NEET REVISION SERIES

CHEMICAL BONDING AND MOLECULAR STRUCTURE

Revise Most Important Questions to Crack NEET 2020

Q-1 - 11467510

Calculate the formal charge on each atoms in nitrite ion .

SOLUTION:

Lewis structure of $NO_2^?$ ion is

(a) FC on N-atom:

No. of valence e^- on N-atom $= 5e^-{}'s$

Lone pair (lp) electrons on N-atom $= 1 \times 2 = 2e^-{}'s$

No. of bonding

$e^-{}'s = 3 \times 2$

$= 6e^-{}'s$

Hence FC on N-atom $= 5 - 2 - \frac{1}{2}(6) = 0$

(b) FC on O-atom (marked 1)

No.of valence $e^{-}{}'s$ on O-atom $6e^{-}{}'s$

Lone pair (lp) electrons on O-atom $= 2 \times 2 = 4e^{-}{}'s$

No. of bonds O-atom forms $= 2$

No . of bonding

$e^{-}{}'s = 2 \times 2$

$= 4e^{-}{}'s$

Hence FC on O-atom (marked 1)

$= 6 - 4 - \frac{1}{2}(4) = 0$

(c) FC on O-atom (marked2) No of valence e^{-} on O-

atom $= 6e^{-}{}'s$

Lone pair (lp) electrons on O-atom $= 3 \times 2 = 6$

No of bonds O-atom forms $= 1$

No of bonding

$e^{-}{}'s = 1 \times 2$

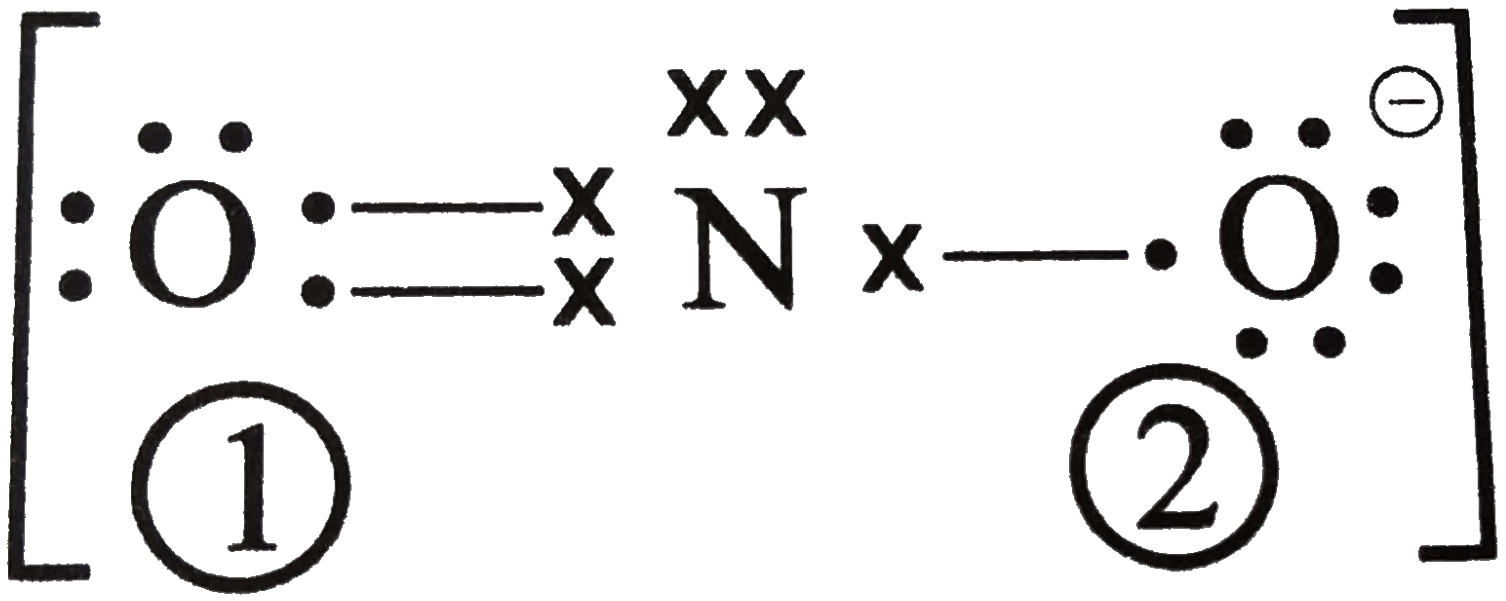
$= 2e^{-}{}'s$

Hence FC on O-atom (marked2)

$$= 6 - 6 - \frac{1}{2}(2) =$$

$$- 1$$

(d) Sum of $FC's =$ Net charge of $NO_2^? = -1$



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Q-2 - 11467969

How many of the following compounds violate octet rule

(i) BrF_5 (ii) SF_6 (iii) IF_7 (iv) $XeOF_4$

(v) CIF_2 (vi) $PCI_4^{\oplus}$.

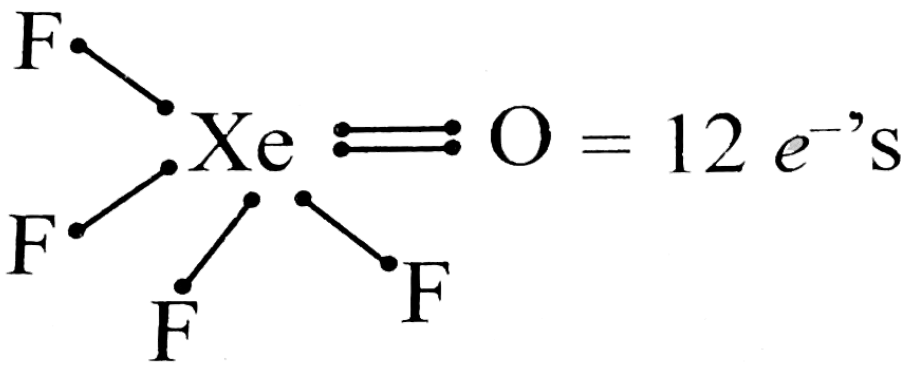
CORRECT ANSWER: 5

SOLUTION:

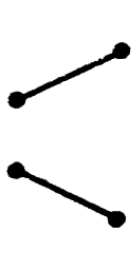
$BrF_5 = 10e^{-}{}'s$

(ii) $SF_6 = 12e^{-}{}'s$

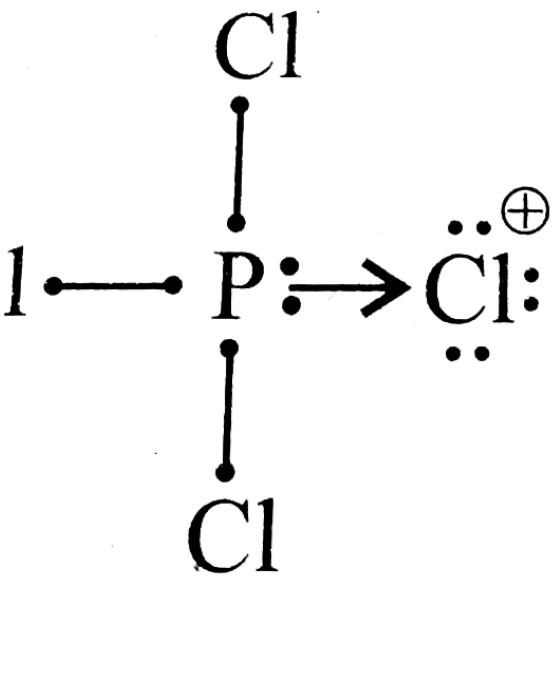
(iii) $IF_7 = 14e^{-}{}'s$

iv. $XeOF_4 \Rightarrow$ 

$= 12\ e^{-}$'s

v. $Cl\,F_2 \Rightarrow$ 

$= 4\ e^{-}$'s

vi. $PCl_4^{\oplus} \Rightarrow$ 

$= 8\ e^{-}$'s

Thus species (i) CIO_4^{Θ} and (iii) SO_4^{2-} are hypervalent species .

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Q-3 - 18698609

The increasing d-character in hybridisation of Xe in

XeF_2, XeF_4, XeF_6 is

(A)

$XeF_2 < XeF_4 < XeF_6$

(B)

$XeF_4 < XeF_2 < XeF_6$

(C)

$XeF_6 < XeF_4 < XeF_2$

(D)

$XeF_2 < XeF_6 < XeF_4$

CORRECT ANSWER: A

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Q-4 - 15217057

Which of the following is not hypovalent molecule or species ?

(A) NaF

(B) $COCl_2$

(C) CaF_2

(D) $BeCl_2$

CORRECT ANSWER: ABC

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Q-5 - 18255160

Which of the following molecules is correct regarding $BeCl_2$?

(A) It violates octet rule and has sp^2-hybridisation

(B) It has sp-hybridisation and follow octet rule

(C) It violates octet rule and has linear structure

(D) All of the above are true

SOLUTION:

(c) For

$$BeCl_2, h = \frac{2+2}{2}$$

$$= 2$$

$\Rightarrow$ Hybridisation=sp

$\Rightarrow$ Linear shape

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Q-6 - 11470010

Out of the following, select the compounds containing ionic,

covalent and coordinate bonds.

$CaCl_2, C_2H_6, MgO, HCI,$

$\overset{\oplus}{N}H_4, O_3$

SOLUTION:

Ionic =$CaCl_2, MgO$

Covalent =C_2H_6, HCl

Coordinate =$\overset{\oplus}{N}H_4, O_3$

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Q-7 - 14938378

The angle between two covalent bonds is maximum in ..

(CH_4, H_2O, CO_2)

CORRECT ANSWER: CO_2E

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Q-8 - 12973552

Which of the following types of bonds are present in N_2O_5?

(i) Ionic

(ii) Coordinate

(iii) Coordinate covalent

(iv) Metallic

(A) (i), (ii)

(B) (ii), (iii)

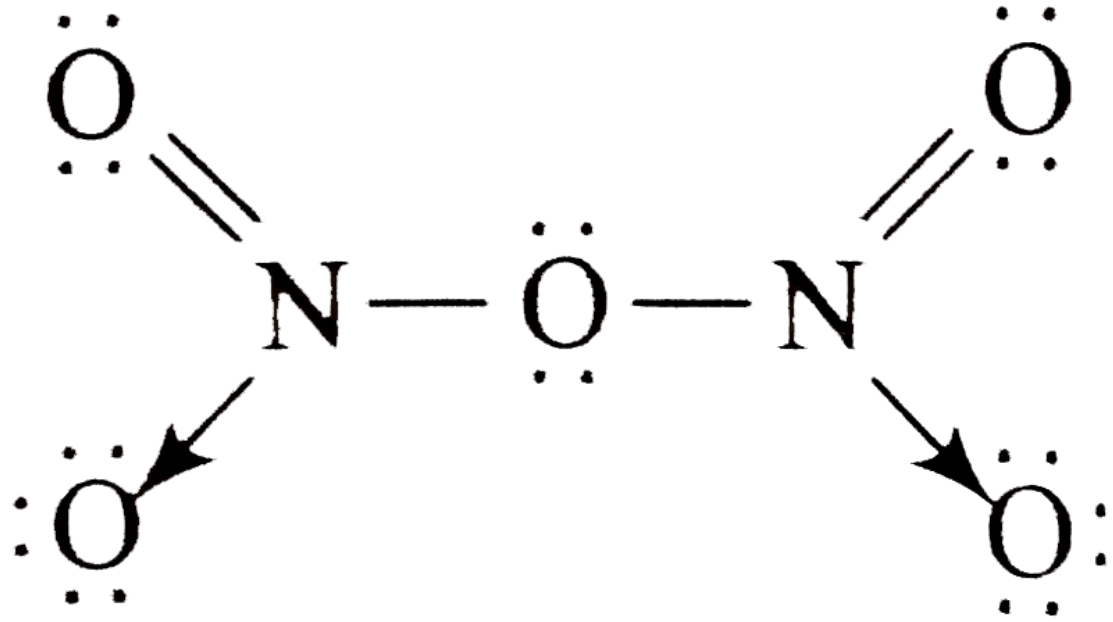
(C) (i), (ii), (iii)

(D) (ii)

CORRECT ANSWER: C

SOLUTION:

X-ray diffraction shows that solid N_2O_5 is ionic $NO_2^+ NO_3^-$ (nitronium nitrate). However, it is covalent in solution and in the gas phase, and has the Lewis structure:



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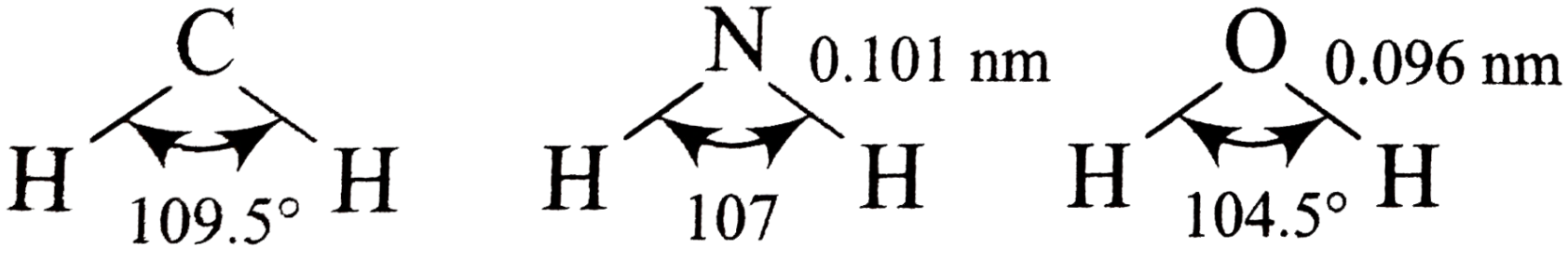
Q-9 - 12973715

The bond lengths and bond angles in the molecules of methane, ammonia, and water are given below:



This variation in bond angle is a result of

(i) the increasing repulsion between H atoms as the bond length decreases

(ii) the number of nonbonding electron pairs in the molecule

(iii) a nonbonding electron pair having a greater repulsive force than

a bonding electron pair

(A) (i), (ii), and (iii) are correct

(B) (i) and (ii) are correct

(C) (ii) and (iii) are correct

(D) only (i) is correct

CORRECT ANSWER: C

SOLUTION:

Option (i) is wrong because the smaller the bond length, the closer the H atoms are, the greater the repulsion between them and, hence, the greater the bond angle. C atom has no lone pair $\left(109.5^{\square}\right)$. N atom has one lone pair $\left(107^{\square}\right)$, and O atom has two lone pairs $\left(104.5^{\square}\right)$. The more the number of lone pairs, the greater the repulsion on bond pairs and, thus, the

smaller the bond angle is. Hence, options (ii) and (iii) are correct.

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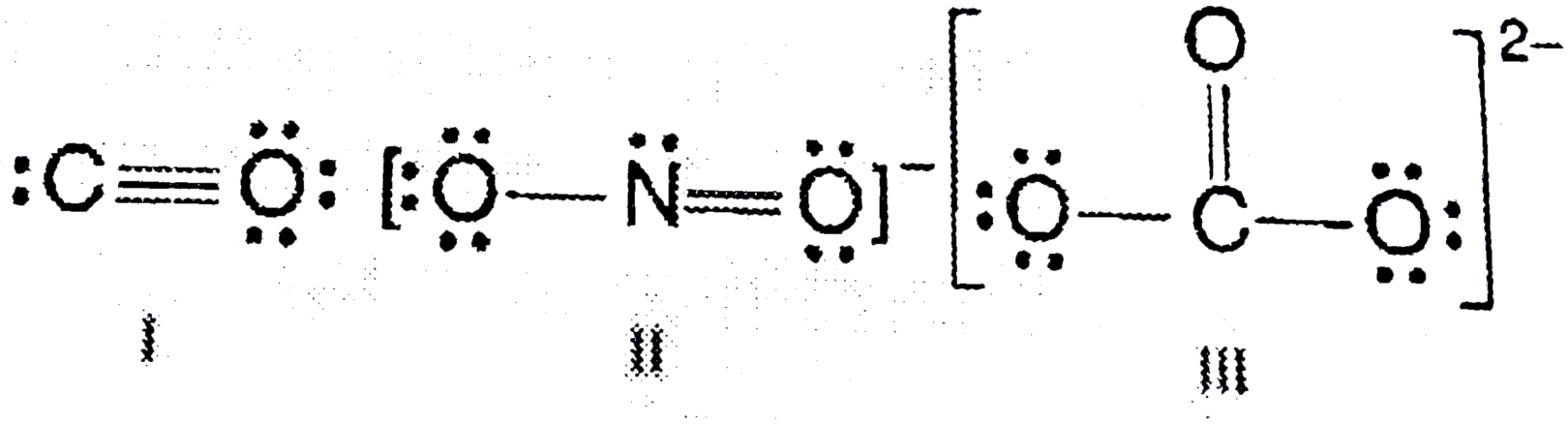
Q-10 - 18255153

Lewis structures of CO, NO_2^- and CO_3^{2-} are I, II and III respectivley given below.



Which of these structure(s) is/are wrong?

(A) Only I

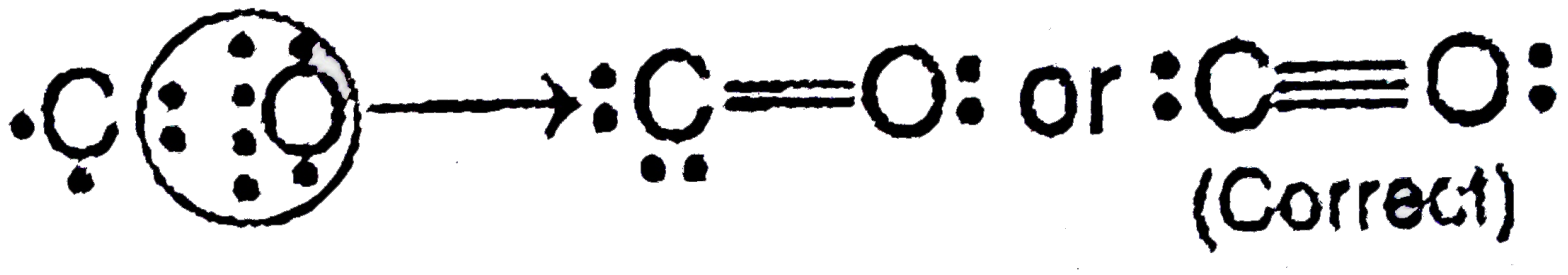
(B) Only II

(C) Only III

(D) I, II and III

SOLUTION:

(a) I may be correctly represented as



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Q-11 - 11467502

Write the Lewis structure of the nitrite ion $\left(NO_2^?\right)$.

SOLUTION:

Count the total number of valence electrons of the nitrogen atom the oxygen atoms and the additional one negative charge (equal to one electron)

$N\left(2s^2 2p^3\right), O\left(2s^2 2p^4\right)$

$5+(2 \times 6)+1=18$ electrons

Step 2 The skeletal struture of $NO_2^?$ is written as

$ON.O$

Step 3 Draw a single bond (one shared electron pair)

between the nitrogen if the remaining two electrons

constitute lone pair on it

$$\left[:\dot{\underset{\cdot\cdot}{O}}:\dot{N}:\dot{\underset{\cdot\cdot}{O}}:\right]^{?}$$

Hence we have to resort to multiple bonding between

nitrogen and one of the oxygen atoms (in the case a

double bond) This leads to the following Lewis

$$\left[\dot{\underset{\cdot\cdot}{O}}::\dot{N}:\dot{\underset{\cdot\cdot}{O}}:\right]^{?} \text{ or } \left[\dot{\underset{\cdot\cdot}{O}}\right.$$

$$\left.=\dot{N}-\dot{\underset{\cdot\cdot}{O}}:\right]^{?} \text{ or } \left[:\dot{\underset{\cdot\cdot}{O}}\right.$$

$$\left.-\dot{N}=\dot{\underset{\cdot\cdot}{O}}\right]^{?}$$

.

Q-12 - 12973640

A coordinate bond is a dative bond. Which of the following is true?

(A) Two atoms bond by sharing electrons from third atom.

(B) Two atoms form bond by sharing their electrons.

(C) Two atoms form bond and one of them provides both electrons.

(D) Three atoms form bond by sharing their electrons.

CORRECT ANSWER: C

SOLUTION:

During the formation of a coordinate covalent bond, two atoms share an electron pair, but both the electrons for sharing are provided by one of the atoms called donor atom. The other atom is called an acceptor atom.

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Q-13 - 12973550

In the linear I_3^- (triiodide ion), the central iodine atom contains

(A) two unpaired electrons

(B) no unshared pair of electrons

(C) four unshared pairs of electrons

(D) three unshared pairs of electrons

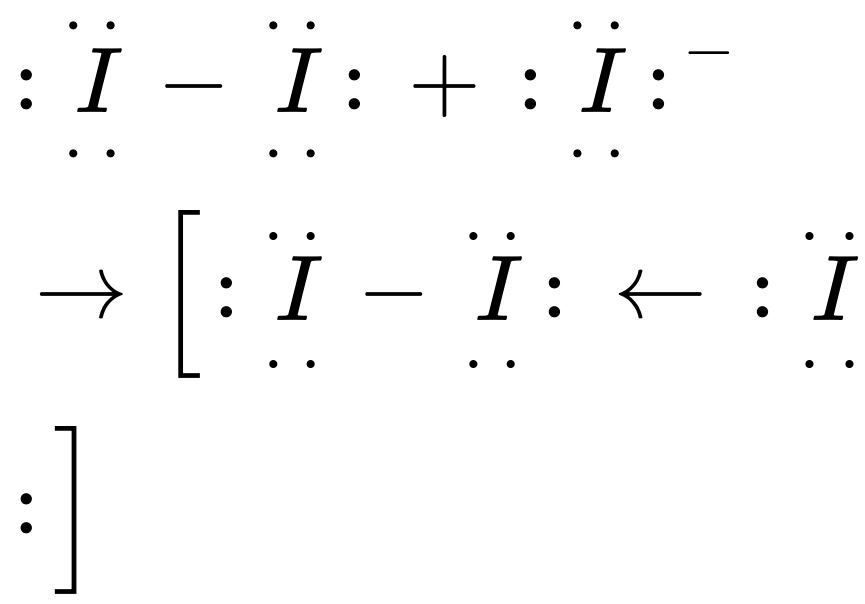
CORRECT ANSWER: D

SOLUTION:

The formation of triiodide ion can be conceptualized as follows:

$I_2 + I^- \rightarrow I_3^-$

or



Calculation of formal charge (FC) shows that

for I on ends, $FC = 7 - (6 + 1) = 0$

for I in middle,

$FC = 7 - (6 + 2) =$

-1

Note that the negative charge on I^- is nullified in I_3^-

by the positive formal charge of the coordinate covalent bond or we can say that it is transferred to the central iodine. Also note that the central iodine atom in I_3^- has an expanded valence shell with 3 lone pairs of electrons. There is a shortcut method. Considering the negative charge on central I atom, we have $7 + 1 = 8$ valence

electrons for central I. Two of these are used up to form two covalent bonds leaving 3 lone pairs.

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Q-14 - 11467712

Which among the following is (are) having two lone pair of electrons on central atom ? .

(A) CO_2

(B) CIF_3

(C) SO_3^{2-}

(D) XeF_4

CORRECT ANSWER: B::D

SOLUTION:

$:\ddot{C}IF_3, :\ddot{X}eF_4$.

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Q-15 - 11467778

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

(A) $[ClO_3]^?$

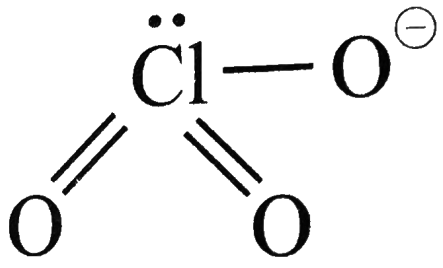
(B) XeF_4

(C) N_2O

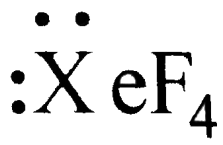
(D) $[I_3]^?$

CORRECT ANSWER: D

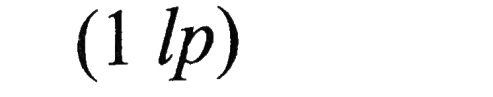
SOLUTION:

a. 

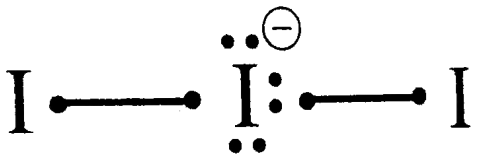
(1 *lp*)

b. 

(2 *lp*)

c. 

(1 *lp*)

d. 

(3 *lp*)

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Q-16 - 11467554

By completing the following structures, adding unshared e^- pairs

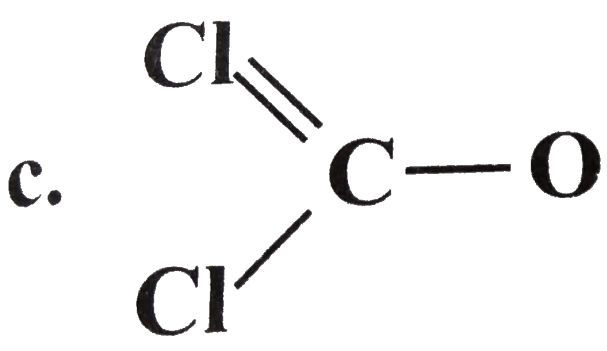
when necessary calculate the charges

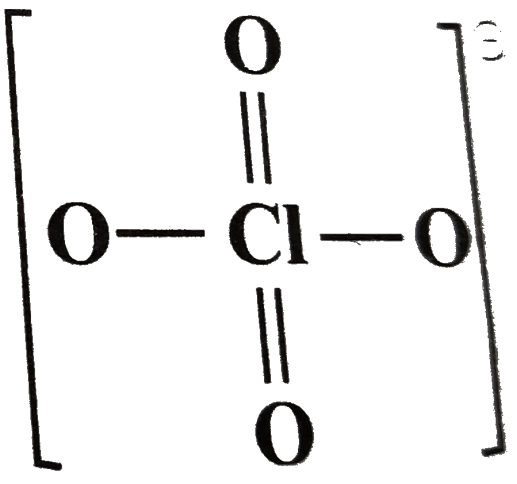
(a) $N \equiv C - \ \equiv N$

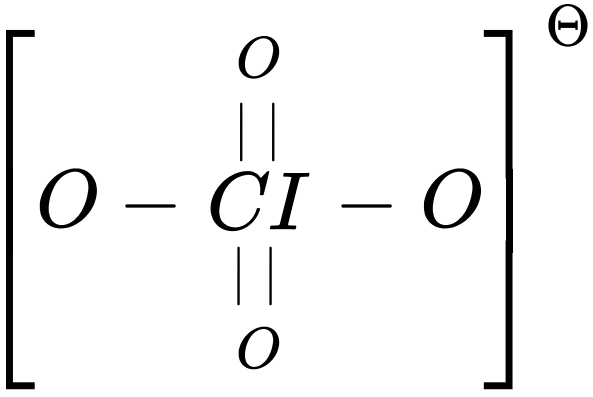
$CI - C \equiv N$

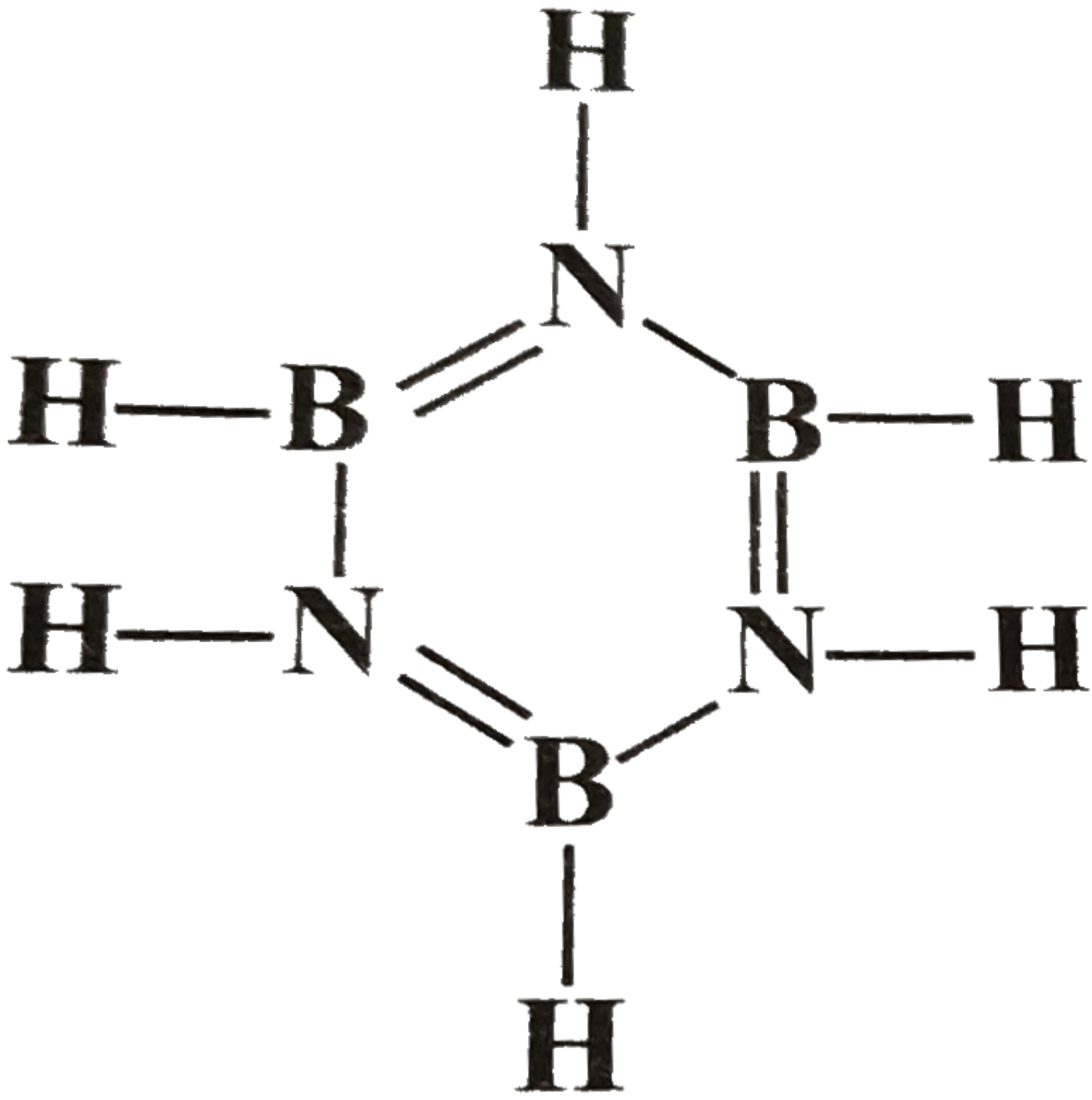
a. 

b. 

c. 

d. 





SOLUTION:

FC on an atom =

$$\left[\begin{array}{c}\text{Total no. of}\\ \text{velence}\quad e^-,s\\ (V)\end{array}\right]$$

$$-\left[\begin{array}{c}\text{Total no. of}\\ \text{non-boding}\quad e^-,s\\ (nb)\end{array}\right]$$

$$-\frac{1}{2}\left[\begin{array}{c}\text{Total no. of}\\ \text{bonding}\quad e^-,s\\ (b)\end{array}\right]$$

$$(\ \text{or}\ )FC=(V)$$

$$-(nb)-\frac{1}{2}(b)$$

(a) $\dot{\dot{N}}\equiv C-C\equiv\dot{\dot{N}}$ (All zero)

$$FConN=(V)-(nb)$$

$$-\frac{1}{2}(b)=5-2-\frac{1}{2}$$

$$\times 6=zero$$

$$FConC = 4 - 0 - \frac{1}{2} \times 8 = Zero$$

$$\left[: \dot{\dot{C}}1 - C \equiv \dot{\dot{N}} \right]$$ (All zero)

$$F\dot{\dot{C}}onCI = (V)$$

$$- (nb) - \frac{1}{2}(b) = 7$$

$$- 6 - \frac{1}{2} \times 2 = zero$$

$$FConC = 4 - 0 - \frac{1}{2} \times 8 = zero$$

$$FConN = 5 - 2 - \frac{1}{2} \times 6 = zero$$

$$FConCI^{1} = 7 - 4 - \frac{1}{2} \times 4 = +1$$

$$FConCI^{2} = 7 - 6 - \frac{1}{2} \times 2 = zero$$

$$FConC = 4 - 0 - \frac{1}{2} \times 8 = zero$$

$$FConO = 6 - 6 - \frac{1}{2} \times 2 = -1$$

$$FConCI = 7 - 0 - \frac{1}{2} \times 12 = +1$$

$$FConO^{1} = 6 - 6 - \frac{1}{2} \times 2 = -1$$

$$FConO^{2} = 6 - 4 - \frac{1}{2} \times 4 = zero$$

$$FConN = 5 - 0 - \frac{1}{2}$$

$$\times 8 = +1$$

$$FConB = 3 - 0 - \frac{1}{2}$$

$$\times 8 = -1$$

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Q-17 - 12973556

Which of the following molecules has the longest nitrogen-nitrogen bond?

(A) N_2H_4

(B) N_2

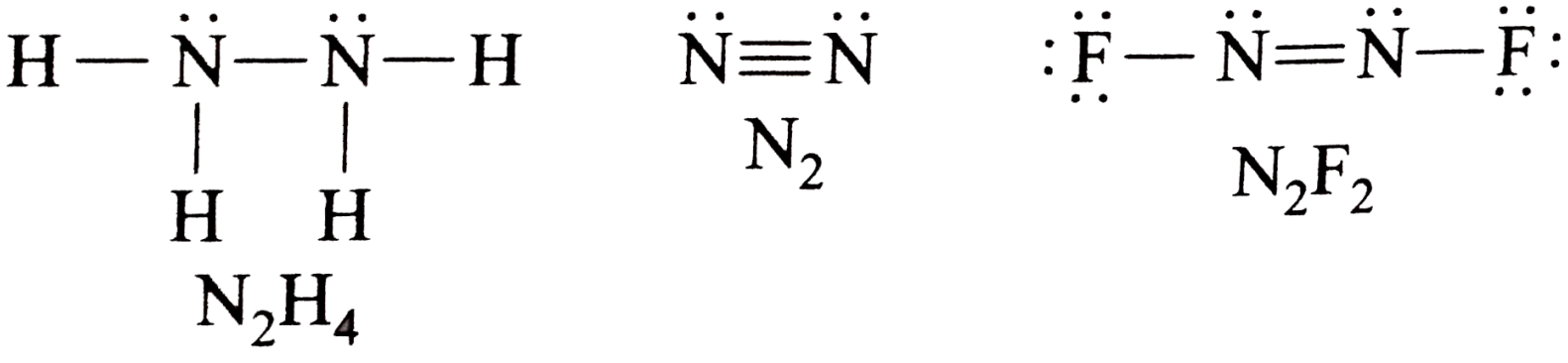
(C) N_2F_2

(D) All have equal bond lengths

CORRECT ANSWER: A

SOLUTION:

First write the Lewis structures:



The nitrogen-nitrogen bond should be the shortest in N_2, where it is a triple bond, and the longest in N_2H_4, where it is a single bond. Experimental values for the nitrogen-nitrogen bond lengths are 109 pm for N_2, $122pm$ for N_2F_2, and $147pm$ for N_2H_4.

Q-18 - 14938370

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

CORRECT ANSWER: INCREASES, DECREASES

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Q-19 - 12973573

How many resonating structures can be drawn for NO_2?

(A) Six

(B) Four

(C) Five

(D) Two

CORRECT ANSWER: B

SOLUTION:

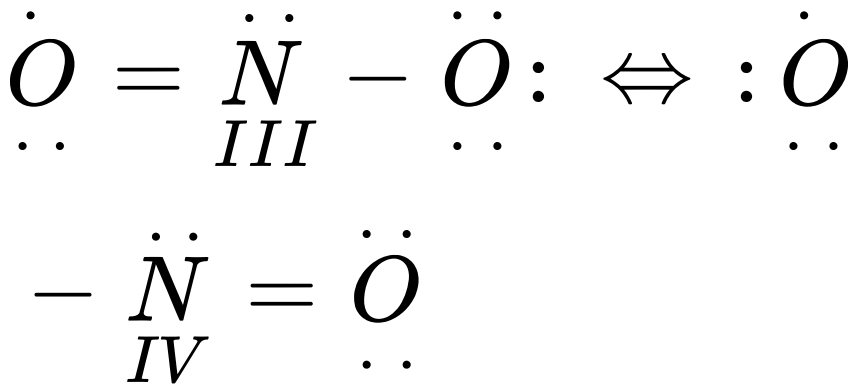
Since NO_2 has $5 + (2 \times 6) = 17$ valence electrons, an odd number, not all of its atoms can have complete octets. Without considering nonbonding electrons, we can write two structures:

$$O = N - O \Leftrightarrow O - N = O$$

In distributing the nonbonding electrons, we can write structures in which N atom has an incomplete octet and has the unpaired (or odd) electron:

$$\overset{\cdot\cdot}{O} = \underset{I}{\dot{N}} - \overset{\cdot\cdot}{O}: \Leftrightarrow :\overset{\cdot\cdot}{O} - \underset{II}{\dot{N}} = \overset{\cdot\cdot}{O}$$

or structures in which the O atoms have incomplete octet, such as



The first two structures, in which the N atom has an incomplete octet, make the most important contribution. Structures such as the last ones, in which the O atom has incomplete octet, are less important, since the most electronegative element usually has the completed octet.

Q-20 - 12973580

Which of the following has the highest dipole moment?

(A) o-Dichlorobenzene

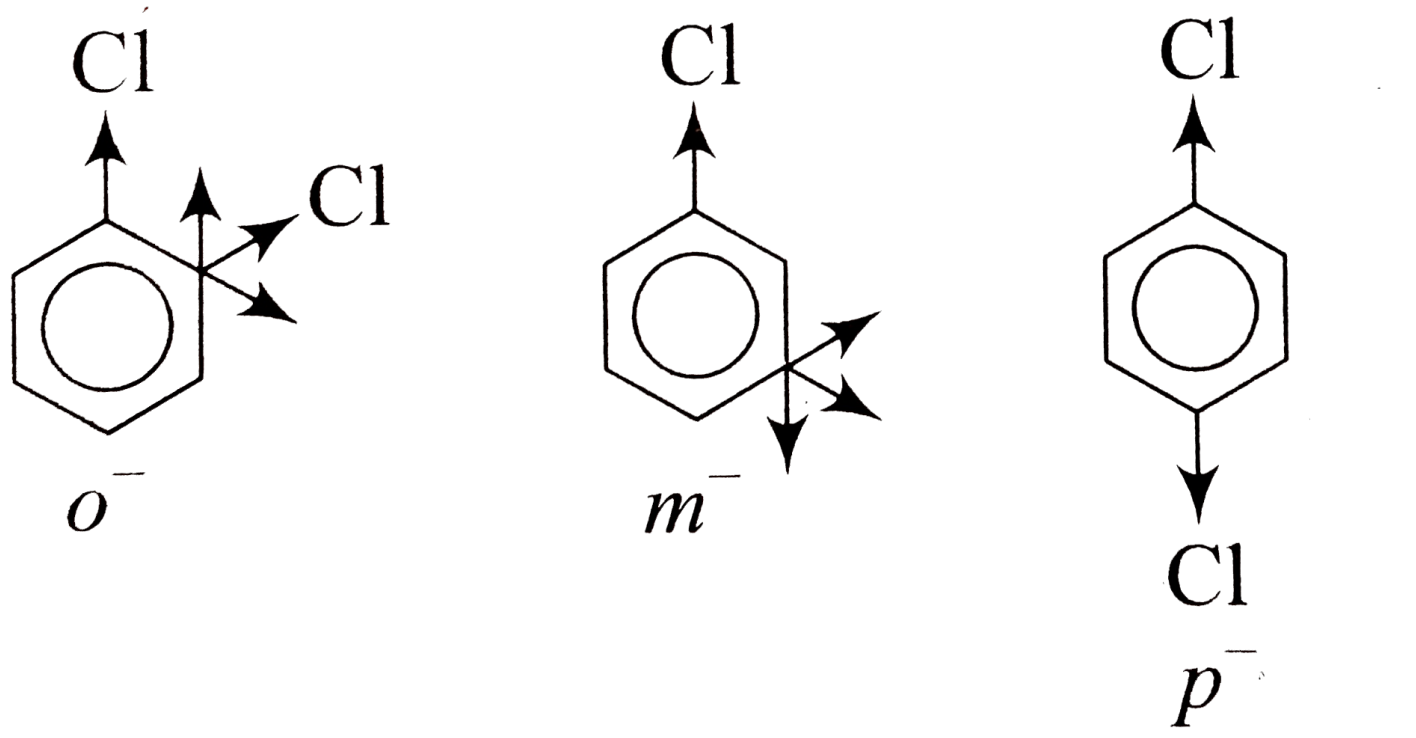
(B) m-Dichlorobenzene

(C) p-Dichlorobenzene

(D) All have equal values

CORRECT ANSWER: A

SOLUTION:



In p-dichlorobenzene, the two $C - Cl$ bond dipoles (equal in magnitude and opposite in direction) cancel each other. In o-dichlorobenzene, the vertical component of one $C - Cl$ bond dipole reinforces the bond dipole of other $C - Cl$ bond dipoles (equal in magnitude and opposite in direction) cancel each other. In o-dichlorobenzene, the vertical component of one $C - Cl$ bond dipole reinforces the bond dipole of other

$C - Cl$ bond while in m-dichlorobenzene, the vertical component of one $C - Cl$ bond dipole opposes the bond dipole of another $C - Cl$ bond.

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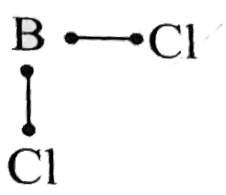
Q-21 - 11469953

Discuss the shape of the following molecules using the $VSEPR$ model:

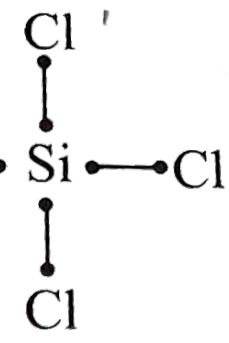
$BeCl_2, BCl_3, SiCl_4, AsF_5, H_2S, PH_3$

SOLUTION:

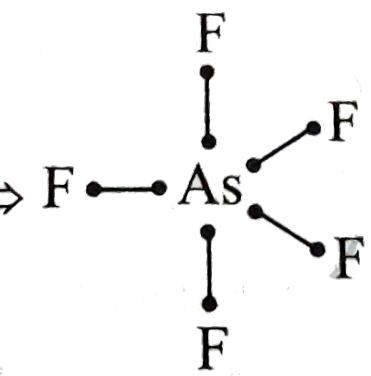
a. $BeCl_2 \Rightarrow$ Cl •—• Be •—• Cl [Central atom (i.e. Be) have only 2 *bp*'s hence, shape is linear.]

b. $BCl_3 \Rightarrow$ 

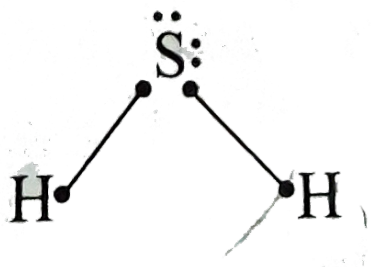
[Central atom (i.e. B) have only 3*bp*'s; hence shape is planar]

c. $SiCl_4 \Rightarrow$ 

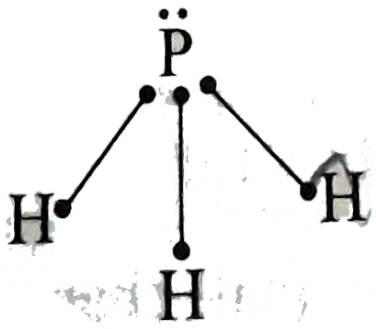
[Central aotm (i.e. Si) have only 4*bp*'s, hence shape is tetrahedral]

d. $AsF_5 \Rightarrow$ 

[Central aotm (i.e. As) have only 5*bp*'s; hence shape is trigonal bipyramidal (Tbp)]

e. $H_2S \Rightarrow$ 

[Central aotm (i.e. S) have 2*bp*'s and 2 *lp*'s; hence shape is V-shaped or bent shape]

f. $PH_3 \Rightarrow$ 

[Central aotm (i.e. P) have 3*bp*'s and 1 *lp*; hence shape is pyramidal]

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Q-22 - 12675656

The number of antibonding electron pairs in O_2^{2-} molecular ion on the basic of molecular orbital theory is

(A) 4

(B) 3

(C) 2

(D) 5

CORRECT ANSWER: A

SOLUTION:

O_2^2 consists of four antibonding electron pair

$[1s \text{ and } 2s$ have two antibonding, electron pair and

$2p_x, 2p_y$ have two antibonding electron pair].

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Q-23 - 12973625

If E is the total energy of the combining atomic orbitals, and E_b and

E_a are the energies of the bonding and antibonding molecular

orbitals formed, respectively, then

(A) $E - E_b < E_a - E$

(B) $E - E_b = E_a - E$

(C) $E - E_b > E_a - E$

(D) Any of these depending upon the nature of combining atoms

---

CORRECT ANSWER: A

SOLUTION:

The energy of the bonding MO is lower than that of the atomic orbitals by an amount $\Delta(= E - E_b)$. This is known as the stabilization energy. Similarly, the energy of the antibonding molecular orbital is increased by $\Delta(= Ea - E)$ and is referred to as the destabilization energy. In general, the destabilization energy is greater

than the stabilization energy because the antibonding MO is raised more in energy than the energy by which the bonding MO is lowered.

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Q-24 - 14625898

In terms of the molecular orbital theory , which of the following species will most likely be the one to gain an electron to form thermodynamically more stable species?

(A) CN

(B) NO

(C) O_2^{2+}

(D) N_2

CORRECT ANSWER: 1

SOLUTION:

$(1) CN (6+7=13)$

$= \sigma 1s^2 \sigma^* 1s^2 \sigma 2s^2 \sigma^* 2s^2 \pi 2p_x^2$

$= \pi 2p_y^2 \sigma 2p_z^1,$

Bond order $= \dfrac{9-4}{2} = 2.5$

$CN^- (6+7+1=14)$

$= \sigma 1s^2 \sigma^* 1s^2 \sigma 2s^2 \sigma^* 2s^2 \pi 2p_x^2$

$= \pi 2p_y^2 \sigma 2p_z^2,$

Bond order $= \dfrac{10-4}{2} = 3$

$(2) NO (7+8=15)$

$= \sigma 1s^2 \sigma^{\cdot} 1s^2 \sigma 2s^2 \sigma^{\cdot} 2s^2 \sigma 2p_z^2 \pi 2p_x^2 = \pi 2p_y^2 \pi^{\cdot} 2p_x^1 = \pi^{\cdot}$

Bond order $= \dfrac{10-5}{2} = 2.5$

$NO^- (7+8+1=16)$

$= \sigma 1s^2 \sigma^{\cdot} 1s^2 \sigma 2s^2 \sigma^{\cdot} 2s^2 \sigma 2p_z^2 \pi 2p_x^2 = \pi 2p_y^2 \pi 2p_x^1 = \pi^{\cdot} 2$

Bond order $= \dfrac{10-6}{2} 2.0$

$(3) O_2^{2+} (8+8-2$

$= 14)$

$= \sigma 1s^2 \sigma^{\cdot} 1s^2 \sigma 2s^2 \sigma^{\cdot} 2s^2 \sigma 2p_z^2 \pi 2p_x^2 = \pi 2p_y^2 \pi^{\cdot} 2p_y = \pi^{\cdot}$

Bond order $= \dfrac{10-4}{2} = 3.0$

$O_2^+(8+8-1=15)$

$= \sigma 1s^2 \sigma^{\cdot} 1s^2 \sigma 2s^2 \sigma^{\cdot} 2s^2 \sigma^* 2p_z^2 \pi 2p_x^2 = \pi 2p_y^2 \pi^{\cdot} 2p_x^1 = \pi$

Bond order $= \dfrac{10-5}{2} = 2.5$

$(4) N_2(7+7$

$= 14$

$)\sigma 1s^2 \sigma^{\cdot} 1s^2 \sigma 2s^2 \sigma^{\cdot} 2s^2 \pi 2p_x^2$

$= \pi 2p_y^2 \sigma 2p_z^2,$

Bond order $= \dfrac{10-4}{2} = 3$

$N_2^-(7+7+1=15)$

$= \sigma 1s^2 \sigma^{\cdot} 1s^2 \sigma 2s^2 \sigma^{\cdot} 2s^2 \pi 2p_x^2$

$= \pi 2p_y^2 \sigma 2p_z^2 \pi^{\cdot} 2p_x^1,$

Bond order $= \dfrac{10-5}{2} = 2.5$

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Q-25 - 14938419

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

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

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

(C) N_2^+ and N_2^- have the same bond order

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

CORRECT ANSWER: A,C

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Q-26 - 12675560

Main axis of diatometic molecule is z, molecular orbatals p_x and p_y overlap to form, which of the following orbital?

(A) π- molecular orbital

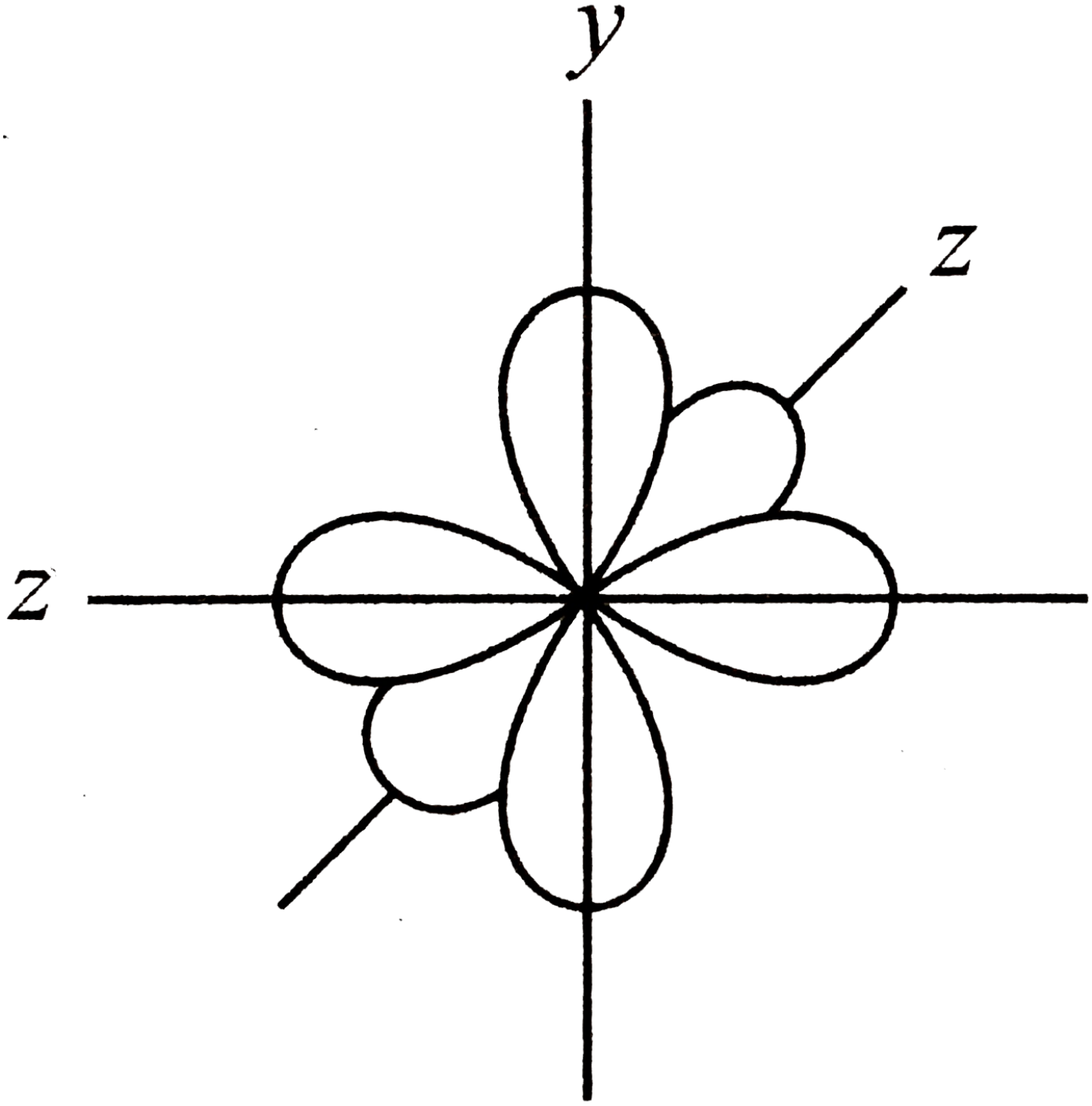
(B) σ- molecular orbital

(C) δ- molecular orbital

(D) no bond will form

CORRECT ANSWER: A

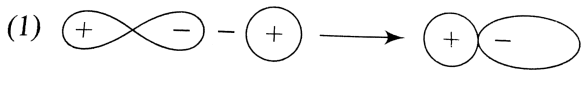
SOLUTION:

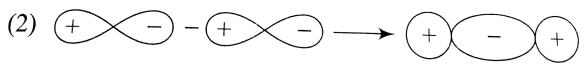


P_y and P_z overlap laterally forming π bonds

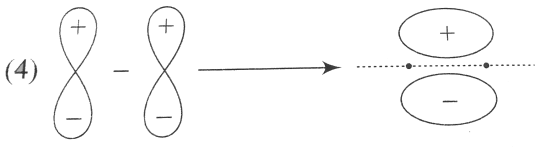
Q-27 - 12973623

Which of the following linear combinations of atomic orbitals is incorrectly depicted?

(A) 

(B) 

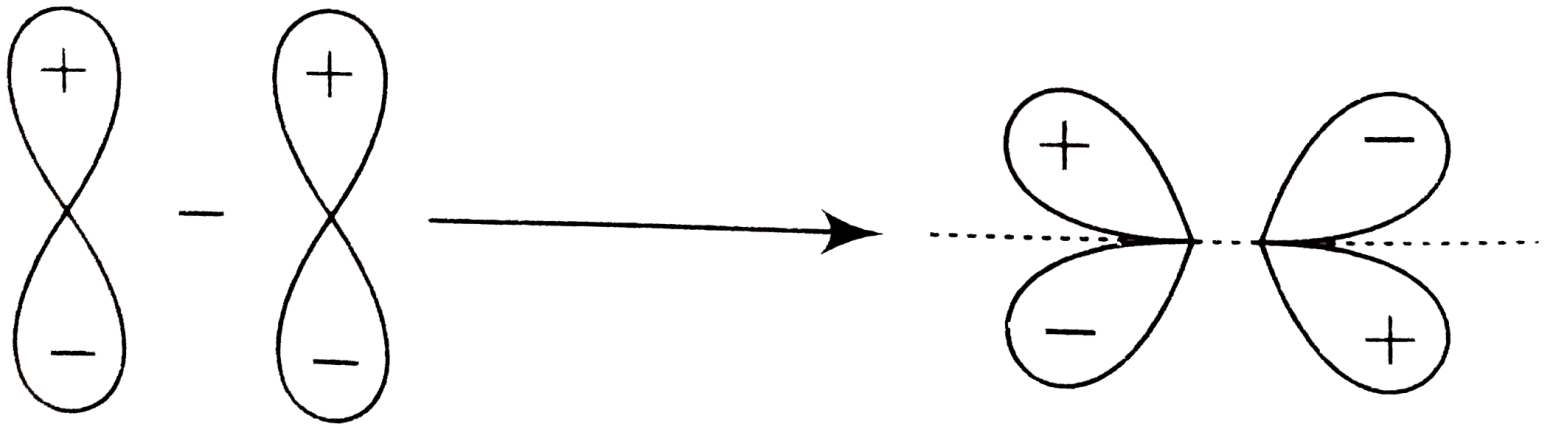
(C) 

(D) 

CORRECT ANSWER: D

SOLUTION:

This combination is incorrectly depicted because it leads to the formation of an antibonding MO.



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Q-28 - 17785726

CONDITIONS FOR COMBINATIONS OF ATOMIC ORBITALS

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Q-29 - 12973624

The energy of σ_{2x}, is greater than that of σ_{1s}^{*} orbital because

(A) σ_{2s} orbital is formed only after $1s$

(B) σ_{2s} orbital is bigger than σ_{1s} orbital

(C) σ_{2s} orbital has a greater value of n than σ_{1s}^{*}

(D) σ_{2s} is a bonding orbital while σ_{2x}^{*} is an antibonding orbital.

CORRECT ANSWER: C

SOLUTION:

Although the antibonding orbital $\left(\sigma_{1s}^{*}\right)$ has higher energy and is, thus, less stable than the bonding orbitals $\left(\sigma_{1s}\right)$, but this antibonding orbital has greater stability than the bonding orbital $\left(\sigma_{2s}\right)$ because the energy of an MO increases as the value of the principal quantum number (n) increases.

This simply reminds us that the concepts of stability and energy applied here are relative.

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Q-30 - 17242101

In a hydrogen atom, which orbital is higher in energy than a 3s-orbital?

(A) 2s

(B) 3p

(C) 3d

(D) 4s

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Q-31 - 12973625

If E is the total energy of the combining atomic orbitals, and E_b and E_a are the energies of the bonding and antibonding molecular orbitals formed, respectively, then

(A) $E - E_b < E_a - E$

(B) $E - E_b = E_a - E$

(C) $E - E_b > E_a - E$

(D) Any of these depending upon the nature of

combining atoms

CORRECT ANSWER: A

SOLUTION:

The energy of the bonding MO is lower than that of the atomic orbitals by an amount $\Delta(= E - E_b)$. This is known as the stabilization energy. Similarly, the energy of the antibonding molecular orbital is increased by $\Delta(= Ea - E)$ and is referred to as the destabilization energy. In general, the destabilization energy is greater than the stabilization energy because the antibonding MO is raised more in energy than the energy by which the bonding MO is lowered.

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Q-32 - 12973626

Which of the following MOs has more than one nodal plane?

(A) π_{2p_y}

(B) σ_{2s}

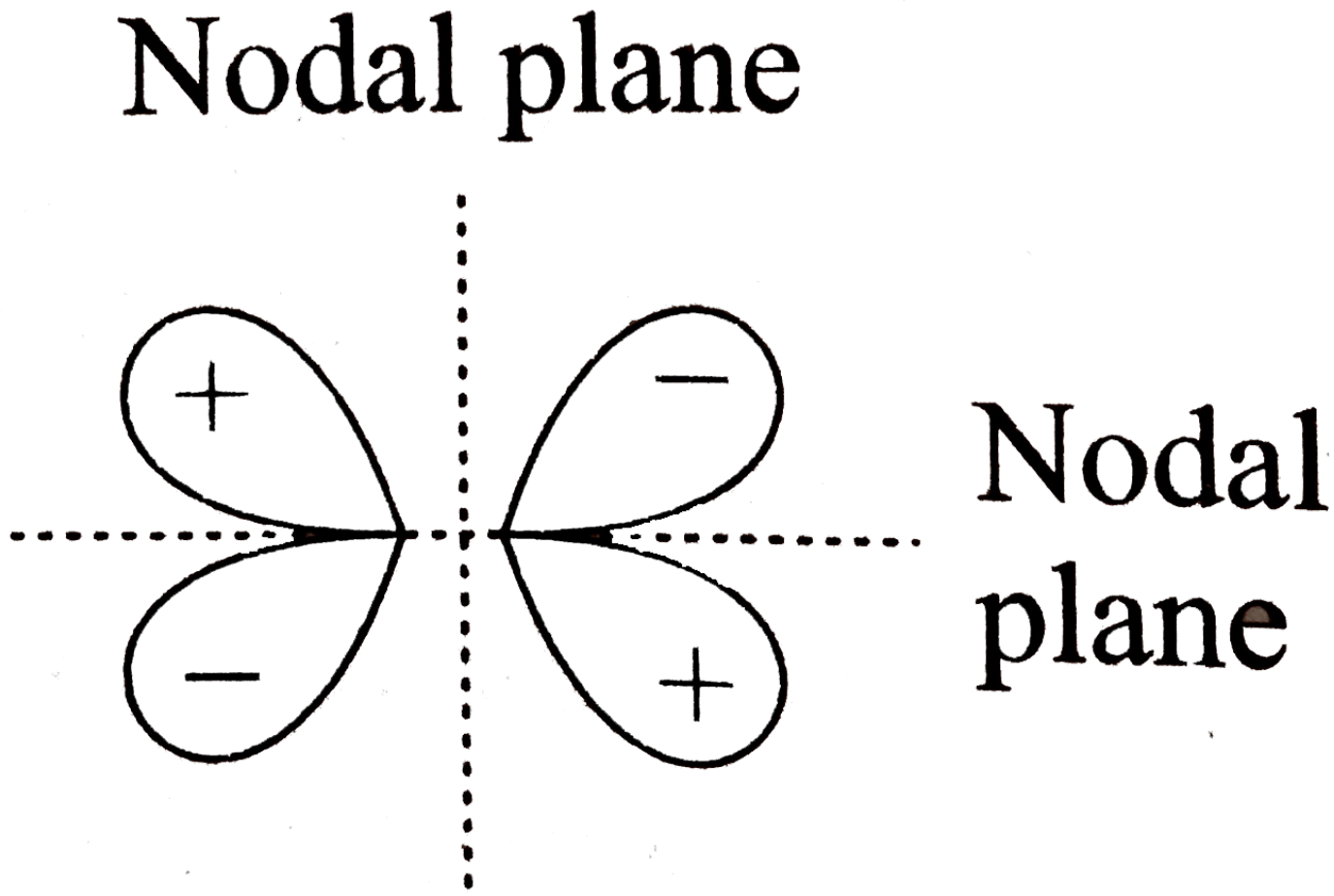
(C) $\sigma^*_{2p_x}$

(D) $\pi^*_{2p_y}$

CORRECT ANSWER: D

SOLUTION:

We assume that the z-axis is the internuclear axis. σ_{2s} has no nodal plane. $\sigma^*_{2p_x}$ and π_{2p_y} both have one nodal plane. $\pi^* 2p_y$ has two nodal planes: one along the internuclear axis while the other perpendicular to the internuclear axis.



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Q-33 - 12973631

The strongest hydrogen bonding exists in

(A) hydrogen sulphide

(B) hydrogen fluoride

(C) ammonia

(D) water

CORRECT ANSWER: B

SOLUTION:

Because F is the most electronegative element. The

correct order of the strength of H bonds is

$$H.F > HO > H.N > H.S$$

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Q-34 - 12973640

A coordinate bond is a dative bond. Which of the following is true?

(A) Two atoms bond by sharing electrons from third atom.

(B) Two atoms form bond by sharing their electrons.

(C) Two atoms form bond and one of them provides both electrons.

(D) Three atoms form bond by sharing their electrons.

CORRECT ANSWER: C

SOLUTION:

During the formation of a coordinate covalent bond, two atoms share an electron pair, but both the electrons for sharing are provided by one of the atoms called donor atom. The other atom is called an acceptor atom.

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Q-35 - 11467774

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

(A) 2

(B) 4

(C) 6

(D) 10

CORRECT ANSWER: C

SOLUTION:

$N \equiv N : N : : N : .$

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Q-36 - 18255160

Which of the following molecules is correct regarding $BeCl_2$?

(A) It violates octet rule and has sp^2-hybridisation

(B) It has sp-hybridisation and follow octet rule

(C) It violates octet rule and has linear structure

(D) All of the above are true

SOLUTION:

(c) For

$$BeCl_2, h = \frac{2+2}{2}$$

$$= 2$$

$\Rightarrow$ Hybridisation=sp

$\Rightarrow$ Linear shape

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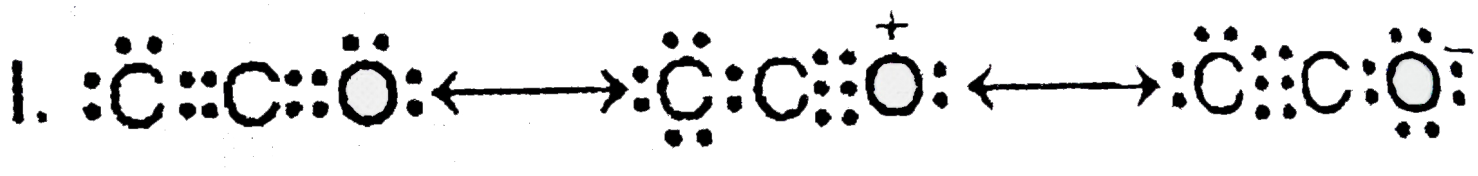
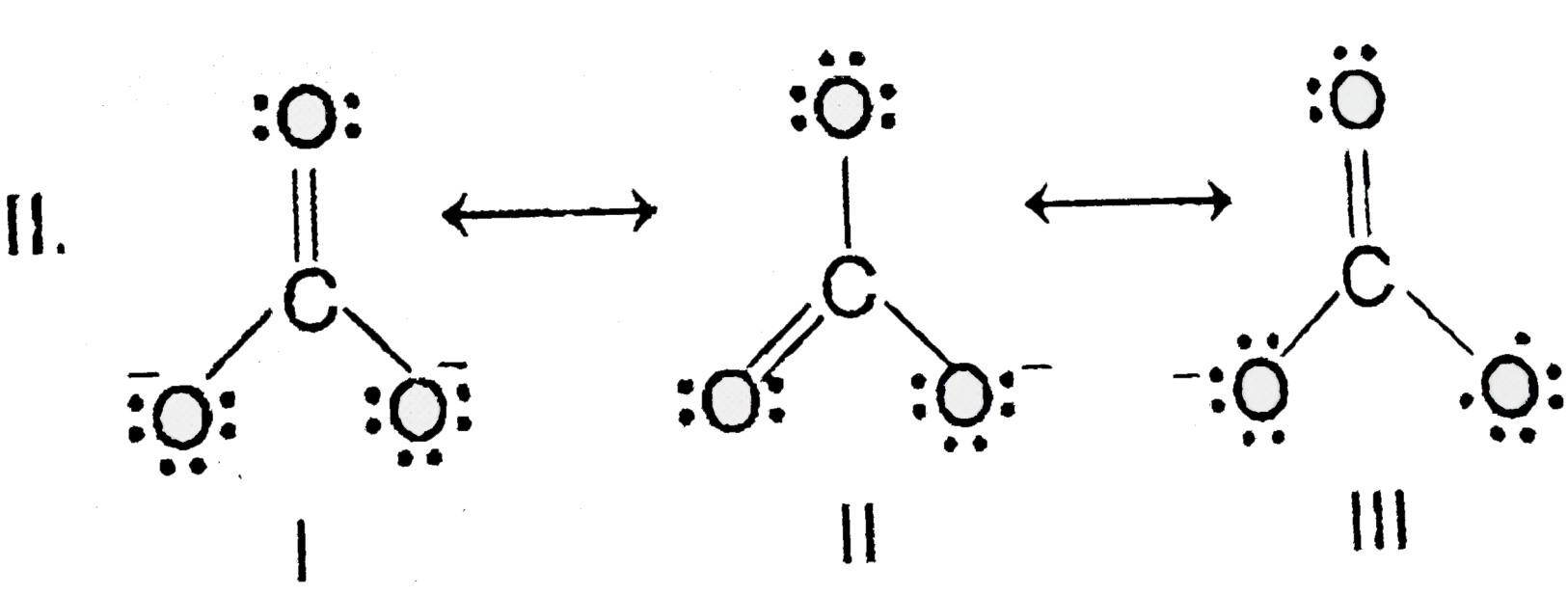
Q-37 - 18255187

Which of the following is not the correct representation of

I. 

II. 

I II III

resonance?

(A) Only I

(B) Only II

(C) Both I and II

(D) None of these

SOLUTION:

(d) Both representation of resonating structure in molecules of CO_2 and CO_3^{2-} are correct.

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Q-38 - 18683740

The ratio of the number of sp, sp^2, and sp^3 orbitals in the compound is

$CH_3 - CH = C = CH - C$
$\equiv C - CH_3$

(A) $1:1:1$

(B) $2:2:1$

(C) $3:2:1$

(D) $3:3:4$

CORRECT ANSWER: D

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Q-39 - 12973677

The number of nodal planes present in a σ^* antibonding orbital is

(A) 2

(B) 3

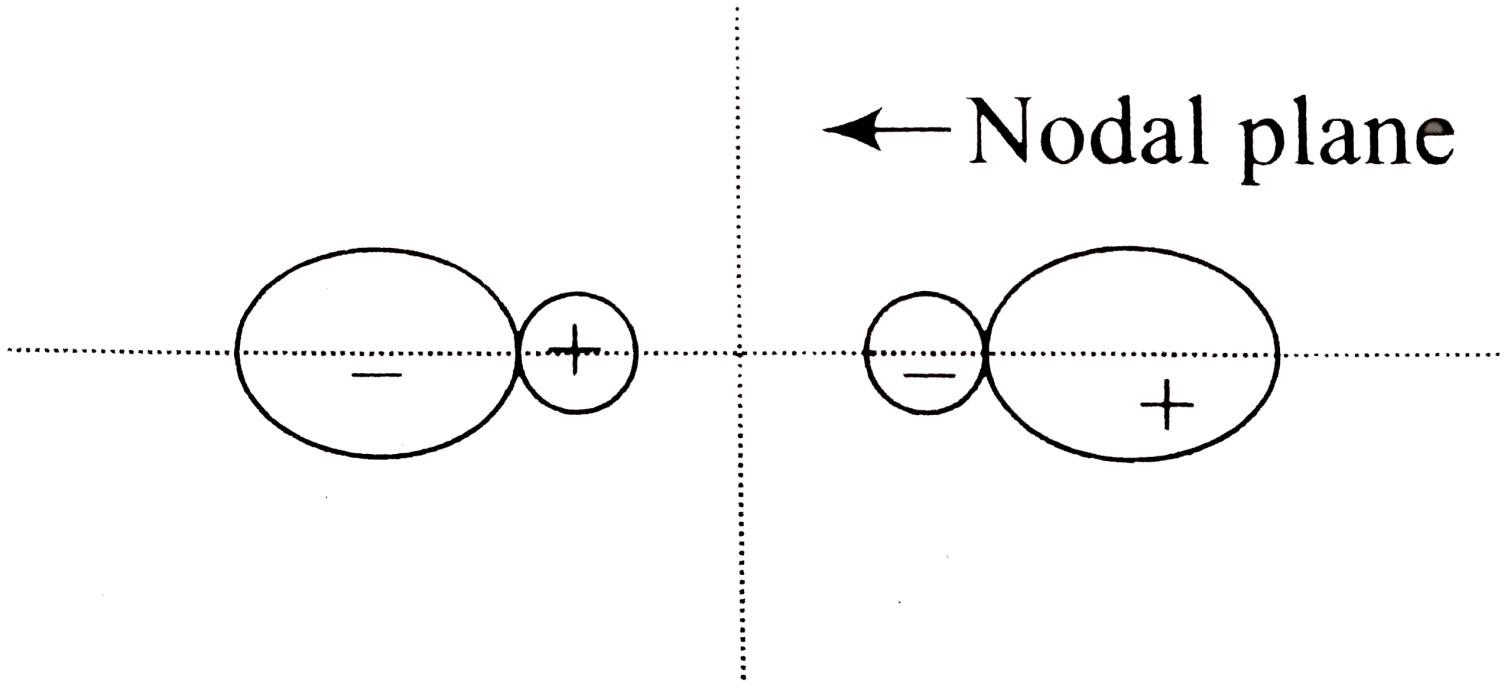
(C) 1

(D) 0

CORRECT ANSWER: C

SOLUTION:

All sigma antibonding MOs having one nodal plane perpendicular to the internuclear axis:



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Q-40 - 11467915

Which of following statement is correct ? .

(A) The bond angle of NCI_3 is greater than that of NH_3

(B) The bond angle of PH_3 is greater than that of PF_5

(C) $CIO_3^?$ and SO_3^{2-} are isostructural

(D) It is not necessary that in Tbp structure the lone pairs always would occupy the equatorial positions .

CORRECT ANSWER: C

SOLUTION:

In NCI_3, CI is more EN thus bond pairs are pushed near Therefore bond angle of $NCI_3 < NH_3$

(b) In PF_5F is more EN Therefore Bond angle of $PF_5 < PH_3$

(c) Hybridisation of $CIO_3^{\Theta} = \frac{1}{2}(7 + 0 + 1) = 4 = sp^3$

Hybridisation of $SO_3^{2-} = \frac{1}{2}(6 + 0 + 2) = 4 = sp^3$

Therefore CIO_3^{Θ} and SO_3^{2-} are isostructural and in both cases d-orbitals participate in (p pi -d pi) bonding

with O-atom

In Tbp structure the lp s always occupy the equatorial position becasue angle between equational bonds is 120 and there is less repulsion between lp-lp thus providing a greater stability to the molecule .

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Q-41 - 12973680

Which of the following has transient existence?

(A) He

(B) H_2^+

(C) H

(D) H^+

CORRECT ANSWER: B

SOLUTION:

H_2^+ has a transient existence. It is formed in the discharge tube by the loss of electron from H_2 molecule.

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Q-42 - 18698701

The number of $(p\pi - p\pi)$ bonds in XeO_4 is :

CORRECT ANSWER: 0

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Q-43 - 12973684

The species having bond order different from that in CO is

(A) NO^+

(B) NO^-

(C) N_2

(D) CN^-

CORRECT ANSWER: B

SOLUTION:

Isoelectronic species usually have the same bond order. NO^+, CN^-, and N_2 are isoelectronic with CO(14 electrons each). Hence, all of them possess the same bond order which is 3. On the other hand, NO^- has 16 electrons. Its configuration is identical to that of O_2, hence, its bond order is 2.

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Q-44 - 11467587

State the bond order and indicate whether the species is

paramagnetic

$CN^{\oplus}$ (b) CN (c) $CN^{?}$ (d) No .

SOLUTION:

$CN^{\oplus}$ Total number of

$e^{-}{}'s = 6 + 7 - 1$

$= 12$

Remaining $pe^{-}{}'s = 12 - 8 = 4$

$N_b = 4, N_a = 0$

Bond order $= \frac{1}{2}(4 - 0) = 2$

Number of unpaired $e^{-}{}'s = 0$ therefore diagmagnetic

CN Total electrons $= 6 + 7 = 13$

Remaining $pe^{-}{}'s = 13 - 8 = 5$

$N_b = 5, N_a = 0$

Bond order $= \frac{1}{2}(5 - 0) = 25$

Number of unpaired $e^{-}{}'s = 1$ therefore paramagnetic

(c) $CN^{?}$ Total electrons $= 6 + 7 + 1 = 14$

Remaining $N_b = 6, N_a = 0$

Bond order $= \frac{1}{2}(6 - 0) = 3$

Number $e^{-}{}'s$ Zero, therefore, diamagnetic

(d) NO: Total electrons $= 7 + 8 = 15$

Remaining $pe^{-}{}'s = 15 - 8 = 7$

Bond order $= \frac{1}{2}(6 - 1) = 2.5$

Number of unpaired $e^{-}{}'s$ 1, therefore paramagnetic .

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Q-45 - 11467975

How many of the following species have bond order of 2.5 ?

$N_2^{\oplus}$ (ii) $N_2^{\ominus}$ (iii) $O_2^{\oplus}$ (iv) $O_2^{\ominus}$ (v) NO (vi) CN .

CORRECT ANSWER: 5

SOLUTION:

For (i) $N_2^{\oplus}$ and (ii) N_2^{Θ}

F or $(iii) O_2^{\oplus}$ and (iv) O_2^{Θ}

For (v) NO and (vi) CN

Hence, $n_2^{\oplus}$, N_2^{Θ}, $O_2^{\oplus}$ NO and CN have bond order $= 2.5$.

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Q-46 - 12661747

A square planar complex is formed by hybridization of which atomic orbitals?

(A) (a) s, p_x, p_y, d_{yz}

(B) (b) s, p_x, p_y, d_{z^2}

(C) (c) $s, p_x, p_y, d_{x^2-y^2}$

(D) (d) s, p_x, p_y, d_{xy}

CORRECT ANSWER: C

SOLUTION:

A square planar complex results from dsp^2-hybridisation involving $(n-1)d_{x^2-y^2}, ns, np_x$ and np_x atomic orbitals.

Q-47 - 13169909

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

(A) sp, sp^3 and sp^2

(B) sp^2, sp^3 and sp

(C) sp, sp^2 and sp^3

(D) sp^2, sp and sp^3

CORRECT ANSWER: 3

SOLUTION:

$NO_2^+ \Rightarrow$ [steric number=2atoms +0 lone pair] $\Rightarrow$ sp hybridisation

Or number of hybrid orbitals

$$(x) \Rightarrow \frac{1}{2}[Ve + MA - c + a]$$

$$\Rightarrow \frac{1}{2}[5 + 0 - 1 + 0]$$

$$\Rightarrow 2 \Rightarrow sp$$

hybridization

$NO_3^- \Rightarrow$ [steric number=3atoms +0lone pair]

$\Rightarrow sp^2$ hybridisation

$NH_4^+ \Rightarrow$ [ateric number =4atoms+0lone pair]

$\Rightarrow sp^2$ hybridisation

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Q-48 - 12676580

Assertion : Superoxides of alkali metals are paramagnetic.

Reason : Superoxides contain the ion O_2^- which has one unpaired electron.

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

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

(C) If assertion is true but reason is false.

(D) If assertion is false but reason is true.

CORRECT ANSWER: A

SOLUTION:

Both Assertion and Reason are true and Reason is the correct explanation of Assertion .

Preasence of unpaired electrons in superoxides of alkali metals make them paramagnetic.

Q-49 - 11467536

Which of the following intermolecular force is vander Waals interaction

(i) Ion dipole, (ii) Dipole -Dipole

(iii) Ion - induced dipole

(b) Which of the following intermolecular forces ion nonvan ber Waals interaction

(i) Dipole induced dipole

(ii) Instantaneous dipole induced dipole

(iii) Ion- induced dipole

(iv) None

(c) Which of the foolowing intermolecular forces have a potential energey distance function as $E \propto \frac{1}{r^2}$

(i) Ion -dipole (ii) Dipole -dipole (iii) Ion -induced dipole (iv) London dispersion forces .

SOLUTION:

$(a)(iii)(b)(iv)(c)(i)$.

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Q-50 - 11467859

For AB_x type molecule which statement (s) si (are) correct about bond angle $(B - A - B)$

(I) Bond angel $\propto EN$ of the central atom A

(II) Bond angle $\propto 1/EN$ of the central atom A

(III) Bond angle $\propto$ Size of central atom

(IV) Bond angle prop 1/Size of central atom .

(A) I,III,III

(B) II,IV

(C) I,IV

(D) II,III

CORRECT ANSWER: C

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Q-51 - 14801323

Bond angle in PH_4^+ is higher than that in PH_3.Why ?

SOLUTION:

P in PH_3 in sp^3- hybridized.It has three bond pairs and one lone pair around P. Due to the stronger lone pair-

bond pair repulsions than bond pair-bond pair repulsions, the tetrahedral angle decreases from $10928'$ to 93.6, As a result, PH_3 is pyramidal. However, when it reacts with a proton, it forms PH_4^+ ion which has four bond pairs and no lone pair.Due to the absence of lone pair-bond pair repulsions and presence of four identical bond pair-bond pair interactions, PH_4^+ assumes tetrahedral geo-metry with a bond angle of $10928'$

Q-52 - 11467740

Which one or more among the following involve (s) (pi -dpi) bonding ? .

(A) $(SiH_3)_3N$:

(B) $(CH_3)_3N$:

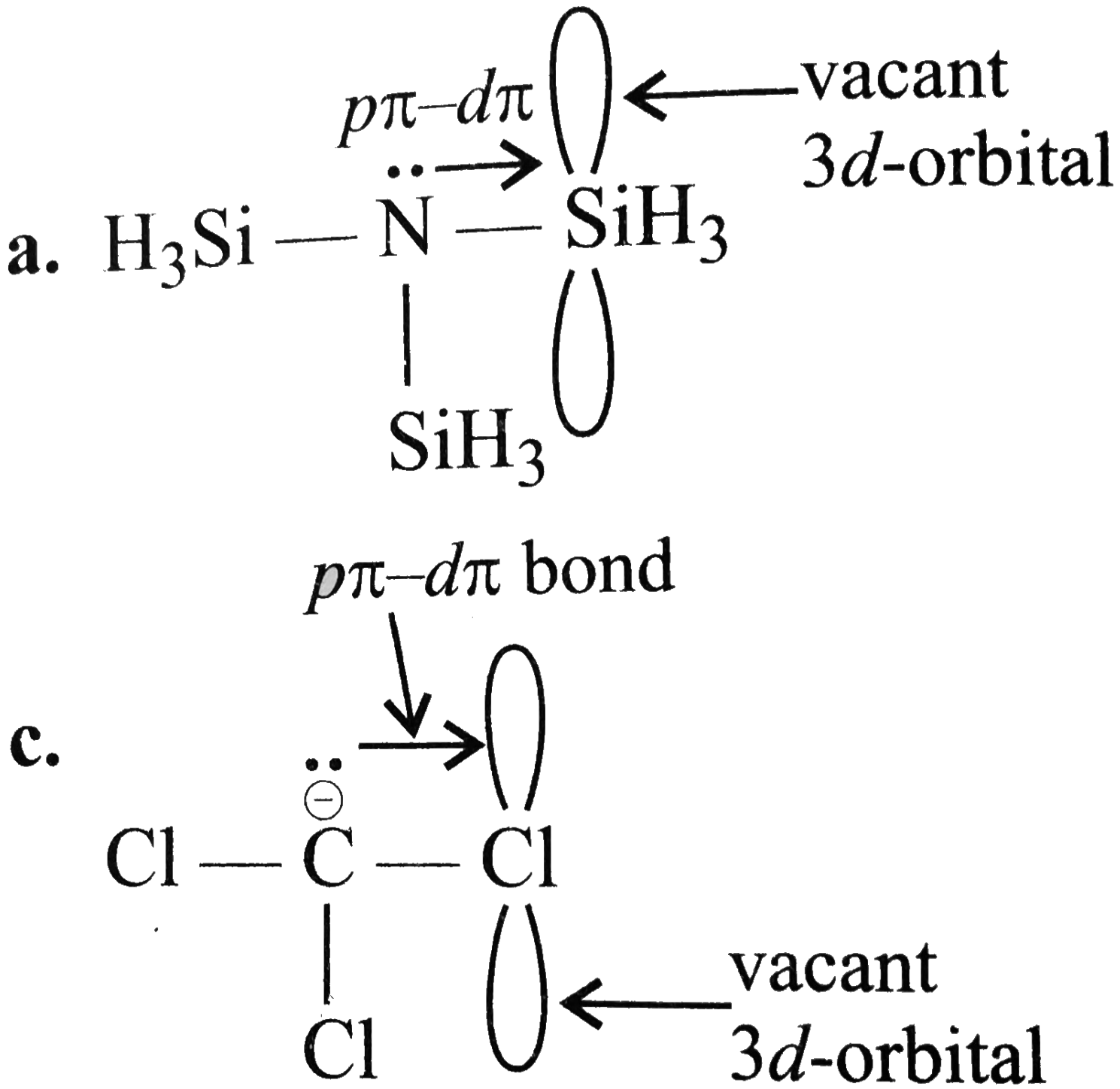
(C) : $\overset{?}{C}CI_3$

(D) : $\overset{?}{C}F_3$

CORRECT ANSWER: A::C

SOLUTION:

Do not have d-orbitals sp ppi- dpi bond is not formed



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Q-53 - 11075367

The nodal plane in the π-bond of ethene is located in:

(A) The molecular plane

(B) A plane parallel to the molecular plane

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

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

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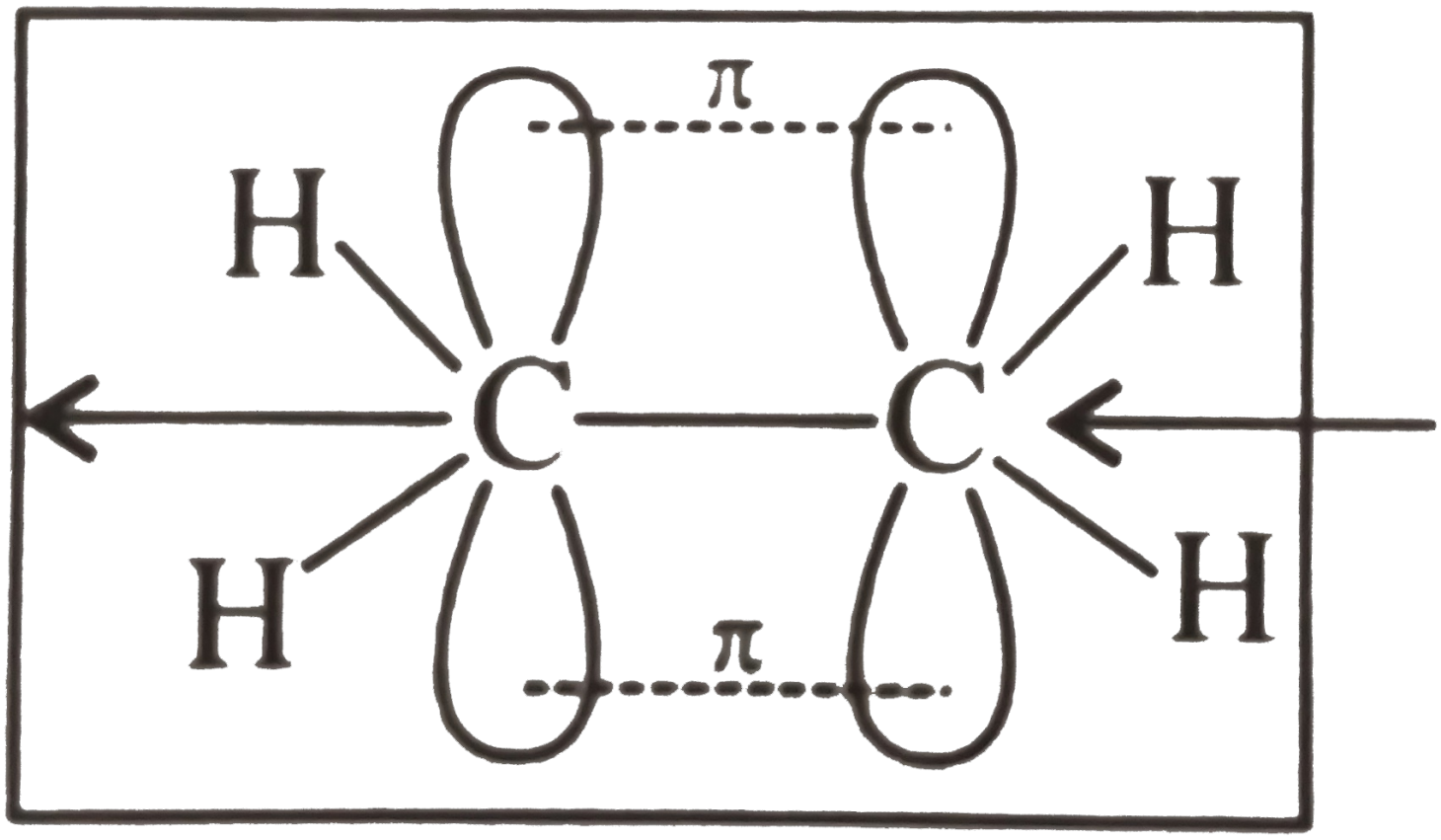
CORRECT ANSWER: A

SOLUTION:

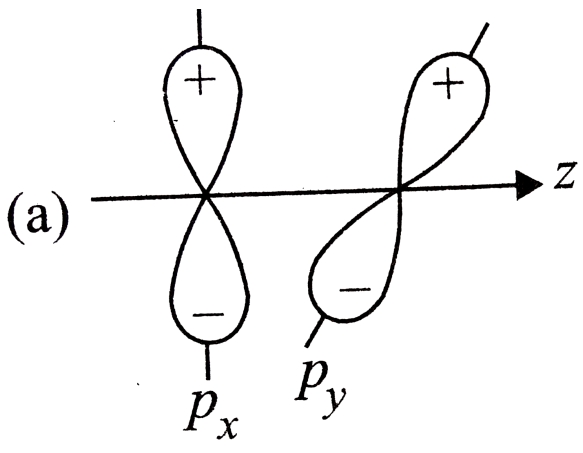
A π-bond has a nodal plane passing through the two bonded nuclei, i.e., molecular plane.



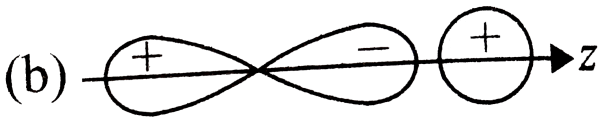
Q-54 - 12675663

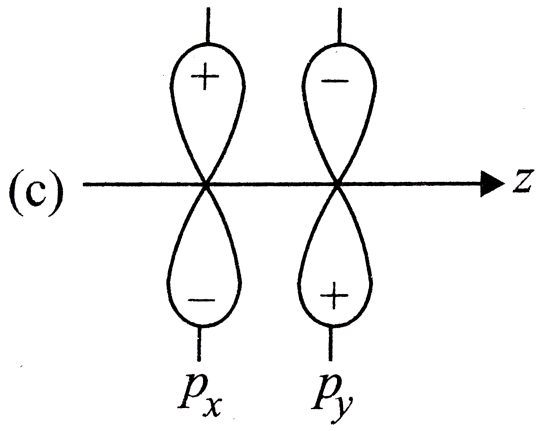
Which of the following is a zero overlap which leads to non-bonding?

(A)



(B)



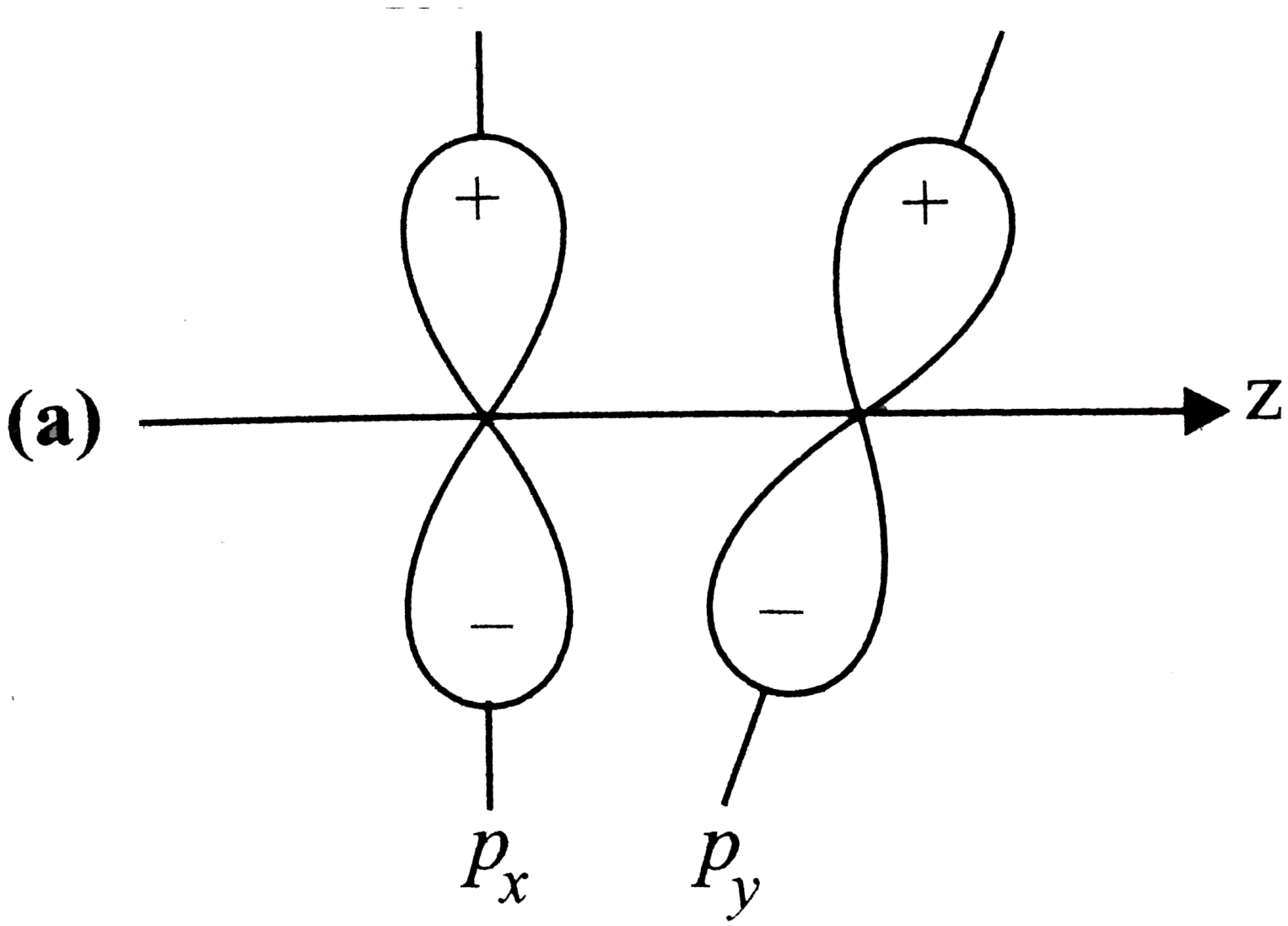


(C)

(D) All

CORRECT ANSWER: A

SOLUTION:



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Q-55 - 20498725

The type of hybridisation of boron in diborane is

(a) sp , (b) sp^2 , (c) sp^3 , (d) dsp^2

SOLUTION:

(c) Boron in diborane is sp3 hybridised.

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Q-56 - 12675594

The molencule which posses both sp^3 and sp^3d^2 hybridisation is

(A) solid PCI_5

(B) gaseous PCI_5

(C) PCI_4

(D) PCI_6

CORRECT ANSWER: A

SOLUTION:

Solid PCI_3 ionises as

$2PCI_5 \Rightarrow PCI_4^+$

$+ PCI_6^-$

PCI_6^- is tetrahedral with P undergoing sp^3

hybridisation PCI_6^- is octahedral with P undergoing

sp^2d^2 hybridisation

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Q-57 - 18698524

The hybridisation of Xe is sp^3d^2 in

(A) XeF_2

(B) XeO_4

(C) XeF_4

(D) XeO_3

CORRECT ANSWER: C

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Q-58 - 12675709

The bond enegies in NO,,NO and NO follow the order

(A) $NO > NO > NO$

(B) $NO > NO > NO$

(C) $NO > NO > NO$

(D) $NO > NO > NO$

CORRECT ANSWER: A

SOLUTION:

Bond order NO $= \frac{1}{2}(10 - 5) = 2.5$

Bond order

$$NO^+ = \frac{1}{2}(10-4)$$

$$= 3.0$$

Bond order

$$NO^- = \frac{1}{2}(10-6)$$

$$= 2.0$$

Since bond energies directily related to bond order

.Therefore cannot order of increasing bond energies is

$$NO^+ > NO > NO^-$$

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Q-59 - 11467893

In Which of the following the double bond consistts of the pi bonds

.

(A) O_2

(B) Be_2

(C) C_2

(D) S_2

CORRECT ANSWER: C

SOLUTION:

Double bond in C_2 consists of both pi bonds because of the presence of $4e^{-}{}'s$ in two $\pi - MO's$ In most of the other molecule a double bond is made up of a single σ bond a π bond .

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Q-60 - 12973775

The main axis of diatomic molecule is z. The orbitals p_x and p_y overlap to form

(A) π molecular orbital

(B) σ molecular orbital

(C) δ molecular orbital

(D) no bond will be formed

CORRECT ANSWER: D

SOLUTION:

Since p_x and p_y orbitals are perpendicular to each other, they cannot overlap sideways or end-to-end. Thus, no bond will be formed.