

Chemical Bonding and Molecular Structure

Question1

Which of the following molecules does not obey octet rule?

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Options:

A.



B.



C.



D.



Answer: C

Solution:

Chlorine is an example of an atom that can have more than 8 electrons in its valence shell (since it is in the third period and can expand its valence shell due to the presence of 3 d orbital). In ClF_3 , chlorine has 10 electrons in its valence shell. Therefore, ClF_3 does not obey the octet rule.

Question2

Which of the following xenon compound has chlorine pentafluoride like structure?



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Options:

A.



B.



C.



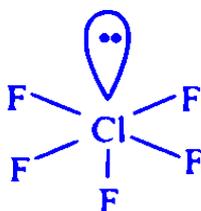
D.



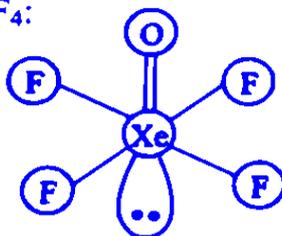
Answer: D

Solution:

ClF_5 :



XeOF_4 :



XeOF_4 and ClF_5 both have square pyramidal molecular structures.

Question3

Which of the following is correct decreasing order of bond length regarding N_2 , O_2 and Cl_2 ?



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Options:

A.



B.



C.



D.



Answer: A

Solution:

As bond order increases, bond enthalpy increases and bond length decreases.

Molecule	Structure	Bond order
Cl_2	$\text{Cl} - \text{Cl}$	1
O_2	$\text{O} = \text{O}$	2
N_2	$\text{N} \equiv \text{N}$	3

∴ Decreasing order of bond length is $\text{Cl}_2 > \text{O}_2 > \text{N}_2$.

Question4

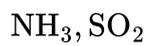
Identify a pair of molecules having similar shapes of both members.

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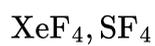


Options:

A.



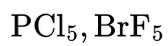
B.



C.



D.



Answer: C

Solution:

Molecule	Shape	Molecule	Shape
NH ₃	Trigonal pyramidal	SO ₂	Bent
XeF ₄	Square planar	SF ₄	See-saw
H ₂ O	Bent	SCl ₂	Bent
PCl ₅	Trigonal bipyramidal	BrF ₅	Square pyramidal

H₂O and SCl₂ show bent molecular geometry.

Question5

Which of the following is more polar?

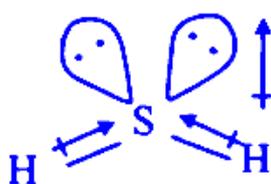
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Options:

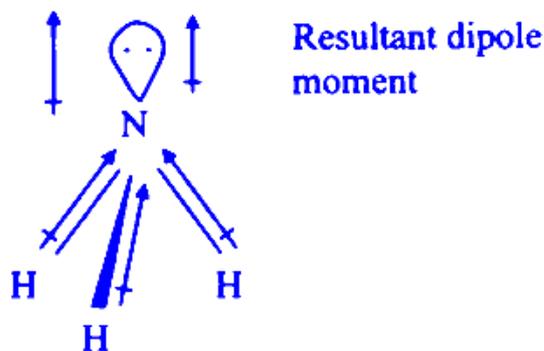
- A. H₂ S
- B. NH₃
- C. NF₃
- D. CHCl₃

Answer: B

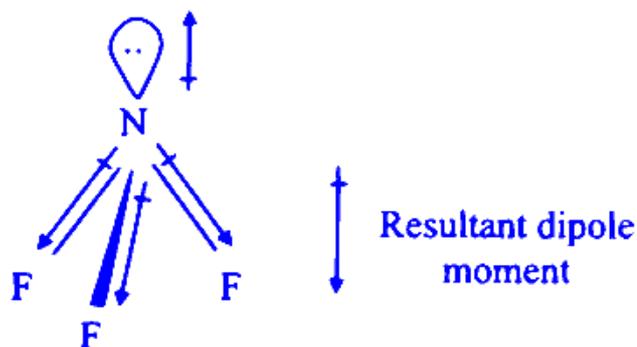
Solution:



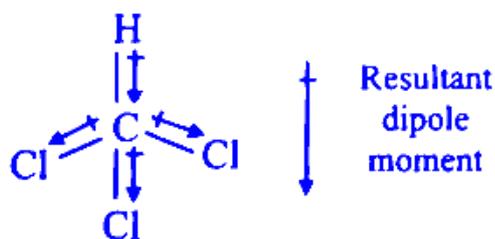
Resultant dipole moment in H₂S = 0.95 D



Resultant dipole moment in $\text{NH}_3 = 1.47 \text{ D}$



Resultant dipole moment in $\text{NF}_3 = 0.23 \text{ D}$



Resultant dipole moment in $\text{CHCl}_3 = 1.04 \text{ D}$

Since the resultant dipole moment of NH_3 is higher, it is more polar.

Question6

Which of the following pair of compounds consists equal number of lone pair of electrons in the valence shell of central atom?

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Options:

- A. BrF_5 and XeF_6
- B. ICl and H_2S
- C. ClF_3 and XeF_2
- D. IF_7 and XeF_4

Answer: A

Solution:

Number of lone pairs

$$= \frac{\text{No. of valence } e^- - \text{no. of bonding } e^-}{2}$$

Compound	No. of Lone pairs	Compound	No. of Lone pairs
BrF_5	1	XeF_6	1
ICl	3	H_2S	2
ClF_3	2	XeF_2	3
IF_7	0	XeF_4	2

\therefore BrF_5 and XeF_6 have one lone pair of electrons in the valence shell of central atom.

Question7

What is the number of electrons in bonding molecular orbitals and antibonding molecular orbitals respectively in F_2 molecule?

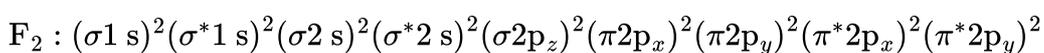
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Options:

- A. 12 and 6
- B. 10 and 8
- C. 8 and 10
- D. 6 and 12

Answer: B

Solution:



No. of electrons in bonding orbitals = 10

No. of electrons in antibonding orbitals = 8.

Question8

What type of overlap is involved in the formation of C – H bonds in acetylene molecules?

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Options:

- A. $sp^3 - s$
- B. $sp^2 - s$
- C. $sp - s$
- D. $sp - sp$

Answer: C

Solution:

Step 1: Hybridization of carbon in acetylene

In acetylene, the structure is $\text{H}-\text{C}\equiv\text{C}-\text{H}$.

Each carbon forms:

- One C–H sigma bond
- One C–C sigma bond
- Two π bonds (from overlap of unhybridized p orbitals).

Thus, each carbon is sp **hybridized** (because it forms two sigma bonds with linear geometry).

Step 2: Overlap in the C–H bond

- Each hydrogen has a $1s$ orbital.
- On carbon, the orbital used for sigma bonding is an sp **hybrid orbital**.

Therefore, the C–H sigma bond arises from **$sp-s$** overlap.

✓ **Correct Answer: Option C: $sp - s$**

Question9

What is shape of interhalogen compound so that central halogen exhibits +3 oxidation state?

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Options:

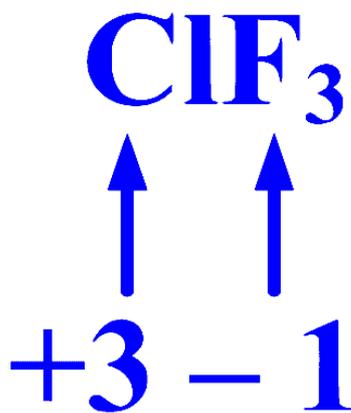
- A. Tetrahedral
- B. Bent 'T' shape
- C. Square pyramidal
- D. Square planar

Answer: B

Solution:

ClF_3 is an interhalogen compound that has bent 'T' shape.





Question10

Which of the following compounds has high lattice enthalpy?

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Options:

- A. LiCl
- B. NaCl
- C. BeF₂
- D. CaCl₂

Answer: C

Solution:

As the size of the cation decrease, lattice enthalpy increases. Hence, BeF₂ exhibits the highest lattice enthalpy among the given.

Question11

Identify from following compounds where valence shell of 'Xe' consists one lone pair of electrons.



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Options:

A. XeF_2

B. XeF_4

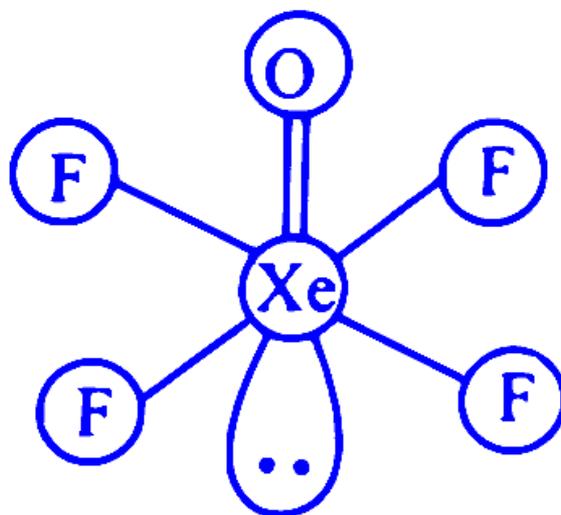
C. XeOF_2

D. XeOF_4

Answer: D

Solution:

Structure of XeOF_4 :



Question12

Which of the following molecules contains maximum number of electrons in antibonding molecular orbitals?

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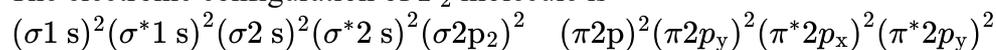
Options:

- A. Li_2
- B. N_2
- C. O_2
- D. F_2

Answer: D

Solution:

The electronic configuration of F_2 molecule is



\therefore No. of electrons in antibonding orbitals = 8

Question13

Identify the correct statement regarding geometry and lone pair of electrons present in CH_4 and SiCl_4 .

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Options:

- A. Both have same geometry with two lone pair of electrons each.
- B. Both have different geometry with one lone pair of electrons each.
- C. Both have same geometry with no lone pair of electrons each.
- D. Both have different geometry with no lone pair of electrons each.

Answer: C

Solution:

We are asked about the geometry and lone pairs in CH_4 and SiCl_4 .

Step 1: Central atom in CH_4

- Carbon has 4 valence electrons.
- Forms 4 sigma bonds with 4 H atoms.
- No lone pairs on the central atom.
- Geometry: tetrahedral.

Step 2: Central atom in SiCl_4

- Silicon has 4 valence electrons.
- Forms 4 sigma bonds with 4 Cl atoms.
- No lone pairs on the central atom.
- Geometry: tetrahedral.

Conclusion:

Both CH_4 and SiCl_4 have **same geometry (tetrahedral)** and **no lone pairs on the central atom**.

Correct answer:

Option C: Both have same geometry with no lone pair of electrons each.

Question14

What different types of bonds are formed by chlorine with oxygen in perchloric acid?

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Options:

- A. 2-single bonds and 2-double bonds
- B. 3-single bonds and 1-double bond

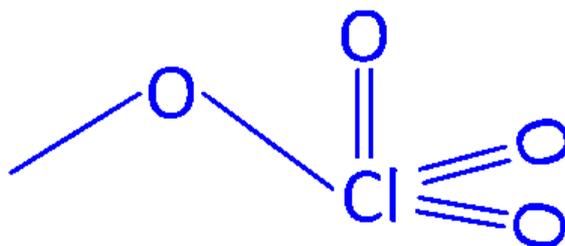
C. 2-single bonds and 3-double bonds

D. 1-single bond and 3-double bonds

Answer: D

Solution:

Perchloric acid, (HClO_4) has a following structure:



Therefore, 1 -single bond and 3 -double bonds are formed by chlorine with oxygen in perchloric acid.

Question15

Which of the following species is not tetrahedral?

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Options:

A. CH_4

B. SF_4

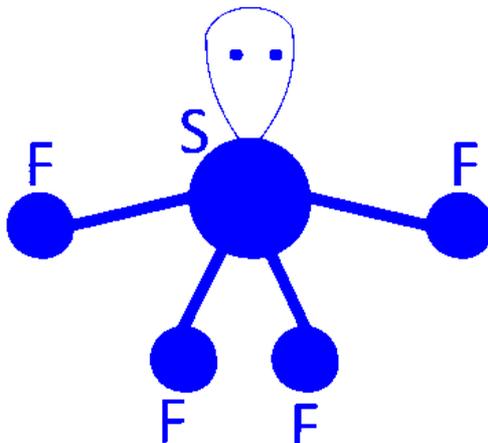
C. $\overset{+}{\text{N}}\text{H}_4$

D. SiCl_4

Answer: B

Solution:

SF_4 has a trigonal bipyramidal electron geometry, and seesaw shaped molecular geometry.



Question16

Which of the following is Lewis base?

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Options:

- A. BF_3
- B. AlCl_3
- C. Cu^{2+}
- D. NH_3

Answer: D

Solution:

A **Lewis base** is a substance that can donate a pair of electrons.

Let's check each option:

- **Option A:** BF_3

BF_3 is electron-deficient and **accepts** electron pairs. It is a Lewis **acid**.

- **Option B:** AlCl_3

AlCl_3 is also electron-deficient and acts as a Lewis **acid**.

- **Option C:** Cu^{2+}

Cu^{2+} is a cation that **accepts** electron pairs to form complexes. It is a Lewis **acid**.

- **Option D:** NH_3

NH_3 has a lone pair of electrons on nitrogen and can **donate** this pair to other species.

Hence, it is a Lewis **base**.

Final Answer:

The correct answer is:

NH_3

Question17

Which of the following molecules consist minimum lone pair of electrons in the valence shell of central atom?

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Options:

- A. SCl_2
- B. PCl_3
- C. ClF_3
- D. XeF_4

Answer: B

Solution:



Molecule	No. of lone pairs on the central atom	No. of bonding pairs on the central atom
SCl ₂	2	2
PCl ₃	1	3
ClF ₃	2	3
XeF ₄	2	4

Question 18

Select the incorrect statement about N₂ molecule.

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Options:

- A. It is more stable than O₂ molecule.
- B. It consists more electrons in bonding molecular orbitals than O₂
- C. Its bond order is 3
- D. It is diamagnetic

Answer: B

Solution:

Electronic configuration	No. of electrons in bonding molecular orbitals	Bond order	Magnetic nature
$\text{N}_2 : (\sigma 1s)^2(\sigma^* 1s)^2$ $(\sigma 2s)^2(\sigma^* 2s)^2$ $(\pi 2p_x)^2(\pi 2p_y)^2$ $(\sigma 2p_z)^2$	10	3	Diamagnetic
$\text{O}_2 : (\sigma 1s)^2(\sigma^* 1s)^2$ $(\sigma 2s)^2(\sigma^* 2s)^2$ $(\sigma 2p_z)^2(\pi 2p_x)^2$ $(\pi 2p_y)^2(\pi^* 2p_x)^1$ $(\pi^* 2p_y)^1$	10	2	Paramagnetic

O₂ molecule has more electrons in antibonding orbital as compare to N₂ which makes it less stable than N₂ molecule.

Question19

What is shape of BrF₅ molecule?

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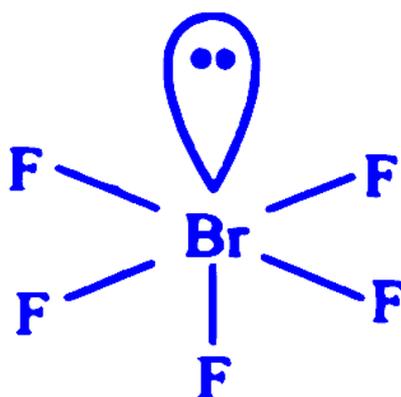
Options:

- A. Trigonal pyramidal
- B. Square planar
- C. Square pyramidal
- D. Bent 'T' shape

Answer: C

Solution:

The shape of BrF₅ is square pyramidal



Question20

Identify the geometry of TeF₄ molecule from the following.

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Options:

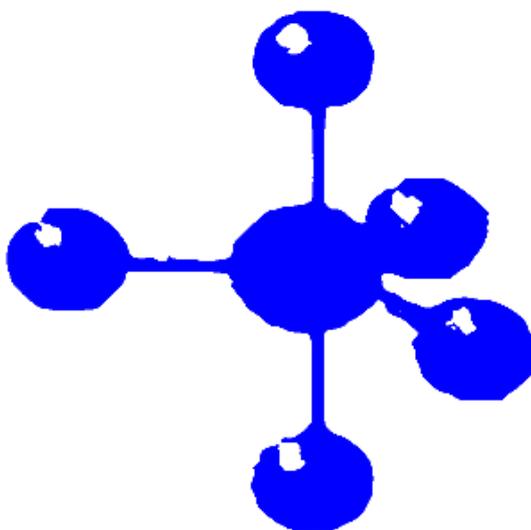
- A. Linear
- B. Tetrahedral
- C. Trigonal bipyramidal
- D. Trigonal

Answer: C

Solution:

Te is from group 16, which means it has 6 electrons in valence shell out of which 4 are bonded with 1 Fluorine atom each thus leaving behind 1 lone pair.

TeF_4 has 1 lone pair and 4 bonding pairs (AB_4E). Its electron geometry is trigonal bipyramidal.



Question21

Identify a molecule having highest number of lone pair of electrons in valence shell of central atom.

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Options:



Answer: C

Solution:

Molecule	No. of lone pairs on the central atom
NH_3	1
SF_4	1
ICl_3	2
PCl_3	1

Question22

Which of the following molecules has a regular geometry as expected?

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Options:



D. XeF_4

Answer: A

Solution:

Let us analyze each molecule using the **VSEPR theory** (Valence Shell Electron Pair Repulsion theory) as described in the NCERT textbook.

Option A: SiCl_4

- **Central atom:** Si
- **Valence electrons on Si:** 4
- **Chlorine atoms:** 4, each forms a single bond
- **Total bonding pairs:** 4
- **Lone pairs on Si:** 0

According to VSEPR theory:

- Steric number = 4 (4 bond pairs + 0 lone pairs)
- Geometry: **Tetrahedral** (regular geometry)

Option B: SF_4

- **Central atom:** S
- **Valence electrons on S:** 6
- **Fluorine atoms:** 4, each forms a single bond
- **Total bonding pairs:** 4
- **Lone pairs on S:** $6 - 4 = 2$ left as non-bonded electrons, which is 1 lone pair

According to VSEPR theory:

- Steric number = 5 (4 bond pairs + 1 lone pair)
- Geometry: **See-saw** (not regular)

Option C: BrF_5

- **Central atom:** Br
- **Valence electrons on Br:** 7
- **Fluorine atoms:** 5, each forms a single bond
- **Total bonding pairs:** 5
- **Lone pairs on Br:** $7 - 5 = 2$ left as non-bonded electrons, which is 1 lone pair



According to VSEPR theory:

- Steric number = 6 (5 bond pairs + 1 lone pair)
- Geometry: **Square pyramidal** (not regular)

Option D: XeF₄

- **Central atom:** Xe
- **Valence electrons on Xe:** 8
- **Fluorine atoms:** 4, each forms a single bond
- **Total bonding pairs:** 4
- **Lone pairs on Xe:** $8 - 4 = 4$ left as non-bonded electrons, which is 2 lone pairs

According to VSEPR theory:

- Steric number = 6 (4 bond pairs + 2 lone pairs)
- Geometry: **Square planar** (all bond pairs are in the same plane and lone pairs are on opposite sides, so the geometry for the atom positions is regular)

But by the definition of "regular geometry" (all positions equivalent and bond angles the same), the square planar geometry, despite being symmetric, is not perfectly regular like tetrahedral because of lone pairs.

Final Answer

The molecule with a regular geometry as expected is:



This has a **tetrahedral (regular) geometry**.

Question23

Which of the following compounds has maximum covalent character?

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Options:

A. LiCl

B. LiI

C. NaCl



D. NaI

Answer: B

Solution:

To find which compound has maximum covalent character, we use **Fajans' Rules** (Class 11, NCERT, Chemical Bonding and Molecular Structure).

According to Fajans' Rules:

- Smaller cation and larger anion → **more covalent character**.
- Cations with higher charge polarise anions more.
- Larger anion is more easily polarised.

Comparing the options:

- Cation: Li^+ (smaller) vs Na^+ (larger)
- Anion: Cl^- (smaller) vs I^- (larger)

Let's arrange as per covalent character:

- **Covalent character increases with smaller cation and larger anion.**
- Li^+ is smaller than Na^+ , so Li-compounds will be more covalent than Na-compounds.
- I^- is larger than Cl^- , so I-compounds will be more covalent than Cl-compounds.

Among the given choices:

- LiI: Smallest cation (Li^+), largest anion (I^-)
- LiCl: Smallest cation (Li^+), smaller anion (Cl^-)
- NaI: Larger cation (Na^+), largest anion (I^-)
- NaCl: Larger cation (Na^+), smaller anion (Cl^-)

Hence, maximum covalent character will be in LiI.

Final answer:

Option B: LiI has the maximum covalent character.

Question24

Which of the following molecule can form hydrogen bonding with itself?

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Options:

A. NH_3

B. C_2H_6

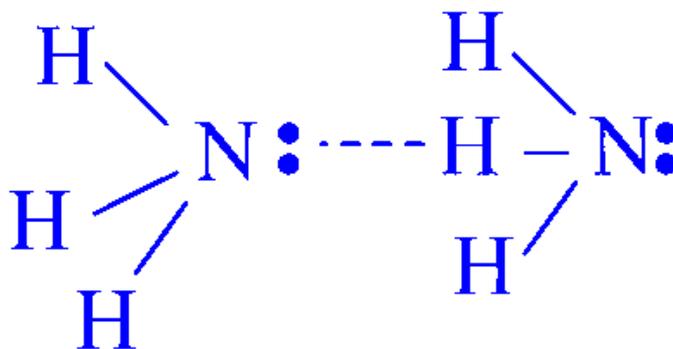
C. H_2S

D. $\text{CH}_3 - \text{O} - \text{CH}_3$

Answer: A

Solution:

One molecule of NH_3 associates with another molecule of NH_3 by inter-molecular hydrogen bonding.



Question25

What is the number of electrons present in antibonding orbitals of N_2 molecule according to molecular orbital theory?

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Options:

A. 14



B. 10

C. 04

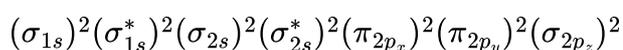
D. 06

Answer: C

Solution:

According to molecular orbital theory, the N_2 molecule is made up of nitrogen atoms with each contributing 7 electrons, making a total of 14 electrons for the N_2 molecule. These electrons are filled into molecular orbitals in the order of increasing energy.

The molecular orbital configuration for N_2 is :



In this configuration :

Bonding orbitals are: σ_{1s} , σ_{2s} , π_{2p_x} , π_{2p_y} , and σ_{2p_z} .

Antibonding orbitals are marked with an asterisk (*), specifically: σ_{1s}^* , and σ_{2s}^* .

Counting the electrons in the antibonding orbitals :

σ_{1s}^* has 2 electrons.

σ_{2s}^* has 2 electrons.

Thus, there are a total of 4 electrons in the antibonding orbitals.

So the number of electrons present in antibonding orbitals of the N_2 molecule is 4.

Option C (04) is the correct answer.

Question26

Identify the angle O – S – O in SO_2 molecule.

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Options:

A. 119.5°

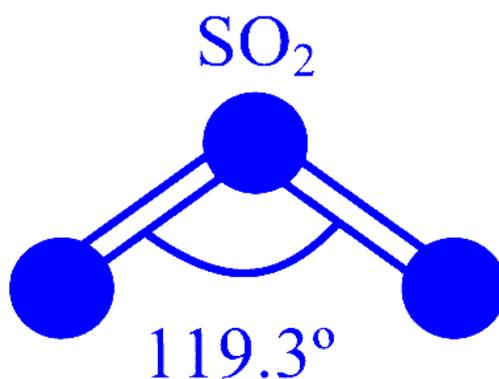
B. 180°

C. 109°

D. 107.5°

Answer: A

Solution:



Question27

What is the total number of electrons present in bonding orbitals of O_2 molecule according to molecular orbital theory?

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Options:

A. 16

B. 06

C. 10

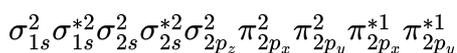
D. 04

Answer: C



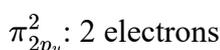
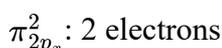
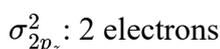
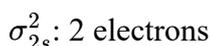
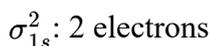
Solution:

In the molecular orbital theory, the electronic configuration for the O_2 molecule can be written as:



Bonding orbitals include all the orbitals without an asterisk (*) in their notation, while antibonding orbitals include those with an asterisk (*).

For O_2 , the bonding orbitals and their respective electrons are:



Adding the electrons in these bonding orbitals gives a total:

$$2 + 2 + 2 + 2 + 2 = 10$$

Thus, the total number of electrons present in the bonding orbitals of the O_2 molecule is 10. Hence, option C is correct.

Question28

Which among the following is an example of odd electron molecule?

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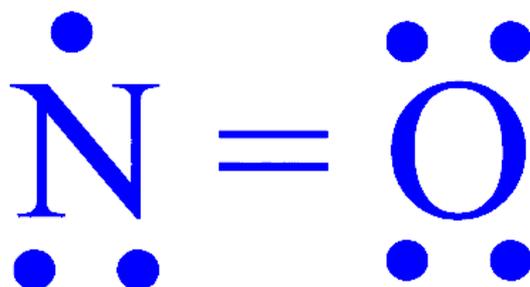
Options:



Answer: C

Solution:

NO (nitric oxide) is an odd electron molecule and do not obey octet rule.



Question29

What is O – O bond length in ozone molecule?

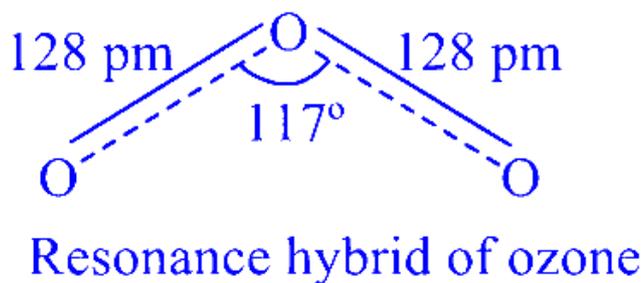
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Options:

- A. 128 pm
- B. 117 pm
- C. 107 pm
- D. 134 pm

Answer: A

Solution:



O – O bond length in resonance hybrid of ozone = 128pm

Question30

Which of the following molecules is an example of sp hybridization?

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Options:

- A. Methane
- B. Acetylene
- C. Ethylene
- D. Ammonia

Answer: B

Solution:

Methane (CH_4) – sp^3 hybridisation

Acetylene (C_2H_2) - sp hybridisation

Ethylene (C_2H_4) – sp^2 hybridisation

Ammonia (NH_3) – sp^3 hybridisation

Question31

Which of the following molecules has zero dipole moment?

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Options:

A. HF

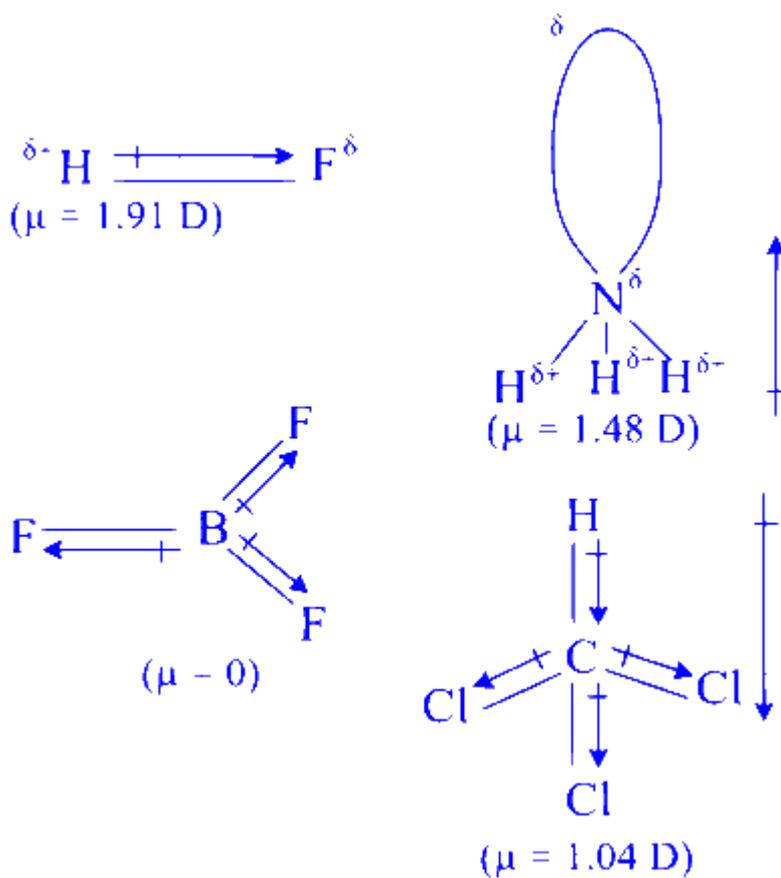
B. NH₃

C. BF₃

D. CHCl₃

Answer: C

Solution:



Question32

Which of the following compounds follows octet rule?

MHT CET 2024 11th May Morning Shift

Options:



Answer: C

Solution:

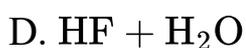
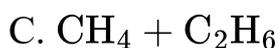
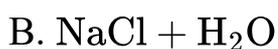
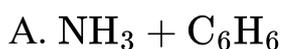
H_2SO_4 and SF_6 molecules have an expanded octet, i.e., more than eight electrons around the central atom. NO_2 molecule has odd number of valence electrons. In SCl_2 , sulphur attains noble gas configuration of 8 by forming two covalent bonds, thus obeying octet rule.

Question33

Which of the following has dipole-induced dipole interaction as inter molecular force?

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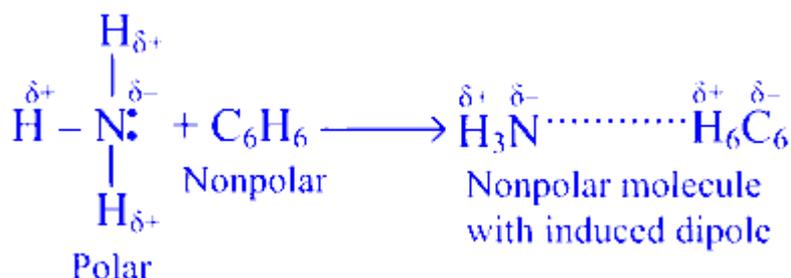
Options:



Answer: A

Solution:

Ammonia (NH_3) is polar having permanent dipole moment and it induces a dipole in non-polar benzene having zero dipole moment.



Question34

What is the number of Lewis structures for NO_2^- ?

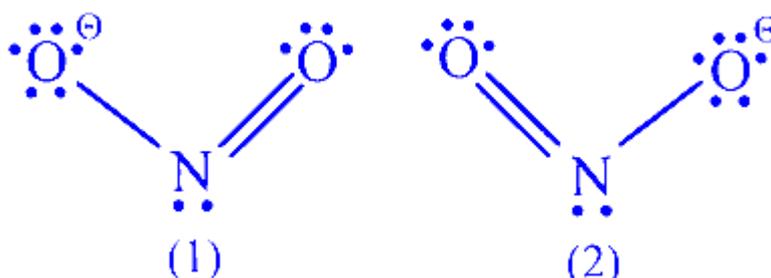
MHT CET 2024 10th May Evening Shift

Options:

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

Answer: B

Solution:



Question35

What is the shape of bromine pentafluoride?

MHT CET 2024 10th May Morning Shift

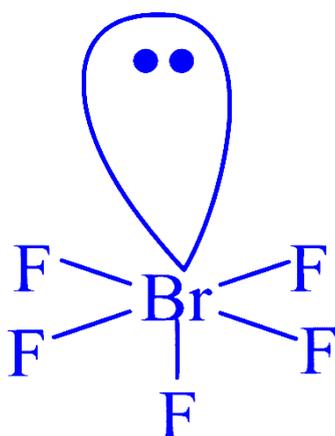
Options:

- A. Trigonal pyramidal
- B. Square pyramidal
- C. Square planar
- D. Distorted octahedral

Answer: B

Solution:

The shape of BrF_5 is square pyramidal.



Question36

Which of the following molecule has bond order 2 ?

MHT CET 2024 10th May Morning Shift

Options:

A. N_2

B. H_2

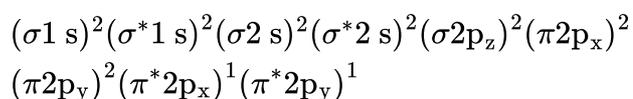
C. O_2

D. F_2

Answer: C

Solution:

The electronic configuration of O_2 molecule is



Bond order of O_2 molecule

$$= \frac{N_b - N_a}{2} = \frac{10 - 6}{2} = 2$$

Question 37

Identify the hybridisation and geometry of SF_4 molecule respectively.

MHT CET 2024 9th May Evening Shift

Options:

A. sp^3d and Trigonal bipyramidal

B. sp^3 and trigonal bipyramidal

C. $sp^3 d^2$ and trigonal bipyramidal

D. $sp^3 d^2$ and octahedral

Answer: A

Solution:

The molecule SF_4 has sulfur (S) as the central atom, which is bonded to four fluorine (F) atoms. Sulfur has a total of six valence electrons, and with four of these used in bonding with the fluorine atoms, two electrons remain as a lone pair on the sulfur atom.

The hybridization of the central atom can be determined by counting the number of regions of electron density around it—these include both the bonded atoms and any lone pairs.

Hybridization: Sulfur in SF_4 forms four sigma bonds with the fluorine atoms and has one lone pair. This sums up to five regions of electron density. The hybridization that accommodates five electron pairs is sp^3d .

Geometry: The presence of one lone pair and four bonded pairs leads to a molecular geometry known as the "see-saw" shape. While the electron pair geometry of a molecule with sp^3d hybridization is trigonal bipyramidal, the actual molecular geometry (considering only bonding pairs) is "see-saw."

Therefore, the correct identification for hybridization and the associated electron pair geometry of SF_4 is:

Hybridization: sp^3d

Geometry: Trigonal bipyramidal (electron pair geometry)

The answer is **Option A:** sp^3d and Trigonal bipyramidal.

Question38

Which from following molecules has trigonal planar geometry?

MHT CET 2024 9th May Evening Shift

Options:

A. CH_4

B. C_2H_2



C. NH_3

D. BF_3

Answer: D

Solution:

Molecule	Geometry
CH_4	Tetrahedral
C_2H_2	Linear
NH_3	Trigonal pyramidal
BF_3	Trigonal planar

Question39

What is bond angle $\text{F} - \text{B} - \text{F}$ in BF_3 ?

MHT CET 2024 9th May Morning Shift

Options:

A. 107°

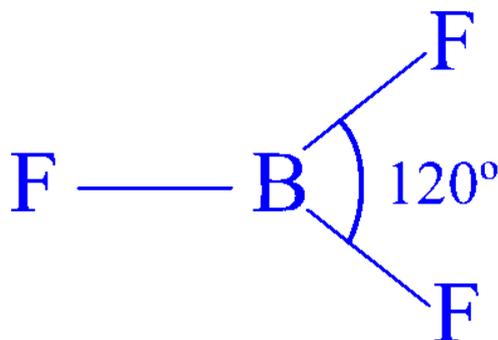
B. 104.5°

C. 120°

D. 109.5°

Answer: C

Solution:



Each F – B – F bond angle in BF_3 molecule is 120° .

Question40

Which from following compounds is most covalent?

MHT CET 2024 9th May Morning Shift

Options:

- A. SbCl_3
- B. PbCl_2
- C. SnCl_4
- D. SnCl_2

Answer: C

Solution:

The metal halides having metals in their higher oxidation states are more covalent than the ones having metals in lower oxidation state.

SbCl_3 ,	PbCl_2 ,	SnCl_4	SnCl_2
↑	↑	↑	↑
+3	+2	+4	+2

∴ SnCl_4 is highly covalent in nature.

Question41

Which among the following forces of attraction is developed between polar and non polar molecules?

MHT CET 2024 9th May Morning Shift

Options:

- A. Dipole-induced dipole interaction
- B. Ion-dipole interaction
- C. Dipole-dipole interaction
- D. van der Waals forces

Answer: A

Solution:

Dipole-induced dipole interaction is the force of attraction developed between polar and non-polar molecules.

When a polar molecule, possessing a permanent dipole, approaches a non-polar molecule, its electric field can distort the electron cloud of the non-polar molecule, inducing a temporary dipole in it. This interaction results in an attractive force between the polar and non-polar molecules, stabilizing them.

This mechanism plays a significant role in many biological and chemical processes where polar and non-polar substances interact. It is generally weaker than permanent dipole-dipole interactions but stronger than inductions resulting from purely temporary dipoles alone.

In summary, the correct answer is:

Option A: Dipole-induced dipole interaction

Question42



What is the number of lone pair of electrons on central halogen atom in BrF_3 ?

MHT CET 2024 4th May Evening Shift

Options:

A. 2

B. 3

C. 1

D. 0

Answer: A

Solution:

Interhalogens of type XX'_3 have sp^3d hybridization. They have two lone pairs of electrons on central atom X.

Question43

Identify the bond order and magnetic nature of Li_2 molecule respectively.

MHT CET 2024 4th May Evening Shift

Options:

A. 1 and diamagnetic

B. 2 and diamagnetic

C. 1 and paramagnetic



D. 2 and paramagnetic

Answer: A

Solution:

To determine the bond order and magnetic nature of the Li_2 molecule, we need to consider its molecular orbital configuration.

Electronic Configuration of Li_2 :

The atomic number of lithium (Li) is 3. In a Li_2 molecule, each lithium atom contributes 3 electrons, totaling 6 electrons for the molecule.

The electrons fill molecular orbitals in the following order: σ_{1s} , σ_{1s}^* , σ_{2s} , σ_{2s}^* .

Filling the Molecular Orbitals:

σ_{1s} : 2 electrons (filled)

σ_{1s}^* : 2 electrons (filled)

σ_{2s} : 2 electrons (filled)

The σ_{2s}^* orbital remains unfilled as we only need to allocate 6 electrons.

Bond Order Calculation:

The bond order is calculated using the formula:

$$\text{Bond Order} = \frac{1}{2}(N_b - N_a)$$

where N_b is the number of electrons in bonding orbitals, and N_a is the number of electrons in antibonding orbitals.

For Li_2 :

Bonding electrons (N_b): 4 (from σ_{1s} and σ_{2s})

Antibonding electrons (N_a): 2 (from σ_{1s}^*)

Thus, the bond order is:

$$\text{Bond Order} = \frac{1}{2}(4 - 2) = \frac{1}{2} \times 2 = 1$$

Magnetic Nature:

Since all electrons are paired in the Li_2 molecule, it is diamagnetic.

Conclusion:

Bond Order: 1

Magnetic Nature: Diamagnetic

Therefore, the correct answer is **Option A: 1 and diamagnetic**.

Question44

Which from following molecules does not have lone pair of electrons in valence shell of central atom?

MHT CET 2024 4th May Morning Shift

Options:

A. NH_3

B. H_2O

C. SO_2

D. BF_3

Answer: D

Solution:

Molecule	No. of lone pairs on the central atom
NH_3	1
H_2O	2
SO_2	1
BF_3	0



Question45

Which from following molecules exhibits lowest dipole moment?

MHT CET 2024 3rd May Evening Shift

Options:

- A. CH_3F
- B. CH_3Cl
- C. CH_3Br
- D. CH_3I

Answer: D

Solution:

As the electronegativity of halogen decreases down the group, the C – X bond dipole moment decreases.

Therefore, the dipole moment order is:



Question46

What is the number of lone pair of electrons involved in IF molecule?

MHT CET 2024 3rd May Evening Shift

Options:

- A. 3



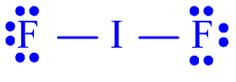
B. 2

C. 1

D. Zero

Answer: A

Solution:

Formula	O.S. of Central Halogen	No. of lone pairs of electrons involved	Structure
IF	+1	3	

Question47

Which of the following types of hybridisation result in trigonal geometry?

MHT CET 2024 3rd May Evening Shift

Options:

A. sp

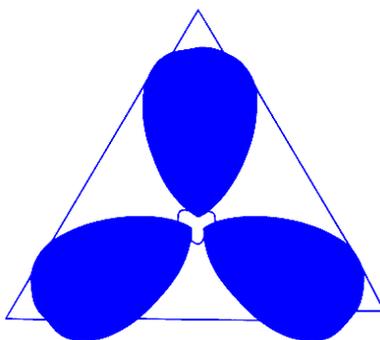
B. dsp^2

C. sp^2

D. sp^3

Answer: C

Solution:



sp^3 hybridisation - trigonal planar geometry

Question48

Identify the structure of XeF_4 molecule from following.

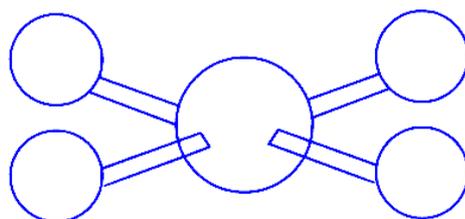
MHT CET 2024 3rd May Morning Shift

Options:

- A. Trigonal pyramidal
- B. Square pyramidal
- C. Square planar
- D. Distorted octahedral

Answer: C

Solution:



XeF_4 (square planar)

Question49

Which from following molecules has two lone pair of electrons in valence shell of its central atom?

MHT CET 2024 3rd May Morning Shift

Options:

A. SO_2

B. NH_3

C. H_2O

D. SF_4

Answer: C

Solution:

The molecule H_2O has two lone pairs of electrons in the valence shell of its central atom, oxygen.

In water (H_2O):

Oxygen is the central atom and is in Group 16 of the periodic table, meaning it has 6 valence electrons.

Each hydrogen atom forms a single bond with the oxygen atom, using 2 of the valence electrons (one for each H – O bond).

This leaves 4 electrons on the oxygen atom, which form 2 lone pairs.

In summary:

H_2O has 2 lone pairs and 2 bonding pairs on the central oxygen atom, leading to a bent molecular geometry due to the repulsion between the lone pairs and the bonding pairs.

Thus, Option C: H_2O is the correct answer.

Question50



Which from following molecules is tetrahedral?

MHT CET 2024 2nd May Evening Shift

Options:

A. C_2H_2

B. CH_4

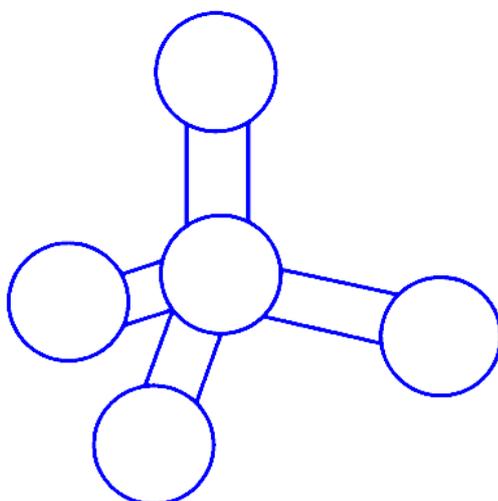
C. $BeCl_2$

D. BF_3

Answer: B

Solution:

CH_4 shows sp^3 hybridisation, thus it has tetrahedral geometry.



CH_4 (tetrahedral)

Question51

What is the bond order in CO molecule?



MHT CET 2024 2nd May Morning Shift

Options:

A. 1

B. 3

C. 2

D. $\frac{1}{2}$

Answer: B

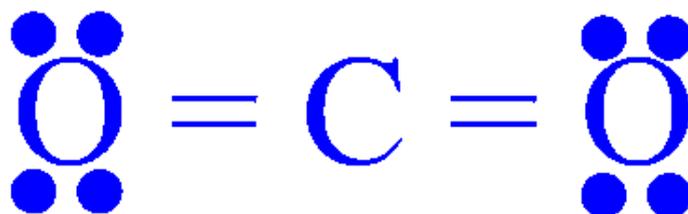
Solution:

According to Lewis theory the bond order is equal to the number of bonds between the two atoms in a molecule.

$C \equiv O$ has bond order 3.

Question52

What is formal charge on carbon in the following Lewis structure?



MHT CET 2023 14th May Evening Shift

Options:

A. 0

B. 1



C. -1

D. 2

Answer: A

Solution:

$$\text{Formal charge} = \text{VE} - \text{NE} - (\text{BE}/2)$$

$$\text{Formal charge on C} = 4 - 0 - (8/2) = 0$$

Question53

Which activity from following is exhibited by Lewis base according to definition?

MHT CET 2023 14th May Morning Shift

Options:

A. accept a pair of electron

B. donate a pair of electron

C. accept H^+ ions

D. donate OH^- ions

Answer: B

Solution:

According to the definition given by G. N. Lewis, a Lewis base is a substance that can donate a pair of electrons to a Lewis acid to form a Lewis adduct. A Lewis base, therefore, is an electron pair donor. So, the correct answer to this question would be:

Option B: donate a pair of electrons.

Question54

What is the geometry of PCl_5 molecule as per VSEPR?

MHT CET 2023 14th May Morning Shift

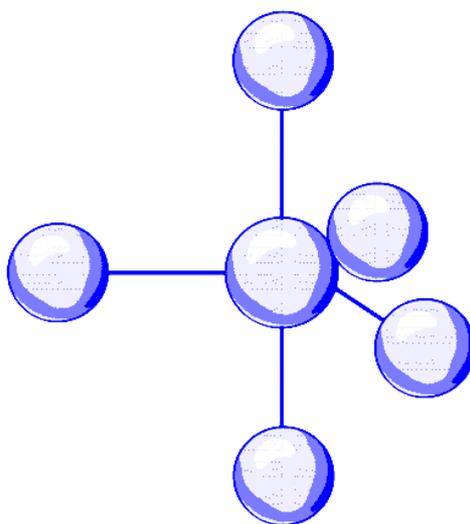
Options:

- A. Trigonal bipyramidal
- B. Octahedral
- C. Tetrahedral
- D. Square pyramidal

Answer: A

Solution:

PCl_5 : Trigonal bipyramidal



Question55

What is the bond order in N_2^+ ?



MHT CET 2023 13th May Evening Shift

Options:

- A. 0
- B. 1
- C. 2
- D. 2.5

Answer: D

Solution:

Total number of electrons in N_2^+ is 13.

So, its electronic configuration is

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

$$\text{So, BO} = \frac{N_b - N_a}{2} = \frac{9 - 4}{2} = 2.5$$

Question 56

Which of the following molecules does NOT obey octet rule?

MHT CET 2023 13th May Morning Shift

Options:

- A. CCl_4
- B. Cl_2
- C. O_2
- D. BeF_2

Answer: D



Solution:

In BeF_2 , Be has 4 electrons in its valence shell. Thus, it does not obey octet rule.

Question57

What is bond order of F_2 molecule?

MHT CET 2023 12th May Evening Shift

Options:

- A. $\frac{1}{2}$
- B. 1
- C. 2
- D. 3

Answer: B

Solution:

The electronic configuration of F_2

$$(\sigma 1s)^2 (\sigma^* 1s)^2 (\sigma 2s)^2 (\sigma^* 2s)^2 (\sigma 2p_z)^2 (\pi 2p_x)^2 (\pi 2p_y)^2 (\pi^* 2p_x)^2 (\pi^* 2p_y)^2$$
$$\text{Bond order of } \text{F}_2 \text{ molecule} = \frac{N_b - N_a}{2} = \frac{10 - 8}{2} = 1$$

Question58

What is the shape of AB_4E type of molecule according to VSEPR?

MHT CET 2023 12th May Morning Shift



Options:

- A. See saw
- B. Bent
- C. Trigonal pyramidal
- D. T shape

Answer: A

Solution:

The correct answer is:

A) See-saw

Explanation:

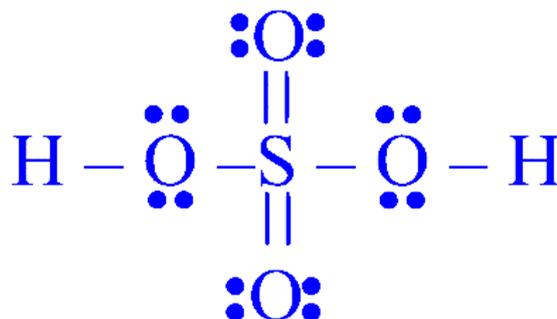
An AB_4E molecule has **5 electron domains** (4 bonding pairs + 1 lone pair).

- Electron geometry: **Trigonal bipyramidal**
- With one lone pair occupying an equatorial position, the **molecular shape becomes see-saw** .

So, according to VSEPR theory, $AB_4E \rightarrow$ **see-saw shape** .

Question59

What is the formal charge on sulfur in following Lewis structure?



MHT CET 2023 11th May Evening Shift

Options:

A. 2

B. -2

C. 0

D. -1

Answer: C

Solution:

Formal Charge (FC) = V.E. - N.E. - $1/2$ (B.E.)

FC on S = $6 - 0 - 1/2(12) = 0$

Question60

Which metal halide from following has lowest ionic character (M = metal atom)?

MHT CET 2023 11th May Morning Shift

Options:

A. MF

B. MCl

C. MBr

D. MI

Answer: D

Solution:

Ionic character of metal halides decreases in the order $MF > MCl > MBr > MI$, where, M is a monovalent metal. Smaller the size of anion, greater is the ionic character (Fajan's rule). Therefore, MI has the lowest ionic character.

Question61

Which among the following halogens combines readily with metals to form metal halides with highest ionic character?

MHT CET 2023 11th May Morning Shift

Options:

- A. Chlorine
- B. Bromine
- C. Iodine
- D. Fluorine

Answer: D

Solution:

Ionic character of metal halides decreases in the order $MF > MCl > MBr > MI$, where, M is a monovalent metal. Smaller the size of anion, greater is the ionic character (Fajan's rule). Therefore, fluorine forms metal halides with highest ionic character.

Question62

Identify a molecule with incomplete octet from following.

MHT CET 2023 11th May Morning Shift

Options:

A. SF_6

B. PCl_5

C. LiCl

D. H_2SO_4

Answer: C

Solution:

Li in LiCl has less than eight electrons in its valence shell. It has only four electrons. Hence, it has an incomplete octet. Molecules like SF_6 , PCl_5 , H_2SO_4 have an expanded octet. They have more than eight electrons around the central atom.

Question63

What is the number of unpaired electrons in NO molecule?

MHT CET 2023 10th May Evening Shift

Options:

A. 0

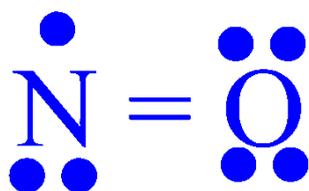
B. 1

C. 2

D. 3

Answer: B

Solution:



No. of unpaired electrons = 1

Question64

Identify the molecule from following that does NOT involve sp^3 hybridisation.

MHT CET 2023 10th May Morning Shift

Options:

- A. CH_4
- B. C_2H_2
- C. H_2O
- D. NH_3

Answer: B

Solution:

In C_2H_2 , both the carbon atoms undergo sp hybridisation.

Question65

Lewis acid is a substance that :

MHT CET 2023 10th May Morning Shift

Options:

- A. gives H^+ ions aqueous solution
- B. accepts a proton
- C. accepts electron pair
- D. donates a proton

Answer: C

Solution:

Lewis acids are defined as substances that can accept an electron pair. According to the Lewis acid-base theory, an acid is an electron pair acceptor, and a base is an electron pair donor. This definition is broader than the Bronsted-Lowry definition of acids and bases, which involves proton transfer.

Given the options :

- Option A : gives H^+ ions in aqueous solution - This describes a Brønsted-Lowry acid, not necessarily a Lewis acid.
- Option B : accepts a proton - This is the definition of a Brønsted-Lowry base.
- Option C : accepts electron pair - This accurately describes a Lewis acid.
- Option D : donates a proton - This is the definition of a Brønsted-Lowry acid.

Therefore, the correct answer is Option C : accepts electron pair.

Question66

What is the number of electrons around sulfur in H_2SO_4 molecule?

MHT CET 2023 9th May Evening Shift

Options:

- A. 4
- B. 6

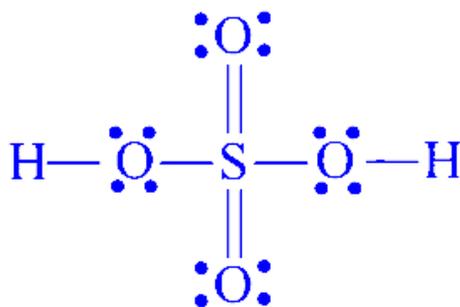


C. 10

D. 12

Answer: D

Solution:



12 electrons around sulphur

Question67

Which of the following molecules has no lone pair of electrons on central atom?

MHT CET 2023 9th May Morning Shift

Options:

A. SO_2

B. SF_6

C. NH_3

D. SF_4

Answer: B



Solution:

Molecule	No. of lone pairs on the central atom
SO ₂	1
SF ₆	0
NH ₃	1
SF ₄	1

Question68

Which of the following molecules possesses highest dipole-dipole interactions ?

MHT CET 2022 11th August Evening Shift

Options:

- A. HCl
- B. HI
- C. HBr
- D. HF

Answer: D

Solution:

Greater the dipole moment higher is dipole-dipole interaction.

Question69

Which of the following is a Lewis acid but NOT a Bronsted acid?

MHT CET 2022 11th August Evening Shift

Options:

A. BCl_3

B. HNO_3

C. NH_3

D. HSO_4^-

Answer: A

Solution:

To identify which of the given compounds is a Lewis acid but not a Bronsted acid, we must first understand the definitions of Lewis and Bronsted acids.

A Lewis acid is a compound that can accept an electron pair, whereas a Bronsted acid is a compound that can donate a proton (H^+). In other words, Lewis acids are electron pair acceptors, and Bronsted acids are proton donors.

Now let's evaluate the given options:

- **Option A:** BCl_3 - Boron trichloride (BCl_3) is a Lewis acid because it has an incomplete octet; the boron atom has only six electrons in its valence shell and thus can accept an electron pair to complete its octet. However, it does not have a releasable proton, which means it cannot donate a proton in a reaction. Hence, BCl_3 is a Lewis acid but not a Bronsted acid.
- **Option B:** HNO_3 - Nitric acid (HNO_3) is both a Lewis acid and a Bronsted acid. It can donate a proton to become NO_3^- (making it a Bronsted acid), and it can also accept an electron pair because the nitrogen atom can participate in coordinate covalent bonding. However, since it is a Bronsted acid, it does not fit the requirement for this question.
- **Option C:** NH_3 - Ammonia (NH_3) is a Lewis base because it has a lone pair of electrons that can be donated to form a bond. It is not a Lewis acid. Ammonia is also not a Bronsted acid, as it doesn't donate protons but rather accepts them.

- **Option D:** HSO_4^- - Hydrogen sulfate ion (HSO_4^-) is a Bronsted acid because it can donate a proton to become sulfate ion (SO_4^{2-}). It does not readily act as a Lewis acid in accepting an electron pair, so its primary function is as a Bronsted acid.

Therefore, the correct answer is:

Option A: BCl_3

Question70

What is the bond order of CO molecule?

MHT CET 2022 11th August Evening Shift

Options:

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

Answer: C

Solution:

$$\text{Bond order of CO} = \frac{6-0}{2} = 3$$

Question71

Which of the following is NOT hydrogen like species?

MHT CET 2022 11th August Evening Shift

Options:

- A. He
- B. He^+
- C. Li^{2+}
- D. Be^{3+}

Answer: A

Solution:

Hydrogen-like species, also known as hydrogenic atoms or ions, are those that have only one electron surrounding the nucleus, irrespective of the charge on the nucleus. To evaluate which of the given species is not hydrogen-like, we need to look at the electron configuration of each.

Option A: He has two protons in its nucleus and two electrons. This is the normal helium atom and it has two electrons, hence it is not a hydrogen-like species since a hydrogen-like species can have only one electron.

Option B: He^+ is a helium ion with one electron removed, thus it has two protons in its nucleus but only one electron. This species is hydrogen-like because it has only one electron.

Option C: Li^{2+} has three protons in its nucleus and, in this ionic state, has had two electrons removed, leaving it with just one electron. Like He^+ , this ion is hydrogen-like.

Option D: Be^{3+} has four protons in its nucleus and, as a trivalent cation, has had three electrons removed. Therefore, it has only one electron remaining, which makes it a hydrogen-like species.

Therefore, the correct answer is Option A: He, because it is not hydrogen-like due to its two electrons.

Question 72

Identify the molecule in which central atom undergoes sp^3 hybridisation?

MHT CET 2022 11th August Evening Shift

Options:

- A. BF_3
- B. H_2O
- C. C_2H_4
- D. BeCl_2

Answer: B

Solution:

The central atom in a molecule undergoes sp^3 hybridization when it forms four sigma (σ) bonds and has no lone pairs of electrons. Let's examine each option to identify the correct one:

Option A: BF_3

The boron atom in boron trifluoride (BF_3) has three bonding pairs and no lone pairs of electrons. As a result, boron is surrounded by three regions of electron density. Boron undergoes sp^2 hybridization to form three sp^2 hybrid orbitals, which overlap with the p orbitals of fluorine to form three σ bonds. Hence, BF_3 does not have sp^3 hybridization.

Option B: H_2O

In water (H_2O), the central oxygen atom has two bonding pairs (with hydrogen atoms) and two lone pairs of electrons. The oxygen atom is thus surrounded by four regions of electron density, which necessitates the use of four orbitals (one s and three p orbitals) to hybridize into four equivalent sp^3 hybrid orbitals. Two of these sp^3 hybrid orbitals form σ bonds with hydrogen atoms, and two accommodate the lone pairs. Therefore, water exhibits sp^3 hybridization.

Option C: C_2H_4

In ethene (C_2H_4), each carbon atom forms three sigma (σ) bonds—two with hydrogen atoms and one with the other carbon atom. In addition, there is a pi (π) bond between the carbon atoms formed from unhybridized p orbitals. Each carbon atom in ethene undergoes sp^2 hybridization to form three sp^2 hybrid orbitals involved in sigma bonding, leaving one p orbital to form the pi bond. Thus, ethene does not exhibit sp^3 hybridization either.

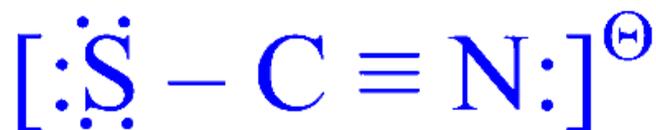
Option D: BeCl_2

In beryllium chloride (BeCl_2), the central beryllium atom forms two sigma (σ) bonds with two chlorine atoms and has no lone pairs. It uses its two available orbitals (one s and one p orbital) to hybridize into two equivalent sp hybrid orbitals. Therefore, beryllium in BeCl_2 undergoes sp hybridization, not sp^3 .

Only **Option B**, H_2O , has a central atom that undergoes sp^3 hybridization. The correct answer is **Option B**: H_2O .

Question 73

What is the formal charge on 'N' atom in



ion?

MHT CET 2021 24th September Evening Shift

Options:

- A. zero
- B. +3
- C. -2
- D. +2

Answer: A

Solution:



$$\text{FC} = \text{VE} - \text{NE} - \frac{\text{BE}}{2}$$

$$\therefore \text{Formal charge of N atom} = 5 - 2 - \frac{6}{2} = 0$$

Question 74

What is the geometry of SbF_5 molecule?

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Options:

- A. Trigonal pyramidal
- B. Trigonal planar
- C. Square pyramidal
- D. Trigonal bipyramidal

Answer: D

Solution:

The geometry of the SbF_5 molecule can be determined using the VSEPR (Valence Shell Electron Pair Repulsion) theory. Antimony pentafluoride (SbF_5) consists of a central antimony (Sb) atom surrounded by five fluorine (F) atoms.

According to VSEPR theory, the electron pairs around the central atom arrange themselves as far apart as possible to minimize repulsion. For a molecule with five bonding pairs and no lone pairs on the central atom, the geometry is trigonal bipyramidal.

In this structure, three fluorine atoms will occupy equatorial positions, forming a trigonal plane around the central antimony atom, and two fluorine atoms will occupy the axial positions above and below this plane, creating a linear line through the central atom.

Therefore, the correct answer is:

Option D
Trigonal bipyramidal

Question 75

What is the formal charge on 'C' atom in



?



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Options:

- A. -1
- B. -2
- C. +1
- D. Zero

Answer: D

Solution:



$$\text{FC} = \text{VE} - \text{NE} - \left(\frac{\text{BE}}{2}\right)$$

$$\therefore \text{Formal charge on C atom} = 4 - 0 - \frac{8}{2} = 0$$

Question 76

Identify the compound formed from elements X, Y, Z having oxidation state +2, +5, -2 respectively.

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Options:

- A. $\text{X}(\text{Y}_4\text{Z})$
- B. $\text{X}_3(\text{YZ}_4)_2$
- C. $\text{X}_3(\text{YZ}_2)_2$
- D. XYZ_2



Answer: B

Solution:

To determine the correct compound formed from elements X, Y, and Z with oxidation states +2, +5, and -2 respectively, we need to balance the charges in the compound such that the total charge is zero.

Let's denote the oxidation states of X, Y, and Z as follows:

X: +2

Y: +5

Z: -2

Now we will analyze each option to see if the total charge equals zero.

Option A: $X(Y_4Z)$

In this case, the compound is XY_4Z .

- Oxidation state of X: +2
- Oxidation state of Y: $+5 \times 4 = +20$
- Oxidation state of Z: -2
- Total charge: $+2 + 20 - 2 = +20$

This compound does not balance to zero, so it is not correct.

Option B: $X_3(YZ_4)_2$

In this case, the compound is $X_3(YZ_4)_2$.

- Oxidation state of 3X: $+2 \times 3 = +6$
- Oxidation state of 2Y: $+5 \times 2 = +10$
- Oxidation state of 8Z: $-2 \times 8 = -16$
- Total charge: $+6 + 10 - 16 = 0$

This compound balances to zero, so it is a possible correct answer.

Option C: $X_3(YZ_2)_2$

In this case, the compound is $X_3(YZ_2)_2$.

- Oxidation state of 3X: $+2 \times 3 = +6$
- Oxidation state of 2Y: $+5 \times 2 = +10$
- Oxidation state of 4Z: $-2 \times 4 = -8$
- Total charge: $+6 + 10 - 8 = +8$

This compound does not balance to zero, so it is not correct.

Option D: XYZ_2

In this case, the compound is XYZ_2 .

- Oxidation state of X: +2
- Oxidation state of Y: +5
- Oxidation state of 2Z: $-2 \times 2 = -4$
- Total charge: $+2 + 5 - 4 = +3$

This compound does not balance to zero, so it is not correct.

Therefore, the correct option is:

Option B: $X_3(YZ_4)_2$

Question 77

How many hydrogen atoms are bonded to ammonium ion during solvation?

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Options:

A. 1

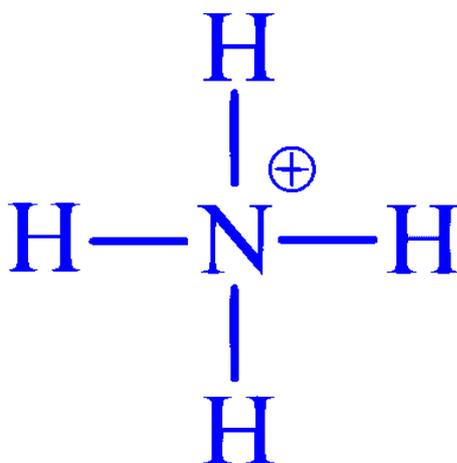
B. 4

C. 3

D. 2

Answer: B

Solution:



Question78

What is the formal charge on 'N' atom in NH_4^+ ion?

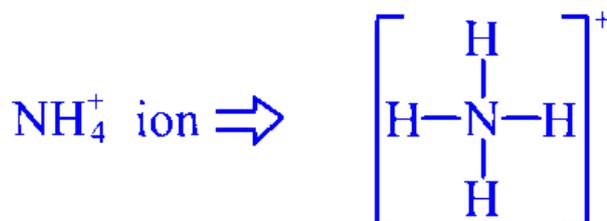
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Options:

- A. +1
- B. -3
- C. -1
- D. zero

Answer: A

Solution:



$$\text{FC} = \text{VE} - \text{NE} - \left(\frac{\text{BE}}{2}\right)$$

$$\therefore \text{Formal charge of 'N' atom} = 5 - 0 - \left(\frac{8}{2}\right) = +1$$

Question79

Which among the following halides has triagonal bipyramidal structure?

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Options:



Answer: B

Solution:

The halide with a trigonal bipyramidal structure is SeF_4 .

Reasoning

- SeF_4 has 5 electron domains around Se (4 bonding pairs + 1 lone pair).
- The electron-pair geometry is trigonal bipyramidal, with the lone pair occupying an equatorial position.
- Hence, SeF_4 is based on a trigonal bipyramidal arrangement (actual molecular shape: see-saw).

For comparison:

- $\text{SeCl}_2 \rightarrow$ bent
- $\text{SF}_6 \rightarrow$ octahedral
- $\text{TeF}_6 \rightarrow$ octahedral

Correct answer: SeF_4

Question80

Identify the molecule having dipole moment.

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Options:



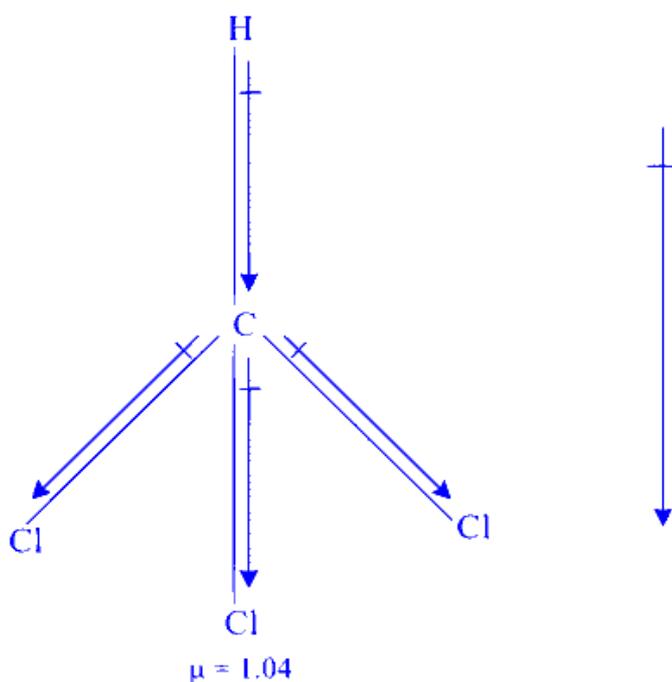
C. CHCl_3

D. CH_4

Answer: C

Solution:

CHCl_3 is polar with a non-zero dipole moment.



Question81

Which of the following concepts is NOT of valence bond theory?

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Options:

- A. Covalent character of bond
- B. Shielding effect of electrons

C. Delocalisation of electron over the two nuclei

D. Combination of atomic orbitals to give molecular orbitals

Answer: D

Solution:

Valence bond theory focuses on the concepts of orbital overlap, hybridization, and the formation of covalent bonds. To determine which concept is NOT part of valence bond theory, let's briefly review each option:

Option A: Covalent character of bond

The covalent character of bonds is indeed a core concept of valence bond theory. It describes how atomic orbitals overlap to form bonds that share electrons between atoms.

Option B: Shielding effect of electrons

The shielding effect refers to the reduction of the effective nuclear charge on the electron cloud, due to a repulsion caused by electrons in inner shells. This concept is more related to atomic structure and periodic trends rather than the valence bond theory.

Option C: Delocalisation of electron over the two nuclei

Delocalization of electrons over two nuclei is a concept that can be included in the valence bond theory through the resonance concept. However, it is more comprehensively dealt with in molecular orbital theory.

Option D: Combination of atomic orbitals to give molecular orbitals

This concept is fundamental to molecular orbital (MO) theory, not valence bond theory. Molecular orbitals are formed by the linear combination of atomic orbitals and describe the behavior of electrons in a molecule more globally.

Therefore, the option that is NOT part of valence bond theory is:

Option D: Combination of atomic orbitals to give molecular orbitals

Question82

Which from following statements is NOT correct for heterolysis?

MHT CET 2021 21th September Evening Shift

Options:

- A. In this electron rich and electron deficient species are formed.
- B. Heterolysis of methyl bromide forms methyl carbocation.
- C. It occurs when bonded atoms have different electronegativity.
- D. Movement of a single electron from a shared pair of covalent bond occurs.

Answer: D

Solution:

In heterolytic cleavage of covalent bond both shared electrons go to one of the two bonded atoms.

Question83

What is the formal charge of oxygen atom in carbon monoxide?

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Options:

- A. +2
- B. +1
- C. -1
- D. zero

Answer: B

Solution:

Carbon monoxide molecule \Rightarrow : $C \equiv O :$

Formal charge of oxygen atom

$$= VE - NE - \frac{1}{2}(BE)$$
$$= 6 - 2 - \frac{1}{2}(6) = +1$$

Question84

What is spin only magnetic moment of an element having one unpaired electron?

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Options:

- A. 0.34 BM
- B. 1.0 BM
- C. 1.73 BM
- D. 3.1 BM

Answer: C

Solution:

$$\mu = \sqrt{n(n+2)} \text{ BM}$$

$$\text{For } n = 1, \mu = \sqrt{3} = 1.73 \text{ BM}$$

Question85

What is the formal charge on carbon atom in CO_3^{2-} ion ?

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Options:

A. -2

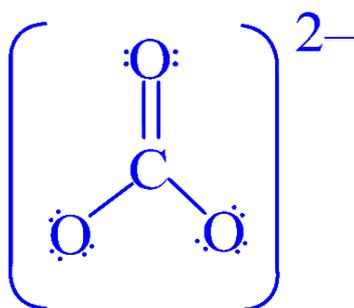
B. -4

C. +4

D. zero

Answer: D

Solution:



Formal charge on C atom

$$= \text{V.E.} - \text{N.E.} - \frac{1}{2} \text{B.E.}$$

$$= 4 - 0 - \frac{1}{2}(8)$$

$$= 0$$

Question86

What is bond angle O-S-O in SO_2 molecule?

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Options:

A. 107°

B. 180°

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C. 90°

D. 119.5°

Answer: D

Solution:



Structure of SO_2

Question87

Which of the following bonds has highest bond enthalpy?

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Options:

A. N-N in NH_3

B. O=O in O_2

C. C-H in CH_4

D. $\text{N}\equiv\text{N}$ in N_2

Answer: D

Solution:

Due to highest bond order in N_2 , it has highest bond enthalpy.



Question88

What is O–O bond length in resonance hybrid of ozone?

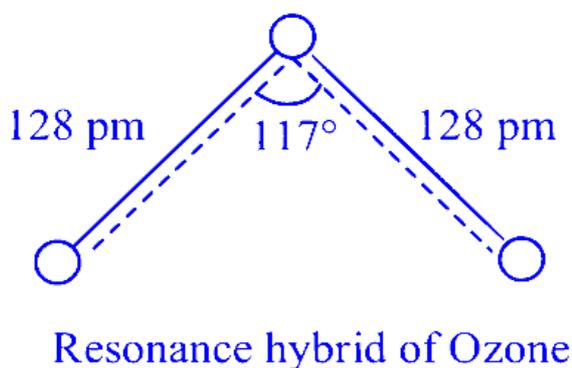
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Options:

- A. 131 pm
- B. 121 pm
- C. 128 pm
- D. 148 pm

Answer: C

Solution:



O–O bond length in resonance hybrid of ozone = 128 pm

Question89

Which of the following molecules has a central atom with complete octet?

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Options:

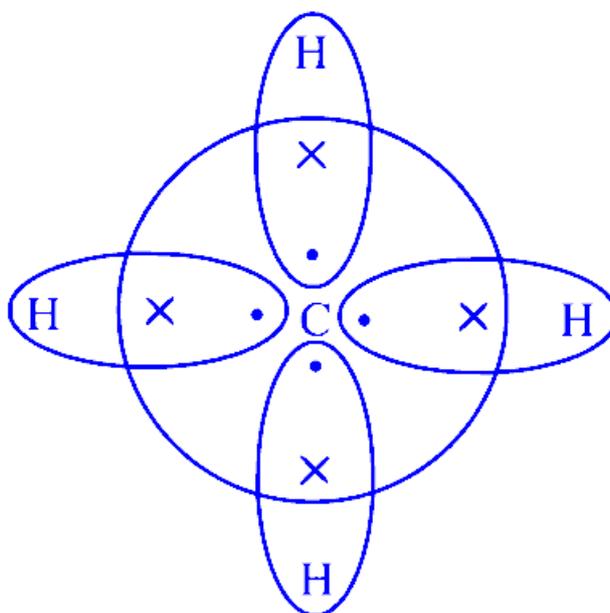
- A. Boron trifluoride
- B. Methane
- C. Aluminium chloride
- D. Sulphur hexafluoride

Answer: B

Solution:

Methane molecule has a central atom (carbon) with complete octet.

Lewis dot structure of CH_4



Carbon only has 4 valence electron, so it can bond at all four point. Hydrogen only has one valence electron and can only share one. So, carbon shares 4 hydrogen electrons at 4 points and complete octet.

Question90

Which of the following is correct decreasing order of the repulsive interaction of electron pairs in a molecule?

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Options:

- A. bond pair - bond pair > lone pair - bond pair > lone pair - long pair
- B. lone pair - bond pair > lone pair - lone pair > bond pair - bond pair
- C. bond pair - bond pair = bond pair - long pair > lone pair - lone pair
- D. lone pair - lone pair > lone pair - bond pair > bond pair - bond pair

Answer: D

Solution:

Correct decreasing order of the repulsive interaction of electron pairs in a molecule is, lone pair-lone pair > lone pair-bond pair > bond pair-bond pair

The bond pairs of electrons is shared by two atoms whereas the lone pair of electrons is only under the influence of central atom. So, the electron cloud of lone pair occupies more space as compared the bond pair. This causes greater repulsion between the lone pair-lone pair.

Question91

In gas phase



bond angle in H_2O_2 is

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Options:

- A. 94.8°
- B. 111.5°



C. 98.4°

D. 147.5°

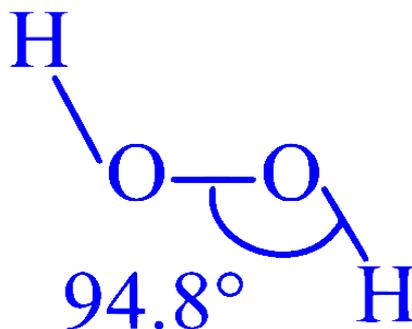
Answer: A

Solution:

In gas phase



bond angle in H_2O_2 is 94.8° .



In case of gas phase, there exist lone pairs on the oxygen and to minimise lone-pair-lone pair repulsion the bond angle reduced from 101.9° (crystalline phase) to 94.8° (gas phase).

Question92

What is the value of C – O – H bond angle in $\text{CH}_3 - \text{OH}$?

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Options:

A. 107°

B. 108.9°

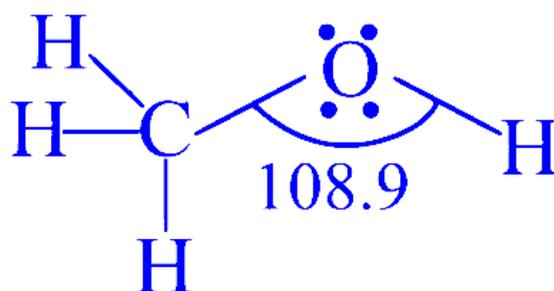
C. 109.5°

D. 110°

Answer: B

Solution:

The value of C – O – H bond angle in $\text{CH}_3 - \text{OH}$ (methanol) is 108.9° due to repulsion between lone pair electrons of oxygen atom. It can be easily shown as below:



Question93

What is the bond order of B_2 molecule?

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Options:

A. 3

B. 0

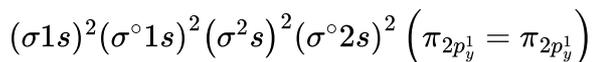
C. 1

D. 2

Answer: C

Solution:

The bond order of B_2 molecule is 1. The ground state electron configuration of B is $1s^2 2s^2 2p^1$. So, B_2 molecule has a total of ten electrons, which are arranged in MOs.



$$\text{Bond order} = \frac{1}{2} (\text{Number of bonding electrons} - \text{number of anti-bonding electrons}) = \frac{1}{2} (6 - 4) = 1$$

Question94

Which of the following molecule contain 50% p-character of hybrid orbital in C atom?

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Options:

A. Acetylene

B. Methane

C. Ethane

D. Propene

Answer: A

Solution:

Acetylene molecule contain 50% p -character of hybrid orbital in C atom because in the hybrid orbital of acetylene both carbons are sp -hybridised. An sp -orbital is composed of one s -orbital and one p -orbital, and thus, it has 50% s -character and 50% p -character.

Question95

What type of inter molecular force is present between magnesium chloride and water?

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Options:

- A. Dipole-induced dipole interaction
- B. Dipole-dipole interaction
- C. Hydrogen bonding
- D. Ion-dipole interaction

Answer: D

Solution:

When magnesium chloride ($MgCl_2$) dissolves in water (H_2O), the primary type of intermolecular force involved is the **ion-dipole interaction**. Let's examine why this is the case and how it differentiates from the other options provided.

- **Ion-dipole interaction:** This occurs between an ion and a polar molecule. Magnesium chloride dissociates into Mg^{2+} and Cl^- ions in water. Water is a polar molecule with a partial positive charge near the hydrogen atoms and a partial negative charge near the oxygen atom. The positive Mg^{2+} ions attract the oxygen end of water molecules, while the negative Cl^- ions attract the hydrogen end of water molecules, establishing ion-dipole interactions. This is the dominant interaction that facilitates the dissolution of $MgCl_2$ in water, making **Option D (Ion-dipole interaction)** the correct answer.
- **Dipole-induced dipole interaction:** This occurs between a polar molecule with a permanent dipole and a nonpolar molecule or atom that does not have a permanent dipole. The electric field of the polar molecule induces a temporary dipole in the nonpolar molecule or atom. Given that $MgCl_2$ dissociates into ions, and water is polar, dipole-induced dipole interactions are not the primary interactions here.
- **Dipole-dipole interaction:** This type of interaction happens between two polar molecules. Since $MgCl_2$ in water exists as ions rather than neutral polar molecules, dipole-dipole interactions are not the main interaction in this context.
- **Hydrogen bonding:** Hydrogen bonding is a special case of dipole-dipole interaction that occurs when hydrogen is bound to a highly electronegative atom (F, O, or N) and is attracted to another electronegative atom. While water molecules indeed participate in hydrogen bonding among themselves, the primary interaction between water and dissolved $MgCl_2$ ions is ion-dipole, not hydrogen bonding.

Therefore, the correct answer to the question is **Option D (Ion-dipole interaction)**.

Question 96

The shape of BrF_5 molecule is

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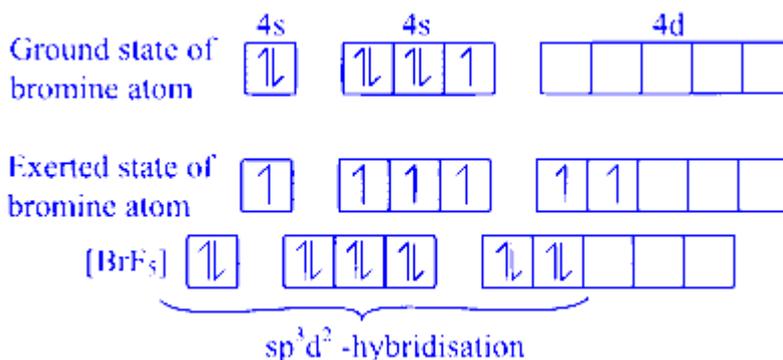
Options:

- A. trigonal pyramidal
- B. square pyramidal
- C. trigonal bipyramidal
- D. square planar

Answer: B

Solution:

The shape of BrF_5 molecule is square pyramidal. It has sp^3d^2 -hybridisation using VBT theory.



The shape of BrF_5 having sp^3d^2 -hybridisation is square pyramidal.

Question97

Which bond in a molecule of ethyl magnesium bromide is ionic in nature?

MHT CET 2019 3rd May Morning Shift

Options:

- A. C – C bond
- B. C – Mg bond



C. Mg – Br bond

D. C – H bond

Answer: C

Solution:

Mg–Br bond in a molecule of ethylmagnesium bromide is ionic in nature because the difference in electronegativity is large. As a result, it possess high magnitude of lattice energy and hence maximum ionic character.

Question98

The number of σ and π -bonds in 2-formylbenzoic acid are respectively

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Options:

A. 10, 3

B. 14, 3

C. 12, 5

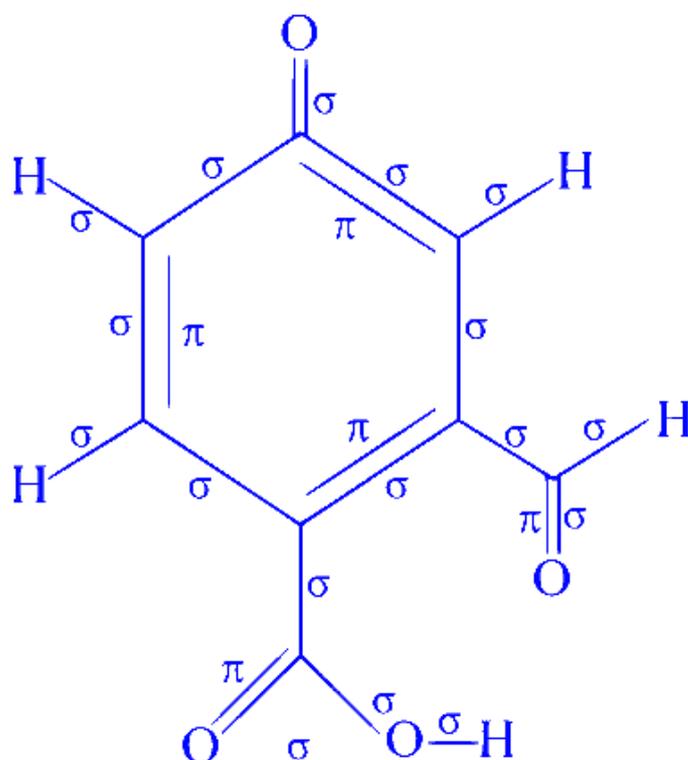
D. 17, 5

Answer: D

Solution:

Structure of 2-formyl benzoic acid is





Thus, it has 17 σ and 5 π bonds.

Question99

In ozone molecule the formal charge on the central oxygen atom is

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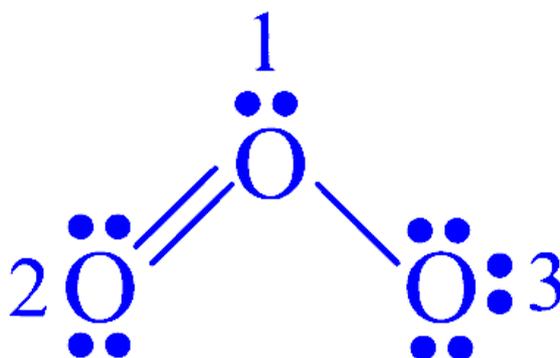
Options:

- A. -1
- B. +2
- C. 0
- D. +1

Answer: D

Solution:

For O_3 ,



Formal charge for central atom O(1)

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

Question100

Which of following bonds has maximum bond length?

MHT CET 2019 2nd May Morning Shift

Options:

- A. C – O
- B. C – H
- C. C – C
- D. C – N

Answer: B

Solution:

Since, C – H bond have less difference in their electronegativities as compared to C – O, C—C and C – N bonds.

This results in less polarity of C – H bond and thus, have maximum bond length.



Question101

What is the H – S – H bond angle in H₂ S ?

MHT CET 2019 2nd May Morning Shift

Options:

- A. 104.5°
- B. 92.1°
- C. 91°
- D. 90°

Answer: B

Solution:

The H – S – H bond angle in H₂ S is 92.1°. Which is slightly lesser than the tetrahedral angle. As sulphur is less electronegative and hence less repulsion is present.

