

Chemical Bonding

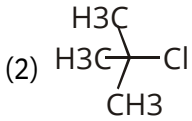
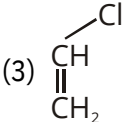
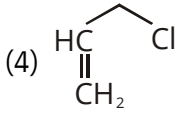
CHEMICAL BONDING

1. The dipole moments of CCl_4 , CHCl_3 and CH_4 are in the order :
 - (1) $\text{CH}_4 = \text{CCl}_4 < \text{CHCl}_3$
 - (2) $\text{CH}_4 < \text{CCl}_4 < \text{CHCl}_3$
 - (3) $\text{CCl}_4 < \text{CH}_4 < \text{CHCl}_3$
 - (4) $\text{CHCl}_3 < \text{CH}_4 = \text{CCl}_4$
2. The relative strength of intermolecular forces in decreasing order is :
 - (1) ion-dipole > ion-ion > dipole-dipole
 - (2) dipole-dipole > ion-dipole > ion-ion
 - (3) ion-dipole > dipole-dipole > ion-ion
 - (4) ion-ion > ion-dipole > dipole-dipole
3. The bond order and the magnetic characteristics of CN^- are :
 - (1) 3, diamagnetic
 - (2) $2\frac{1}{2}$, paramagnetic
 - (3) 3, paramagnetic
 - (4) $2\frac{1}{2}$, diamagnetic
4. The predominant intermolecular forces present in ethyl acetate, a liquid, are :
 - (1) hydrogen bonding and London dispersion
 - (2) Dipole-dipole and hydrogen bonding
 - (3) London dispersion and dipole-dipole
 - (4) London dispersion, dipole-dipole and hydrogen bonding
5. Arrange the following bonds according to their average bond energies in descending order : C-Cl , C-Br , C-F , C-I
 - (1) $\text{C-I} > \text{C-Br} > \text{C-Cl} > \text{C-F}$
 - (2) $\text{C-Br} > \text{C-I} > \text{C-Cl} > \text{C-F}$
 - (3) $\text{C-F} > \text{C-Cl} > \text{C-Br} > \text{C-I}$
 - (4) $\text{C-Cl} > \text{C-Br} > \text{C-I} > \text{C-F}$
6. 'X' melts at low temperature and is a bad conductor of electricity in both liquid and solid state. X is :
 - (1) Carbon tetrachloride
 - (2) Mercury
 - (3) Silicon carbide
 - (4) Zinc sulphide
7. If the magnetic moment of a dioxygen species is 1.73 B.M, it may be :
 - (1) O_2
 - (2) O_2^+
 - (3) O_2^-
 - (4) O_2^{2+}
8. The acidic, basic and amphoteric oxides, respectively, are :
 - (1) MgO , Cl_2O , Al_2O_3
 - (2) Cl_2O , CaO , P_4O_{10}
 - (3) Na_2O , SO_3 , Al_2O_3
 - (4) N_2O_3 , Li_2O , Al_2O_3
9. The number of sp^2 hybrid orbitals in a molecule of benzene is :
 - (1) 24
 - (2) 6
 - (3) 12
 - (4) 18
10. Among the sulphates of alkaline earth metals, the solubilities of BeSO_4 and MgSO_4 in water, respectively, are:
 - (1) high and high
 - (2) poor and poor
 - (3) high and poor
 - (4) poor and high
11. The number of $\text{Cl}=\text{O}$ bonds in perchloric acid is, "_____"
12. The increasing order of boiling points of the following compounds is :

OH	OH	OH	OH
I	II	III	IV

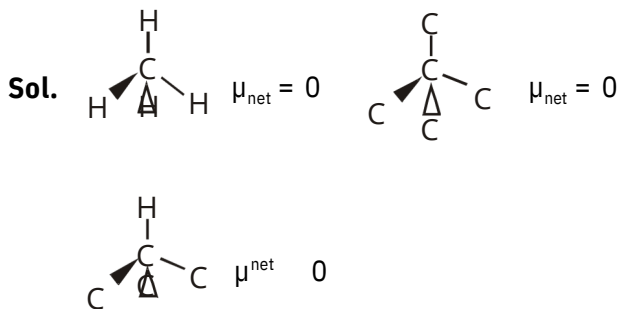
 - (1) $\text{I} < \text{IV} < \text{III} < \text{II}$
 - (2) $\text{IV} < \text{I} < \text{II} < \text{III}$
 - (3) $\text{I} < \text{III} < \text{IV} < \text{II}$
 - (4) $\text{III} < \text{I} < \text{II} < \text{IV}$
13. The compound that has the largest H-M-H bond angle ($\text{M}=\text{N}, \text{O}, \text{S}, \text{C}$), is :
 - (1) H_2O
 - (2) CH_4
 - (3) NH_3
 - (4) H_2S
14. Hydrogen peroxide, in the pure state, is :
 - (1) non-planar and almost colorless
 - (2) linear and almost colorless
 - (3) planar and blue in color
 - (4) linear and blue in color
15. The structure of PCl_5 in the solid state is
 - (1) square pyramidal
 - (2) tetrahedral $[\text{PCl}_4]^-$ and octahedral $[\text{PCl}_6]^-$
 - (3) square planar $[\text{PCl}_4]^-$ and octahedral $[\text{PCl}_6]^-$
 - (4) trigonal bipyramidal

Chemical Bonding

16. Among the following compounds, which one has the shortest C–Cl bond ?
- (1) $\text{H}_3\text{C}-\text{Cl}$
- (2) 
- (3) 
- (4) 
17. The reaction in which the hybridisation of the underlined atom is affected is :-
- (1) $\text{NH}_3 \xrightarrow{\text{H}}$
- (2) $\text{XeF}_4 \xrightarrow{\text{SbF}_5}$
- (3) $\text{H}_2\text{SO}_4 \xrightarrow[420\text{ K}]{\text{NaCl}}$
- (4) $\text{HPO}_3 \xrightarrow{\text{Disproportionation}}$
18. Of the species, NO, NO+, NO₂⁺, NO⁻, the one with minimum bond strength is :
- (1) NO₂⁺ (2) NO⁺ (3) NO (4) NO⁻
19. In a molecule of pyrophosphoric acid, the number of P–OH, P=O and P–O–P bonds/moiety(ies) respectively are :
- (1) 3, 3 and 3 (2) 2, 4 and 1
(3) 4, 2 and 0 (4) 4, 2 and 1
20. Match the type of interaction in Column A with the distance dependence of their interaction energy in Column B :
- | A | B |
|-------------------------|---------------------|
| (I) ion - ion | (a) $\frac{1}{r}$ |
| (II) dipole - dipole | (b) $\frac{1}{r^2}$ |
| (III) London dispersion | (c) $\frac{1}{r^3}$ |
| | (d) $\frac{1}{r^6}$ |
- (1) (I)-(a), (II)-(b), (III)-(c)
(2) (I)-(a), (II)-(c), (III)-(d)
(3) (I)-(a), (II)-(b), (III)-(d)
(4) (I)-(b), (II)-(d), (III)-(c)
21. The molecular geometry of SF₆ is octahedral. What is the geometry of SF₄ (including lone pair(s) of electrons, if any) ?
- (1) Trigonal bipyramidal
(2) Square planar
(3) Tetrahedral
(4) Pyramidal
22. If AB₄ molecule is a polar molecule, a possible geometry of AB₄ is :
- (1) Square pyramidal
(2) Tetrahedral
(3) Square planar
(4) Rectangular planar
23. The shape/structure of [XeF₅]⁻ and XeO₃F₂, respectively, are :
- (1) pentagonal planar and trigonal bipyramidal
(2) trigonal bipyramidal and pentagonal planar
(3) octahedral and square pyramidal
(4) trigonal bipyramidal and trigonal bipyramidal

SO LU TION

1. **NTA Ans. (1)**

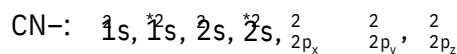


2. **NTA Ans. (4)**

Sol. Order is
ion – ion > ion – dipole > dipole – dipole

3. **NTA Ans. (1)**

Sol. According to MOT (If z is internuclear axis)
The configuration of



$$\text{Bond order} = \frac{1}{2}(10 - 4)$$

$$= 3$$

CN– is diamagnetic due to absence of unpaired electron

4. **NTA Ans. (3)**

Sol. Ethyl acetate $(\text{H}_3\text{C}-\overset{\text{O}}{\parallel}{\text{C}}-\text{O}-\text{CH}_2-\text{CH}_3)$ is polar

molecule. Hence there will be dipole-dipole attraction and London dispersion forces are present.

5. **NTA Ans. (3)**

Sol. Bond length order in carbon halogen bonds are in the order of $\text{C}-\text{F} < \text{C}-\text{Cl} < \text{C}-\text{Br} < \text{C}-\text{I}$
Hence, Bond energy order
 $\text{C}-\text{F} > \text{C}-\text{Cl} > \text{C}-\text{Br} > \text{C}-\text{I}$

6. **NTA Ans. (1)**

Sol. CCl_4 is molecular solid so does not conduct electricity in liquid & solid state.

7. **NTA Ans. (1)**

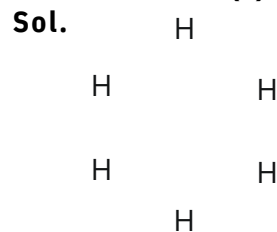
Sol. number of unpaired electron magnetic moment

O^\ominus	1	1.73 B.M
O_2	1	1.73 B.M
O_2	2	2.83 BM
O_2		

8. **NTA Ans. (4)**

Sol. 1. MgO Basic
Cl₂O Acidic
Al₂O₃ amphoteric
2. Cl₂O Acidic
CaO Basic
P₄O₁₀ Acidic
3. Na₂O Basic
SO₃ Acidic
Al₂O₃ amphoteric
4. N₂O₃ Acidic
Li₂O Basic
Al₂O₃ amphoteric

9. **NTA Ans. (4)**



Each carbon atom is sp² hybridized
Therefore each carbon has 3 sp² hybrid orbitals.

Hence total sp² hybrid orbitals are 18.

10. **Official Ans. by NTA (1)**

11. **Official Ans. by NTA (3.00)**

12. **Official Ans. by NTA (1)**

Sol	OH	OH	OH	OH
	CH ₃	O	N	O
	I	II	III	IV
BP value from net	202°C	279°	28.4° C	24.3° C
	BP dipole moment (μ)			

Alter

Increasing order of boiling point is :

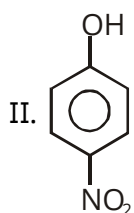
OH

I.

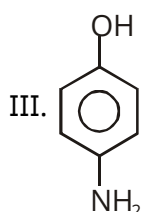
CH₃

Shows hydrogen bonding from –O–H group only

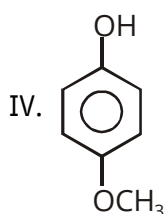
Chemical Bonding



Shows strongest hydrogen bonding from both sides of -OH group as well as -NO₂ group.



Shows stronger hydrogen from both side of -OH group as well as -NH₂ group.

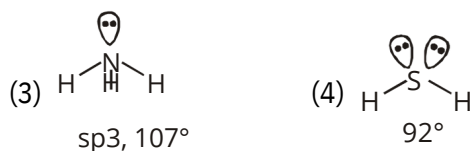
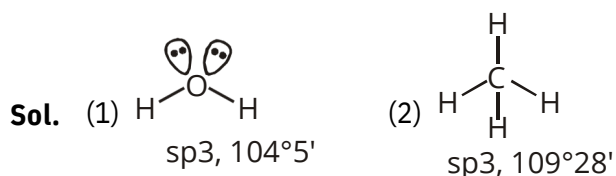


Shows stronger hydrogen bonding from one side -OH-group and another side of -OCH₃ group shows only dipole-dipole interaction.

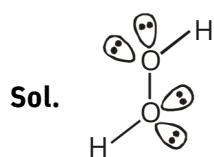
Hence correct order of boiling point is:

(I) < (IV) < (III) < (II)

13. **Official Ans. by NTA (2)**

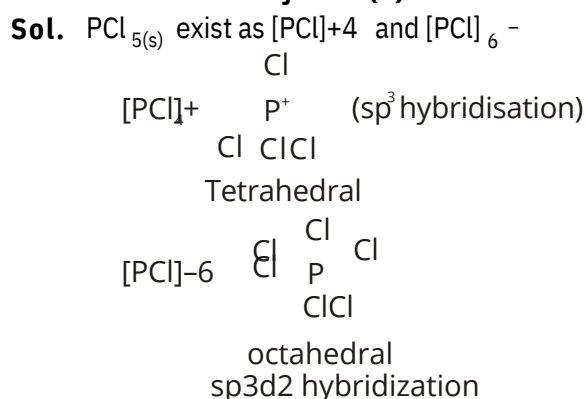


14. **Official Ans. by NTA (1)**

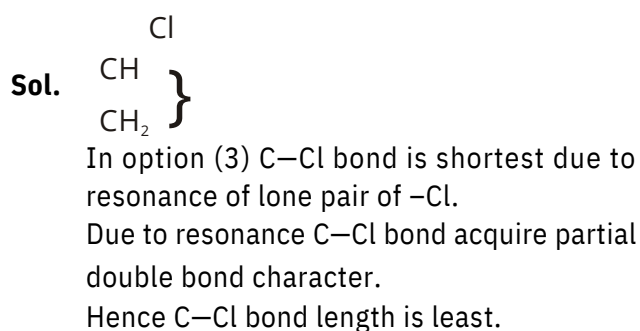


hydrogen peroxide, in the pure state, is non-planar and almost colourless (very pale blue) liquid.

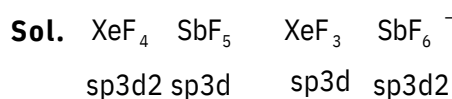
15. **Official Ans. by NTA (2)**



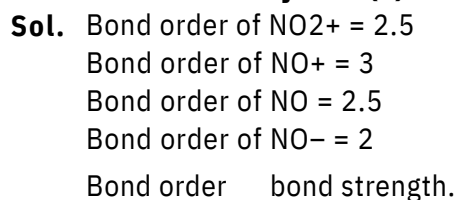
16. **Official Ans. by NTA (3)**



17. **Official Ans. by TA (2)**

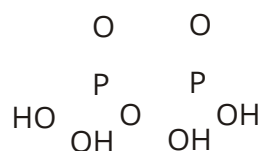


18. **Official Ans. by NTA (4)**



19. **Official Ans. by NTA (4)**

Sol. Pyrophosphoric acid.



P - OH linkages = 4

P = O linkages = 2

P-O-P linkages = 1

Chemical Bonding

20. Official Ans. by NTA (3)

Official Ans. by ALLEN (2)

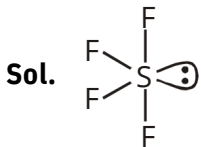
Sol. Type of interaction Interaction Energy(E)

ion - ion E $\frac{1}{r}$

dipole - dipole E $\frac{1}{r^3}$

London dispersion E $\frac{1}{r^6}$

21. Official Ans. by NTA (1)

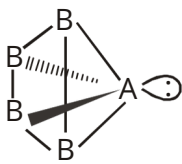


4 bonds +1 lone pair

Shape (including lone pair of electrons) is Trigonal bipyramidal

22. Official Ans. by NTA (1)

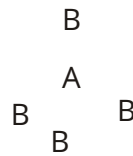
Sol. (1) If AB₄ molecule is a square pyramidal then it has one lone pair and their structure should be



and it should be polar because dipole moment

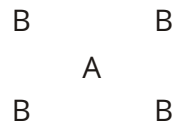
of lone pair of 'A' never be cancelled by others.

(2) If AB₄ molecule is a tetrahedral then it has no lone pair and their structure should be



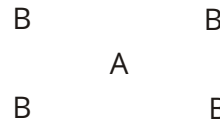
and it should be non polar due to perfect symmetry.

(3) If AB₄ molecule is a square planar then



it should be non polar because vector sum of dipole moment is zero.

(4) If AB₄ molecule is a rectangular planar then



it should be non polar because vector sum of dipole moment is zero.

23. Official Ans. by NTA (1)



XeF₅
sp³d³
Pentagonal planar

XeO₃F₂
sp³d
Trigonal bipyramidal