# CHEMICAL BONDING

## COVALENT BOND

**1.** The strength of bonds by 2s - 2s, 2p - 2p and 2p -2s overlapping has the order :-

(1) s – s > p – p > s – p (2) s – s > p – s > p – p

(3) p – p > s – p > s – s (4) p – p > s – s > p – s

**2.** Which is not characteristic of π-bond:-

(1) π - bond is formed when a sigma bond already formed

(2) π - bond are formed from hybrid orbitals

(3) π - bond may be formed by the overlapping of p-orbitals

(4) π-bond results from lateral overlap of atomic orbitals

**3.** Which compound of xenon is not possible

(1) $XeF_2$ (2) $XeF_4$ (3) $XeF_5$ (4) $XeF_6$

**4.** Similarity of fluorine and oxygen may not be attributed to-

(1) Their atomic and ionic radii are closely similar

(2) The atom of both elements attain an octet of electrons in their valence shell

(3) Both of them are highly electronegative elements

(4) Both form stable pπ – pπ multiple bonds with themselves

## HYBRIDISATION

**5.** Among the following species identify the isostructural pairs:-

$NF_3$, $NO_3^-$, $BF_3$, $H_3O^+$, $HN_3$

(1) [$NF_3$, $NO_3^-$] and [$BF_3$, $H_3O^+$]

(2) [$NF_3$, $HN_3$] and [$NO_3^-$, $BF_3$]

(3) [$NF_3$, $H_3O^+$] and [$NO_3^-$, $BF_3$]

(4) [$NF_3$, $H_3O^+$] and [$HN_3$, $BF_3$]

**6.** Which of the set of species have same hybridisation state but different shapes:-

(1) $NO_2^+$, $NO_2$ , $NO_2^-$ (2) $ClO_4^-$, $SF_4$, $XeF_4$

(3) $NH_4^+$, $H_3O^+$, $OF_2$ (4) $SO_4^{-2}$, $PO_4^{-3}$, $ClO_4^-$

**7.** Which of the following elements can not exhibit $sp^3d$ hybridisation state:-

(a) C (b) P (c) Cl (d) B

Correct answer is:-

(1) a, c (2) a, d (3) b, c (4) b, d

**8.** Which of the following set is not correct:–

(1) $SO_3$, $O_3$, $NH_4^+$ all have coordinate bonds

(2) $H_2O$, $NO_2$, $ClO_2^-$, all are 'V' shape molecules

(3) $I_3^-$, $ICl_2^-$, $NO_2^+$ ; all are linear molecules

(4) $SF_4$, $SiF_4$, $XeF_4$ are tetrahedral in shape

**9.** The shape of $XeO_2F_2$ will be :-

(1) Square planar

(2) Tetrahedral

(3) Pentagonal bipyramidal

(4) See saw

**10.** A σ bonded molecule $MX_3$ is T–shaped. The number of non–bonding pairs of electrons is

(1) 0

(2) 2

(3) 1

(4) Can be predicted if atomic number of M is known

**11.** The structure and hybridization of $Si(CH_3)_4$ is :

(1) bent, sp (2) trigonal, $sp^2$

(3) octahedral, $sp^3d$ (4) tetrahedral, $sp^3$

**12.** When the hybridization state of carbon atom changes from $sp^3$, $sp^2$ and sp, the angle between the hybridized orbitals.

(1) decrease considerably

(2) increase progressively

(3) decrease gradually

(4) all of these

**13.** Molecular shapes of $SF_4$, $CF_4$ and $XeF_4$ are :-

(1) The same, with 2, 0 and 1 lone pairs of electrons respectively

(2) The same, with 1,1 and 1 lone pairs of electrons respectively

(3) Different, with 0,1 and 2 lone pairs of electrons respectively

(4) Different, with 1,0 and 2 lone pairs of electrons respectively

**14.** Select the correct matching :

| **List I** | **List II** |
|---|---|
| A : $XeF_4$ | 1. Pyramidal |
| B : $XeF_6$ | 2. T-shape |
| C : $XeO_3$ | 3. Distorted octahedral |
| D : $XeOF_2$ | 4. Square planar |

| | A | B | C | D |
|---|---|---|---|---|
| (1) | 4 | 3 | 1 | 2 |
| (2) | 1 | 2 | 3 | 4 |
| (3) | 2 | 1 | 3 | 4 |
| (4) | 4 | 1 | 3 | 2 |

**15.** The dipole moment of $NH_3$ is:-

(1) Less than dipole moment of $NCl_3$

(2) Higher than dipole moment of $NCl_3$

(3) Equal to the diple moment of $NCl_3$

(4) None of these

**16.** Which set of molecules is polar :-

(1) $XeF_4$, $IF_7$, $SO_3$ (2) $PCl_5$, $C_6H_6$, $SF_6$

(3) $SnCl_2$, $SO_2$, $NO_2$ (4) $CO_2$, $CS_2$, $C_2H_6$

**17.** Species having zero dipole moment :-

(1) $XeF_4$

(2) 1,2,4 trichloro benzene

(3) $SF_4$

(4) $CH_2Cl_2$

**18.** $PCl_5$ is non polar because :-

(1) P – Cl bond is non-polar

(2) Its dipole moment is zero

(3) P – Cl bond is polar

(4) P & Cl have equal electronegativity

**19.** The correct order of dipole moment is :

(1) $CH_4 < NF_3 < NH_3 < H_2O$

(2) $NF_3 < CH_4 < NH_3 < H_2O$

(3) $NH_3 < NF_3 < CH_4 < H_2O$

(4) $H_2O < NH_3 < NF_3 < CH_4$

**20.** Which of the following has the highest value of dipole moment :

(1) HCl (2) HF (3) HI (4) HBr

## MOLECULAR ORBITAL THEORY

**21.** The ion that is isoelectronic with CO and having same bond order is :-

(1) $CN^-$ (2) $O_2^+$ (3) $O_2^-$ (4) $N_2^+$

**22.** Which of the following is paramagnetic:-

(1) $O_2^-$ (2) $CN^-$ (3) CO (4) $NO^+$

**23.** The no. of antibonding electron pair in $O_2^-$ is

(1) 4 (2) 3 (3) 8 (4) 10

**24.** Which of the following ion has not bond order of 2.5 ?

(1) $O_2^-$ (2) $O_2^+$ (3) $N_2^+$ (4) $N_2^-$

**25.** In a homonuclear molecule which of the following set of orbitals are degenerate ?

(1) $\sigma_{2s}$ and $\sigma_{1s}$ (2) $\pi_{2p_x}$ and $\pi_{2p_y}$

(3) $\pi_{2p_x}$ and $\sigma_{2p_z}$ (4) $\sigma_{2p_z}$ and $\pi^*_{2p_x}$

## COORDINATE BOND

**26.** In Co-ordinate bond, the acceptor atoms must essentially contain in its valency shell an orbital:-

(1) With paired electron

(2) With single electron

(3) With no electron

(4) With three electron

**27.** The bonds present in $N_2O_5$ are :–

(1) Only ionic

(2) Covalent & coordinate

(3) Only covalent

(4) Covalent & ionic

**28.** Which of the following has no coordinate bond ?

(1) $PH_3$ (2) $P_2H_6^{+2}$ (3) $P_2H_5^{\oplus}$ (4) $PH_4^+$

## WEAK FORCES

**29.** In dry ice the bond present between two molecules is

(1) Ionic bond (2) Covalent bond

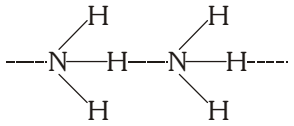
(3) Hydrogen bond (4) Vander Waal

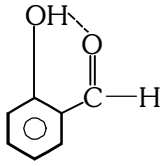
**30.** Intermolecular hydrogen bonds are not present in:-

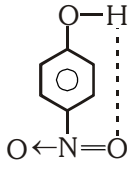
(1) $CH_3CH_2OH$ (2) $CH_3COOH$

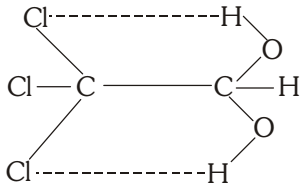
(3) $C_2H_5NH_2$ (4) $CH_3OCH_3$

**31.** In which of the following molecule, the shown hydrogen bond is not possible:-

(1) 

(2) 

(3) 

(4) 

**32.** The incorrect order of decreasing boiling points is

(1) $NH_3 > AsH_3 > PH_3$

(2) $H_2O > H_2Se > H_2S$

(3) $Br_2 > Cl_2 > F_2$

(4) $CH_4 > GeH_4 > SiH_4$

**33.** Acetic acid exists as dimer in benzene due to:-

(1) Condensation reaction

(2) Hydrogen bonding

(3) Presence of carboxyl group

(4) None of the above

**34.** Maximum no. of hydrogen bonds formed by a water molecule in ice is

(1) 4 (2) 3

(3) 2 (4) 1

**35.** Density of ice is less than that of water because of

(1) presence hydrogen bonding

(2) crystal modification of ice

(3) open porous structure of ice due to hydrogen bonding

(4) different physical states of these

**36.** Which of the following compounds show intramolecular hydrogen bonding :

(A) o - nitrophenol

(B) p - nitrophenol

(C) phenol

(D) salicylaldehyde

(1) A & B (2) A & C

(3) A & D (4) B & C

**37.** The pair of molecules forming strongest hydrogen bonds are :

(1) $SiH_4$ and $SiF_4$

(2) $CH_3-\overset{\overset{O}{\|}}{C}-CH_3$ and $CHCl_3$

(3) $H-\overset{\overset{O}{\|}}{C}-OH$ and $CH_3-\overset{\overset{O}{\|}}{C}-OH$

(4) $H_2O$ and $H_2$

## IONIC BOND

**38.** Conditions for ionic bond formation is/are :

(a) Small cation, large anion

(b) Low IP of cation, high electron affinity of anion

(c) Large cation, small anion and less charge

(d) Less lattice enrgy

Correct answer is :

(1) a, d (2) b, c and d

(3) b and c (4) a, b

**39.** An ionic compound $A^+ B^-$ is most likely to be formed when –

(1) Ionization energy of A is low

(2) Electron affinity of B is high

(3) Electron affinity of B is low

(4) Both (1) and (2)

**40.** As compared to covalent compounds electrovalent compounds generally possess

(1) High m.p. and high b.p.

(2) Low m.p. and low b.p.

(3) Low m.p. and high b.p.

(4) high m.p. and low b.p.

**41.** The most stable carbonate is

(1) $Li_2CO_3$ (2) $BeCO_3$

(3) $CaCO_3$ (4) $BaCO_3$

**42.** $CCl_4$ is more covalent than LiCl because :

(1) There is more polarization of Cl in $CCl_4$

(2) There is more polarization of Cl in LiCl

(3) $CCl_4$ has more weight

(4) None of above

**43.** The correct order of decreasing polarisable ions is:

(1) $Cl^-, Br^-, I^-, F^-$ (2) $F^-, I^-, Br^-, Cl^-$

(3) $F^-, Cl^-, Br^-, I^-$ (4) $I^-, Br^-, Cl^-, F^-$

**44.** Ionic conductances of hydrated $M^+$ ions are in the order –

(1) $Li^+(aq) > Na^+(aq) > K^+(aq) > Rb^+(aq) > Cs^+(aq)$

(2) $Li^+(aq) > Na^+(aq) < K^+(aq) < Rb^+(aq) < Cs^+(aq)$

(3) $Li^+(aq) > Na^+(aq) > K^+(aq) > Rb^+(aq) < Cs^+(aq)$

(4) $Li^+(aq) < Na^+(aq) < K^+(aq) < Rb^+(aq) < Cs^+(aq)$

**45.** Which of the following halides has the highest melting point –

(1) NaCl (2) KCl

(3) NaBr (4) NaF

# ANSWER KEY

| CHEMICAL BONDING | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Que.** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** | **15** | **16** | **17** | **18** | **19** | **20** |
| **Ans.** | 3 | 2 | 3 | 4 | 3 | 3 | 2 | 4 | 4 | 2 | 4 | 2 | 4 | 1 | 2 | 3 | 1 | 2 | 1 | 2 |
| **Que.** | **21** | **22** | **23** | **24** | **25** | **26** | **27** | **28** | **29** | **30** | **31** | **32** | **33** | **34** | **35** | **36** | **37** | **38** | **39** | **40** |
| **Ans.** | 1 | 1 | 2 | 1 | 2 | 3 | 2 | 1 | 4 | 4 | 3 | 4 | 2 | 1 | 3 | 3 | 3 | 3 | 4 | 1 |
| **Que.** | **41** | **42** | **43** | **44** | **45** | | | | | | | | | | | | | | | |
| **Ans.** | 4 | 1 | 4 | 4 | 4 | | | | | | | | | | | | | | | |

# SOLUTION

## CHEMICAL BONDING

**1.** Bond strength order

$2s - 2s < 2s - 2p < 2p - 2p$

**2.** Hybrid orbital does not form π-bond.

**3.** $XeF_5$ does not formed

**5.** $NF_3$ - Pyramidal $H_3O^+$ Pyramidal shape

$NO_3^-$ - Trigonal planar $HN_3$ bent shape

$BF_3$ - Trigonal planar

**6.** Option (1) $NO_2^+$ sp (linear), $NO_2$ $sp^2$ (bent), $NO_2^-$ $sp^2$ (bent)

Option (2) $ClO_4^-$ $sp^3$ (Td), $SF_4$ $sp^3d$ (see saw), $XeF_2$ $sp^3d$ (linear)

Option (3) $NH_4^+$ $sp^3$ (Td), $H_3O^+$ $sp^3$ (Py), $OF_2$, $sp^3$ (bent)

Option (4) $SO_4^{2-}$ $sp^3$ (Td), $PO_4^{3-}$ $sp^3$ (Td), $ClO_4^-$ $sp^3$ (Td)

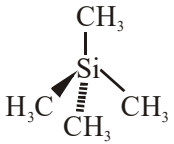
**7.** C & B does not show $sp^3d$ hybridisation due to non avalibility of 'd' orbital

**8.** $SF_4$ is see saw

**9.** $XeO_2F_2$ $sp^3d$ see saw

**10.** T- Shaped species is formed when two lone pair and 3σ bond is formed.

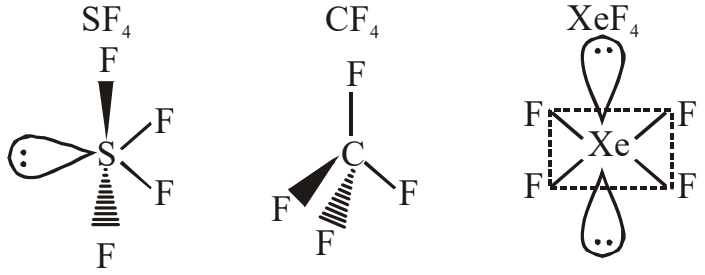
**11.** $Si(CH_3)_4$ $sp^3$, Td



**12.**

| | | | |
|---|---|---|---|
| Hybridisation | $sp^3$ | $sp^2$ | sp |
| Bond angle | 109°28' | 120° | 180° |

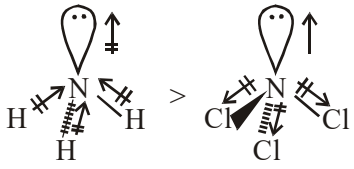
**13.**




**14.**

| | |
|---|---|
| $XeF_4$ | square planar |
| $XeF_6$ | distorted octahedral |
| $XeO_3$ | Pyramidal |
| $XeOF_2$ | T-shape |

**15.**







(dipole moment)

**16.** $SnCl_2$, $SO_2$, $NO_2$ are polar and other molecules in options are non-polar.

**17.** $XeF_4$ having zero dipole moment

**18.** In non-polar species the net dipole moment is zero

**19.** $CH_4 < NF_3 < NH_3 < H_2O$

**20.** In HX, electronegativity difference increases dipole moment also increases.

**21.**

| | CO | $CN^-$ | $O_2^+$ | $O_2^-$ | $N_2^+$ |
|---|---|---|---|---|---|
| Bond order | 3 | 3 | 2.5 | 1.5 | 2.5 |

**22.** $CN^-$ , CO, $NO^+ \rightarrow$ No unpaired $e^-$ is present

$\therefore$ Diamagnatic

**23.** $O_2^-$ , bonding $e^-$ in BMO = 10

$e^-$ in AMO = 7 (3 pair and 1 singe)

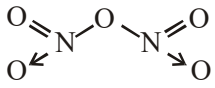
**24.**

| $O_2$ | $O_2^-$ | $O_2^+$ | $N_2^+$ | $N_2^-$ |
|---|---|---|---|---|
| Bond order | 1.5 | 2.5 | 2.5 | 2.5 |

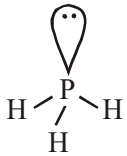
**25.** $\pi_{2px}$ and $\pi_{2py}$ having same energy.

**26.** In co-ordinate bond formation the acceptor atom must have vacant orbital.

**27.**




**28.**

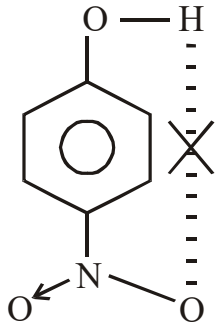



co-ordiante bond is not present.

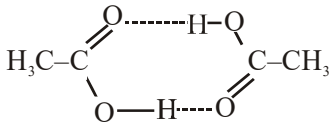
**29.** dry ice $CO_2$(solid)

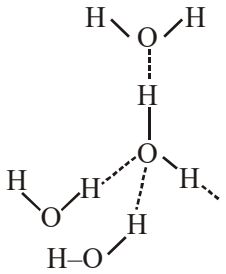
vander waal forces exist between $CO_2$ molecules

**30.** $CH_3OCH_3$ – No hydrogen bonding

**31.**  Not possible due to greater distance

**32.** $CH_4 < SiH_4 < GeH_4$

**33.** 

**34.**  4-Hydrogen bond / Water molecules.

**35.** Ice having open cage like structure and having large voids.

**36.** p-nitrophenol and phenol show intermolecular H-bonding.

**37.** Hydrogen bond exist between HCOOH & $CH_3COOH$

**38.** Condition favour ionic bond formation.

(1) How IP of atom forming cation

(2) High EA of atom forming anion

(3) Greater LE of formed product

(4) Greater cation and small anion

**39.** See solution of 89

**40.** Electrovalent compound generally having high mp & bp.

**41.** Ionic Character ↑ Thermal stability ↑

**43.** $F^- < Cl^- < Br^- < I^-$ (polarizibility)

**44.** If the charges are constant then greater the ionic mobility greater will be conductance

**45.** NaF having greater ionic character among given species ∴ greater m.p.