct and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If both (A) and (R) are incorrect.

Answer: A

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4. In the following question, an Assertion (A) is followed by a corresponding Reason (R). Use the following keys to choose the appropriate answer.

Assertion : BF_3 is a weaker Lewis acid than BCl_3.

Reason : In BF_3 molecule, back bonding $(p\pi - p\pi)$ is stronger than in BCl_3. : If both (A) and (R) are correct and (R) is the correct explanation of (A)., If both (A) and (R) are correct, but (R) is not the correct explanation of (A)., If (A) is correct, but (R) is incorrect., If both (A) and (R) are incorrect.

A. If both (A) and (R) are correct and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If both (A) and (R) are incorrect.

Answer: A

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5. In the following question, an Assertion (A) is followed by a corresponding Reason (R). Use the following keys to choose the appropriate answer.

Assertion : Polarising power of $Ag^{\oplus}$ is more than $K^{\oplus}$.

Reason : Among two cations of similar size, the polarising power of cation with pseudo noble gas configuration is larger than cation with noble gas configuration.

A. If both (A) and (R) are correct and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If both (A) and (R) are incorrect.

Answer: A

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6. In the following question, an Assertion (A) is followed by a corresponding Reason (R). Use the following keys to choose the appropriate answer.

Assertion : Both $\pi(2p_x)$ and $\pi^*(2p_x)$ MO's have one nodal plane each.

Reason : All MO's formed by side way overlapping of 2p orbitals have one nodal plane. : If both (A) and (R) are correct and (R) is the correct explanation of (A)., If both (A) and (R) are correct, but (R) is not the correct explanation of (A)., If (A) is correct, but (R) is incorrect., If both (A) and (R) are incorrect.

A. If both (A) and (R) are correct and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If both (A) and (R) are incorrect.

Answer: D

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7. In the following question, an Assertion (A) is followed by a corresponding Reason (R). Use the following keys to choose the appropriate answer.

Assertion : All F-S-F angles in SF_4 are greater than 90° but less than 180°.

Reason : The lp-bp repulsion is weaker than bp-bp repulsion.

A. If both (A) and (R) are correct and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If both (A) and (R) are incorrect.

Answer: C

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8. In the following question, an Assertion (A) is followed by a corresponding Reason (R). Use the following keys to choose the appropriate answer.

Assertion : The geometry of XeF_2 and CO_2 are same.

Reason : Both the compounds have central atom in sp hybridisation.

A. If both (A) and (R) are correct and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If both (A) and (R) are incorrect.

Answer: C

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9. In the following question, an Assertion (A) is followed by a corresponding Reason (R). Use the following keys to choose the appropriate answer.

Assertion : Bond angle of H_2S is smaller than H_2O in gas phase.

Reason : Electronegativity of the central atom increases, bond angle decreases.

A. If both (A) and (R) are correct and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If both (A) and (R) are incorrect.

Answer: C

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10. In the following question, an Assertion (A) is followed by a corresponding Reason (R). Use the following keys to choose the appropriate answer.

Assertion : Fluorine molecule has bond order one.

Reason : The number of electrons in the antibonding molecular orbitals is two less than that in bonding molecular orbitals.

A. If both (A) and (R) are correct and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If both (A) and (R) are incorrect.

Answer: A

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11. In the following question, an Assertion (A) is followed by a corresponding Reason (R). Use the following keys to choose the appropriate answer.

Assertion : LiCl is a typical ionic compound exhibiting covalent characters.

Reason : Electronegativity difference between Li and Cl is too small.

A. If both (A) and (R) are correct and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If both (A) and (R) are incorrect.

Answer: C

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12. In the following question, an Assertion (A) is followed by a corresponding Reason (R). Use the following keys to choose the appropriate answer.

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. If both (A) and (R) are correct and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If both (A) and (R) are incorrect.

Answer: D

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13. In the following question, an Assertion (A) is followed by a corresponding Reason (R). Use the following keys to choose the appropriate answer.

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. : If both (A) and (R) are correct and (R) is the correct explanation of (A)., If

both (A) and (R) are correct, but (R) is not the correct explanation of (A)., If (A) is correct, but (R) is incorrect., If both (A) and (R) are incorrect.

A. If both (A) and (R) are correct and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If both (A) and (R) are incorrect.

Answer: B

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14. In the following question, an Assertion (A) is followed by a corresponding Reason (R). Use the following keys to choose the appropriate answer.

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 (A) and (R) are correct and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If both (A) and (R) are incorrect.

Answer: A

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15. In the following question, an Assertion (A) is followed by a corresponding Reason (R). Use the following keys to choose the appropriate answer.

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 (A) and (R) are correct and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If both (A) and (R) are incorrect.

Answer: D

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16. In the following question, an Assertion (A) is followed by a corresponding Reason (R). Use the following keys to choose the appropriate answer.

Assertion : When two hydrogen atoms approach each other from infinite

distance nearly 436 kJ mol^{-1} of energy is released when the distance between them is 74 pm.

Reason : When two atoms approach each other to forms covalent bond between them, potential energy of the system continuously decreases.

A. If both (A) and (R) are correct and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If both (A) and (R) are incorrect.

Answer: C

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17. In the following question, an Assertion (A) is followed by a corresponding Reason (R). Use the following keys to choose the

appropriate answer.

Assertion : BF_3 molecule is planar but NF_3 is pyramidal.

Reason : N atom is smaller than B.

A. If both (A) and (R) are correct and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If both (A) and (R) are incorrect.

Answer: B

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18. In the following question, an Assertion (A) is followed by a corresponding Reason (R). Use the following keys to choose the appropriate answer.

Assertion : H_2 molecule is more stable than HeH molecule.

Reason : The electron in antibonding orbital of the molecule destabilises it.

A. If both (A) and (R) are correct and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If both (A) and (R) are incorrect.

Answer: B

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19. In the following question, an Assertion (A) is followed by a corresponding Reason (R). Use the following keys to choose the appropriate answer.

Assertion : The HF_2^- ion exists in the solid state and also in the liquid state but not in aqueous solution.

Reason : The magnitude of hydrogen bonding in between HF molecules is weaker than that in between HF and H_2O molecules. : If both (A) and (R) are correct and (R) is the correct explanation of (A)., If both (A) and (R) are correct, but (R) is not the correct explanation of (A)., If (A) is correct, but (R) is incorrect., If both (A) and (R) are incorrect.

A. If both (A) and (R) are correct and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If both (A) and (R) are incorrect.

Answer: A

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20. Assertion : H-S-H bond angle in H_2S is closer to 90° but: H-O-H bond angle in H_2O is 104.5°.

Reason : lp-lp repulsion is stronger in H_2S than in H_2O.

A. If both (A) and (R) are correct and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If both (A) and (R) are incorrect.

Answer: B

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Questions

1. The dipole moment of water is 1.84D and dipole moment of O-H bond is 1.5D. Calculate the H-O-H bond angle in water.

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2. The percentage ionic character of a bond A-B is 86.41% and the bond length is 162.3 pm. What is the dipole moment of the molecule?

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3. The dipole moment of HF molecule is 1.91D and the bond distance is 0.92 Å. What is the fractional charge on H and F in the HF bond? (Electronic charge = 4.8×10^{-10} e.s.u.).

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4. Calculate the lattice energy of sodium chloride crystal from the following data: Born exponent, n=8, Madelung constant for NaCl=1.748, Ionic radius of $Na^+ = 0.95\text{Å}$, Ionic radius of $Cl^- = 1.81\text{Å}$.

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5. Calculate the percentage ionic character of Si-H bond in SiH_4 assuming Pauling electronegativity values of Si and H to be 1.8 and 2.1 respectively.

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6. The electronegativities of H and F are 2.1 and 4.0 respectively. What is the percentage ionic character of HF bond on the basis of Hanny Smith equation?

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Level Iii Single Correct Answer Type

1. Which set of species is arranged in order of increasing O-N-O bond angle? : NO_2^-, NO_2^+, NO_2 , NO_2, NO_2^-, NO_2^+ , NO_2^+, NO_2, NO_2^- , NO_2^-, NO_2, NO_2^+

A. NO_2^-, NO_2^+, NO_2

B. NO_2, NO_2^-, NO_2^+

C. NO_2^+, NO_2, NO_2^-

D. NO_2^-, NO_2, NO_2^+

Answer: D

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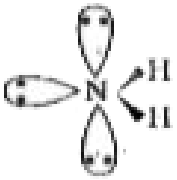
2. Which of the following best represents the 3-dimensional view $\overset{\Theta}{H_2N}$:



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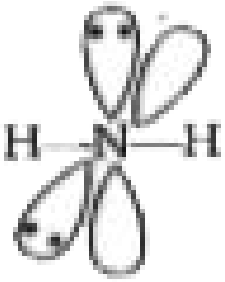

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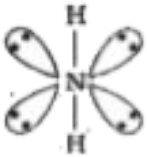
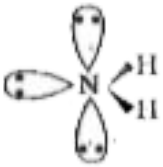


A.



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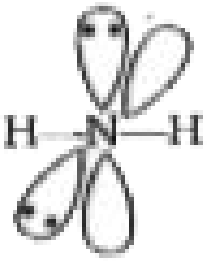
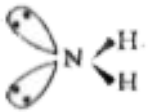


C.



D. 

Answer: C

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3. Which statement about the best Lewis structure of a molecule composed of one atom each of N, S and Cl correct?

A. Nitrogen is the central atom and there is one N-S double bond

B. Nitrogen is the central atom and there is one N-Cl double bond

C. Sulphur is the central atom and there is one S-N double bond

D. Sulphur is the central atom and there is one S-Cl double bond

Answer: A

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4. Which one of the following may require pollinators, but is genetically similar to autogamy?

A. only I and II

B. only I and IV

C. only IV and V

D. only I, III and IV

Answer: B

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5. According to VSEPR theory which of the following molecules is (are) bent (non-linear)?

$I. CO_2 II C_2H_2 III. O_3 IV. BeCl_2 V. KrF_2$

A. only III

B. only III and V

C. only III, IV and V

D. All of these

Answer: A

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6. The dipole moment of KCl is 3.336×10^{-29} Cm. The interatomic distance K^+ and Cl^- ion in KCl is 260 pm . Calculate the dipole moments of KCl, if there were opposite charges of the fundamental unit located to nucleus

A. $4.165 \times 10^{-29} Cm$

B. $4.325 \times 10^{-27} Cm$

C. $5.321 \times 10^{-29} Cm$

D. $5.012 \times 10^{-27} Cm$

Answer: A

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7. The correct order of Cl-O bond lengths in ClO^-, ClO_2^-, ClO_3^- and ClO_4^- is

A. $ClO^- < ClO_2^- < ClO_3^- < ClO_4^-$

B. $ClO_4^- < ClO_3^- < ClO_2^- < ClO^-$

C. $ClO_3^- < ClO_4^- < ClO_2^- < ClO^-$

D. $ClO_4^- = ClO_3^- = ClO_2^- = ClO^-$

Answer: B

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8. What fraction of charge is present on iodine in covalently bonded $H^{\delta+} - I^{\delta-}$ if the dipole moment of HI is 0.38 D and the bond length is 1.61 Å.

A. 0.05

B. 0.16

C. 0.33

D. 0.79

Answer: A

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9. The HF molecule has a dipole moment of 1.83 D and a bond length of 91.7 pm. What is the amount charge, in electronic charge units, on either end of the bond?

A. +0.416 e, -0.416 e

B. +0.356 e,-0.416 e

C. +0.416 e, -0.356 e

D. +0.26 e,-0.532 e

Answer: A

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10. The Se=C=Se molecule is non-polar because

A. the bonds in the molecule are all non-polar

B. the bonds in the molecule are polar but their effect on the overall polarity is cancelled by the effect of lone pairs in the valence shell of the carbon atom

C. the bonds in the molecule are polar but their effect on the overall polarity is cancelled by the fact that they are equal in magnitude and oppositely directed

D. the bonds in the molecule are polar but the polar effect is cancelled by the resonance hybrids which distribute the charge evenly.

Answer: C

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Level Iii Multiple Correct Answer Type

1. The planar shape of $N(SiH_3)_3$ is explained by the

A. type of hybrid orbitals of nitrogen

B. additional $d\pi - p\pi$ overlap along the N - Si bond

C. higher electronegativity of nitrogen

D. higher electronegativity of silicon

Answer: A::B

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2. The pair of species having identical shapes for molecules of both species are

A. BF_3, PCl_3

B. XeF_2, CO_2

C. CF_4, SIF_4

D. PF_5, IF_5

Answer: B::C

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3. Which of the following molecules are polar and sp^3d^2 hybridized?

A. IF_5

B. XeF_4

C. $XeOF_4$

D. ICl_4^-

Answer: A::C

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4. Among the following bonds, which are more ionic than covalent?

A. Si-O

B. Ba - O

C. Se-Cl

D. K-Br

Answer: B::D

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5. Which among the following have bond order 2.5?

A. O_2

B. N_2^{2-}

C. N_2^+

D. O_2^+

Answer: C::D

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6. Which of the following statements are not true?

A. CuCl is more covalent than NaCl

B. HF is more polar than HBr

C. HF is less polar than HBr

D. Chemical bond formation takes place when forces of attraction overcome the forces of repulsion

Answer: A::B::D

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7. Which among the following are isostructural?

A. XeO_2F_2, SF_4

B. CO_2, I_3^-

C. SO_3^{2-}, CO_3^{2-}

D. ClF_3, XeF_2

Answer: A::B

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8. Select correct orders for corresponding property as indicated in bracket for the following:

A. $NH_3 > BiH_3 > SbH_3 > AsH_3 > PH_3$ (boiling point)

B. $H_2O > H_2Te > H_2Se > H_2S$ (boiling point)

C. $NH_3 > PH_3 > AsH_3 > SbH_3$ (basic character)

D. $H_2O < H_2S < H_2Se < H_2Te$ (acidic character)

Answer: B::C::D

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9. Which of the following statements are correct?

A. Linear overlap of two atomic p-orbitals leads to a sigma-bond

B. The bond angle H-N-H in NH_3 is greater than the bond angle H-As-H in AsH_3 .

C. Anhydrous HCl is a bad conductor of electricity but aqueous HCl is a good conductor

D. o-nitrophenol is steam volatile whereas p-nitrophenol is not

Answer: A::B::C::D

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10. Which of the following statements are not correct?

A. All molecules with polar bonds have dipole moment

B. $SnCl_2$ is a nonlinear molecule

C. Intramolecular hydrogen bond is present between two different molecules

D. Intermolecular hydrogen bond is present within the molecules.

Answer: A::C::D

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11. Which of the following statements are not correct?

A. Hydrogen bonds are not present amongst gaseous hydrogen fluoride

B. Both SO_4^{2-} and SO_3^{2-} have tetrahedral geometry

C. In ozone both the bond lengths between oxygen atoms are not identical because it contains one double bond and one coordinate - covalent bond

D. In CO_3^{2-} all the three carbon-oxygen bond length are identical.

Answer: A::B::C

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12. Which of the following statements are not correct?

A. beryllium, like nitrogen, forms diatomic molecule Be_2

B. He_2 molecule does not exist but He_2^+ does exist

C. The dipole moment of CH_3F is greater than that of CH_3CI

D. HBr is a stronger acid than HI because of hydrogen bonding

Answer: A::C::D

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Level Iii Numerical Type

1. Among the triatomic molecules/ions, $BeCl_2, N_3^-, N_2O, NO_2^+, O_3, SCl_2, ICl_2^-, I_3^-$ and XeF_2, the total number of linear molecule(s)/ion(s) where the hybridization of the central atom does not have contribution from d-orbital(s) is

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2. A σ- bonded molecule MX_3 is T-shaped. The number of non-bonding pairs of electrons in the valence shell of the central-atom

A. 1

B. 2

C. 3

D. 4

Answer: 2

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3. In a regular octahedral molecule SF_6 the number of F-S-F bonds at 180° is

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4. The maximum number of atoms lying the same plane in B_2H_6 is .....

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5. A slightly polar molecule AB has dipole moment of 0.24 D. If bond-length is 1 Å, ionic character is ....

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6. How many of the following compounds have sp^3 hybridization?

$i.\ SO_4^{2-}\ ii.\ SO_5^{2-}\ iii.\ PO_4^{3-}\ iv.\ PO_5^{2-}\ v.\ I_3^{-v}i.\ CO_3^{2-}\ vii.\ CO_4^{2-}$

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Level Iii Matching Column Type

1.

Column I	Column II
A) CO_2	p) Zero dipole moment
B) CH_4	q) Expansion of octet
C) $ClF_2^{\oplus}$	r) sp^3 hybridisation
D) PCl_5	s) sp^3d hybridisation
E) $ClF_2^{\ominus}$	t) Linear

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2.

Column I	Column II
A) SO_3^{2-}	p) The central atom does not have lone pair.
B) HNC	q) All atoms of the species have lone pair(s)
C) SiF_4	r) It has co-ordinate bond
D) NO_3^-	s) It has σ-bond and π-bond as well as coordinate bond.
	t) Species having only σ bond

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3.

Column I	Column II
A) IF_7	p) The axial bond length is larger than the equatorial bond length
B) $[SiF_6]^{2-}$	q) The axial bond length is shorter than the equatorial bond length
C) BrF_3	r) $d_{x^2-y^2}$ orbitals are involved in bonding
D) $[PI_4]^+$	s) All possible bond angles are not identical
	t) All possible bond angles are identical

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4.

Column I	Column II
A) N_2^+ is stable than N_2^-	p) due to one have greater number of electrons in antibonding molecular orbitals than other
B) NO can easily lose its electron than N_2	q) one has B.O.3 and other has 2.5
C) NO have large bond length than NO^-	r) both are paramagnetic with same bond order
D) He_2^+ exists, but is less stable than H_2^+	s) one is paramagnetic and other diamagnetic

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5.

Column I	Column II
A) Liquid bromine	p) Hydrogen bond
B) Solid hydrogen fluoride	q) Ion-dipole force
C) Solution of sodium fluoride in water	r) Dispersion force
D) Liquid methylamine	s) Dipole induced dipole interaction
E) Noble gas clathrate in ice	

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Level Iii Satement Type

1. In the following question, an Assertion (A) is followed by a corresponding Reason (R). Use the following keys to choose the appropriate answer.

Assertion : In case of $(CH_3)_3N$ geometry is pyramidal, but in case of $(SiH_3)_3N$ it is planar.

Reason : The maximum covalency of Si is six but that of C is four. : If both (A) and (R) are correct and (R) is the correct explanation of (A)., If both (A) and (R) are correct, but (R) is not the correct explanation of (A)., If (A) is correct, but (R) is incorrect., If both (A) and (R) are incorrect.

A. Statement 1 is True, statement 2 is True, Statement 2 is Correct explanation for Statement 1.

B. Statement 1 is True, Statement 2 is True, Statement 2 is NOT a correct explanation for Statement 1.

C. Statement 1 is True, Statement 2 is False.

D. Statement 1 is False, Statement 2 is True.

Answer: B

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2. Statement 1 : According to Fajan's rule, covalent character is favoured by small cation and small anion.

Statement 2 : The magnitude of covalent character in the ionic bond depends upon the extent of polarization.

A. Statement 1 is True, statement 2 is True, Statement 2 is Correct explanation for Statement 1.

B. Statement 1 is True, Statement 2 is True, Statement 2 is NOT a correct explanation for Statement 1.

C. Statement 1 is True, Statement 2 is False.

D. Statement 1 is False, Statement 2 is True.

Answer: D

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3. In the following question, an Assertion (A) is followed by a corresponding Reason (R). Use the following keys to choose the appropriate answer.

Assertion : When two hydrogen atoms approach each other from infinite distance nearly 436 kJ mol^{-1} of energy is released when the distance between them is 74 pm.

Reason : When two atoms approach each other to forms covalent bond between them, potential energy of the system continuously decreases.

A. Statement 1 is True, statement 2 is True, Statement 2 is Correct explanation for Statement 1.

B. Statement 1 is True, Statement 2 is True, Statement 2 is NOT a correct explanation for Statement 1.

C. Statement 1 is True, Statement 2 is False.

D. Statement 1 is False, Statement 2 is True.

Answer: C

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4. In the following question, an Assertion (A) is followed by a corresponding Reason (R). Use the following keys to choose the appropriate answer.

Assertion : The HF_2^- ion exists in the solid state and also in the liquid state but not in aqueous solution.

Reason : The magnitude of hydrogen bonding in between HF molecules is weaker than that in between HF and H_2O molecules. : If both (A) and (R) are correct and (R) is the correct explanation of (A)., If both (A) and (R) are correct, but (R) is not the correct explanation of (A)., If (A) is correct, but (R) is incorrect., If both (A) and (R) are incorrect.

A. Statement 1 is True, statement 2 is True, Statement 2 is Correct explanation for Statement 1.

B. Statement 1 is True, Statement 2 is True, Statement 2 is NOT a correct explanation for Statement 1.

C. Statement 1 is True, Statement 2 is False.

D. Statement 1 is False, Statement 2 is True.

Answer: A

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5. Statement1 : The boiling point of NH_3 lies between that of SbH_3 and BiH_3.

Statement 2 : PH_3 has much lower boiling point that NH_3 but it increases fromPH_3 to AsH_3, to SbH_3, BiH_3 due to increase in van der Waals forces.

A. Statement 1 is True, statement 2 is True, Statement 2 is Correct explanation for Statement 1.

B. Statement 1 is True, Statement 2 is True, Statement 2 is NOT a correct explanation for Statement 1.

C. Statement 1 is True, Statement 2 is False.

D. Statement 1 is False, Statement 2 is True.

Answer: D

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Level Iii Linked Comprehension Type

1. In an ionic bond, the cation tends to polarize the electron cloud of the anion by pulling electron dens towards itself. This causes development of covalent character in the ionic bond because the electron dens gets localised in-between the nuclei. The tendency of the cation to bring about the polarization of the anion expressed as its polarizing power. The ability of ion to undergo polarization is called its polarisability. The polarising power of a cation or an anion is decided on the basis of Fajans' rules.

The ionic conductance of which of the following is the highest?

A. $Li^+(aq)$

B. $Na^+(aq)$

C. $K^+(aq)$

D. $Cs^+(aq)$

Answer: D

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2. Among the following which will have the lowest melting point and the highest solubility in polar solvent: $LiCl$, $BeCl_2$, BCl_3, $\mathrm{CCl_4}$

A. $\mathrm{CCl_4}$, $LiCl$

B. $LiCl$, $\mathbb{C}l_4$

C. $BeCl_2$, BCl

D. BCl_3, $BeCl_2$

Answer: A

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3. Arrange the following species in decreasing order of polarising powers:

Ag^+, Tl^+, Na^+

A. $Tl > Ag > Na^+$

B. $Tl^+ < Na^+ < Ag^+$

C. $Ag^+ > Tl^+ > Na^+$

D. $Na^+ > Tl^+ > Ag^+$

Answer: C

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4.

Percent ionic characters for HF, HBr and HI follow the order.

A. HF lt HBr lt HI

B. HF gt HBr gt HI

C. HF gt HI gt HBr

D. HI gt HBr gt HF

Answer: B

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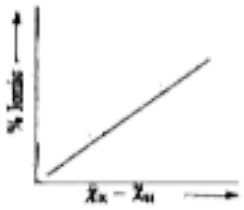
5. The percent ionic character of a polar bond may be computed from the expression Percent ionic character = $\frac{P_{\text{observed}}}{P_{\text{ionic}}} \times 100$ where P stands for dipole moment.

Based on the values of percent ionic character computed by the above expression, Pauling obtained t expression, percent ionic character = $18(\chi_x - xhi_H)^{1.4}$

where Chi_x and χ_H are electronegativity values of a halogen atom and H, respectively.

The variation of percent ionic character and electronegativity difference for H-X(where X is halogen) is shown in Figure:

A.



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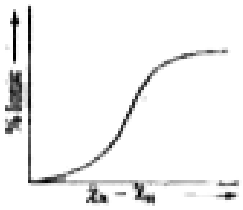

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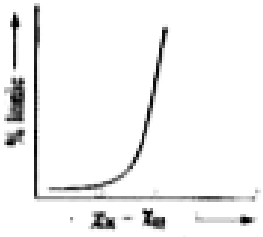
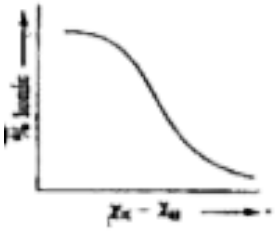


D.



Answer: B

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6. The percent ionic character of a polar bond may be computed from the expression Percent ionic character = $\frac{P_{\text{observed}}}{P_{\text{ionic}}} \times 100$ where P stands for dipole moment.

Based on the values of percent ionic character computed by the above expression, Pauling obtained t expression, percent ionic character = $18(\chi_x - xhi_H)^{1.4}$

where Chi_x and χ_H are electronegativity values of a halogen atom and H, respectively.

The variation of percent ionic character and electronegativity difference for H-X(where X is halogen) is shown in Figure:

A. 1.2

B. 2.08

C. 3.1

D. 3.5

Answer: B

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7. On the basis of M.O. theory which one of the following species does not exist?

A. He_2^{2+}

B. He_2

C. He_2^{+}

D. Li_2^{+}

Answer: B

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8. Which one of the following is paramagnetic and has bond order 1/2?

A. H_2

B. H_2^{+}

C. N_2

D. F_2

Answer: B

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9. During change of $NO^+ \rightarrow NO$, the electron is added to:

A. σ -orbitals

B. π- orbital

C. σ^* - orbital

D. π^* - orbital

Answer: D

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10. In which of the following molecules is the bond angle largest?

A. PF_3

B. PCl_3

C. PBr_3

D. PI_3

Answer: D

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11. The shape of a molecule is determined by electron-pair repulsions in the valence shell. A lp occupies a larger space than a bp because it is not shared by two nuclei. Thus, the lp-lp repulsion is greater than the lp - bp repulsion, which in turn is greater than the bp - bp repulsion. The presence of lp causes distortion of bond angles, hence, a deviation from an ideal shape. The extent of distortion depends upon the orientation of the lp's around the central atom. In a trigonal bipyramid, the lp's occupy equatorial positions than the axial ones. In AB type molecules, as the EN of A increases, the bp's come closer and the repulsion between them

increases. On the other hand, as EN of B increases, the bp's get farther and repulsion decreases.

Which of the following statements is true?

A. F-N-F angle in NF_3 is greater than H-N-H angle in NH_3 .

B. F-N-F angle in NF_3 is smaller than H-N-H angle in NH_3

C. H-O-H angle in H_2O is greater than H-N-H angle in NH_3

D. F-O-F angle in F_2O is greater than H-N-H angle in H_2O

Answer: B

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12.

Which of the following species will have the lone pair effects cancelled?

A. ICl_2^-

B. ClF_3

C. PCl_5

D. BrF_5

Answer: A

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