

- The number of species from the following which have square pyramidal structure is \_\_\_\_\_  
 $\text{PF}_5, \text{BrF}_4^-, \text{IF}_5, \text{BrF}_5, \text{XeOF}_4, \text{ICl}_4^-$   
**[2023 (06 Apr Shift 1)]**
- The number of species having a square planar shape from the following is \_\_\_\_\_  
 $\text{XeF}_4, \text{SF}_4, \text{SiF}_4, \text{BF}_4^-, \text{BrF}_4^-, [\text{Cu}(\text{NH}_3)_4]^{2+}, [\text{FeCl}_4]^{2-}, [\text{PtCl}_4]^{2-}$   
**[2023 (06 Apr Shift 2)]**
- In an ice crystal, each water molecule is hydrogen bonded to \_\_\_\_\_ neighbouring molecules.  
**[2023 (06 Apr Shift 2)]**
- Given below are two statements : One is labelled as Assertion A and the other is labelled as Reason R.  
 Assertion A : Butan-1-ol has higher boiling point than ethoxyethane.  
 Reason R : Extensive hydrogen bonding leads to stronger association of molecules.  
 In the light of the above statements, choose the correct answer from the options given below :  
**[2023 (08 Apr Shift 1)]**
  - A is true but R is false
  - Both A and R are true and R is the correct explanation of A
  - Both A and R are true but R is not the correct explanation of A
  - A is false but R is true
- The number of following factors which affect the percent covalent character of the ionic bond is \_\_\_\_\_  
 A) Polarising power of cation  
 B) Extent of distortion of anion  
 C) Polarisability of the anion  
 D) Polarising power of anion  
**[2023 (08 Apr Shift 1)]**
- The number of species from the following carrying a single lone pair on central atom Xenon is \_\_\_\_\_  
 $\text{XeF}_5^+, \text{XeO}_3, \text{XeO}_2, \text{F}_2, \text{XeF}_5^-, \text{XeO}_3, \text{F}_2, \text{XeOF}_4, \text{XeF}_4$   
**[2023 (08 Apr Shift 2)]**
- The pair from the following pairs having both compounds with net non-zero dipole moment is \_\_\_\_\_  
**[2023 (10 Apr Shift 1)]**
  - 1, 4-Dichlorobenzene, 1, 3-Dichlorobenzene
  - cis-butene, trans-butene
  - $\text{CH}_2\text{Cl}_2, \text{CHCl}_3$
  - Benzene, anisidine
- The compound which does not exist is \_\_\_\_\_  
**[2023 (10 Apr Shift 1)]**
  - $\text{NaO}_2$
  - $\text{BeH}_2$
  - $\text{PbEt}_4$
  - $(\text{NH}_4)_2\text{BeF}_4$
- The number of bent-shaped molecule/s from the following is \_\_\_\_\_  
 $\text{N}_3^-, \text{NO}_2^-, \text{I}_3^-, \text{O}_3, \text{SO}_2$   
**[2023 (10 Apr Shift 1)]**
- The sum of lone pairs present on the central atom of the interhalogen  $\text{IF}_5$  and  $\text{IF}_7$  is \_\_\_\_\_  
**[2023 (10 Apr Shift 1)]**
- The number of molecules from the following which contain only two lone pair of electrons is \_\_\_\_\_  
 $\text{H}_2\text{O}, \text{N}_2, \text{CO}, \text{XeF}_4, \text{NH}_3, \text{NO}, \text{CO}_2, \text{F}_2$   
**[2023 (10 Apr Shift 2)]**

12. Match List-I with List-II:

	List-I Species		List-II Geometry/Shape
A.	$\text{H}_3\text{O}^+$	I.	Tetrahedral
B.	Acetylide anion	II.	Linear
C.	$\text{NH}_4^+$	III.	Pyramidal
D.	$\text{ClO}_2^-$	IV.	Bent

Choose the correct answer from the options given below:

[2023 (11 Apr Shift 1)]

- (1) A(III), B(IV), C(I), D(II)
- (2) A(III), B(I), C(II), D(IV)
- (3) A(III), B(II), C(I), D(IV)
- (4) A(III), B(IV), C(II), D(I)

13. Which one of the following pairs is an example of polar molecular solids?

[2023 (11 Apr Shift 2)]

- (1)  $\text{SO}_2(\text{s})$ ,  $\text{CO}_2(\text{s})$
- (2)  $\text{SO}_2(\text{s})$ ,  $\text{NH}_3(\text{s})$
- (3)  $\text{MgO}(\text{s})$ ,  $\text{SO}_2(\text{s})$
- (4)  $\text{HCl}(\text{s})$ ,  $\text{AlN}(\text{s})$

14. The maximum number of lone pairs of electron on the central atom from the following species is .....

$\text{ClO}_3^-$ ,  $\text{XeF}_4$ ,  $\text{SF}_4$  and  $\text{I}_3^-$

[2023 (11 Apr Shift 2)]

15. The bond order and magnetic property of acetylide ion are same as that of

[2023 (12 Apr Shift 1)]

- (1)  $\text{O}_2^+$
- (2)  $\text{N}_2^+$
- (3)  $\text{NO}^+$
- (4)  $\text{O}_2^-$

16. Given below are two statements:

Statement I:  $\text{SbCl}_5$  is more covalent than  $\text{SbCl}_3$

Statement II: The higher oxides of halogens also tend to be more stable than the lower ones.

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

[2023 (12 Apr Shift 1)]

- (1) Statement I is incorrect but statement II is correct
- (2) Both Statement I and Statement II are incorrect
- (3) Both Statement I and Statement II are correct
- (4) Statement I is correct but statement II is incorrect

17. In which of the following processes, the bond order increases and paramagnetic character changes to diamagnetic one?

[2023 (13 Apr Shift 1)]

- (1)  $\text{O}_2 \rightarrow \text{O}_2^+$
- (2)  $\text{O}_2 \rightarrow \text{O}_2^{2-}$
- (3)  $\text{NO} \rightarrow \text{NO}^+$
- (4)  $\text{N}_2 \rightarrow \text{N}_2^+$

18.  $\text{ClF}_5$  at room temperature is a

[2023 (13 Apr Shift 1)]

- (1) Colourless liquid with trigonal bipyramidal geometry
- (2) Colourless gas with square pyramidal geometry
- (3) Colourless gas with trigonal bipyramidal geometry
- (4) Colourless liquid with square pyramidal geometry

19. Among the following compounds, the one which shows highest dipole moment is

[2023 (13 Apr Shift 1)]

(1)



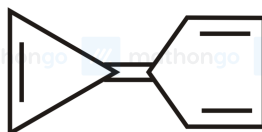
(2)



(3)



(4)



20. Match List-I with List-II.

List-I	List-II
A. Weak intermolecular forces of attraction	I. Hexamethylenediamine + adipic acid
B. Hydrogen bonding	II. $\text{AlEt}_3 + \text{TiCl}_4$
C. Heavily branched polymer	III. 2-chloro-1,3-butadiene
D. High density polymer	IV. Phenol + formaldehyde

Choose the correct answer from the options given below

[2023 (13 Apr Shift 2)]

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

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

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

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

21. Given below are two statements :

Statement I :  $\text{SO}_2$  and  $\text{H}_2\text{O}$  both possess V-shaped structure

Statement II : The bond angle of  $\text{SO}_2$  is less than that of  $\text{H}_2\text{O}$ .

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

[2023 (13 Apr Shift 2)]

(1) Both Statement I and Statement II are incorrect

(2) Both Statement I and Statement II are correct

(3) Statement I is incorrect but Statement II is correct

(4) Statement I is correct but Statement II is incorrect

22. Consider the following statement

(A)  $\text{NF}_3$  molecules has a trigonal planar structure.

(B) Bond Length of  $\text{N}_2$  is shorter than  $\text{O}_2$ .

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

(D) Dipole moment of  $\text{H}_2\text{S}$  is higher than that of water molecule.

Choose the correct answer from the options given below:

[2023 (15 Apr Shift 1)]

(1) (A) and (B) are correct

(2) (A) and (D) are correct

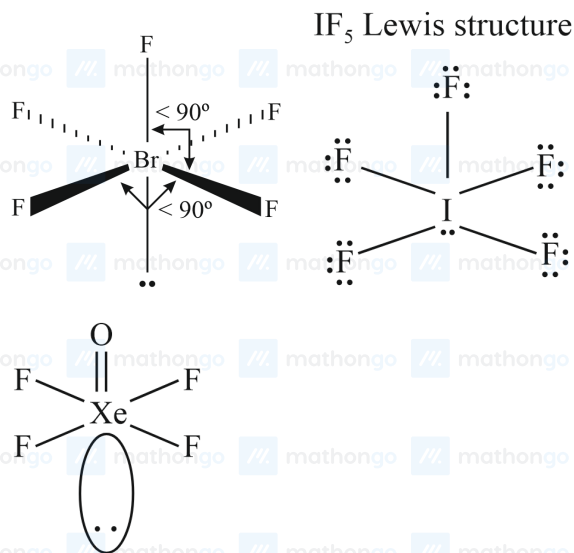
(3) (C) and (D) are correct

(4) (B) and (C) are correct

ANSWER KEYS

1. (3)      2. (4)      3. (4)      4. (2)      5. (3)      6. (4)      7. (3)      8. (1)  
9. (3)      10. (1)      11. (3)      12. (3)      13. (2)      14. (3)      15. (3)      16. (3)  
17. (3)      18. (4)      19. (4)      20. (4)      21. (4)      22. (4)  
1. (3)

Among the given,  $\text{IF}_5$ ;  $\text{BrF}_5$  and  $\text{XeOF}_4$  have square pyramidal structure. VSEPR theory helps us to predict the shape of molecules from the number of electron pairs and lone pairs of electrons that surrounds the central atoms.



2. (4)

$\text{XeF}_4$  is  $\text{sp}^3 \text{d}^2$  hybridised with two lone pairs of electrons, hence, it is square planar.

$\text{SF}_4$  is  $\text{sp}^3 \text{d}$  hybridised with one lone pair of electrons, hence, it is See saw.

$\text{SiF}_4$  is  $\text{sp}^3$  hybridised with zero lone pairs of electrons, hence, it is Tetrahedral

$\text{BF}_4^-$  is  $\text{sp}^3$  hybridised with zero lone pairs of electrons, hence, it is Tetrahedral

$[\text{Cu}(\text{NH}_3)_4]^{2+}$  is  $\text{dsp}^2$  hybridised and is Square planar

$[\text{FeCl}_4]^{2-}$  is  $\text{sp}^3$  hybridised and is Tetrahedral

$[\text{PtCl}_4]^{2-}$  is  $\text{dsp}^2$  hybridised and is Square planar

$\text{BrF}_4^-$  is  $\text{sp}^3 \text{d}^2$  with Square planar geometry.

So, 4 square planar shape compounds are present.

3. (4)

Hydrogen bonding occurs between hydrogen and strongly electronegative atoms like F, N, O. In water or ice hydrogen bonding occurs as there is hydrogen as well as oxygen both are present. Water has 2 hydrogen atoms and 1 oxygen atom. The oxygen of one water molecule has two lone pairs of electrons, each of which can form hydrogen bonds with hydrogen on other two water molecules. Each water molecule is H-bonded to 4 neighbouring molecules.

4. (2)

Butan-1-ol can undergo hydrogen bonding due to the presence of an  $-\text{OH}$  group, ethoxyethane (also known as diethyl ether) can also participate in hydrogen bonding.

Even though there are no hydrogen atoms directly bonded to a highly electronegative atom (like F, O, or N) in ethoxyethane, the molecule still has polar  $\text{C}-\text{O}$  bonds that can lead to dipole-dipole interactions with other polar molecules.

Owing to intermolecular hydrogen bonding in butanol, it has higher boiling point than ethoxyethane.

5. (3) mathongo mathongo mathongo mathongo mathongo mathongo mathongo mathongo mathongo mathongo mathongo n

The percentage of covalent character in an ionic bond is determined by the polarization power of the cation, the polarizing ability of the anion, and the degree of distortion of the anion's electron cloud that occurs due to the electric field of the cation. The polarization power of a cation refers to its ability to distort the electron cloud of the anion in the ionic bond. So the options A, B, C are correct.

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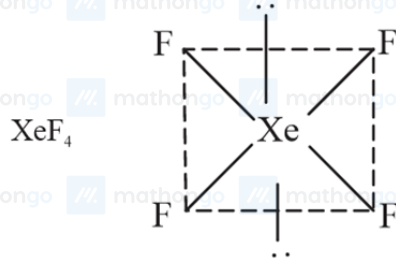
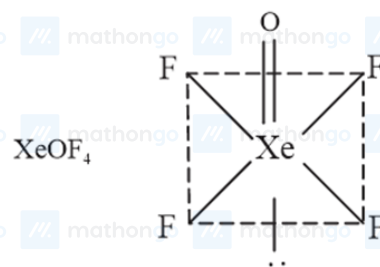
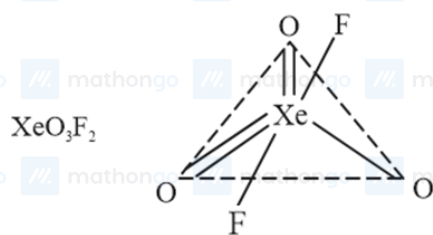
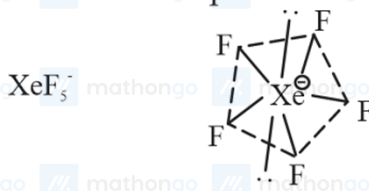
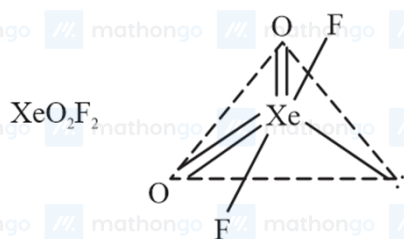
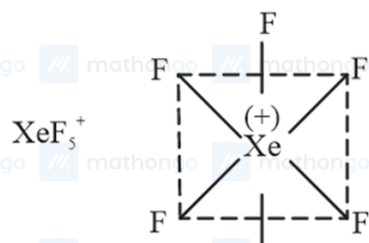
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6. (4)



The central Xe atom in  $\text{XeO}_3$  has three bonding domains and one lone pair of electrons. Hence, the electron geometry is tetrahedral and molecular geometry is pyramidal.

$\text{XeO}_2\text{F}_2$  is trigonal bipyramidal and the shape is a see-saw.

$\text{XeOF}_4$  is in square pyramidal shape.

So,  $\text{XeF}_5^+$ ,  $\text{XeO}_3$ ,  $\text{XeO}_2$ ,  $\text{F}_2$  and  $\text{XeOF}_4$  have single lone pair on central atom.

7. (3)

The dipole moment is the vector sum of all the bond moments. The  $\text{CH}_2\text{Cl}_2$  and  $\text{CHCl}_3$  both have net non-zero dipole moment because the bond moments are not cancelled each other due to their tetrahedral structure. The 1, 4-dichlorobenzene, trans-butene, benzene have zero dipole moment due to cancellation of bond moments. The 1, 3-dichlorobenzene, cis-butene, anisidine has non-zero dipole moment.

8. (1)

Oxide and peroxides of sodium are stable ( $\text{Na}_2\text{O}$  and  $\text{Na}_2\text{O}_2$ ) K, Rb, Cs form superoxides. Beryllium forms a hydride with molecular formula  $\text{BeH}_2$  Organic lead (tetraethyl lead; TEL) is used as an antiknock agent in gasoline and jet fuels. The compound  $(\text{NH}_4)_2\text{BeF}_4$  on thermal decomposition produces  $\text{BeF}_2$  and  $\text{NH}_4\text{F}$ .

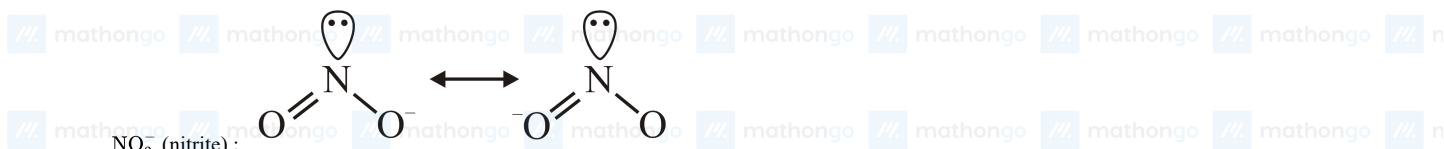
9. (3)

$\text{N}_3^-$  (Azide):  $\text{N}^- = \text{N}^+ = \text{N}^- \leftrightarrow \text{N}^- - \text{N}^+ \equiv \text{N}$   
It has  $\text{sp}$  hybridised central atom. Hence it is linear in shape.

$\text{I}_3^-$  (triiodide):



It has linear geometry,  $\text{sp}^3\text{d}$  hybridisation with three lone pairs at central atom.



$\text{NO}_2^-$  (nitrite):

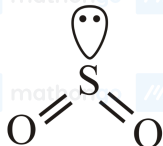
It is (nonlinear) bent shaped as it has  $\text{sp}^2$  hybridisation with one lone pair at central atom.



$\text{O}_3$  (ozone):

It is bent in shape with  $\text{sp}^2$  hybridisation and one lone pair at central atom.

$\text{SO}_2$  (sulphur dioxide):



It is bent in shape with  $\text{sp}^2$  hybridisation and one lone pair at central atom.

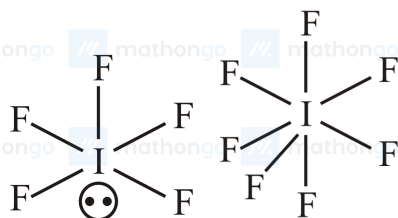
So 3 among the given molecules is bent in shape.

10. (1) mathongo // mathongo // mathongo // mathongo // mathongo // mathongo // mathongo // mathongo // mathongo // mathongo // n

In  $\text{IF}_5$ , the central atom is iodine, which has 7 valence electrons. Iodine in this molecule has 5 bonding pairs and 1 lone pair. Therefore, the number of lone pairs on the central atom of  $\text{IF}_5$  is 1.

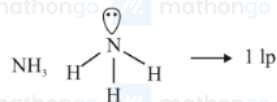
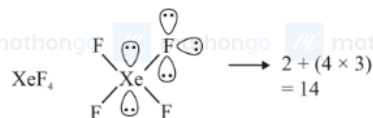
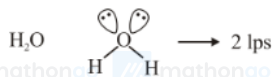
In  $\text{IF}_7$ , the central atom is also iodine, which has 7 valence electrons. Iodine in this molecule has 7 bond pairs and 0 lone pairs. Therefore, the number of lone pairs on the central atom of  $\text{IF}_7$  is 0.

Therefore, the sum of the number of lone pairs in the central atom of  $\text{IF}_5$  and  $\text{IF}_7$  is  $1 + 0 = 1$ .

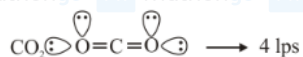


11. (3) mathongo // mathongo // mathongo // mathongo // mathongo // mathongo // mathongo // mathongo // mathongo // mathongo // n

The lone pair of electrons can be identified by drawing structure of the given molecules as follows,



Reference for structure NCERT - XI pg 105

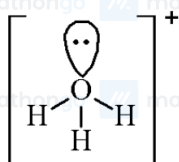


The number of molecules having only 2 lone pair of electrons = 3

Which are  $\text{H}_2\text{O}$ ,  $\text{N}_2$  and  $\text{CO}$ .  $\text{XeF}_4$  have 2 lone pairs on central atom, but we are asked about lone pair in molecule

12. (3) The molecular geometry of  $\text{H}_3\text{O}^+$  is pyramidal. It consists of three hydrogen atoms bonded to the central oxygen atom, with one lone pair of electrons on the oxygen atom.
- The acetylide ion consists of two carbon atoms bonded together by a triple bond ( $\text{C} \equiv \text{C}$ ) with a lone pair of electrons on the terminal carbon atom. So it is linear.
- The  $\text{NH}_4^+$  ion consists of a central nitrogen atom bonded to four hydrogen atoms. It is tetrahedral.
- The  $\text{ClO}_2^-$  ion is bent in shape due to its molecular geometry. It consists of one central chlorine atom bonded to two oxygen atoms, with an additional lone pair of electrons on the central chlorine atom.

(A)  $\text{H}_3\text{O}^+ \rightarrow$  (III) Pyramidal

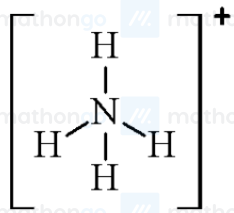


Pyramidal

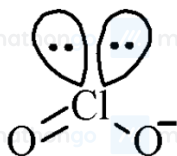
(B) Acetylide ion  $\rightarrow$  (II) Linear



(C)  $\text{NH}_4^+$  ion  $\rightarrow$  (I) Tetrahedral



(D)  $\text{ClO}_2^-$  ion  $\rightarrow$  (IV) Bent



13. (2)  $\text{SO}_2$  is a bent molecule with a central sulfur atom bonded to two oxygen atoms. The oxygen atoms are more electronegative than sulfur, causing a separation of charge. This results in a bent molecular geometry and a net dipole moment, making  $\text{SO}_2$  a polar molecule.
- $\text{NH}_3$  is a trigonal pyramidal molecule with a central nitrogen atom bonded to three hydrogen atoms. Again, the electronegativity difference between nitrogen and hydrogen leads to a separation of charge. The arrangement of the atoms in  $\text{NH}_3$  gives it a net dipole moment, making it a polar molecule.

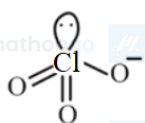
14. (3)

$\text{ClO}_3^-$ : The central atom is Cl, there is one lone pair of electrons on the central atom.

$\text{XeF}_4$ : The central atom is Xe. It has two lone pair on central atom.

$\text{SF}_4$ : The central atom is S. It contains one lone pair on central atom.

$\text{I}_3^-$ : It contains three lone pair on central atom.



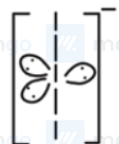
1 L.P. on central atom



2 L.P. on central atom



1 L.P. on central atom



3 L.P. on central atom

15. (3)

The bond order of the acetylide ion  $\text{HC} \equiv \text{C}^-$  is 3, indicating a triple bond between the carbon atoms.

The acetylide ion consists of two carbon atoms with a triple bond between them and a negative charge. In the triple bond, there are six bonding electrons (two pi bonds and one sigma bond) and zero antibonding electrons.

Among the given options  $\text{NO}^+$  will have the same bond order and magnetic property like acetylide ion.

Species	Bond Order	Magnetic moment
$\text{HC} \equiv \text{C}^-$	3	0
$\text{O}_2^+$	2.5	$\sqrt{3}$ B.M
$\text{N}_2^+$	2.5	$\sqrt{3}$ B.M
$\text{NO}^+$	3	0
$\text{O}_2^-$	1.5	$\sqrt{3}$ B.M

16. (3)

The oxidation state of +5 in pentahalides is more covalent as compared to the +3 oxidation state in trihalides. Due to the higher positive oxidation state of the central atom in pentahalide state, these atoms will have larger polarising power than the halogen atom attached to them since the polarising power is directly proportional to the charge. More is the polarisation, larger will be the covalent character of the bond. Hence, due to larger polarisation of bond in pentahalide state as compared to trihalide state, the  $\text{SbCl}_5$  is more covalent than  $\text{SbCl}_3$ .

Higher oxides of halogens are more stable than lower ones due to the formation of more number of bonds, which results in higher release of energy. So, both the statements I and II are correct.

17. (3)

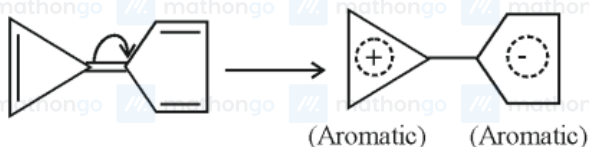
Process	Change in magnetic nature	Bond order change
$\text{N}_2 \rightarrow \text{N}_2^+$	Dia $\rightarrow$ Para	3 $\rightarrow$ 2.5
$\text{NO} \rightarrow \text{NO}^+$	Para $\rightarrow$ Dia	2.5 $\rightarrow$ 3
$\text{O}_2 \rightarrow \text{O}_2^{2-}$	Para $\rightarrow$ Dia	2 $\rightarrow$ 1
$\text{O}_2 \rightarrow \text{O}_2^+$	Para $\rightarrow$ Para	2 $\rightarrow$ 2.5

18. (4)

Chlorine pentafluoride is an inter halogen compound.  $\text{ClF}_5$  is colourless liquid. The central chlorine atom is having five bond pairs and one lone pair on it.

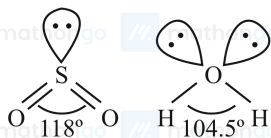
Hence, according to VSEPR theory it has square pyramidal geometry. It is toxic by inhalation and an irritant to skin, eyes and mucus membranes.

19. (4) The compound which possess aromatic character will show highest dipole moment. From the given compounds the following compound will have the highest dipole moment. Because the Positive and negative ends acquire aromaticity.



20. (4)
- (A) Weak Intermolecular Forces are present in polymer of 2-chloro, 1, 3-butadiene. It is a monomer of neoprene which is a rubber (elastomer).
- (B) Hydrogen Bonding is present in NYLON-6, 6 which is a polymer of Hexamethylenediamine and adipic acid. This hydrogen bonding is due to the presence of amide group.
- (C) Heavily branched polymer is Bakelite which is polymer of phenol and formaldehyde. It is a crosslinked polymer.
- (D) High density polymer (polyethylene) preparation requires  $\text{Al}(\text{Et})_3$  and  $\text{TiCl}_4$  as a catalyst (Ziegler Natta Catalyst)

21. (4)
- The molecule  $\text{SO}_2$  is having two sigma bond pairs and lone pair, hence, it exhibits angular or V-shape structure. The molecule  $\text{H}_2\text{O}$  is having two sigma bond pairs and a lone pair hence, it exhibits angular or V-shape structure. So, both molecules are having same shape. But double bond-double bond repulsions are greater than single bond repulsions, hence, the bond angle in sulphur dioxide is greater than water.



$\text{SO}_2$  and  $\text{H}_2\text{O}$  both have V-Shape

Bond angle:  $\text{SO}_2 > \text{H}_2\text{O}$

22. (4)
- In  $\text{NF}_3$ , nitrogen is having three bond pairs and a lone pair, hence, it has pyramidal shape.
- The bond order of  $\text{N}_2 = 3$ , and The bond order of  $\text{O}_2 = 2$ . Bond length is inversely related to bond order. Hence, bond length of  $\text{N}_2$  is shorter than  $\text{O}_2$
- Isoelectronic species have identical bond order



Dipole moment of  $\text{H}_2\text{O}$  is more than that of  $\text{H}_2\text{S}$  due to higher electronegativity of O.