PYQ Session by ATS Sir

JEE Mains
PYQ's

Question

Number of molecules from the following which are exceptions to octet rule is _____.

[08 April, 2024 (Shift-I)]

CO_2, NO_2, H_2SO_4, BF_3, CH_4, SiF_4, ClO_2, PCl_5, BeF_2, C_2H_6, $CHCl_3$, CBr_4

6

Question

For compound having the formula $GaAlCl_4$, the correct option from the following is

[11 April, 2023 (Shift-I)]

A Ga is more electronegative than Al and is present as a cationic part of the salt $GaAlCl_4$

B Oxidation state of Ga in the salt $GaAlCl_4$ is +3.

C Cl forms bond with both Al and Ga in $GaAlCl_4$

D Ga is coordinated with Cl in $GaAlCl_4$

$$\overset{+3}{Ga}\,\overset{+3}{Al}Cl_4 \downarrow Ga^{+} + AlCl_4^{-}$$

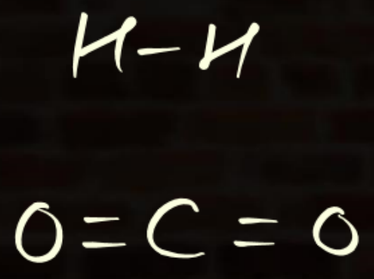
$$EN \rightarrow B > Tl > In > Ga > Al$$

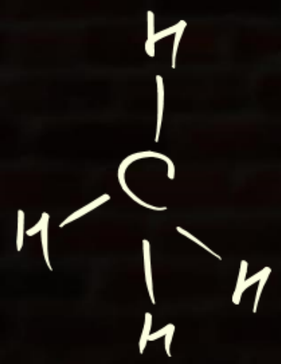
Question

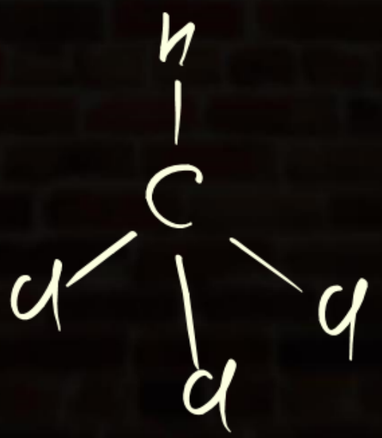
The number of non-polar molecules from the following is _____

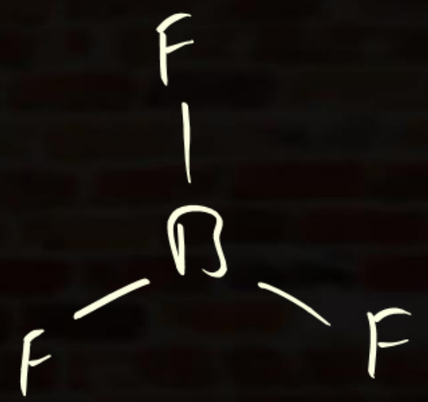
HF, H_2O, SO_2, H_2, CO_2, CH_4, NH_3, HCl, $CHCl_3$, BF_3

[27 Jan, 2024 (Shift-II)]









(4)

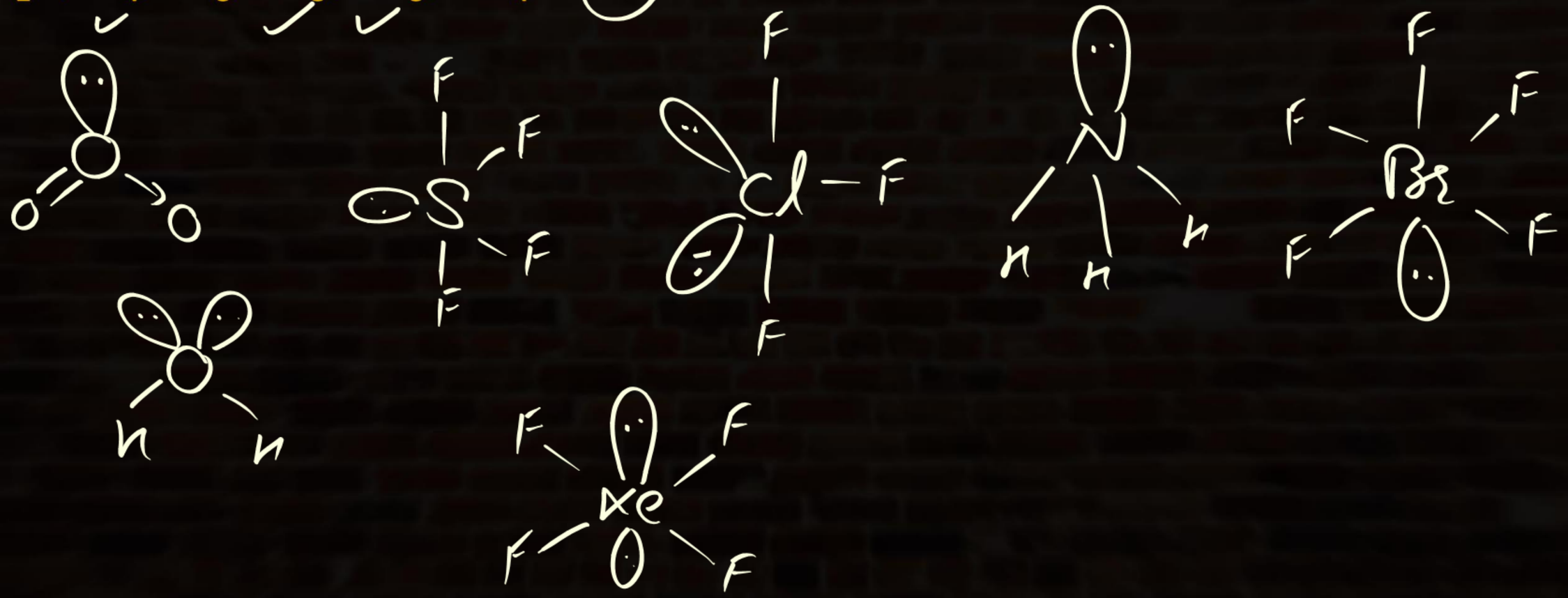
Question

Number of compounds with one lone pair of electrons on central atom amongst following is:

[29 Jan, 2024 (Shift-I)]

O_3, H_2O, SF_4, ClF_3, NH_3, BrF_5, XeF_4

4



Question

Match List-I with List-II.

[30 Jan, 2024 (Shift-I)]

List-I (Molecule)		List-II (Shape)	
(A)	BrF_5	(I)	T-shape
(B)	H_2O	(II)	See saw
(C)	ClF_3	(III)	Bent
(D)	SF_4	(IV)	Square pyramidal

A (A)-I, (B)-II, (C)-IV, (D)-III

B (A)-II, (B)-I, (C)-III, (D)-IV

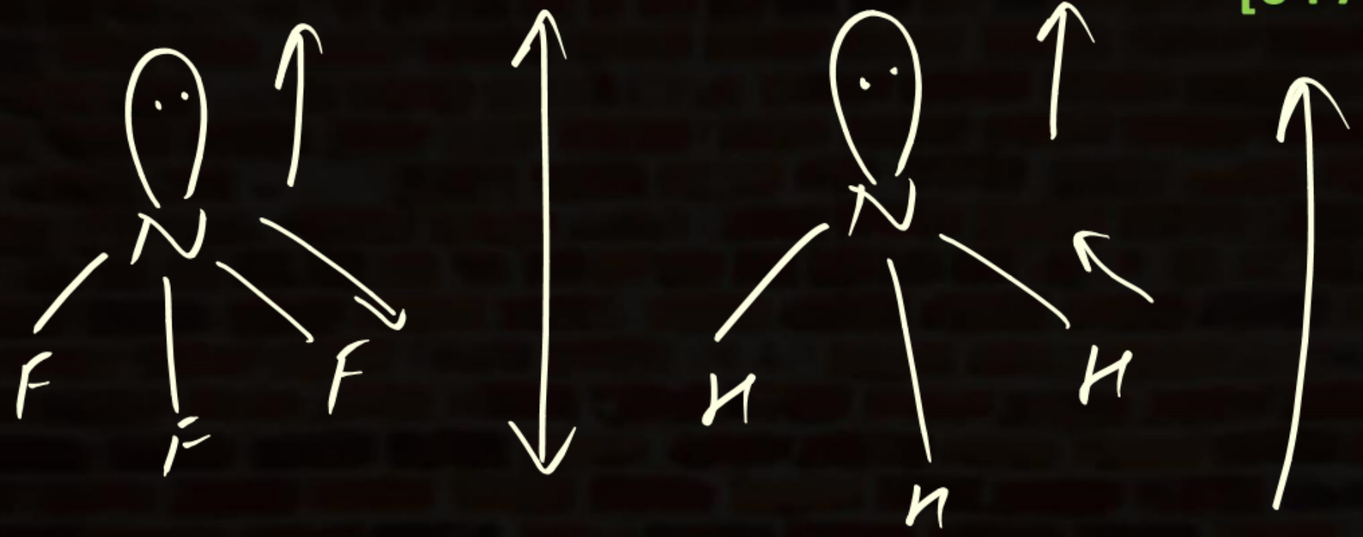
C (A)-III, (B)-IV, (C)-I, (D)-II

D (A)-IV, (B)-III, (C)-I, (D)-II

Question

Which one of the following molecules has maximum dipole moment?

[04 April, 2024 (Shift-I)]



A NF_3

B CH_4

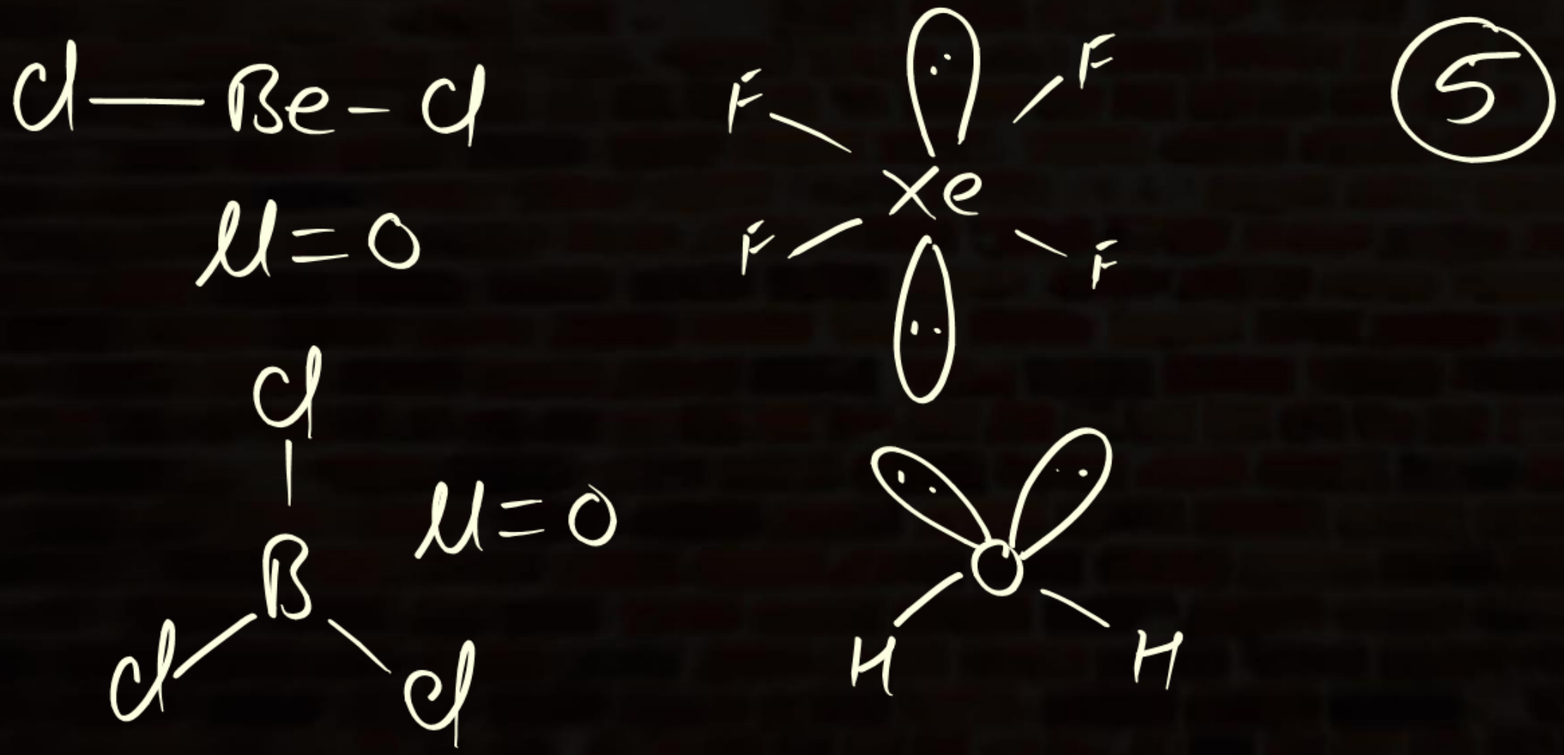
C NH_3

D PF_5

Question

Number of compounds/species from the following with non-zero dipole moment is_____ [04 April, 2024 (Shift-II)]

$BeCl_2$, BCl_3, NF_3, XeF_4, CCl_4, H_2O, H_2S, HBr, CO_2, H_2, HCl



(5)

Question

Match List-I with List-II. **[05 April, 2024 (Shift-II)]**

Choose the correct answer from the options given below:

List-I		List-II	
A.	ICl	I.	T -Shape
B.	ICl_3	II.	Square pyramidal
C.	ClF_5	III.	Pentagonal bipyramidal
D.	IF_7	IV.	Linear

A (A)–(I), (B)–(IV), C–(III), D–(II)

B (A)–(I), (B)–(III), C–(II), D–(IV)

C (A)–(IV), (B)–(I), C–(II), D–(III)

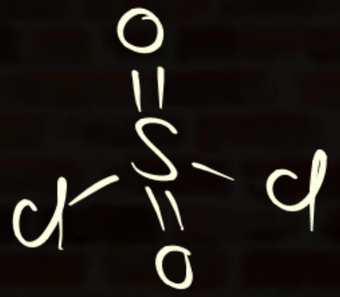
D (A)–(IV), (B)–(III), C–(II), D–(I)

Question

Match List-I with List-II:

Choose the correct answer from the options given below: [06 April, 2024 (Shift-I)]

List-I (Molecule / Species)		List-II (Property / Shape)	
A.	SO_2Cl_2	I.	Paramagnetic
B.	NO	II.	Diamagnetic
C.	NO_2^-	III.	Tetrahedral
D.	I_3^-	IV.	Linear



(A) A-IV, B-I, C-III, D-II

(B) A-III, B-I, C-II, D-IV

(C) A-II, B-III, C-I, D-IV

(D) A-III, B-IV, C-II, D-I

Question

Match List-I with List-II:

Choose the correct answer from the options given below: **[06 April, 2024 (Shift-I)]**

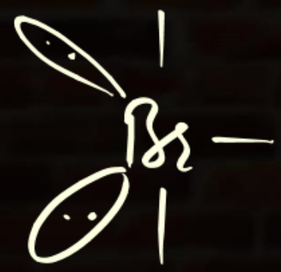
List-I (Compound /Species)		List-II (Shape / Geometry)	
A.	SF_4	I.	Tetrahedral
B.	BrF_3	II.	Pyramidal
C.	BrO_3^-	III.	See saw
D.	NH_4^+	IV.	Bent T-shape

(A) A-II, B-III, C-I, D-IV

(B) A-III, B-IV, C-II, D-I

(C) A-II, B-IV, C-III, D-I

(D) A-III, B-II, C-IV, D-I



Question

Total number of species from the following with central atom utilizing sp^2 hybrid orbitals for bonding is _____. [06 April, 2024 (Shift-II)]

NH_3, SO_2, SiO_2, $BeCl_2$, C_2H_2, C_2H_4, BCl_3, HCHO, C_6H_6, BF_3, $C_2H_4Cl_2$

× $NH_3 \rightarrow sp^3$

✓ $SO_2 \rightarrow sp^2$

× $SiO_2 \rightarrow sp^3$

× $BeCl_2 \rightarrow sp$

× $C_2H_2 \rightarrow sp$

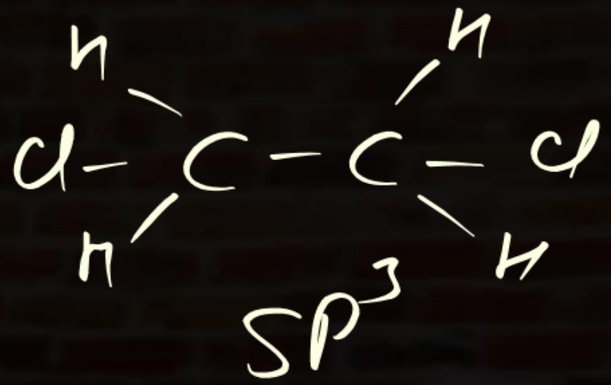
✓ $C_2H_4 \rightarrow sp^2$

✓ $BCl_3 \rightarrow sp^2$

✓ $H-\overset{\overset{O}{\|}}{C}-O \rightarrow sp^2$

✓ $C_6H_6 \rightarrow sp^2$

✓ $BF_3 \rightarrow sp^2$



(6)

Question

The correct increasing order for bond angles among BF_3, PF_3 and $C\ell F_3$ is:

[09 April, 2024 (Shift-II)]

A $PF_3 < BF_3 < C\ell F_3$

B $BF_3 < PF_3 < C\ell F_3$

C ✓ $C\ell F_3 < PF_3 < BF_3$

D $BF_3 = PF_3 < C\ell F_3$

$BF_3 \rightarrow sp^2 \quad 120$

$PF_3 \rightarrow sp^3 \quad \lesssim 109$

$ClF_3 \rightarrow sp^3d$

Question

Consider the following statements: [15 April, 2023 (Shift-I)]

(A) NF_3 molecule has a trigonal planar structure.

(B) Bond length of N_2 is shorter than O_2.

(C) Isoelectronic molecules or ions have identical bond order.

(D) Dipole moment of H_2S is higher than that of water molecule.

Choose the correct answer from the option below:

A (A) and (D) are correct

B (C) and (D) are correct

C (A) and (B) are correct

D (B) and (C) are correct

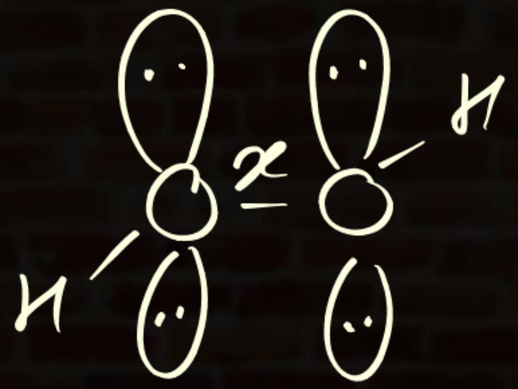
BO ↑ BL ↓

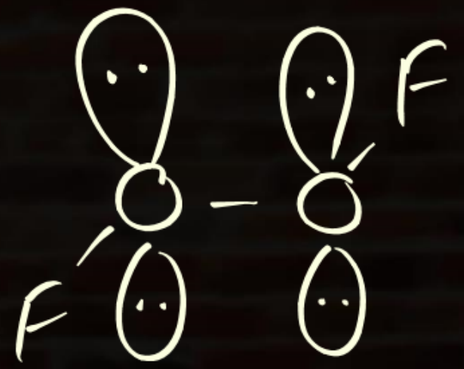
$N_2 \rightarrow 3$

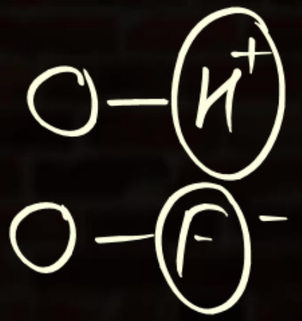
$O_2 \rightarrow 2$

Question

O–O bond length in H_2O_2 is X than the O–O bond length in F_2O_2. The O–H bond length in H_2O_2 is Y than that of the O–F bond in F_2O_2.
Choose the correct option for X and Y from the given below. [1 Feb, 2023 (Shift-II)]







(A) X - shorter, Y - shorter

(B) X - shorter, Y - longer

(C) X - longer, Y - longer

(D) X - longer, Y - shorter

Question

The number of molecules or ions from the following, which do not have odd number of electrons are _____. [29 Jan, 2023 (Shift-I)]

(A) NO_2 (B) ICl_4^- (C) BrF_3 (D) ClO_2 (E) NO_2^+ (F) NO

3

Question

The number of following factors which affect the percent covalent character of the ionic bond is____

[8 April, 2023 (Shift-I)]

A Polarising power of cation

B Extent of distortion of anion

C Polarisability of the anion

D Polarising power of anion

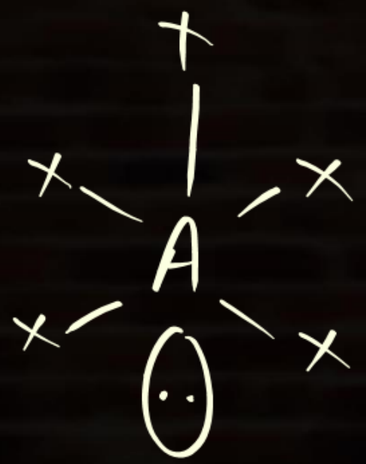
3

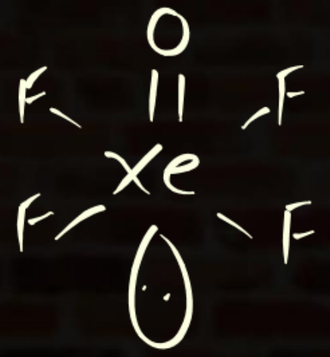
Question

The number of species from the following which have square pyramidal structure is.

PF_5, BrF_4^-, IF_5; BrF_5, $XeOF_4$, ICl_4^-

[6 April, 2023 (Shift-I)]





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Question

Consider the species CH_4, NH_4^+ and BH_4^-. Choose the correct option with respect to the species. [29 June, 2022 (Shift-II)]

10e⁻/sp³

A They are isoelectronic and only two have tetrahedral structures

B They are isoelectronic and all have tetrahedral structures

C Only two are isoelectronic and all have tetrahedral structures

D Only two are isoelectronic and only two have tetrahedral structure

Question

Number of lone pairs of electrons in the central atom of SCl_2, O_3, ClF_3 and SF_6, respectively are:

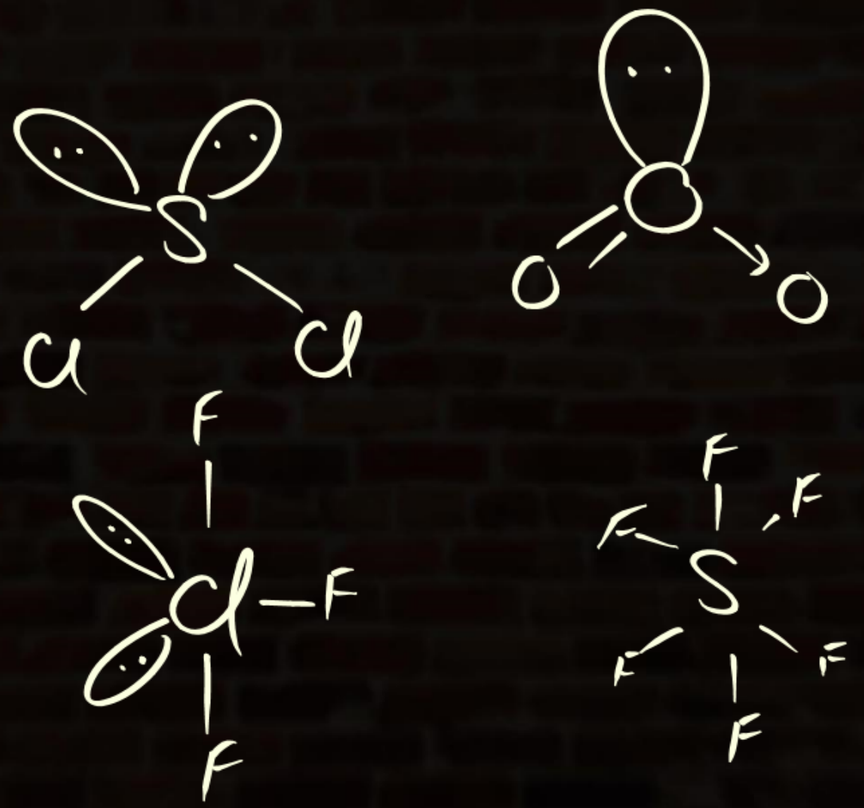
[29 July, 2022 (Shift-I)]

A 0, 1, 2 and 2

B 2, 1, 2 and 0

C 1, 2, 2 and 0

D 2, 1, 0 and 2



Question

Which among the following species has unequal bond lengths?

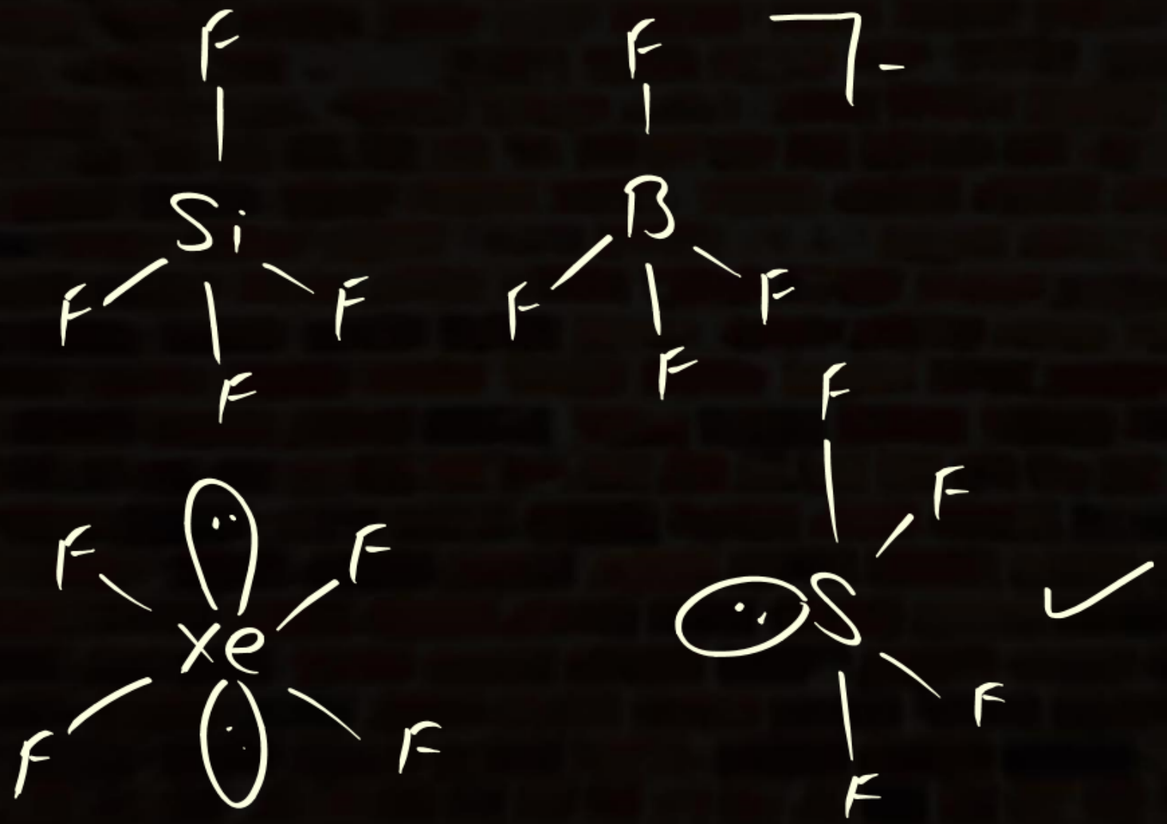
[25 Feb, 2021 (Shift-II)]

A SiF_4

B BF_4^-

C SF_4

D XeF_4



Question

Identify the species having one π-bond and maximum number of canonical forms from the following: [25 July, 2021 (Shift-II)]

A SO_2 2π

B CO_3^{2-} 1π | 3RS

C O_2 1π | 2R.S

D SO_3 3π

Question

Among the following, the molecule expected to be stabilized by anion formation is:
C_2, O_2, NO, F_2

[9 April, 2019 (Shift-I)]

A NO

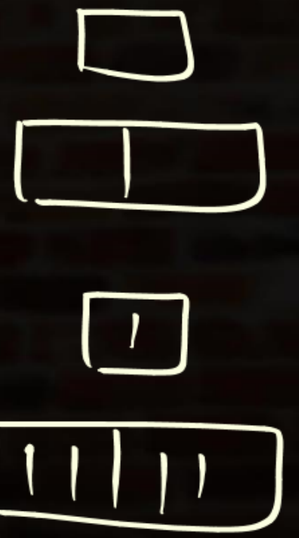
B C_2

C F_2

D O_2

B.O ⟶ B.O
X X^-

X			
C_2	2	C_2^-	2.5
NO	2.5	NO^-	2
F_2	1	F_2^-	0.5
O_2	2	O_2^-	1.5



8e⁻

Question

The covalent alkaline earth metal halide (X = Cl, Br, I) is: [8 April, 2019 (Shift-II)]

A CaX_2

B SrX_2

C BeX_2

D MgX_2

Question

The number of species from the following which are paramagnetic and with bond order equal to one is____.

H_2, He_2^+, O_2^+, N_2^{2-}, O_2^{2-}, F_2, Ne_2^+, B_2

[29 Jan, 2024 (Shift-I)]

(1)

Para | B.O → 1

× H_2 → 1 | Dia

× He_2^+ → 0.5 | Para

× O_2^+ → 2.5

× N_2^{2-} → 2

× F_2 → 1 Dia

× Ne_2^+ →

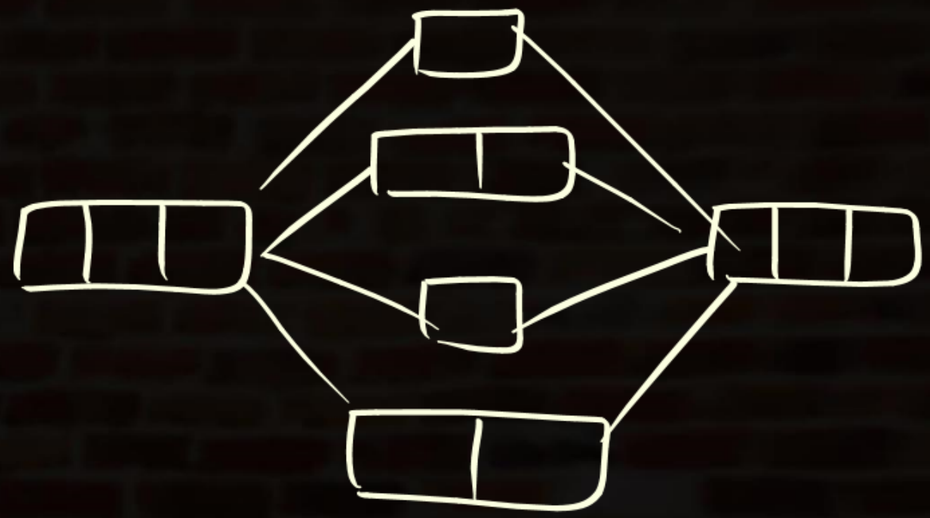
B_2 → 1, Para

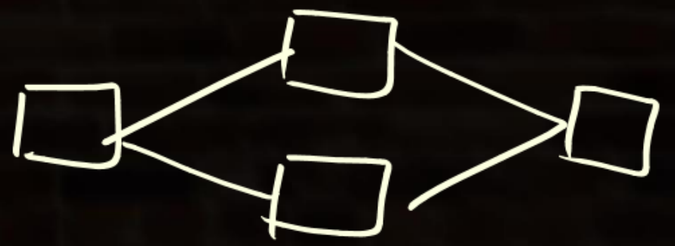
Question

The total number of molecular orbitals formed from 2s and 2p atomic orbitals of a diatomic molecule.

[30 Jan, 2024 (Shift-I)]

8 MO





Question

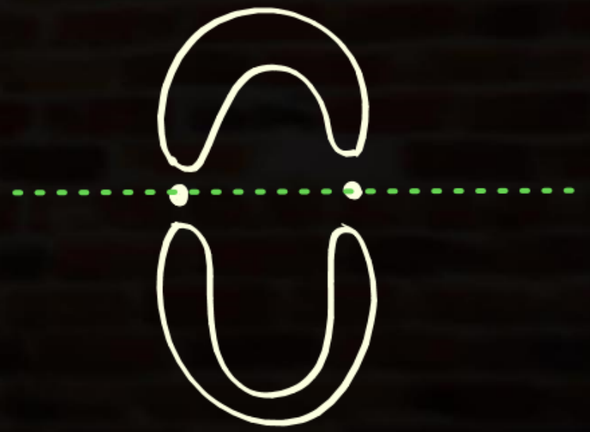
Given below are two statements:

Statement-I: A π bonding MO has lower electron density above and below the inter-nuclear axis.

Statement-II: The π* antibonding MO has a node between the nuclei.

In the light of the above statements, choose the most appropriate answer from the options given below:

[01 Feb, 2024 (Shift-II)]



A Both Statement-I and Statement-II are false

B Both Statement-I and Statement-II are true

C Statement-I is false but Statement-II is true

D Statement-I is true but Statement-II is false

Question

When Ψ_A and Ψ_B are the wave functions of atomic orbitals, then σ^* is represented by:

[08 April, 2024 (Shift-II)]

A $\Psi_A - 2\Psi_B$

B $\Psi_A - \Psi_B$

C $\Psi_A + 2\Psi_B$

D $\Psi_A + \Psi_B$

Question

What is the number of unpaired electron(s) in the highest occupied molecular orbital of the following species:

$N_2 : N_2^+; O_2; O_2^+$?

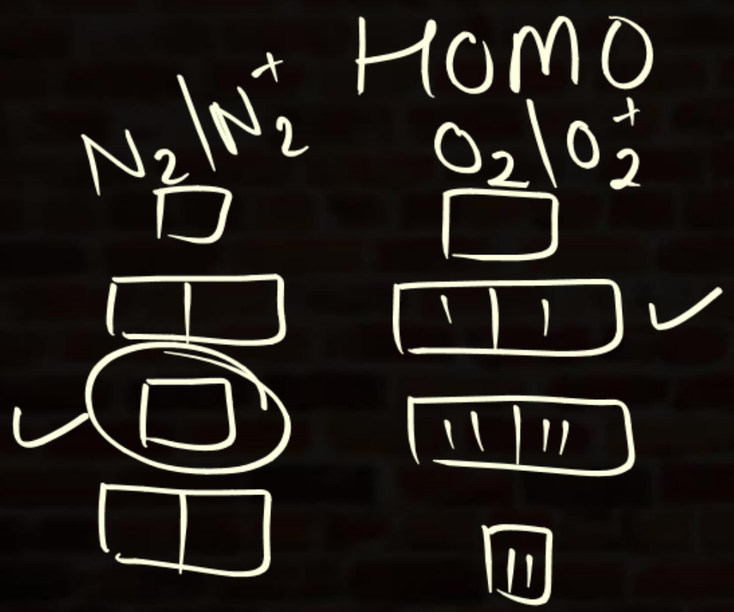
[24 Jan, 2023 (Shift-II)]

A 0, 1, 2, 1

B 2, 1, 2, 1

C 0, 1, 0, 1

D 2, 1, 0, 1



$N_2 \rightarrow 2$

$N_2^+ \rightarrow 1$

$O_2 \rightarrow 2$

$O_2^+ \rightarrow 1$

Question

According to MO theory the bond orders for O_2^{2-}, CO and NO^+ respectively, are.

[29 Jan, 2023 (Shift-II)]

A 1,3 and 3

B 1,3 and 2

C 1,2 and 3

D 2,3 and 3

$O_2^{2-} \rightarrow 18 \rightarrow 1$

$CO \rightarrow 14 \rightarrow 3$

$NO^+ \rightarrow 14 \rightarrow 3$

Question

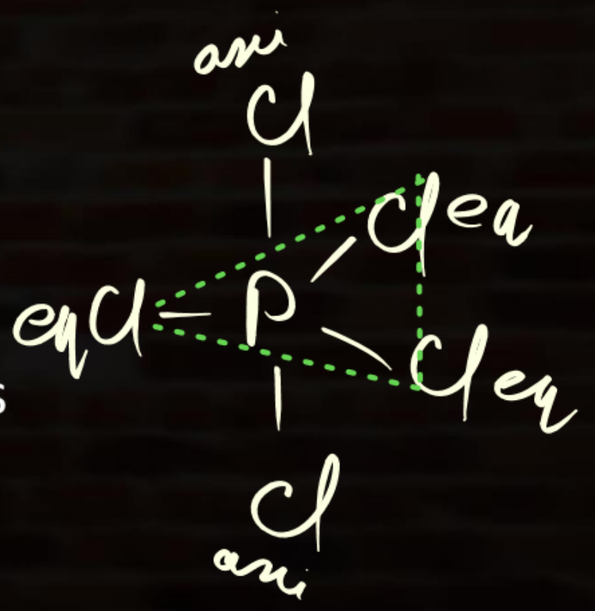
Identify the incorrect statement for PCl_5 from the following.

[27 June, 2022 (Shift-II)]

A. In this molecule, orbitals of phosphorous are assumed to undergo sp^3d hybridization

B. The geometry of PCl_5 is trigonal bipyramidal.

C. PCl_5 has two axial bonds stronger than three equatorial bonds



D. The three equatorial bonds of PCl_5 lie in a plane.

Question

Match List-I with List-II.

[27 July, 2022 (Shift-II)]

List-I		List-II	
A.	$\psi_{MO} = \psi_A - \psi_B$	I.	Dipole moment
B.	$\mu = Q \times r$	II.	Bonding molecular orbital
C.	$\frac{N_b - N_a}{2}$	III.	Anti-bonding molecular orbital
D.	$\psi_{MO} = \psi_A + \psi_B$	IV.	Bond order

A (A)-(II), (B)-(I), (C)-(IV), (D)-(III)

B (A)-(III), (B)-(IV), (C)-(I), (D)-(II)

C (A)-(III), (B)-(I), (C)-(IV), (D)-(II)

D (A)-(III), (B)-(IV), (C)-(II), (D)-(I)

Question

Of the species, NO, NO^+, NO^{2+} and NO^-, the one with minimum bond strength is

[3 Sept, 2020 (Shift-I)]

A NO^+

B NO

C NO_2^+

D NO^-

B.O ↑ Bond Strength ↑

$NO \rightarrow 15 \longrightarrow 2.5$

$NO^+ \rightarrow 14 \longrightarrow 3.0$

$NO^{+2} \rightarrow 13 \longrightarrow 2.5$

$NO^- \rightarrow 16 \rightarrow 2.0$

Question

Among the following species, the diamagnetic molecule is **[9 April, 2019 (Shift-II)]**

A O_2 Para

B NO Para

C B_2 Para

D CO Dia

Question

In which of the following processes, the bond order has increased and paramagnetic character has changed to diamagnetic? [9 Jan, 2019 (Shift-II)]

A $NO \rightarrow NO^+$
2.5 3.0

B $N_2 \rightarrow N_2^+$
3 2.5

C $O_2 \rightarrow O_2^+$

D $O_2 \rightarrow O_2^{2-}$

Question

Two pi and half sigma bonds are present in

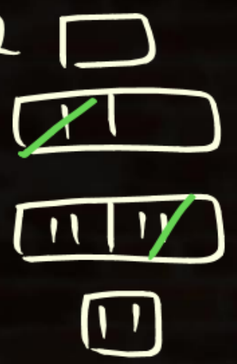
A O_2^+

B N_2

C O_2

D N_2^+

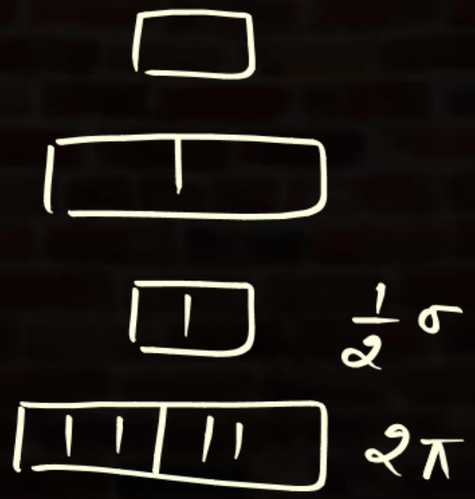
O_2^{-}



$1\sigma / 1\pi / \frac{1}{2}\pi$

$N_2 \rightarrow 1\sigma / 2\pi$

$O_2 \rightarrow 1\sigma / 1\pi$



Question

The correct statement/s about Hydrogen bonding is/are : [04 April, 2024 (Shift-II)]

A. Hydrogen bonding exists when H is covalently bonded to the highly electro negative atom.

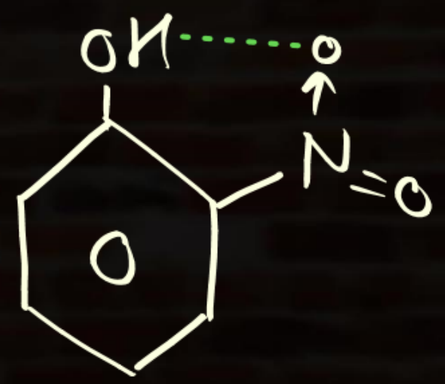
B. Intermolecular H bonding is present in o-nitro phenol

C. Intramolecular H bonding is present in HF.

D. The magnitude of H bonding depends on the physical state of the compound.

E. H-bonding has powerful effect on the structure and properties of compounds.

Choose the correct answer from the options given below:



(A) A only

(B) A, D, E only

(C) A, B, D only

(D) A, B, C only

Question

Select the compound from the following that will show intramolecular hydrogen bonding.

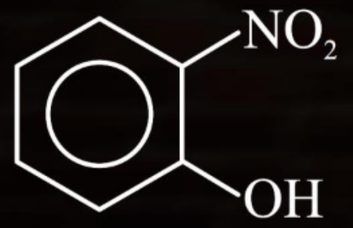
[01 Feb, 2024 (Shift-II)]

A H_2O

B NH_3

C C_2H_5OH

Inter

D 

Intra

Question

The correct order of increasing intermolecular hydrogen bond strength is

[27 June, 2022 (Shift-II)]

A $HCN < OH_2 < NH_3$

B $HCN < CH_4 < NH_3$

C $CH_4 < HCN < NH_3$

D $CH_4 < NH_3 < HCN$

JEE Advanced
PYQ's

Question

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

[IIT JEE 1986]

A Unequally shared between the two

B Transferred fully from one atom to another

C With identical spins

D Equally shared between them

Question

The compound which contains both ionic and covalent bonds is [IIT JEE 1979]

A CH_4

B H_2

C KCN $K^+ + C \equiv N^-$

D KCl

Question

Statement-I: LiCl is predominantly a covalent compound.
Statement-II: The electronegativity difference between Li and Cl is too small.

[IIT JEE 1983]

A. Statement-I is correct; Statement-II is correct Statement-II is the correct explanation of Statement-I

B. Statement-I is correct; Statement-II is correct Statement-II is not the correct explanation of Statement-I

C. Statement-I is correct; Statement-II is incorrect

D. Statement-I is incorrect; Statement-II is correct

Question

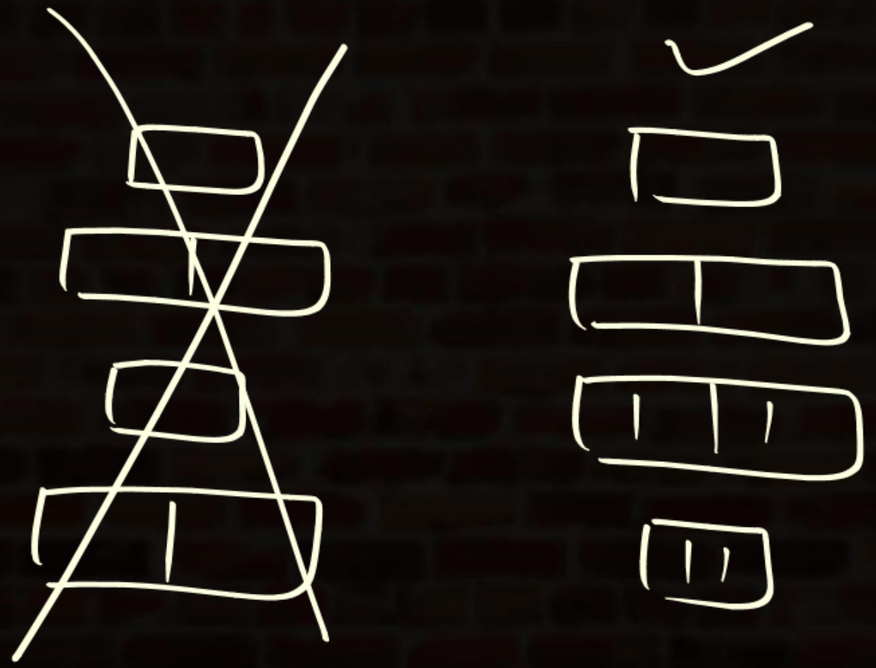
Assuming 2s-2p mixing is not operative, the paramagnetic species among the following is [JEE Adv. 2014]

(A) Be_2

(B) $B_2 \rightarrow 10e^-$

(C) $C_2 \rightarrow 12e^-$

(D) N_2



$8e^-$

Question

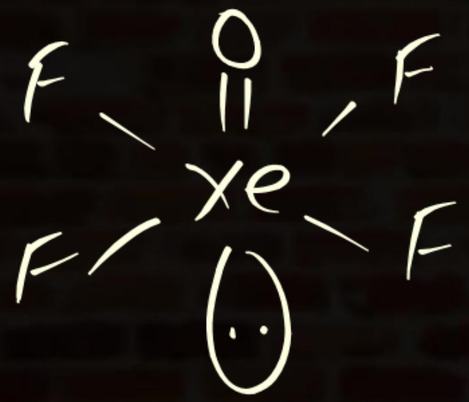
Number of lone pair(s) in $XeOF_4$ is/are. [IIT JEE 2004]

A 0

B 1

C 2

D 3



Question

Which of the following are isoelectronic and isostructural? **[IIT JEE 2003]**

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

A NO_3^-, CO_3^{2-}

B SO_3, NO_3^-

C ClO_3^-, CO_3^{2-}

D CO_3^{2-}, SO_3

Question

In compounds of type ECl_3, Where E = B, P, As or Bi, the angles Cl – E – Cl is in order.

[IIT JEE 1999]

A. B > P = As = Bi

B. B > P > As > Bi

C. B < P = As = Bi ✗

D. B < P < As < Bi ✗

$BCl_3 \rightarrow SP^2 \rightarrow 120°$

P

As

Bi

Question

The correct order of increasing C–O bond length of CO, CO_2, CO_3^{2-} is. **[IIT JEE 1999]**

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

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

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

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

CO 3

CO_2 2

CO_3^{2-} 1.33

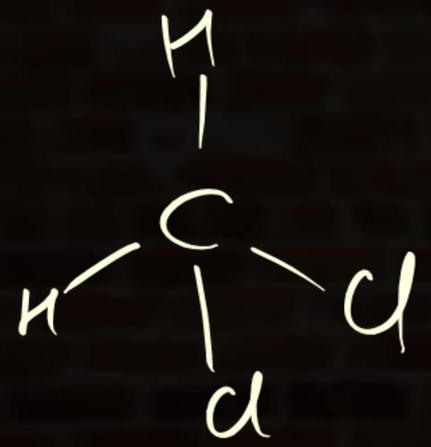
B.O ↑ B.L ↓

Question

The molecule which has zero dipole moment is. [IIT JEE 1989]

A CH_2Cl_2

B BF_3



C NF_3

D ClO_2

Question

Each of the following option contains a set of four molecules. Identify the option(s) where all four molecules posses permanent dipole moment at room temperature.

(JEE Adv. 2019)

A SO_2, C_6H_5Cl, H_2Se, BrF_5

B $BeCl_2$, CO_2, BCl_3, $CHCl_3$

C NO_2, NH_3, $POCl_3$, CH_3Cl

D BF_3, O_3, SF_6, XeF_6

Question

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

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

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

6

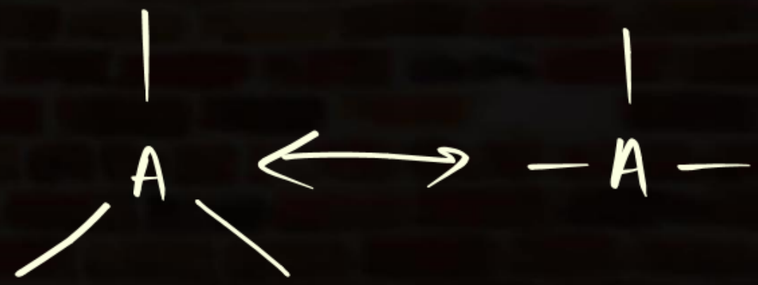
[JEE Adv. 2017]

$TeBr_6^{2-} \longrightarrow$ ①

$BrF_2^+ \rightarrow$ ②

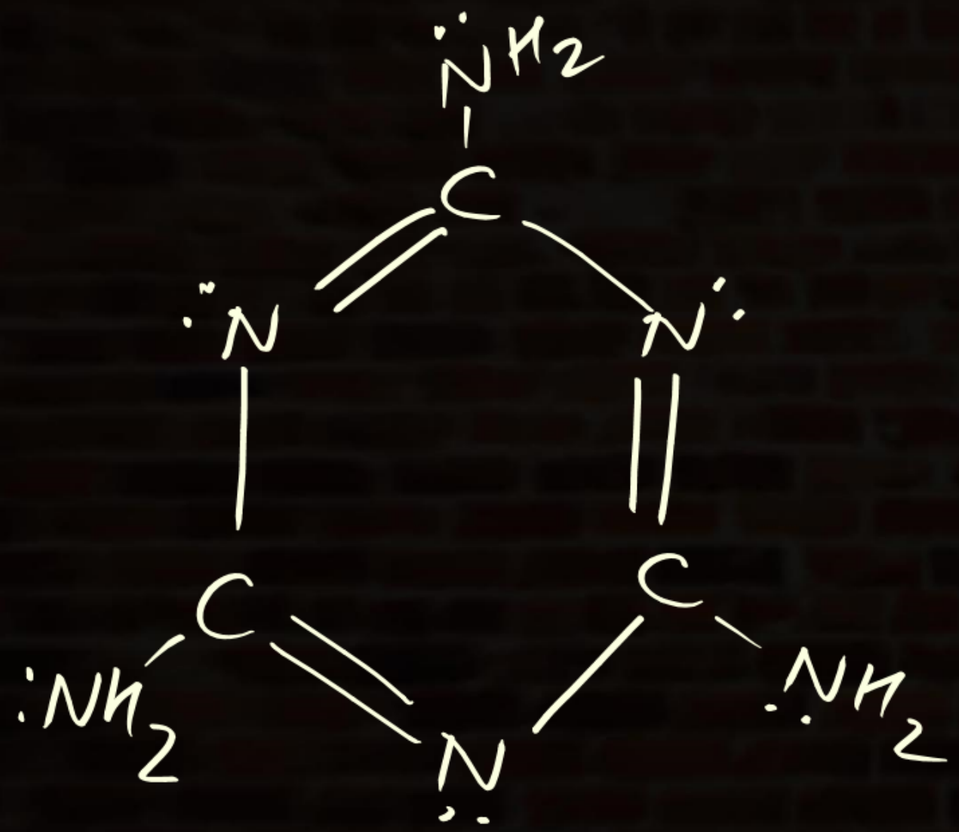
$SNF_3 \rightarrow$ 0

XeF_3^- ↓ ③



Question

The total number of lone-pair of electrons in melamine is. [JEE Adv. 2013]



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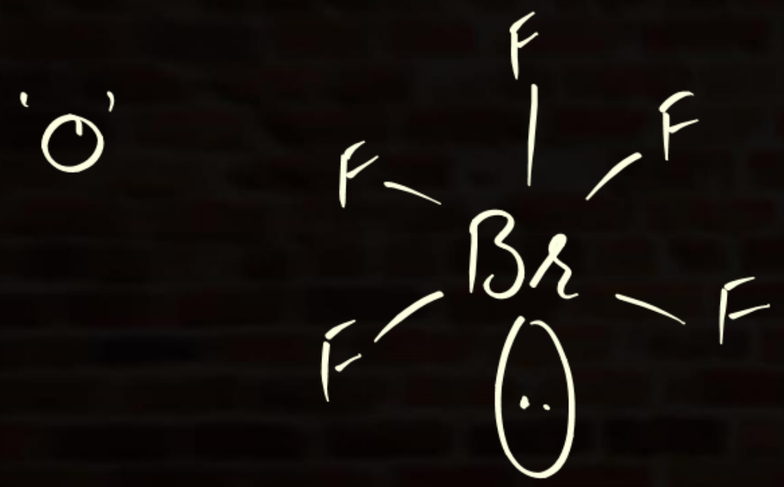
Question

Based on VSEPR theory, the number of 90° F – Br – F angles in BrF_5 is _____.

[IIT JEE 2010]



Question

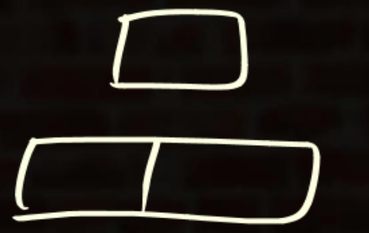
Assuming that Hund's rule is violated, the bond order and magnetic nature of the diatomic molecule B_2 is. **[IIT JEE 2010]**

A 1 and diamagnetic

B 0 and diamagnetic

C 1 and paramagnetic

D 0 and paramangetic

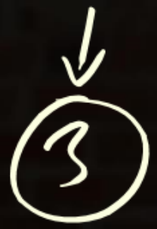


$B_2 \rightarrow 10e^-$

$8e^-$

Question

The species having bond order different from that in CO is. (IIT JEE 2007)



A $NO \longrightarrow 2.5$

B $NO^{+} \longrightarrow 3.0$

C $CN^{-} \longrightarrow 3.0$

D $N_2 \longrightarrow 3.0$

Question

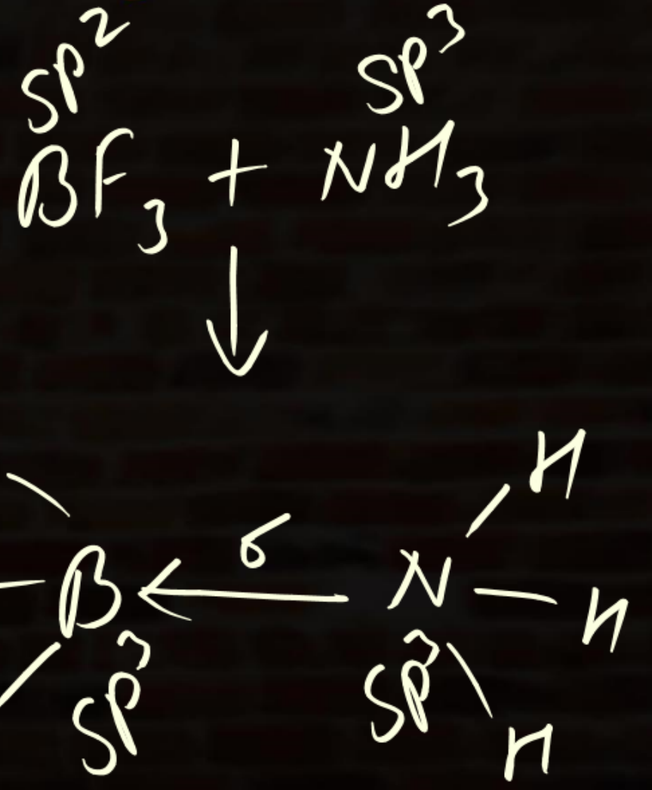
Specify the coordination geometry around and hybridizing N and B atoms in a 1 : 1 complex of BF_3 and NH_3.

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

B N : pyramidal, sp^3; B : pyramidal, sp^3

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

D N : pyramidal, sp^2; B : tetrahedral, sp^2



Question

Among KO_2, AlO_2^-, BaO_2 and NO_2^+ (single positive), unpaired electron is present in.

[IIT JEE 1997]

A NO_2^+ and BaO_2

B KO_2 and AlO_2^-

C Only KO_2

D Only BaO_2

$KO_2 \rightarrow K^+ + O_2^-$

$Ba^{+2} + O_2^{2-}$

NO_2^-

Question

Which one of the following molecules is planar ? [IIT JEE 1996]

A NF_3 Py

B NCl_3 Py

C PH_3 Py

D BF_3 T-P

Question

The species in which the central atom uses sp^2 hybrid orbitals in its bonding is.

[IIT JEE 1988]

A PH_3

B NH_3 sp^3

C CH_3^+ sp^2

D SbH_3

Question

Match the orbital overlap figures shown in column – I with the description given in column –II and select the correct answer using the codes given below the columns.

[JEE adv. 2014]

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

(A) A-4, B-3, C-2, D-1

(B) A-1, B-2, C-3, D-4

(C) A-2, B-3, C-1, D-4

(D) A-4, B-1, C-2, D-3

Question

Match each of the diatomic molecules in Column-I with its property/properties in Column-II. [IIT JEE 2009]

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

(A) P, Q, R, T (B) Q, R, S, T

(C) P, Q, R, (D) P, Q, R, S

Question

The maximum possible number of hydrogen bonds a water molecule can form is.

[IIT JEE 1992]

A 2

B 4

C 3

D 1

THANK YOU