INDIAN SCHOOL AL WADI AL KABIR

Class: XI	**Department: SCIENCE 2023-2024 (CHEMISTRY)**	**Date of submission: 30.08.2023**
Worksheet No: 04	**Chapter: CHEMICAL BONDING AND MOLECULAR STRUCTURE**	**Note: A4 FILE FORMAT**
NAME OF THE STUDENT	**CLASS & SEC:**	**ROLL NO.**

Multiple Choice Questions (1 M)

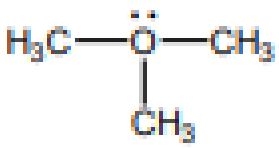
1. The type of bond between atoms in a molecule of CO_2 is _____
   (a) Ionic bond
   (b) Metallic bond
   (c) Hydrogen bond
   (d) Covalent bond.

2. sp^3d^2 hybridization is present in SF_6, find its geometry
   (a) octahedral geometry
   (b) square planar geometry
   (c) tetragonal geometry
   (d) tetrahedral geometry

3. _____ is an example of zero overlap
   (a) p_z - p_z overlap
   (b) p_z - s overlap
   (c) p_z - p_y overlap
   (d) p_y - p_y overlap

4. Find the pair with sp^2 hybridisation of the central molecule.
   (a) NH_3 and NO_2^-
   (b) BF_3 and CH_4
   (c) BF_3 and NO_2^-
   (d) NH_2^- and H_2O

5. What is the formal charge on oxygen in the following structure?



   (a) +1
   (b) -2
   (c) -1

(d) 0

6. The correct decreasing order of boiling points of the following compounds is
(a) $HF > H_2O > NH_3$
(b) $H_2O > HF > NH_3$
(c) $NH_3 > HF > H_2O$
(d) $NH_3 > H_2O > HF$

7. In which of the following molecules octet rule is not followed?
(a) NH_3
(b) CH_4
(c) CO_2
(d) NO

***Assertion Reason* type questions**

Given below are two statements labelled as Assertion (A) and Reason (R)

8. **Assertion (A)**: Though the central atom of both NH_3 and H_2O molecules are sp^3 hybridised, yet H–N–H bond angle is greater than that of H–O–H.
Reason (R): This is because nitrogen atom has one lone pair and oxygen atom has two lone pairs.
(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true but R is not the correct explanation of A.
(c) A is true but R is false.
(d) A is false but R is true.

9. **Assertion (A)**: ClF_3 has a bent T shape.
Reason (R): It has two lone pairs arranged at 180°.

(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true but R is not the correct explanation of A.
(c) A is true but R is false.
(d) A is false but R is true.

10. **Assertion (A)**: NaBr is more covalent than NaF.
Reason (R): Br being larger in size has lesser polarisability.

(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true but R is not the correct explanation of A.
(c) A is true but R is false.
(d) A is false but R is true.

Very Short answer type (2 M)

11. What is the total number of σ and π bonds in the following molecules?

(a) C_2H_6 (b) C_2H_4 (c) HCOOH (d) CH_3COOH

12. Account for the following
(a) The bond dissociation enthalpies of O-H bonds in H_2O are not the same.
(b) The double bond in C_2 molecule consists of π bonds.

13. Amongst the following compounds, which do not obey the octet rule and why?
(a) H_2O (b) PCl_5 (c) CH_4 (d) BeF_2

14. Arrange the following in the increasing order of bond length.
C_2 , C_2^- , C_2^{2-}

15. Using the concept of hybridization explain the structures of PCl_5 and SF_6.

16. When a magnet is lowered in liquid oxygen, some O_2 molecules stick to it. No such behaviour is observed with liquid N_2. Explain.

Short answer type (3 M)

17. Draw the Lewis dot structures for
(a) H_2SO_4 (b) PCl_3 (c) H_2S

18. (a) Define the term lattice enthalpy.
(b) CO_2 and SO_2 are triatomic molecules. Do they have the same dipole moment? Justify your answer.

19. (a) Label the covalent radius and van der Waals radius (99 and 180 pm respectively) in the diagram of a chlorine molecule.

(b) Which species of each group is predicted to have the strongest bond?
i. O_2, F_2, N_2 ii. H_2, H_2^-, H_2^+

Passage based questions (4 M)

20.
When covalent bond is formed between two similar atoms, for example in H_2, O_2, Cl_2, N_2 or F_2, the shared pair of electrons is equally attracted by the two atoms. As a result, electron pair is situated exactly between the two identical nuclei. The bond so formed is called Nonpolar covalent bond. Contrary to this in case of a heteronuclear molecule like HF, the shared electron pair between the two atoms gets displaced more towards fluorine since the electronegativity of fluorine is far greater than that of hydrogen. The resultant covalent bond is a polar covalent bond.
As a result of polarisation, the molecule possesses the dipole moment which can be defined as the product of the magnitude of the charge and the distance between the centres of positive and negative charge. In case of polyatomic molecules, the dipole moment not only depend upon the individual dipole moments of bonds known as bond dipoles but also on the spatial arrangement of various bonds in the molecule. Just as all the covalent bonds have some partial ionic character, the ionic bonds also have partial covalent character. The partial covalent character of ionic bonds was discussed by Fajans in terms of a set of rules.

(a) Which among the following has higher dipole moment, NH_3 or NF_3. Explain.

(b) Define the term bond angle.

(c) Choose the correct answer based on the information in parenthesis and give appropriate explanation
(i) BF_3 or H_2O (Non-polar)
(ii) NaF or NaI (more covalent)

OR

(c) Predict whether the bond angle in the following molecules is more than or less than or equal to 120°.
(i) BeF_2
(ii) CH_4
(iii) SF_6
(iv) NH_3

Long answer type (5 M)

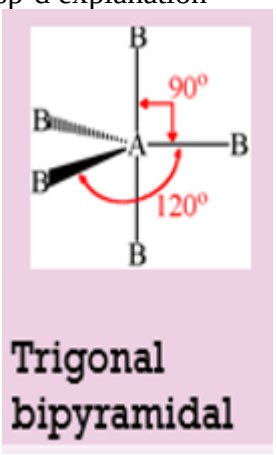
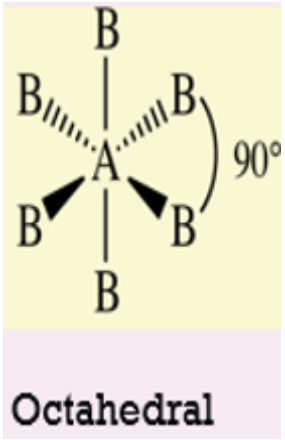
21. Complete the table

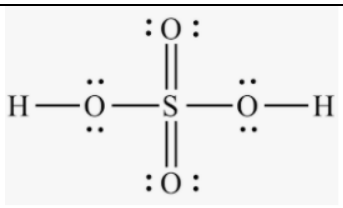
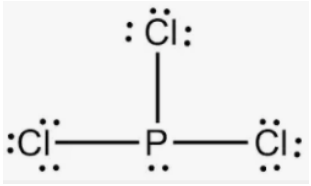
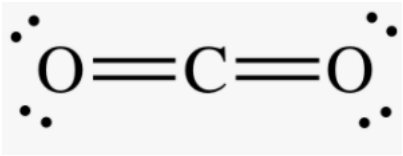
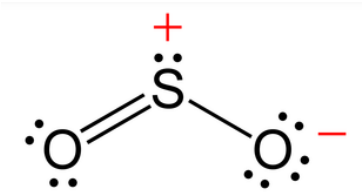
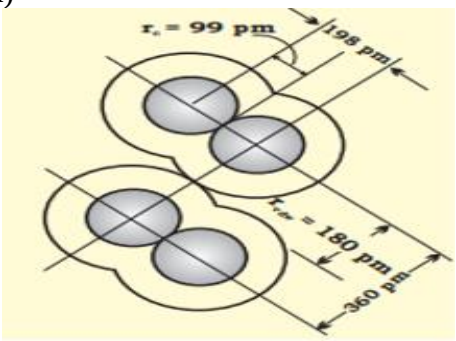
Molecule	Bond pairs	Lone pairs	Geometry	Hybridisation
CH_4				
NH_3				
BrF_5				
H_2O				
PF_5				

22. Give reasons for the following statements
(a) The C-C bond length in ethane is 154 pm whereas in ethylene it is 134 pm.
(b) H_2O is a liquid whereas H_2S is a gas.
(c) PCl_5 is a reactive molecule.
(d) The O- O bond lengths in O_3 are the same.
(e) BF_3 is a non-polar molecule.

Answers

Q.No	Answers	Marks
1	(d) covalent bond.	1
2	(a) octahedral geometry	1
3	(c) p_z - p_y overlap	1
4	(c) BF_3 and NO_2^-	1
5	(a) +1	1
6	(b) $H_2O > HF > NH_3$	1
7	(d) NO	1
8	(a) Both A and R are true and R is the correct explanation of A	1
9	(c) A is true but R is false	1
10.	(c) A is true but R is false.	1
11	(a) 7 σ bonds, 0 π bond (b) 5 σ bonds, 1 π bond (c) 4 σ bonds, 1 π bond (d) 7 σ bonds, 1 π bond	½ ×4

12	(a) Due to difference in the chemical environment. (b) This is because of the presence of four electrons in two pi molecular orbitals.	1 1
13	(b) Expanded octet (d) Incomplete octet	1 1
14	C_2 $(\sigma 1s)^2 (\sigma^* 1s)^2 (\sigma 2s)^2 (\sigma^* 2s)^2 (\pi 2p_x^2 = \pi 2p_y^2)$ B.O = ½ (8-4) = 2 C_2^- $(\sigma 1s)^2 (\sigma^* 1s)^2 (\sigma 2s)^2 (\sigma^* 2s)^2 (\pi 2p_x^2 = \pi 2p_y^2) (\sigma 2pz^1)$ B.O = ½ (9-4) = 2.5 C_2^{2-} $(\sigma 1s)^2 (\sigma^* 1s)^2 (\sigma 2s)^2 (\sigma^* 2s)^2 (\pi 2p_x^2 = \pi 2p_y^2) (\sigma 2pz^2)$ B.O = ½ (10-4) = 3 Increasing bond length $C_2^{2-} < C_2^- < C_2$	½ ½ ½ ½
15	PCl_5 SF_6. sp^3d explanation sp^3d^2 explanation   	1 1
16.	O_2 is paramagnetic (due to unpaired electrons). N_2 is diamagnetic (due to paired electrons) Electronic configurations of N_2 and O_2.	1 ½ ×2
17.	(a) H_2SO_4 (b) PCl_3 (c) H_2S	1×3

	  	
18.	(a) The Lattice Enthalpy of an ionic solid is defined as the energy required to completely separate one mole of a solid ionic compound into gaseous constituent ions. (b) CO_2 (linear) SO_2 (bent)   No, they don't have the same dipole moment. In CO_2, the dipoles cancel out and hence have zero dipole moment.	1 1 1
19.	(a)  (b) i. N_2 ii. H_2	1 1 1
20.	(a) NH_3, Orbital dipoles and bond dipoles are in the same direction. (b) It is defined as the angle between the orbitals containing bonding electron pairs around the central atom in a molecule/complex ion (c) (i) BF_3 , Diagram explanation – dipoles- cancel (ii) NaI, Explanation Fajans rules- I larger anion-greater polarisability OR (c) (i) more (ii) less	½ × 2 1 ½ × 2 ½ × 2 ½ × 2

	(iii) less (iv) less	½ × 2
21.		

Molecule	Bond pairs	Lone pairs	Geometry	Hybridisation	
CH_4	4	0	Tetrahedral	sp^3	½ ×2
NH_3	3	1	Trigonal pyramid	sp^3	½ ×2
BrF_5	5	1	Square pyramid	sp^3d^2	½ ×2
H_2O	2	2	Bent	sp^3	½ ×2
PF_5	5	0	Trigonal bipyramid	sp^3d	½ ×2

22.	(a) Ethane is single covalent bonded, sp^3 hybridised. Ethene is double bonded, sp^2 hybridisation, Thus shorter bond length.	1
	(b) H_2O molecules are associated to each other using strong H bonds. Since associated they are in liquid state. In H_2S there is no H bond.	1
	(c) Axial bonds are longer and weaker than equatorial bonds.	1
	(d) Resonance, partial double bond character	1
	(e) The resultant of 1^{st} and 2^{nd} dipoles cancel out the third dipole.	1

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