

Class-IX

Foundation

Plus.

VBT & VSEPR

Theory.

Teaching Task

Q1) Ans:- D.

Solution:-

→ $\text{XeF}_2 \rightarrow 3$ lone pairs,

→ $\text{XeF}_4 \rightarrow 2$ lone pairs.

→ $\text{XeF}_6 \rightarrow 1$ lone pair.

Q2) Ans:- A

Solution:- The bond angle of H_2O is $104^\circ 30'$ [$< 109.5^\circ$ Expected]

→ The expected bond angle of F_2O is $< 109.5^\circ$ but observed angle is 103° because of 'F' high Electronegativity

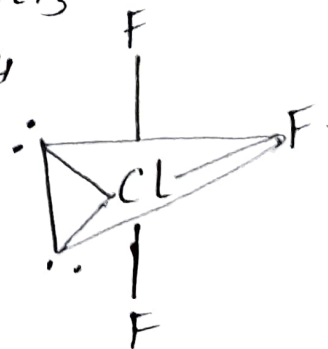
Q3) Ans:- C

Solution:- The molecular geometry of ClF_3

is said to be T-shaped. ClF_3 acquires

such a shape because 2 lone pairs take up equatorial positions as they require more space & greater repulsion.

They are arranged in trigonal bipyramidal shape with 3 bonds & 2 lone pairs.



Q4) Ans:- B

Solution:- Tetrahedral, see-saw, and trigonal bipyramidal are the forms of PCl_4^+ , PCl_4^- & AsCl_5 respectively.

Q5) Ans:- B.

Solution:-

→ There are 12 F-S-F 90° bond angles.

→ S in SF_6 has an expanded octet. The sulphur have 12 electrons in SF_6 .

Q6) Ans:- A

Solution:- The central iodine atom undergoes sp^3d hybridization and has 3 lone pairs of electrons and a bond pair of electrons.

Thus, I_3^- has trigonal bipyramidal geometry & linear shape.

Q7) Ans:- D.

Solution:-

→ SF_4 is square pyramid due to one lone pair of S.

→ CF_4 has tetrahedral geometry.

→ XeF_4 has square planar structure with 2 lone pairs of Xe.

Q8) Ans:- C

Solution:-

A) XeOF_4



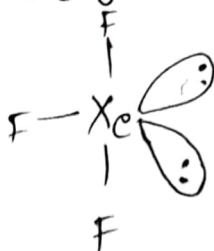
lone pair $\rightarrow$ 1

B) XeO_2F_2



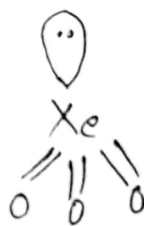
lone pair - 1

C) XeF_3^-



Lone pairs $\rightarrow$ 2

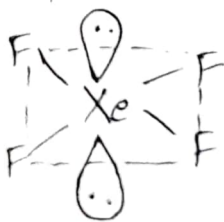
D) XeO_3



Q9) Ans:- C

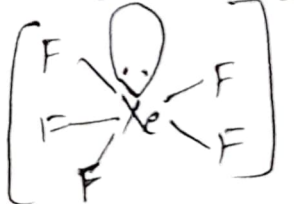
Solution:-

XeF_4

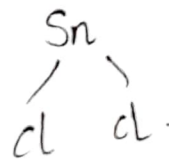


Square planar.

XeF_5^-



Pentagonal planar.

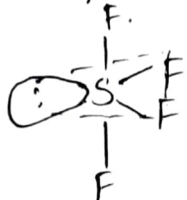


(angular)

Q10) Ans:- B.

Solution:-

A) $\text{XeF}_4 \rightarrow 4 \text{ bond pairs \& 2 lone pairs.}$

B) $\text{SF}_4 \rightarrow$  $\rightarrow 4 \text{ bond pairs \& 1 lone pair.}$

C) $\text{XeF}_3^- \rightarrow 3 \text{ bond pairs \& 2 lone pairs.}$

D) $\text{XeO}_3 \rightarrow 6 \text{ bond pairs \& 1 lone pair.}$

Multiple Correct Answer Type

Q11) Ans:- A, D

Solution:-

A) $\text{XeOF}_2 \rightarrow \text{Trigonal bipyramidal.}$

B) $\text{ICl}_4^- \rightarrow \text{Square planar.}$

C) $[\text{SbF}_5]^{2-} \rightarrow \text{Square pyramidal.}$

D) $\text{NH}_2^- \rightarrow \text{Bent shape.}$

Q12) Ans:- A, B, D.

Solution:-

A) $\text{BrF}_6^+ \rightarrow \text{Octahedral.}$

B) $\text{SnCl}_5^- \rightarrow \text{Trigonal bipyramidal.}$

D) $\text{IF}_4^+ \rightarrow \text{See-saw.}$

Q13) Ans:- C.

Solution:- π bonds are weaker than sigma bonds.
 $\rightarrow$ π bonds are formed by sidewise overlap of 2 parallel p orbitals.

Comprehension Type

Q14) Ans:- A.

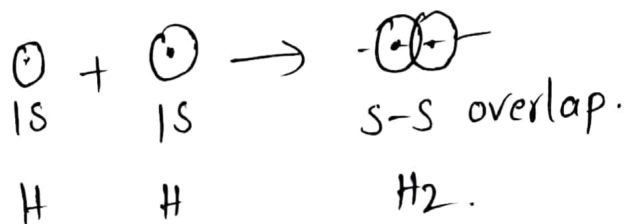
Solution:- The potential energy of a system decreases during bond formation. In the formation of bond force of attraction are more than force of repulsion, during that time it loses energy.

Q15) Ans:- C.

Solution:- According to valence bond theory (VBT), the 2 electrons in a hydrogen molecule (H_2) have opposite spins ($\uparrow\downarrow$).

Q16) Ans:- A.

Solution:- The covalent bond formed b/w 2 hydrogen atoms is represented by $\overline{s-s}$.

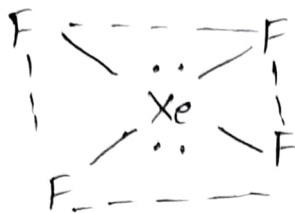


Q17) Ans:- D

Solution:- $AB_4E_2 \rightarrow 4 \text{ bond pairs, } 2 \text{ lone pairs}$

$XeF_4 \rightarrow 4 \text{ bond pairs, } 2 \text{ lone pairs}$

Hybridisation $\rightarrow sp^3d^2$



Q18) Ans:- D.

Solution:-

A) $CH_4 \rightarrow 109^\circ 28'$

B) $NH_3 \rightarrow 107^\circ 48'$

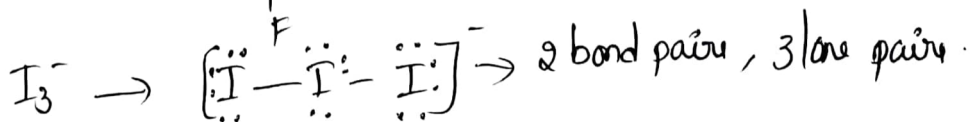
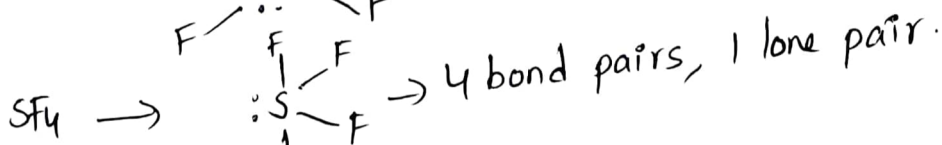
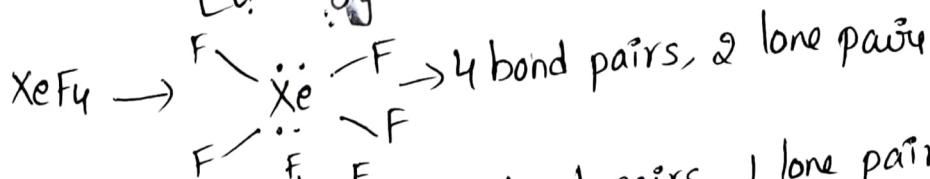
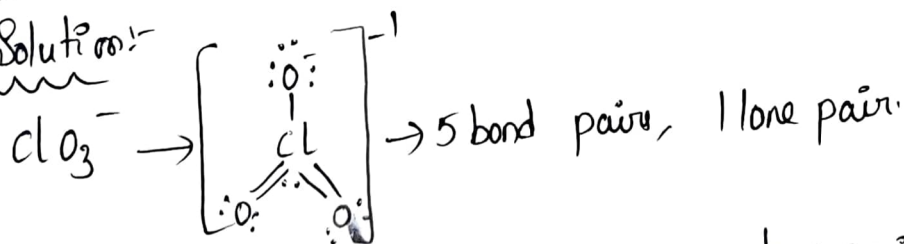
C) $H_2O \rightarrow 104^\circ 27'$

D) $BeF_2 \rightarrow 180^\circ$ (Maximum bond angle).

Integer Type

Q19) Ans:- 3.

Solution:-



Q20) Ans:- 3.

Solution:- SO_3^{2-} , ClO_3^- and AsO_3^{3-} are non-planar
(pyramidal geometry).

NO_3^- , CO_3^{2-} , BO_3^{3-} are trigonal planar.

Q21) Ans:- 3.

Solution:- No. of lone pairs on S in $\text{SF}_4 \rightarrow 1$.

No. of lone pairs on C in $\text{CF}_4 \rightarrow 0$.

No. of lone pairs on Xe in $\text{XeF}_4 \rightarrow 2$.

Total lone pairs = $1 + 0 + 2 = 3$.

Matrix Matching

Q22) Ans:- A) p B) s c) r D) q.

Solution:-

A) NO_2^+ $\longrightarrow$ p) 180° (linear).

B) NO_2^- $\longrightarrow$ s) 115° .

C) NO_2 $\longrightarrow$ r) 134°

D) NO_3^- $\longrightarrow$ q) 120° .

Learner's Task

Conceptual Understanding Questions

Q1) Ans:- B.

Solution:- The formation of π bond shortens the distance between two atoms.

Q2) Ans:- D.

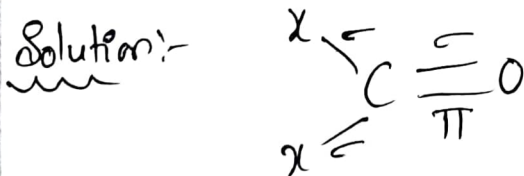
Solution:- In the formation of a covalent bond between 2 atoms results by pairing of electrons present in the valence shell having opposite spins



Q3) Ans:- C

Solution:- The order of bond energy of subshells in the 2nd orbit is $s-s < s-p < p-p$.

Q4) Ans:- D.



3 - sigma bonds, 1 - π bond.

Q5) Ans:- B.

Solution:- $\leftarrow$ bond involves axial overlap, it is directional, it has cylindrical symmetry, hybridised orbitals also involved in $\leftarrow$ bond formation

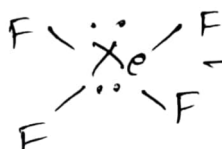
Q6) Ans:- B.

Solution:- σ bonds are stronger than π bonds because, in ' σ ' bonds axial overlapping done, whereas in π bonds side wise overlapping.

Q7) Ans:- C.

Solution:- When 2 atoms with the same spin of electrons approach each other for bonding, orbital overlap will not occur & bonding will not occur because the electrons with same spin violate the Pauli-Exclusion principle & Hund's rule.

Q8) Ans:- C.

Solution:- $\text{XeF}_4 \rightarrow$  $\rightarrow$ Square planar.

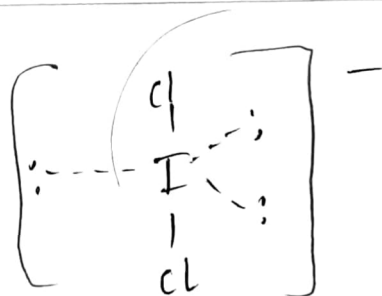
The shape of XeF_4 is not distorted due to presence lone pairs above & below the Xe - the bond pairs are in the equatorial position.

Q9) Ans:- A.

Solution:-

ICl_2^- has a linear shape with 3 lone pairs of electrons

in an equatorial position of trigonal bipyramidal. Thus it has symmetrical repulsions



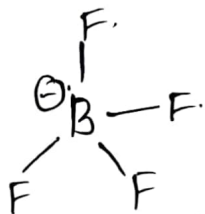
Q10) Ans:- B.

Solution:- The shape of NH_3 is similar to CH_3^- because both have a pyramidal shape. This is because the nitrogen atom in NH_3 & the carbon atom in CH_3^- both have sp^3 hybridization and one lone pair of electrons each.

JEE Main Level Questions

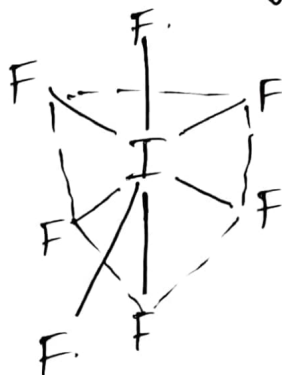
Q1) Ans:- C.

Solution:- BF_4^- has a regular tetrahedral structure.



Q2) Ans:- C

Solution:- $\text{IF}_7 \rightarrow$ Pentagonal bipyramidal shape with bond angle 72° , 90° & 180° . (sp^3d^3 hybridisation)



Q3) Ans:- C.

Solution:-

- A) CO_3^{2-} & NO_3^- are iso structural $\rightarrow$ Trigonal shape & bond angle of 120°
- B) PCl_4^+ & SiCl_4 are both tetrahedral in shape, bond angle 109° , so they are isostructural.
- C) PF_5 has trigonal bipyramidal shape.
 BrF_5 has square pyramidal shape.
- D) AlF_6^{3-} and SF_6 both are octahedral.

Q4) Ans:- A.

Solution:- A ' π ' bond is weaker than ' σ ' bond.
 $\rightarrow$ Double bond is stronger than single bond.
 $\rightarrow$ Ionic bond is stronger than covalent bond.

Q5) Ans:- B.

Solution:- Covalent bond formed b/w electrons are having anti parallel spins.

a) $\uparrow + \downarrow \rightarrow$ possible.

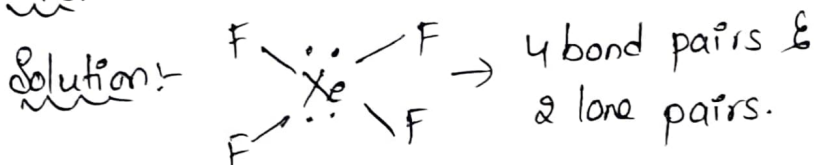
b) $\uparrow + \uparrow \rightarrow$ same spin not possible.

c) $\downarrow + \downarrow \rightarrow$ Not possible.

d) $\uparrow + \uparrow \rightarrow$ Not possible.

Q6) Ans:- C.

Solution:-

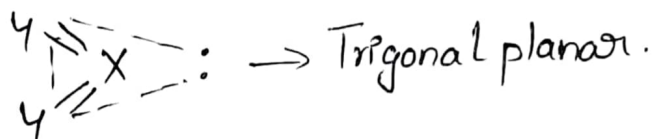


Q7) Ans:- C.

Solution:- XY_2

— bonds = 2, lone pair = 1

sp^2 hybridization.



Q8) Ans:- D.

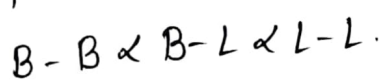
Solution:- BF_3, BCl_3, BBr_3

In all these molecules, central atom has sp^2 hybridization, so all have bond angle of 120° .

But due to presence of lone pair on NF_3 & NH_3 they show lower angle.

Q9) Ans:- B.

Solution:- If an atom has lone pairs & bonded electron pairs, the greater lone pair - lone pair repulsion will cause decrease in bond angle.

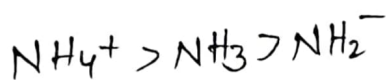


NH_2^- has 2 bond pairs & 2 lone pairs.

$NH_3 \rightarrow$ 3 bond pairs & 1 lone pair.

$NH_4^+ \rightarrow$ 4 bond pairs.

NH_4^+ has no lone pairs. So its bond angle is high.

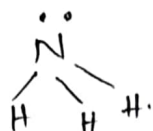


Q10) Ans:- B.

Solution:-

1) $\text{NH}_3 \rightarrow$

Hybridisation = $sp^3 \rightarrow$ Bond angle $107^\circ 48'$.



Trigonal pyramidal.

2) $\text{H}_2\text{S} \rightarrow \frac{6+2}{2} = \frac{8}{2} = 4 \rightarrow sp^3 \rightarrow$ Tetrahedral.



Bond angle = 90° .

3) $\text{H}_2\text{O} \rightarrow sp^3 \rightarrow 104^\circ 27'$.

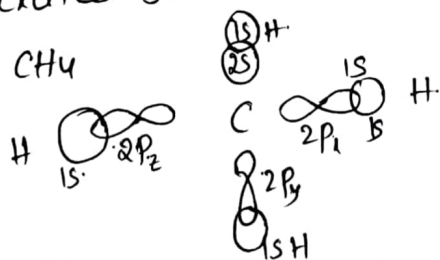
4) $\text{CH}_4 \rightarrow sp^3 \rightarrow 109^\circ 28'$.

Advanced Level Questions

Q11) Ans:- A, B, D

Solution:- $\text{C} = 1s^2 2s^2 2p^2$

Excited state : $2s^1 2p^3$



If 'C' does not undergo hybridisation

- A) The 3 p-orbitals are perpendicular, so the 3 C-H bonds formed by $sp-1s$ are perpendicular.
- B) One C-H bond will be weaker than remaining 3 bonds.
- C) The shape of molecule may not be tetrahedral.
- D) The angle of C-H bond formed by s-s overlapping will be uncertain w.r. to the other three bonds.

Q12) Ans:- A, C.

Solution:- CO_2 is isostructural with HgCl_2 & C_2H_2 .

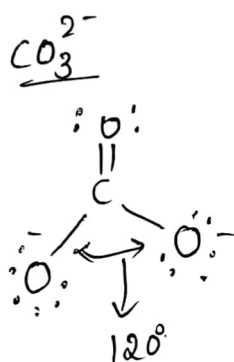
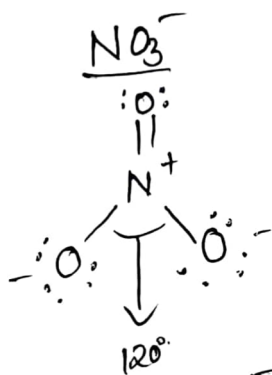
$\rightarrow \text{O}=\text{C}=\text{O} \rightarrow$ Linear, 180° ; no lone pairs

$\rightarrow \text{Cl}-\text{Hg}-\text{Cl} \rightarrow$ Linear, 180° ; no lone pairs

$\rightarrow \text{H}-\text{C}=\text{C}-\text{H} \rightarrow$ linear, 180° , no lone pairs.

Q13) Ans:- B.

Solution:- NO_3^- and CO_3^{2-} ions both are trigonal planar because repulsions b/w oxygen atom is same b/w all atoms of oxygen. So they are equally distributed.



Trigonal species.

$\rightarrow$ Both same no. of lone pairs i.e. zero

Q14) Ans:- A.

Solution:- Bond formation is an exothermic process, meaning releases energy. To get stability atoms lose energy while forming bond.

Stability $\propto \frac{1}{\text{Energy}}$ ($\because$ Energy released)

Q15) Ans:- C

Solution:-

A) $H_2 \rightarrow$ S-S overlapping.

B) $HCl \rightarrow$ S-P overlapping.

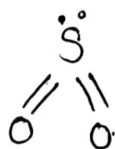
C) $Cl_2 \rightarrow$ P-P overlapping.

D) $NH_3 \rightarrow$ S-P overlapping.

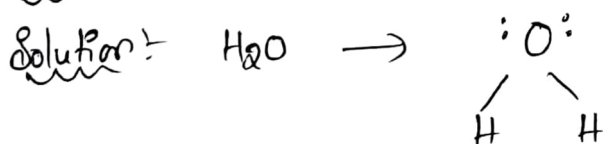
Q16) Ans:- B.

Solution:- SO_2 has 2 bond pairs & 1 lone pair.

So it is AB_2E type molecule, bent shape, sp^2 hybridisation



Q17) Ans:- B.

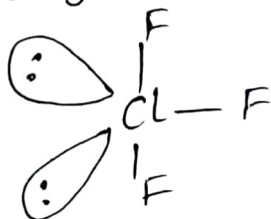


Lone pairs $\rightarrow 2$ Bond pairs $\rightarrow 2$.

Ratio of lone pairs & Bond pairs = $2:2$
 $= 1:1$

Q18) Ans:- A.

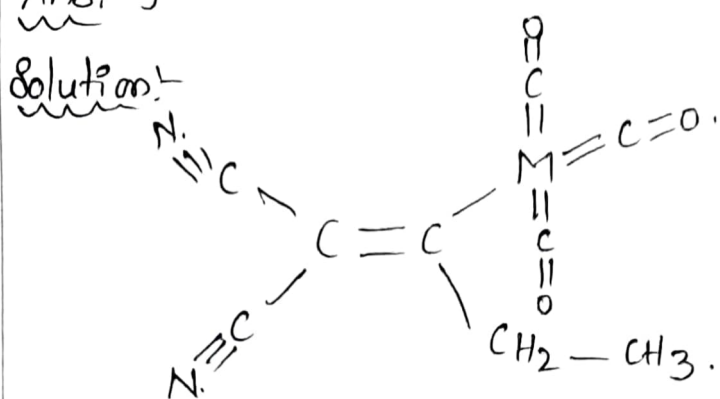
Solution:- $ClF_3 \rightarrow$ T shape.



Integer Type

Q19) Ans:- 5

Solution:-



σ bonds $\rightarrow 19$.

π bonds $\rightarrow 11$.

$$\begin{aligned}\text{Total} &\rightarrow 30 = 5 \times 6 \\ &= 6x = 6 \times 5 \\ &\underline{\underline{x = 5}}\end{aligned}$$

Q20) Ans:- 5

Solution:- The molecule ML_x is planar with 7 pairs of electrons around M in the valence shell. There will be 5 bond pairs of electrons & 2 lone pairs. The electron geometry will be pentagonal bipyramidal & molecular geometry will be planar.

5 Bond pairs of electrons will be in one plane & 2 lone pairs of electrons will be opposite to each other, one above the plane & other below the plane. This will minimize the electronic repulsion.

Hence the value of $x = \underline{\underline{5}}$

Matrix Matching

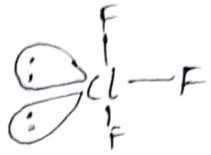
Q21) Ans: A) q B) r C) p D) s

Solution:

A) ClF_3

→

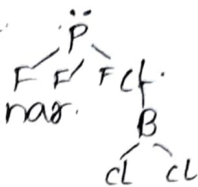
q) T-shaped.



B) PF_3

→

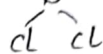
r) Pyramidal.



C) BF_3

→

p) Trigonal planar.



D) SF_6

→

s) Octahedral.

